

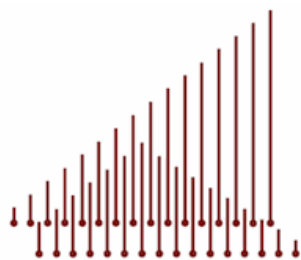


Changing Mindsets: Effectiveness trial

Evaluation Report

July 2019

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National Institute
of Economic and
Social Research



The Education Endowment Foundation (EEF) is an independent grant-making charity dedicated to breaking the link between family income and educational achievement, ensuring that children from all backgrounds can fulfil their potential and make the most of their talents.




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About the evaluator

The impact and process evaluations were completed by NIESR researchers. Francesca Foliano led the impact evaluation, working with David Wilkinson. The process evaluation was carried out by Jonathan Buzzeo and Johnny Runge. Heather Rolfe oversaw the design and delivery of the process evaluation and contributed to the report; Richard Dorsett, Cinzia Rienzo, and Matthew Burnsall were involved in the early stages of the research.

Executive summary

The project

The Changing Mindsets project aimed to improve attainment outcomes at the end of primary school by teaching Year 6 pupils that their brain potential was not a fixed entity but could grow and change through effort exerted. The programme, delivered by Portsmouth University, taught pupils about the malleability of intelligence through workshops. Teachers attended short professional development courses on approaches to developing a ‘growth mindset’ before delivering sessions to pupils weekly, over eight consecutive weeks. Teachers were encouraged to embed aspects of the growth mindset approach throughout their teaching—for example, when giving feedback outside of the sessions. They were also given access to digital classroom resources, such as a video case study of Darwin overcoming adversity in his own life, as a practical example of the importance of having a growth mindset.

The project was a randomised controlled trial (RCT) and included 101 schools and 5018 pupils across England, assigned to either intervention or control groups. The trial ran from September 2016 to February 2017. The process evaluation involved interviews with teachers, focus groups with pupils receiving the intervention, lesson observations, and surveys of both treatment schools and control groups throughout the course of the intervention.

Table 1: Key conclusions

Key conclusions
1. Pupils in schools that received the intervention did not make any additional progress in literacy nor numeracy—as measured by the national Key Stage 2 tests in reading, grammar, punctuation, and spelling (GPS), and maths—compared to pupils in the control group. This finding has high security.
2. This evaluation also examined four measures of non-cognitive skills: intrinsic value, self-efficacy, test anxiety, and self-regulation. The evaluation did not find evidence of an impact on these measures for pupils in schools that received Changing Mindsets. A positive impact was found for the intrinsic value measure, but the impact was small and was not statistically significant.
3. Among pupils eligible for free school meals (‘FSM pupils’), those in schools that received the intervention did not make any additional progress in literacy nor numeracy—as measured by the national Key Stage 2 tests in reading, GPS, and maths—compared to FSM pupils in schools that did not receive the intervention.
4. One explanation for the absence of a measurable impact on pupil attainment is the widespread use of the growth mindset theory. Most teachers in the comparison schools (that did not receive the intervention) were familiar with this, and over a third reported that they had attended training days based on the growth mindset approach.

EEF security rating

These findings have a high security rating. This was an effectiveness trial, delivered as it would be at scale in a range of schools. The trial was a well-designed two-armed randomised controlled trial. Attrition rates for the primary outcomes were approximately 11%, and above 40% for secondary outcomes. The trial was well-powered and the pupils in Changing Mindsets schools had similar prior attainment to those in the comparison schools.

Additional findings

Separate exploratory analysis was undertaken for three subgroups: females, males, and pupils who were shown in the pre-trial tests to believe that the ability to learn is a fixed trait. There was no evidence of an impact of the Changing Mindsets intervention on the outcomes of Year 6 students in these subgroups.

The programme was delivered as intended and well received by schools, teachers, and pupils; the latter showed good understanding of its messages and how they relate to their own learning. Despite the absence of a measurable impact, teachers perceived changes in pupils’ attitudes, enthusiasm, and perseverance. Based on their experiences of the programme, some schools were planning to continue and extend its use, including introducing it to younger age groups, implementing whole-school approaches, and working with parents.

The findings add to an extensive empirical literature that has investigated the effects of the growth mindset approach on pupils' attainment and learning motivation by using experimental research designs and school-based interventions based on rigorous randomised trials. Other studies have often focused on older pupils, including interventions run in high schools in the U.S. and Norway, but have found evidence that it is possible to shape pupil's beliefs about their intelligence with long-term impact on their attainment.







The pervasiveness of growth mindset theory is one potential explanation for the absence of a measurable impact of the intervention: for example, over a third of teachers in comparison schools had previously attended training days based on growth mindset interventions. However, while many staff members were aware of similar approaches prior to their involvement in the project, few said they had used these within their own teaching practices. Due to the ubiquitous nature of growth mindset, it may be hard to find schools for future research where awareness of the concept is low.

Cost

The Changing Mindsets intervention costs approximately £4 per pupil. This cost was estimated using the assumption that the University of Portsmouth delivers the training to the school during an inset day and provides the intervention materials for all staff. The Changing Mindsets intervention costs £1,800 in the first year. There is no cost in the subsequent years.

Impact

Table 2: Summary of impact on primary outcome

Outcome/ Group	Effect size (95% confidence interval)	Estimated months' progress	P value	No. of pupils	EEF security rating	EEF cost rating
KS2 maths	-0.01 (-0.04; 0.01)	0	0.37	4454		£ 
KS2 reading	-0.00 (-0.02; 0.02)	0	0.72	4437		£ 
KS2 Grammar Punctuation and Spelling	-0.00 (-0.03; 0.03)	0	0.90	4448		£ 

Introduction

Background evidence

Research in education and labour economics highlights the importance of non-cognitive traits such as perseverance and resilience in determining long-term outcomes in education and the labour market (Heckman, 2006). A policy-relevant research question is whether schools can foster these non-cognitive skills and, as a consequence, boost pupil attainment. An extensive literature in psychology developed by Carol Dweck and colleagues introduced the idea that it is possible to increase pupils' perseverance and, as a consequence, to improve their attainment by teaching them that their brain has the potential to grow through effort exerted on challenging tasks (Dweck, 2006; Yeager and Dweck, 2012). In this literature, pupils' beliefs about their ability to learn are referred to as 'implicit theories of intelligence'; a 'fixed mindset' is the belief that the ability to learn is a fixed trait and a 'growth mindset' is instead the belief that intelligence can be developed through effort and dedication.

Studies in experimental psychology and economics conducted in the U.S. and Norway have investigated the effect of school-based interventions that shape pupils' beliefs in their ability to learn: they conclude that pupils who are taught that their intelligence can be developed through effort and dedication show more perseverance (Bettinger et al., 2016) and achieve more in mathematics and English (Paunesku et al., 2015 and Yeager et al., 2016). These findings have led to a widespread use of interventions inspired by growth mindset theory in the U.S. education system. However, all the studies that find promising results are based on changing mindsets trials for secondary school pupils. In addition, some of these studies are conducted with only limited samples of students. It is indeed relevant to investigate if similar or greater effects can be achieved when the intervention is run with younger pupils and in different education systems. To this end, a pilot trial was first conducted to test the efficacy of the growth mindset approach in improving pupil attainment in primary schools (Rienzo et al., 2015); within this trial, two small interventions were delivered by Portsmouth University. The first intervention taught pupils about the malleability of intelligence through six workshops and four further sessions delivered by two local organisations: its estimated effect was an average of two additional months' progress in English and maths, although the results were not statistically significant. The second intervention involved a professional development course of two half-days that trained teachers on approaches to developing and reinforcing growth mindsets through their teaching: this intervention had no impact on progress in maths for the pupils taught by those teachers and two months less progress in English (again not statistically significant). The promising nature of the first pilot trial led to the development of a more substantial trial that incorporated elements of both the previous interventions and scaled up the sample size. In this larger scale randomised controlled trial, Year 6 teachers in treatment schools received training that introduced them to mindset theory and evidence and provided tips for how to embed the approach in their classrooms (for example, how to communicate incremental beliefs to pupils through feedback and praise). In addition, teachers were given the materials and training to run an eight-week programme (up 2.5 hours a week) of weekly lessons and activities with their pupils. Schools in the waitlist control group received the training two academic terms later. This evaluation seeks to assess the impact on the attainment of pupils who received the intervention, compared to pupils who did not receive the intervention.

Intervention

The Changing Mindsets project was developed to evaluate the effect of a growth mindset on achievement in English schools. The trial sought to increase the achievement of primary school pupils in numeracy and literacy by helping them to develop a growth mindset. The project's theory of change is that teacher behaviour and language changes as a result of the training and that, along with the delivery of mindset classes, pupils change their own mindset and expectations of self. This leads to changes in pupils' learning behaviour as they become more resilient and engage in challenge and opportunity. As a consequence, pupils' academic attainment improves, as well as their self-esteem and mental wellbeing.

The project combines two interventions from a previous efficacy trial that showed promising results: (1) training pupils in the treatment schools by using a structured series of learning resources and activities and (2) training teachers in mindset theory and offering tips for every day practice (Rienzo et al, 2015). The Changing Mindsets project trained teachers in mindset theory but also gave them the resources to deliver a programme in the classroom.

Pupils were exposed to the mindset theory over a structured series of classes led by their own teachers. The aim of these sessions was to change the way that pupils think about their intelligence, in particular to build high expectations and resilience and to encourage specific plans and goals that emphasise growth, the development of skill, or the expansion of knowledge. The programme was delivered to pupils through eight sessions. These covered themes including the meaning of intelligence, dealing with mistakes and emotions, understanding the brain and encouraging challenge, effort and persistence, stereotypes, and inspirational people. In addition, teachers worked to make the intervention more effective by embedding the growth mindset approach in their everyday class activities, for example, by repeating the message that making mistakes is an opportunity to learn rather than a negative experience.

Teachers received one day of training that was prepared and delivered by a team of education psychologists from the University of Portsmouth. This training introduced teachers to mindset theory and evidence and provided tips on how to embed the approach in their classrooms/schools (for example, how to communicate incremental beliefs to pupils through feedback and praise). To supplement these suggested changes to everyday practice, teachers were given the materials and training to run an eight-week programme (up to 2.5 hours a week) of weekly lessons and activities with their Year 6 pupils. Specifically, teachers were given a training manual that included comprehensive lesson plans for the eight sessions and a USB stick with additional material to support their interaction with children and their parents. In addition, teachers were granted free access to online videos supplied by the Positive Edge Foundation;¹ these videos were referenced in the lesson plans and teachers were encouraged to use the videos to explain or emphasize particular concepts such as resilience and learning from mistakes.² The videos focus on three famous people (Darwin, Einstein, and Wilma Rudolph), describing their lives and how they overcame adversity, in line with the growth mindset message. They included, for example, a video about Charles Darwin's less-than-promising school performance and a medal-winning athlete who overcame a difficult start in life. Other materials provided by the project team included posters on growth mindset and pupil quizzes.

Design

The design is for a two-arm trial, with schools participating in the trial randomly assigned to either the intervention group or the control group. All schools paid £500 to receive the intervention. All schools received the full Changing Mindsets training. Schools in the intervention group received their training in September or October 2016, while waitlist control schools received the training two academic terms later. This is an effectiveness trial that was delivered as it would be at scale and it included primary schools in the South East, South West, Midlands, North East, and North West of England. Within each school, the trial focused on all Year 6 pupils with the exception of those who did not consent to be part of the study.

Headteachers and Year 6 teachers of schools in the intervention group were invited to attend one of approximately ten training days hosted across the U.K. in September and October 2016. Headteachers and Year 5 teachers of schools in the control (waitlist) group instead were invited to attend one of approximately ten training days hosted across the U.K. in June and July 2017. The waitlist design was chosen to keep the control schools interested in the trial and to minimize their attrition. It was also chosen to reduce the possibility of these schools adopting a similar programme during the academic year of the intervention.

Year 6 teachers in schools that were randomly assigned to the treatment group delivered the intervention to the whole class. Schools were eligible if they had not used a systematic mindset programme with their Year 6 cohort before and if they were able to attend one of the training dates provided by the team from the University of Portsmouth. Schools that wanted to enter the randomisation needed to provide the following: (1) a headteacher consent form, (2) confirmation that parent opt-out consent forms were sent out, (3) pupil data form including UPNs for all Year 6 pupils, (4) the response to a baseline school questionnaire.

¹ Positive Edge Education is a private company that develops holistic educational programs designed to inspire and engage, founded by Thomas Westenholz.

² Appendix C includes a sample of slides from the training day provided by the Growing Learners group at the University of Portsmouth.

Impact and Process Evaluation

The impact evaluation is a rigorous empirical analysis based on experimental data collected during the trial. The primary aim of the Changing Mindsets impact study is to evaluate whether a growth mindset approach in school can increase Year 6 literacy and maths scores, measured by Key Stage 2 Standard Attainment Tests. The secondary aim of the impact study is to evaluate whether the growth mindset approach in schools has an impact on Year 6 pupils' motivation, effort, seeking behaviour, and attitude towards tests. These non-cognitive traits are captured by four subscales of the adapted MSLQ, namely intrinsic value, self-efficacy, test anxiety, and self-regulation (Pintrich and Van De Groot, 1990). It is important to notice here that the protocol only mentions self-efficacy and self-regulation as the secondary outcomes of interest; however, the Statistical Analysis Plan (SAP) includes all four subscales. The aims of this impact evaluation are therefore in line with the SAP approved by the EEF.³

The impact assessment is supplemented by a comprehensive process evaluation aimed at understanding how the Changing Mindsets intervention programme was implemented and delivered in treatment schools and whether this differed from the intended delivery model. It also aimed to shed light on implementers' as well as pupils' responsiveness to the intervention, and the perceived impact on participants. It also gathered information on the activity of schools within the control group over the course of the trial period. Methods included fieldwork visits to six treatment schools using individual interviews with teachers and senior leaders, focus groups with pupils, and observations of three lessons. Schools were selected to include a range of key characteristics: Ofsted rating, proportion of pupils receiving free school meals, geographical location, and whether located in urban or rural settings. Interviews used semi-structured topic guides and were recorded digitally and transcribed. A framework method was used to analyse transcripts thematically using Excel.⁴ Other methods used to collect data from the wider sample of schools were: an end-of-project survey of treatment schools, a fidelity survey administered to treatment schools over the course of the intervention, and a control group survey. Because of the small scale of these surveys, they were analysed manually.

Ethics and trial registration

We take seriously the ethical issues raised in both the quantitative and qualitative elements of the research. NIESR adheres to the Ethics Guidelines of the Social Research Association (SRA). Members of the process evaluation team have Disclosure and Barring Service (DBS) clearance. The ethical implications of the research have been discussed with reference to the SRA guidelines (in particular their Standard Protocols for Checking Ethical Considerations) by members of the project team and NIESR's Senior Management Team to determine the appropriate course of action and whether further approval is needed. While NIESR has an ethics committee consisting of trustees, we do not consider that this trial requires such additional clearance; this decision has been ratified by our Director. As part of this

³ The protocol can be found here:

https://educationendowmentfoundation.org.uk/public/files/Projects/Evaluation_Protocols/EEF_Project_Protocol_CHanging_Mindset_Regrant.pdf; the SAP can be found here:

https://educationendowmentfoundation.org.uk/public/files/Projects/Changing_Mindsets_SAP_2018.02.08.pdf

⁴ A framework approach enables the analysis of qualitative data in a written form, and is therefore appropriate for the analysis of transcripts of interviews with teachers and other project participants, as well as research notes taken during observation of classroom interventions. It entails coding data into themes and issues. In this case, codes were a mixture of predetermined ones, developed during the design of the process evaluation and taking account of the aims of the intervention, as well as those that emerged from the text of transcripts and observations. Codes identified different types of information, for example, more tangible one such as knowledge of Mindset, experiences of the training, and of putting the approach into practice as well others such values and feelings. Throughout the analysis process, we looked for similarities and differences in the data. The framework approach allows for tracts of text to be classified under more than one code, and codes were, in some cases, amalgamated to form wider groups, particularly where substantial issues were concerned.

The codes and groups developed in the analysis of data formed the analytical framework and were used to structure the findings into a preliminary report. We then re-structured this document to follow the format required by the EEF. This involved structuring the findings using the main EEF process evaluation criteria: implementation, outcomes, and fidelity.

trial we collected personal information and applied for extracts from the National Pupil Database (NPD) using this information. However, we did not link this data with any other sources; whether participants are in the treatment or control groups they are identified from the school that they attend. Participants' confidentiality and anonymity was safeguarded by the methods that we have in place.

Recruitment took place prior to the introduction of the General Data Protection Regulation (GDPR), the new European Union privacy law that defines guidelines and regulations on how data is processed, used, stored, or exchanged. Schools that had registered their interest and were eligible for the trial were sent a welcome pack that included a headteacher informed consent form and a letter for parents. The headteacher informed consent form set out the details of the trial and clarified that schools were free to withdraw from the intervention at any point.

Participants' parents were provided with a letter that included information on the aims of the research and the use of data in order for them to be able to make an informed decision about whether to withdraw their child's data from the study at any time. Data from the NPD and pupil information obtained from the schools were transmitted and stored using the security principles underlined in the NIESR Data Security policy. This includes secure transfer of data and use of password-protection and encryption as appropriate during data storage.

This trial was registered on the International Standard Randomised Control Trial Number registry at <http://www.isrctn.com/ISRCTN14702744>.

Data protection

We processed individual and personal data in line with the requirements of the GDPR and our legal basis for processing the data is legitimate interest. Additionally, NIESR was certified as GDPR compliant on the 29 of May 2018 by the British Assessment Bureau.

Project team

The Changing Mindsets project was developed by Growing Learners, a group of education research psychologists, led by Professor Sherria Hoskins and based in the Psychology Department at the University of Portsmouth.⁵

The Growing Learners team included:

Dr Sherria Hoskins,
Dr Frances Warren,
Dr Joanna Nye.

The project also included additional materials and videos from Positive Edge Education, a company that develops holistic educational programmes designed to inspire and engage, founded by Thomas Westenholz.⁶

The impact and process evaluations were completed by NIESR researchers. Francesca Foliano led the impact evaluation, working with David Wilkinson. The process evaluation was carried out by Jonathan Buzzeo and Johnny Runge. Heather Rolfe oversaw the design and delivery of the process evaluation and contributed to the report; Richard Dorsett, Cinzia Rienzo, and Matthew Burnsall were involved in the early stages of the research.

⁵ <http://www.port.ac.uk/department-of-psychology/community-collaboration/growing-learners/>

⁶ <https://positiveedgeeducation.com/>

Methods

Trial design

Table 3: Summary of trial design and randomisation

Trial type and number of arms		Effectiveness trial, two arm randomised controlled trial.
Unit of randomisation		Schools.
Stratification variables		Tertiles of school-level KS1 performance in 2014/2015 and five geographical areas: Midlands, North East, North West, South East, and South West of England
Primary outcome	variable	KS2 scores in maths, reading, grammar, punctuation and spelling (GPS), and numeracy.
	measure (instrument, scale)	Test scores in reading and GPS are measures of literacy (range of scores: 80–120); numeracy: KS2 test scores in maths are a measure of numeracy (range of scores: 80–120).
Secondary outcome(s)	variable(s)	Four subscales of the MSLQ: self-efficacy, intrinsic value, test anxiety, and self-regulation.
	measure(s) (instrument, scale)	Four subscales of the MSLQ that were adapted by the Growing Learners team and administered to all Year 6 pupils in the study. All items are scored from 1–7, (with 1 indicating 'strongly disagree' and 7 indicating 'strongly agree'. Subscales are then calculated as a mean score.

Table 3 presents a summary of the trial design. The design of this effectiveness study is a two-arm cluster randomised trial, with schools participating in the trial randomly assigned to either the intervention group or the control group. School-level randomisation was chosen over class or pupil level to minimise the chance of contamination of control by treatment. The trial had a waitlist design. All schools paid £500 to receive the intervention. All schools received the full Changing Mindsets training. Schools in the intervention group received their training in September and October 2016, while waitlist control schools received the training two academic terms later. Randomisation was carried out using block randomisation techniques, controlling for prior attainment at the school level and geographical area. Blocks were defined according to tertiles of school-level Key Stage 1 (KS1) performance within each of five locations: Midlands, North East, North West, South East, and South West of England. The purpose of blocking was to improve the balance between the treatment and control groups in terms of key outcome-related characteristics and also to increase the precision of estimates. The trial was delivered as it would be at scale and 101 schools with about 5,000 Year 6 pupils were recruited to the trial.

Participant selection

The study was advertised to schools with an advert on the EEF website, adverts on social media (for example, Facebook groups for Year 6 teachers), and by contacting schools via email from the National College of Teachers. In addition, a snowball method was utilised whereby interested schools and other school contacts were asked to pass on the advert to other schools in their own networks, and some schools volunteered via this route.

Schools registered their interest in taking part using a Google Form, and 179 schools did so.

All volunteer schools were telephoned to check that they met the inclusion criteria for the project and to outline the key commitments for the school.

Schools were eligible to participate in the study if:

- they had not used a systematic mindsets programme with their Year 6 cohort before; and

- they were able to attend one of the training dates provided by Portsmouth University.

The delivery team agreed to prioritise schools with a high number of free school meal (FSM) pupils, or schools where there was a significant gap between FSM and non-FSM pupils, as these were considered the schools that needed the most support. However, it was not necessary to apply these criteria as the intervention was never oversubscribed. One private school expressed an interest but was not included in the trial due to the potential impact of additional heterogeneity on the robustness of impact estimates.

Schools that were interested in taking part and that met the eligibility criteria were emailed a 'welcome pack' which included a description of the study in detail, a permission form for the headteacher to complete, an information letter to parents giving them the option to withdraw their child from the study, a form to request the children's UPNs and the 'school questionnaire' (that included a Mindset scale and adapted MSLQ questions) plus instructions.

Prior to being randomised, schools needed to provide the following:

- headteacher consent for their school to part in the trial (*loco parentis*);
- confirmation that the information letters to parents had been sent out;
- a pupil data form including UPNs for all Year 6s; and
- completed pre-test non-cognitive measures.

Schools entered the randomisation phase when they returned the headteacher consent form and were revealed their allocation group only after returning all the remaining material.

All pupils attending Year 6 in selected schools were eligible for the treatment. Parent/guardian consent for participation in the research analysis and linking between pupil non-cognitive tests and administrative data in the National Pupil Database (NPD) was sought after randomisation to intervention or control group. All consent forms are available in Appendix D.

The protocol was not changed during the implementation. Six schools dropped out from the study after the randomisation and did not provide any pre-treatment information and therefore, in accordance with the SAP, were not included in the analysis.

Data

Data used in this evaluation includes administrative records from the National Pupil Database and information on pupils' attitudes towards school and learning collected before and after the treatment by the project team through an adapted version of the MSLQ.

Outcome measures

The primary outcomes are reading and numeracy as measured by the KS2 national assessment tests in reading, GPS, and maths. KS2 tests are taken by all pupils at the end of Year 6 (age 10–11) and are externally graded. KS1 teacher assessments in reading, writing, and maths are jointly used to define a comprehensive set of dummies for prior attainment. In KS1, teachers assess pupils against level of achievement (W, 1, 2C, 2B, 2A, 3, 4). To control for prior attainment, we convert these levels into points by using the conversion tables provided by the DfE (DfE, 2015) and we then calculate the average KS1 attainment based on non-missing KS1 assessments. As in Crawford et al. (2016), we define the following categories: 11–14.99 points, 'did not achieve grade level'; 15–16.99 points, 'achieved grade level'; more than 17 points, 'achieved above grade level'; or 'all missing'. These categories are then used to create a set of dummy variables to control for prior attainment in the empirical analysis. In addition, by including in the analysis a dummy for the category of 'all KS1 assessments missing' we do not exclude all the pupils for whom we have no information about prior attainment. KS1 assessments for the pupils in the study were held in the academic year 2012/2013 when pupils in the trial were in Year 2 (age 6–7). Specifically, in the regression analysis we use KS2 scaled point scores, that range from 80 to 120, as primary outcomes and dummies for categories of average scores in KS1 as control for prior attainment.

KS2 test scores are robust measures of achievement and were chosen as primary outcomes for two reasons: they are blind assessments produced by external markers, therefore they cannot be affected by the treatment status of the pupils and they are finely scored and therefore they introduce high granularity in the data. Dummies for categories of average KS1 attainment are a more comprehensive measure of prior attainment as they contain information from three different assessments and they have the advantage of reducing the impact of missing KS1 assessments.

The secondary outcome variables are four measures of non-cognitive skills, captured through four subscales of the MSLQ. All pupils in the study were administered a 'school questionnaire' before and after the intervention. This questionnaire included three items designed to measure pupils' mindsets and 31 MSLQ items. The aim of the first three items was to measure whether pupils had a fixed mindset and believed their intelligence to be a fixed trait, or whether they had a growth mindset, that is, believed that intelligence could grow with effort. The pupils' mindsets measure created with these questions has been used and validated in several studies in experimental psychology (see for instance Yaeger et al., 2016). The standard 31 MSLQ questions were adapted by Portsmouth University to make them relevant to the age and British location of participants. Schools administered the pre-trial questionnaires to pupils when they were in Year 5 (March–July 2016). The post-trial questionnaires were administered by schools after KS2 national assessment (May–July 2017). Specifically, the secondary outcome measures focus on four subscales of the MSLQ: self-efficacy, intrinsic value, test anxiety, and self-regulation. The intrinsic value scale measures to what extent pupils' participation in an academic task is an aim in itself, rather than participation being a means to an aim; the self-efficacy scale measures how pupils judge their ability to accomplish a task as well as their confidence in their skills to perform that task; the test anxiety scale measures students' concern about taking an exam; finally the self-regulation scale measures pupils' ability to plan, monitor, and regulate their cognitive strategies to succeed in an academic task. At the time of writing the protocol, only two subscales of the MSLQ were included, namely self-efficacy and self-regulation. At the SAP stage, intrinsic value and test anxiety were also included among the secondary outcomes.

The three pupil mindset measures are scored from 1 to 6, with 1 indicating 'strongly disagree' and 6 indicating 'strongly agree'. All items on the adapted version of the MSLQ are scored from 1 to 7, with 1 indicating 'strongly disagree' and 7 indicating 'strongly agree'.⁷ Subscales (intrinsic value, self-efficacy, test anxiety, and self-regulation) are then calculated as a mean score. The full set of pupil mindset questions, MSLQ items, and a description of the subscales are included in Appendix E.

For secondary outcomes, the MSLQ was chosen as it is a widely-used tool developed for assessing motivation and learning strategies (Duncan and McKeachie, 2005). The 'junior' version of the questionnaire had been already used in the U.K. schooling system to assess the effectiveness of an intervention to increase engagement in science in Scottish schools (Moote, Williams and Sproule, 2011; 2013).

Sample size

Our initial calculations of the sample size targeted the participation of 100 schools for a minimum detectable effect size of 0.20 based on the following assumptions:

- proportion of schools assigned to treatment, 0.50;
- 40 children per cluster (average cohort size assumption pre-randomisation);
- 0.05 significance level;
- 0.8 power;
- 0.25 intra-cluster correlation; and
- 0.5 cluster variance predicted by KS1 attainment.

The ICC parameter was a deliberately conservative assumption of around twice the size of those published by Allen et al. (2018). A conservative assumption was chosen to reflect the fact that we would be conducting an FSM subgroup analysis.

⁷ Three items on the self-regulation scale need reversing before totalling the sub-scale score and the total score.

The minimal detectable effect size (MDES) decreases to 0.19 when considering the achieved sample at randomisation reflecting the involvement of 101 schools rather than 100 assumed at the protocol and a larger cluster size of 48 with all other assumptions unchanged (see Table 4).

The MDES at analysis decreases to 0.11 when considering the achieved sample largely because the actual intra-cluster correlation was 0.09 rather than 0.25:

- proportion of schools assigned to treatment, 0.50;
- 47 children per cluster;
- 0.05 significance level;
- 0.8 power;
- 0.09 intra-cluster correlation; and
- 0.56 proportion of cluster variance predicted by covariates.

Assuming the FSM subgroup is 15.7% of the total size of the sample (calculated from DFE data for 2014/2015) and ignoring that it may be higher if recruited schools are in more disadvantaged areas) and maintaining all other assumptions (which is likely to be a conservative approach, given lower levels of within-group variation in this subgroup), this gives eight pupils per cluster in the subgroup analysis and an estimated MDES for this group of 0.27 standard deviations at protocol stage. At randomisation this falls to 0.23, largely due to larger cluster sizes (17 rather than 8) since the proportion of FSM pupils in recruited schools is 35.7%, and falls further to 0.15 at analysis stage, again reflecting a lower observed intra-cluster correlation (0.13 as opposed to 0.25).

Randomisation

An independent NIESR consultant (Dr Richard Dorsett) used Stata 13 to randomise schools 50:50 to the intervention group or to the control group after school recruitment and consent had been received. Randomisation was within blocks defined according to tertiles of school-level KS1 performance within each of the five locations. This resulted in 15 blocks. Each school was assigned a random number between 0 and 1 from a uniform distribution. Schools were then sorted by block and random number. The first school in the list was randomly assigned to be in the treatment or control group. Each subsequent school in the list was assigned to be in the opposite group of the previous schools, thus assuring an equal distribution allocation. The Stata code for this randomisation is given in Appendix F.

The number of schools in each block is presented in Table 4.

Table 4: Number of schools in randomisation blocks

Blocks	No. of schools
Midlands—low achievement	12
Midlands—medium achievement	8
Midlands—high achievement	8
North East—low achievement	7
North East—medium achievement	10
North East—high achievement	9
North West—low achievement	4
North West—medium achievement	6
North West—high achievement	4
South East—low achievement	10
South East—medium achievement	7
South East—high achievement	9
South West—low achievement	2
South West—medium achievement	2
South West—high achievement	3

School data was obtained from the Performance table data for the academic year 2014/2015 downloaded from gov.uk. The final randomisation consisted of 50 schools in the treatment group and 51 schools in the control group.

Statistical analysis

The two types of schools included in the trial are:

- a) intervention schools that deliver Changing Mindsets; and
- b) control schools that will receive the intervention one year later.

The estimates of the impact of the intervention on primary and secondary outcomes are obtained as the difference between (a) and (b) by using an 'intention to treat' approach, that is, all pupils in the trial are included in the final analysis whenever possible.

Statistical significance is assessed using two-sided tests at the 5% level. Estimates of effect with 95% confidence intervals (CIs) and p-values are provided.

The original intention was to conduct an analysis into the effect of non-compliance. For this analysis the University of Portsmouth had to collect information on the amount of tuition received by pupils (number of sessions and ratio of tutor to pupils in their group). Due to a very low response rate of schools it was decided that the initially-planned analysis into the effect of non-compliance was not possible due to concerns of data quality.

Primary outcomes analysis

The difference in reading, GPS, and maths attainment between identified pupils in the intervention group and those in the control group is estimated using multilevel models in order to take into account clustering of pupils within schools, because pupils' scores are likely to be correlated within schools. We estimated mixed models using restricted maximum likelihood estimation with school effects as random variables and a set of binary indicators for the stratification groups as fixed effects in Stata. We control for KS1 achievement by using binary indicators for categories of average scores in KS1 tests: 11–14.99 points, 'did not achieve grade level'; 15–16.99 points, 'achieved grade level'; more than 17 points, 'achieved above grade level'; or 'missing'. The baseline category is less than 11.

Estimates are obtained separately for each primary outcome. In addition, models including only the treatment assignment and KS1 scores are estimated as required by the EEF and results presented in Appendix G.

The estimated equation is:

$$y = X\beta + Z\mu + \epsilon$$

Where:

y = vector of outcome scores

X = covariate matrix (KS1 scores in 'simplest' model and this plus dummies for stratification groups in the 'precise' model)

Z = design matrix identifying which school or cluster an individual attended

μ = vector of school random effects

β , = fixed effect parameters

ϵ_{ij} = residual error term for j -th member of cluster (school) i

with the covariance structure given by Σ , where:

$$\Sigma = (\sigma_a^2 + \sigma_e^2) \begin{bmatrix} I & \dots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \dots & I \end{bmatrix}$$

Where σ_a^2 is a measure of school level variation; σ_e^2 is a measure of student level variation and I is given by:

$$I = \begin{bmatrix} 1 & \rho & \dots & \rho \\ \rho & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & \rho \\ \rho & \dots & \rho & 1 \end{bmatrix}$$

And ρ is the intra-school correlation coefficient:

$$\rho = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_e^2}$$

The fixed effect parameters and variance components are estimated by restricted maximum likelihood estimation using the Stata command:

mixed KS2 KS1 TREAT i.block || ks2_urn: reml - for the precise model and:

mixed KS2 KS1 TREAT || ks2_urn: reml - for the simplest model

Because the analysis includes multiple primary outcomes there is a higher chance of detecting spurious results due to random sampling error, however, the SAP did not specify that any adjustments for multiple testing would be applied (we return to this issue in the Impact Evaluation section).

Analysis was conducted in Stata v15 using the principles of intention to treat and only including prior attainment, stratification block dummies, and the allocation dummy as covariates. This is in line with the most recent EEF statistical analysis guidance.⁸

Non-compliance with the intervention

The original intention was for the University of Portsmouth to collect information on the amount of tuition received by pupils (number of sessions and ratio of tutor to pupils in their group). The University asked schools to provide data on the number of pupils absent from each lesson and the extent to which they adapted the material to fit their own style. Response rates were lower than expected and decreased over time, from 49 schools in session one to nine in session eight. An explanation for this low response rate could simply be that schools were busy. The delivery team asked teachers to complete the fidelity survey each week (and sent email reminders each time). This weekly task was probably considered by teachers as an additional chore and this could explain the worsening response rate. The delivery team was also mindful of striking the right balance: they did not want schools to feel pressured so much that they would be inclined to drop out from the project altogether. Given the low response rate it was not possible to conduct the initially-planned analysis into the effect of non-compliance due to concerns of data quality.

Secondary outcomes analysis

To assess the changes on the secondary variables we used the same econometric approach as above, but because the questions were asked pre- and post-intervention and the scores are non-cognitive, we use the post-intervention non-cognitive score for each subscale as outcome variables and control by the pre-intervention continuous non-cognitive score rather than KS1 attainment. We believe this approach is justified by the EEF guidance that states that ‘pre-tests should only be conducted if they are needed to evidence the causal model for an intervention’—which is the intention of the non-cognitive test analysis. As with the analysis of the primary outcome variable, we use the simplest and precise specification and compare results.

Subgroup analysis

We carried out a separate analysis for the FSM subsample following the same empirical approach as that used for primary outcomes. The p-value from an interaction effect model (by including FSM as a main effect and an interaction

⁸https://educationendowmentfoundation.org.uk/public/files/Grantee_guide_and_EEF_policies/Evaluation/Writing_a_Protocol_or_SAP/EEF_statistical_analysis_guidance_2018.pdf

with treatment status) is also reported, but the subgroup analysis represents the main subgroup result as we believe that is easier for the teaching community to interpret.

Results from additional subgroup analyses that were not pre-specified in the evaluation protocol and the SAP and, as such, were purely exploratory, are reported in Appendix H. In these additional analyses we considered subgroups of girls, boys, and pupils with 'fixed mindset'.⁹ In particular we focused on girls and pupils with fixed mindset as they are the subgroups that showed promising results in previous trials based on U.S. and Norwegian data: girls are more likely to be affected by stereotypes threats in mathematics and some studies have shown that exposing students to a growing mindset approach would make their performances less vulnerable to stereotype threats (see for instance Aronson et al., 2002); pupils with a baseline fixed mindset are the ones with more scope to change their beliefs about their intelligence and, therefore, the ones who could benefit more from the intervention, as found by Bettinger et al. (2018).

Effect size calculation

Effect sizes are calculated based on the adjusted mean difference between the intervention and control group (controlling for prior attainment) and the variance components produced by Stata 15 using the syntax described above. The effect sizes and 95% confidence intervals are calculated using equations (19) and (20) given in Hedges (2007) for cluster randomised trials estimated via multilevel models and allowing for unequal cluster sizes.

Missing data analysis

In accordance with the SAP, we describe and summarise the extent of missing data in the primary and secondary outcomes. In addition, we describe the reasons for missing data. First, we assess whether the missing data is missing at random (MAR). We use the standard approach where we create an indicator variable for each variable in the impact model specifying whether the data is missing or not and use logistic regression to test whether the missing status can be predicted from the following variables: all variables in the precise model plus school average KS1 (continuous variable as opposed to terciles), gender, ethnicity, and FSM eligibility. Where predictability is confirmed we proceed with multiple imputation.

Implementation and process evaluation (IPE)

The aims of the IPE were to understand how the Changing Mindsets intervention programme was implemented and delivered in treatment schools, and to what extent this differed (if at all) from the intended delivery model. It also aimed to shed light on implementers' as well as pupils' responsiveness to the intervention, and the perceived impact the programme had on those involved. Finally, the process evaluation sought to gather information on the activity of schools within the control group over the course of the trial period, and establish how far this differed from the intervention programme.

The IPE used the following methods:

- fieldwork visits to six treatment schools conducted from December 2016 to February 2017, which included:
 - semi-structured interviews with nine Year 6 teachers, three headteachers or deputy headteachers, and four teachers from other Year groups to understand experiences of implementation and perceived outcomes;
 - three focus groups with eight to ten Year 6 pupils receiving the intervention to understand pupils' responses to the programme and views on its impact on their learning; and

⁹ Pupils with a fixed mindset are defined as pupils in the highest tercile of the pre-trial mindset measure obtained as the average of the three mindset items included in the 'school questionnaire'. These items are scored 1–6 with 1 indicating 'strongly disagree' and 6 indicating 'strongly agree'. The three items are the following: 'you have a certain amount of intelligence, and you really can't do much to change it'; 'your intelligence is something about you that you can't change very much'; and 'you can learn new things but you can't really change your basic intelligence'. The higher the mindset measure, the more fixed a pupil mindset is.

- three lesson observations of the final Changing Mindsets session to understand implementation and, to some extent, fidelity;
- an end-of-project survey, administered to treatment schools from January to February 2017, to assess fidelity and experiences of delivery;
- a separate fidelity survey, administered eight times to treatment schools over the course of the intervention from September 2016 to February 2017; and
- a control group survey, administered in June 2017, to gain an understanding of whether control schools were also using Growth Mindset in their teaching and learning that might weaken the impact of the intervention.

All activities were carried out by NIESR with the exception of the fidelity and control group surveys, which were designed and administered by Portsmouth University to collect information on each module. The control group survey took the form of a paper questionnaire and was completed by attendees at the training days that were provided after programme implementation had finished at the end of academic year 2016/2017. This was forwarded to NIESR and incorporated into the external evaluation. All other surveys were administered and completed by respondents online.

It should be noted that the views and experiences presented here are not necessarily representative of all participating schools. The response rate to the fidelity survey decreased over the course of the intervention (from 49 to 9 respondents), while the end-of-project survey was completed by just over half of treatment schools (26 out of 50). However, steps were taken to ensure that the treatment schools visited as part of fieldwork included a range by location and intake which might be reflected in experiences of the project.

Schools were selected to include a range of key characteristics: Ofsted rating, proportion of FSM pupils, geographical location, and whether located in urban or rural settings. The project team provided NIESR with a full list of treatment schools from which we drew up a profile according to characteristics of interest. These were Ofsted rating, proportion of FSM pupils, and area of the country. Using these main criteria, we aimed to achieve a range of schools within the sample of six. In two cases schools were not responsive to our request for participation and alternatives were approached from a reserve list.

The response rate to the control group survey was good in that it was completed by 37 out of 51 schools in this treatment allocation.

Costs

The process evaluation collected additional data on costs by asking schools whether additional costs were incurred in the delivery of the programme. Some teachers said they had sourced additional materials for teaching, for example videos, but it was generally agreed that the project resources were both sufficient and very good. The intervention team provided information regarding the actual total cost to the school in order to implement the intervention.

Timeline

The timeline of the trial is summarised in Table 5. There were no changes to the timeline agreed at the protocol stage.

Table 5: Timeline

Date	Activity
From Jan 2016	Schools approached
Jan–May 2016	Schools recruited and agree to participate
May/July 2016	Pre-trial Mindset and MSLQ questionnaires
Jun 2016	Schools randomly allocated to treatment or control group
Sep 2016	Intervention group attended one-day training event
Sep–Dec 2016	Intervention delivered in schools by intervention group
Sep 2016–Feb 2017	Fidelity survey to treatment schools during implementation period
Dec 2016–Feb 2017	Fieldwork visits to six treatment schools
Jan–Feb 2017	End-of-project survey to treatment schools
Jun 2017	Control group survey
May 2017	Pupils sit Key Stage 2 exams
March/July 2017	Post-trial Mindset and MSLQ questionnaires
Jun 2017	Control group attended one-day training event
Autumn term 2017	Intervention delivered by control schools

Impact evaluation

Participants

A flow of participants through the evaluation is presented in Figure 1.

The sample of interest is students in intervention and control schools in Year 6 in the academic year 2016/2017. These pupils were assessed at the end of KS2 in May 2017 and were administered post-trial questionnaires between May and July 2017.

The precise number of pupils initially randomised into the trial is 5018. For these pupils the project team obtained the unique pupil numbers (UPNs) from the 101 schools participating in the study. Eleven pupils were withdrawn from the trial by their parents and 132 UPNs could not be matched to administrative records of pupils in those schools. Of the remaining 4875 pupils randomised in the trial, 291 are lost as six schools withdrew from the study after the randomisation (85 in two treatment schools and 206 in four control schools). The final number of pupils that could be included in the primary analysis is 4584. There were some missing observations in the primary outcomes, specifically 147 in reading scores, 136 in GPS scores, and 130 in maths scores. However, to minimize potential bias from missing-not-at-random we allow the sample to vary by outcome instead of imposing a common sample of pupils where there is no missing data for any of the variables used in the empirical analysis.

In the secondary outcome analyses the samples were restricted to schools that sent back their pupils' MSLQ responses and to pupils that responded to the baseline and follow-up questionnaires; 79 schools (40 in the intervention group and 39 in the control group) provided the pre and post-trial responses of 2917 pupils. This low figure could be explained by the lack of engagement of schools towards the end of the project, which spanned a long period of time. The high proportion of missing observations in the secondary outcomes can potentially affect the robustness of the results of the secondary analysis, and, as a consequence, their external validity.

Table 6 shows the minimum detectable effect size (MDES) for the overall and FSM samples at the different stages of the trial. At the time of preparing the trial protocol the MDES was 0.20 for the overall sample and 0.27 for the FSM sample. At randomisation this was similar for the overall sample (0.19), but reduced from 0.27 to 0.24 for the FSM sample reflecting a larger number of FSM pupils in trial schools than had been assumed when writing the protocol. For the final analysis sample, the MDES was much lower: 0.11 (overall sample) and 0.15 (FSM sample) as the protocol assumption for the intra-cluster correlations proved too conservative (assumed to be 0.25 for both samples but turned out to be 0.09 and 0.13 for the overall and FSM samples respectively).

Figure 1: Participant flow diagram

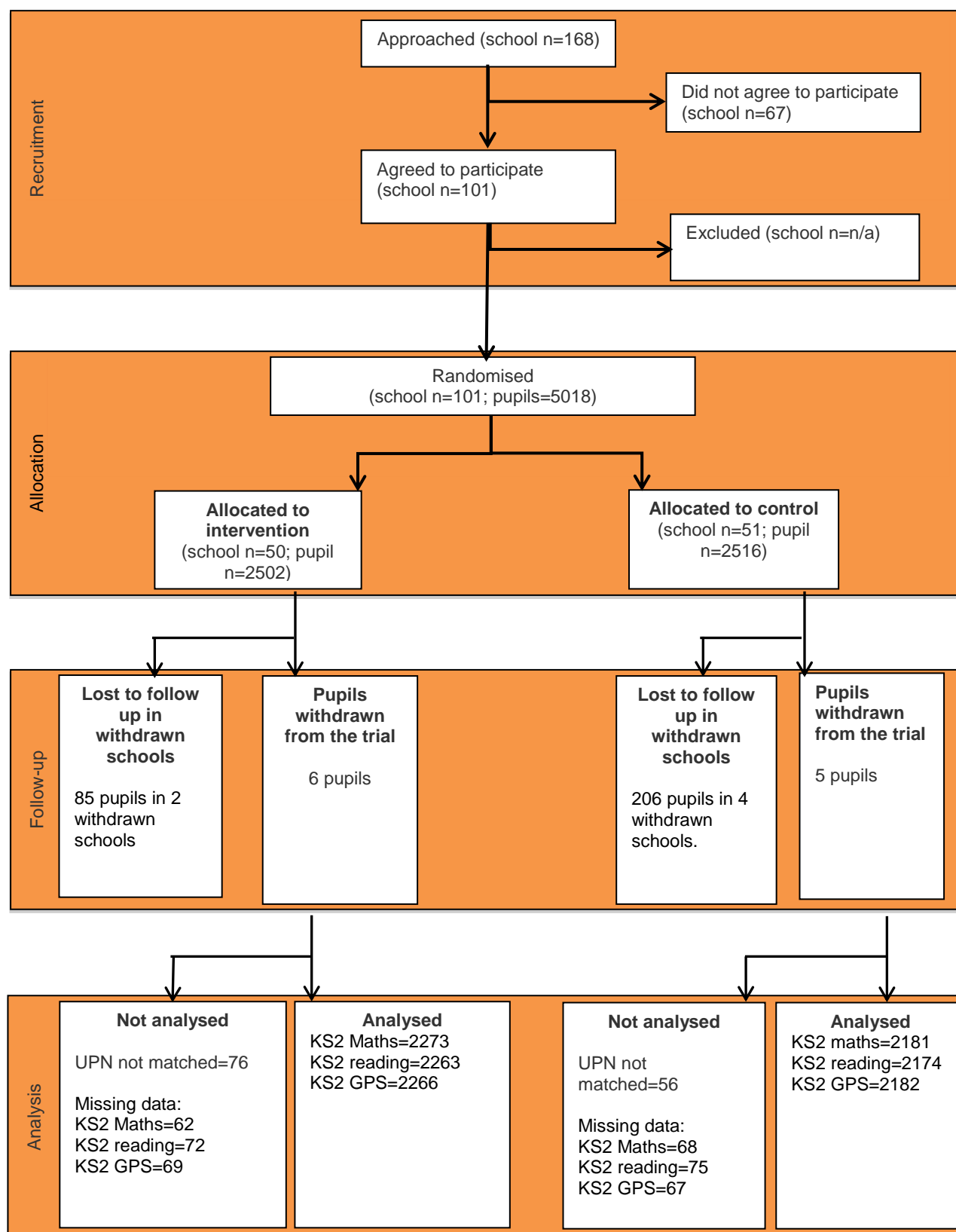


Table 6: Minimum detectable effect size at different stages

		Protocol		Randomisation		Analysis	
		Overall	FSM	Overall	FSM	Overall	FSM
MDES		0.20	0.27	0.19	0.23	0.11	0.15
Pre-test/ post-test correlations	level 1 (pupil)	0.50	0.50	0.50	0.50	0.68	0.66
	level 3 (school)	0.50	0.50	0.50	0.50	0.56	0.6
Intraclass correlations (ICCs)	level 3 (school)	0.25	0.25	0.25	0.25	0.09	0.13
Alpha		0.05	0.05	0.05	0.05	0.05	0.05
Power		0.8	0.8	0.8	0.8	0.8	0.8
One-sided or two-sided?		2	2	2	2	2	2
Average cluster size		40	8	48	17	47	17
Number of schools	intervention	50	50	50	50	48	48
	control	50	50	51	51	47	47
	total	100	100	101	101	95	95
Number of pupils	intervention	2000	314	2502	832	2335	782
	control	2000	314	2516	857	2249	797
	total	4000	628	5018	1689	4584	1579

Attrition

As previously outlined, the precise number of pupils initially randomised into the trial was 5018. For these pupils, the project team obtained the unique pupil numbers (UPNs) from the 101 schools participating in the study. Eleven pupils were withdrawn from the trial by their parents and 132 UPNs could not be matched to administrative records of pupils in those schools. Of the remaining 4875 pupils, 291 are lost as six schools withdrew from the study after the randomisation (85 in two treatment schools and 206 in four control schools). The final number of pupils that could be included in the primary analysis is 4584. Table 6 presents the total rate of attrition for all the pre-test and post-test outcomes included in the analysis. The total rate of attrition for primary outcomes is 11.58% for reading, 11.24% for maths, and 11.36% for GPS. As these rates of attrition are greater than the 5% threshold specified in the SAP, we investigate further whether the missing data is at random (MAR) or whether there is a pattern of missingness that can be predicted by some available variables by using a logistic analysis. As Table 7 shows, attrition is a much bigger problem for secondary outcomes, with the percentage of missing observations being above 40% for all four subscales of the MSLQ. As for primary outcomes, patterns of missingness in secondary outcomes are investigated using a logistic analysis.

Table 7: Rate of attrition

Variable	Treated (in the analysis)	Controls (in the analysis)	Attrition rate
Maths score at KS2	2273	2181	11.24
Reading score at KS2	2263	2174	11.58
GPS score at KS2	2266	2182	11.36
Intrinsic value measure (post-treatment)	1508	1409	41.87
Self-efficacy measure (post-treatment)	1507	1409	41.89
Self-regulation measure (post-treatment)	1501	1398	42.23
Anxiety measure (post-treatment)	1507	1409	41.89

Pupil and school characteristics

The University of Portsmouth approached 168 schools; of these, 67 did not accept to participate in the study. Finally, 101 schools were included in the randomisation: 50 were allocated to the intervention group and 51 were allocated to the control group. After the randomisation, six schools (two treatment, four control) withdrew from the study and were not included in the final analysis.

Table 8 reports the main school characteristics for the schools that participated in the randomisation and their pupils by treatment status. The most relevant difference at school level is the proportion of academy schools: 28% in the intervention group and 17.65% in the control group. Schools in the intervention group have also more pupils on roll than schools in the control group (a mean of 362.52 in treatment schools and of 341.86 in control schools). Another small difference concerns the proportion of EAL pupils in the schools—17.46% in the intervention group and 15.49% in the control group. There are no other relevant differences between intervention and control schools in school-level characteristics.

There are also few, and small, differences between the two groups of schools in pupil-level characteristics. For example, there is a marginally higher proportion of white pupils (73.26%) and a lower proportion of black pupils (4.05%) in the intervention compared to the control group (respectively 69.78% and 6.84%). Although the difference in the proportion of black pupils is small in terms of percentage points it is significant in percentage terms given the low baseline proportion. All the other characteristics and pupil pre-intervention outcomes are, on average, similar in the two groups, as shown by the standardised differences. It is important to highlight that there is a good balance in all the pre-test outcomes as all the differences found are very small and likely to be attributed to chance. In particular, the pre-intervention mindset measure, which is a measure of fixed mindset captured through an additional set of questions administered to the pupils with the MLSQ questionnaire, is very similar, on average, in the two groups.

Table 8: Baseline comparison as randomised

Variable	Intervention group		Control group	
	n/N(missing)	Percentage	n/N(missing)	Percentage
School level (categorical)				
Religiously affiliated	12/50 (0)	24.00	12/51 (0)	23.53
Academy	14/50 (0)	28.00	9/51 (0)	17.65
Community school	22/50 (0)	44.00	29/51 (0)	56.86
Voluntary or Foundation school	7/50 (0)	14.00	3/51 (0)	5.88
Voluntary aided school	7/50 (0)	14.00	9/51 (0)	17.65
OFSTED: Outstanding	8/50 (0)	16.00	9/50 (1)	18.00
OFSTED: Good	37/50 (0)	74.00	36/50 (1)	70.59
OFSTED: Satisfactory	4/50 (0)	8.00	5/50 (1)	10.00
OFSTED: Inadequate	1/50 (0)	2.00	1/50 (1)	2.00

Variable	Intervention group		Control group		
School level (continuous)	n(missing)	Mean	n(missing)	Mean	
Number of pupils	50 (0)	362.52	51 (0)	341.86	
% of Free School Meal	50 (0)	14.54	51 (0)	15.56	
% SEN with support	50 (0)	12.93	51 (0)	12.15	
% SEN with statement	50 (0)	1.24	51 (0)	1.45	
% English Additional Language	50 (0)	17.46	51 (0)	15.49	
Variable	Intervention group		Control group		
Pupil level (categorical)	n/N(missing)	Percentage	n/N(missing)	Percentage	
Female	1194/2420 (0)	49.34	1190/2455 (0)	48.47	
Ever FSM	832/2420 (0)	34.38	857/2455 (0)	34.91	
Ethnicity: Asian	359/2420 (0)	14.83	397/2455 (0)	16.17	
Ethnicity: Black	98/2420 (0)	4.05	168/2455 (0)	6.84	
Ethnicity: Mixed	148/2420 (0)	6.12	108/2455 (0)	4.40	
Ethnicity: White	1773/2420 (0)	73.26	1713/2455 (0)	69.78	
Variable	Intervention group		Control group		
Pupil level (continuous)	n(missing)	Mean	n(missing)	Mean	Std. diff.
Reading points at KS1	2288 (132)	16.38	2324 (131)	16.37	0
Writing points at KS1	2288 (132)	14.99	2324 (131)	15.21	-0.06
Mathematics points at KS1	2288 (132)	16.18	2324 (131)	16.23	-0.01
Mindset measure	2030 (390)	3.18	1814 (641)	3.15	0.02
Intrinsic value measure	2038 (382)	5.60	1827 (628)	5.66	-0.06
Self-efficacy measure	2037 (383)	5.21	1827 (628)	5.28	-0.06
Anxiety measure	2037 (383)	3.80	1827 (628)	3.72	0.05
Self-regulation measure	2034 (386)	4.73	1820 (635)	4.82	-0.08

Table 9 presents the baseline comparison at analysis and therefore does not include the six schools that dropped out after the randomisation. This table is useful as it allows us to explore whether attrition was differential between the groups. The baseline comparison at the analysis is very similar to the one at randomisation: the differences between treatment and control group are very small and are likely to be attributed to chance. As the balance does not change when attrition is taken into account in the baseline comparison, it is confirmed that differential attrition is not a threat to the validity of the trial.

Table 9: Baseline comparison at analysis

Variable	Intervention group		Control group	
School level (categorical)	n/N(missing)	Percentage	n/N(missing)	Percentage
Religiously affiliated	11/48 (0)	22.92	12/47 (0)	25.53
Academy	14/48 (0)	29.17	9/47 (0)	19.15
Community School	21/48 (0)	43.75	25/47 (0)	53.19
Voluntary or Foundation school	7/48 (0)	14.58	3/47 (0)	6.38
Voluntary aided school	6/48 (0)	12.50	9/47 (0)	19.15
OFSTED: Outstanding	7/48 (0)	14.58	8/47 (0)	17.02
OFSTED: Good	36/48 (0)	75.00	34/47 (0)	72.34
OFSTED: Satisfactory	4/48 (0)	8.33	4/47 (0)	8.51
OFSTED: Inadequate	1/48 (0)	2.08	1/47 (0)	2.13

Variable	Intervention group		Control group		
School level (continuous)	n(missing)	Mean	n(missing)	Mean	
Number of pupils	48 (0)	361.96	47 (0)	340.57	
% of Free School Meal	48 (0)	14.87	47 (0)	16.6	
% SEN with support	48 (0)	13.06	47 (0)	12.59	
% SEN with statement	48 (0)	1.22	47 (0)	1.51	
% English Additional Language	48 (0)	17.51	47 (0)	15.58	
Variable	Intervention group		Control group		
Pupil level (categorical)	n/N(missing)	Percentage	n/N(missing)	Percentage	
Female	1150/2335 (0)	49.25	1079/2249 (0)	47.98	
Ever FSM	809/2335 (0)	34.65	826/2249 (0)	36.73	
Ethnicity: Asian	351/2335 (0)	15.03	371/2249 (0)	16.50	
Ethnicity: Black	93/2335 (0)	3.98	163/2249 (0)	7.25	
Ethnicity: Mixed	142/2335 (0)	6.08	100/2249 (0)	4.45	
Ethnicity: White	1708/2335 (0)	73.15	1546/2249 (0)	68.74	
Variable	Intervention group		Control group		Std. diff.
Pupil level (continuous)	n(missing)	Mean	n(missing)	Mean	
Reading points at KS1	2209 (126)	16.39	2122 (127)	16.26	0.03
Writing points at KS1	2209 (126)	15.00	2122 (127)	15.12	-0.03
Mathematics points at KS1	2209 (126)	16.21	2122 (127)	16.16	0.01
Miniset measure	2030 (305)	3.18	1753 (496)	3.14	0.03
Intrinsic value measure	2038 (297)	5.60	1766 (483)	5.68	-0.08
Self-efficacy measure	2037 (298)	5.21	1766 (483)	5.29	-0.07
Anxiety measure	2037 (298)	3.80	1766 (483)	3.72	0.05
Self-regulation measure	2034 (301)	4.73	1759 (490)	4.83	-0.09

In summary, there is a good balance between the treated and the control group in school and pupil characteristics and the small differences found seem fairly consistent with the amount of imbalance that would occur due to chance.

Outcomes and analysis

This evaluation assesses whether supporting schools in encouraging ‘growth mindset’ in their pupils—that is, the belief that intelligence can be developed rather than being a fixed trait—has an effect on pupils’ numeracy and literacy skills and on a subset of non-cognitive skills (self-efficacy, intrinsic value, test anxiety, and self-regulation).

Analyses of primary and secondary outcomes are undertaken on an ‘intention to treat’ basis: all pupils for which there is available data are included in the estimation of the effect size, regardless of whether the school completed the intervention or implemented it as agreed during the teacher training day.

We present now the findings of the statistical analyses of primary and secondary outcomes. The code used to calculate the effect size in academic outcomes is provided in Appendix H.

Academic outcomes

The academic outcomes included in the analysis are KS2 scores in maths, reading, and GPS. Means and standard deviations of post-test scores are very similar between the treatment and control group. The mean (and standard deviation) of scores of KS2 scores in maths, reading, and GPS is, respectively, 103.82 (sd 7.42), 103.82 (sd 8.06), and 105.87 (sd 7.51) for the treated group; and 104.06 (sd 7.06), 103.70 (sd 8.37), and 105.76 (sd 7.38) for the control group. Histograms for the post-test scores are presented in Appendix I.

We estimate three multilevel models to assess the effect of the intervention on KS2 academic outcomes. Table 10 reports the effect size for KS2 maths, reading, and GPS; Table 11 presents all parameters used for the calculations in Table 10. The intra-cluster correlations (ICC) were respectively 0.11, 0.07, and 0.12. The effect size for the impact of the intervention on each of the three academic outcomes is zero. The confidence intervals of the effect of the intervention on KS2 maths, reading, and GPS were, respectively, -0.04 to 0.01, -0.02 to 0.02, and -0.03 to 0.03. Therefore, there is no evidence of an impact of the Changing Mindsets intervention on literacy or numeracy skills of Year 6 students.

As the effect is zero for all primary outcomes, we do not proceed with any multiple comparison adjustments in the reporting of the results.

Table 10: Primary analysis

Outcome	Raw means				n in model (intervention; control)	Effect size (95% CI)	p-value
	Intervention group		Control group				
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)			
KS2 maths	2273 (62)	103.82 (103.51;104.13)	2181 (68)	104.07 (103.77; 104.36)	4454 (2273; 2181)	-0.01 (-0.04; 0.01)	0.37
KS2 reading	2263 (72)	103.82 (103.49;104.16)	2174 (75)	103.70 (103.35; 104.05)	4437 (2263; 2174)	-0.00 (-0.02; 0.02)	0.72
KS2 GPS	2266 (69)	105.87 (105.56;106.18)	2182 (67)	105.76 (105.45; 106.07)	4448 (2266; 2182)	-0.00 (-0.03; 0.03)	0.90

Table 11: Effect size estimation in primary analysis

Outcome	Unadjusted differences in means	Adjusted differences in means	Intervention group		Control group		Pooled variance
			n (missing)	Variance of outcome	n (missing)	Variance of outcome	
KS2 maths	-0.25	-0.38	2273 (62)	55.1	2181 (68)	49.9	52.56
KS2 reading	0.12	-0.13	2263 (72)	64.98	2174 (75)	70.13	67.49
KS2 GPS	0.11	0	2266 (69)	56.43	2182 (67)	54.56	55.5

Non-cognitive outcomes

The non-cognitive traits included in the analysis as secondary outcomes are the following subscales of the MLSQ: intrinsic value, self-efficacy, test anxiety, and self-regulation. Means and standard deviations of the post-test subscales are very similar between the treatment and control group. The mean (and standard deviation) of intrinsic value, self-efficacy, test anxiety, and self-regulation is, respectively, 5.54 (sd 1.01), 5.11 (sd 1.07), 3.44 (sd 1.74), and 4.76 (sd 1.07) for the treated group; and 5.49 (sd 1.02), 5.17 (sd 1.07), 3.50 (sd 1.73), and 4.72 (sd 1.08) for the control group. Histograms for the post-test scores are presented in Appendix I.

As in the primary outcome analyses, we estimate four multilevel models to assess the effect of the intervention on non-cognitive outcomes. The estimates from a mixed model for the four subscales of the adapted MSLQ are used to calculate the effect sizes of the intervention on non-cognitive outcomes. Table 12 reports the effect size for each subscale, and Table 13 presents all parameters used for the calculations in Table 12. The results show that the effect size for the impact of the intervention is not statistically different from zero for any of the four subscales. The effect size for intrinsic value is 0.09 with confidence interval -0.10 to 0.28; for self-efficacy, -0.05 (CI: -0.21; 0.10); for test anxiety, -0.01 (CI: -0.09; 0.06); and self-regulation, 0.05 (CI: -0.11; 0.21).

Therefore, there is no evidence of an impact of the Changing Mindsets intervention on the tested non-cognitive outcomes of Year 6 students.

Table 12: Secondary analysis

Outcome	Raw means						p-value
	Intervention group		Control group		n in model (intervention; control)	Effect size (95% CI)	
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)			
Intrinsic value	1508 (827)	5.54 (5.49; 5.59)	1409 (840)	5.51 (5.46; 5.56)	2917 (1508; 1409)	0.09 (-0.10; 0.28)	0.36
Self-efficacy	1507 (828)	5.13 (5.08; 5.18)	1409 (840)	5.21 (5.15; 5.26)	2916 (1507; 1409)	-0.05 (-0.21; 0.10)	0.53
Test anxiety	1507 (828)	3.46 (3.37; 3.55)	1409 (840)	3.46 (3.37; 3.55)	2916 (1507; 1409)	-0.01 (-0.09; 0.06)	0.74
Self-regulation	1501 (834)	4.77 (4.72; 4.82)	1398 (851)	4.74 (4.69; 4.80)	2899 (1501; 1398)	0.05 (-0.11; 0.21)	0.52

Table 13: Effect size estimation in secondary analysis

Outcome	Unadjusted differences in means	Adjusted differences in means	Intervention group		Control group		Pooled variance
			n (missing)	Variance of outcome	n (missing)	Variance of outcome	
Intrinsic value	0.03	0.07	1508 (827)	0.98	1409 (840)	1.06	1.02
Self-efficacy	-0.08	-0.04	1507 (828)	1.14	1409 (840)	1.15	1.15
Test anxiety	0	-0.03	1507 (828)	3.05	1409 (840)	3.03	3.04
Self-regulation	0.03	0.05	1501 (834)	1.14	1398 (851)	1.21	1.17

Subgroup analysis

The statistical analysis plan proposed a separate analysis for disadvantaged pupils, identified by the indicator 'Ever FSM' included in the NPD records. Tables 14 and 15 present the results for primary and secondary outcomes respectively. In the primary analysis the effect size is zero for the FSM subgroup, as for the full sample. The confidence intervals of the effect of the intervention on KS2 maths, reading, and GPS were, respectively, -0.03 to 0.03, -0.02 to 0.03, and -0.03 to 0.03.

In the secondary analysis, the effect size for the intrinsic value subscale is positive but not statistically significant. The other effect sizes are very small or negative and not statistically significant. Therefore, there is no evidence of an impact of the Changing Mindset intervention on the tested non-cognitive outcomes of Year 6 students that have ever been eligible for FSM.

We also carried out separate analysis for three other subgroups: females, males, and pupils with 'fixed mindset' in the pre-trial tests. These analyses were not pre-specified in the protocol nor in the SAP and as such they are exploratory attempts to understand whether the intervention had an effect on groups that showed promising results in other studies. The results of these exploratory analyses show that there is no evidence of an impact of the Changing Mindset intervention on the tested cognitive and non-cognitive outcomes of Year 6 students in these subgroups. The results for these additional subgroup analyses are reported in Appendix J.

Table 14: Primary analysis for FSM subgroup

Outcome	Raw means				n in model (intervention; control)	Effect size (95% CI)	p-value
	Intervention group		Control group				
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)			
KS2 maths	782 (27)	101.81 (101.28; 102.34)	797 (29)	102.24 (101.75; 102.74)	1579 (782; 797)	0.00 (-0.03; 0.03)	0.92
KS2 reading	780 (29)	101.46 (100.91; 102.02)	794 (32)	101.40 (100.82; 101.98)	1574 (780; 794)	0.01 (-0.02; 0.03)	0.68
KS2 GPS	779 (30)	103.82 (103.29; 104.36)	797 (29)	104.13 (103.61; 104.64)	1576 (779; 797)	0.00 (-0.03; 0.03)	0.92

Table 15: Secondary analysis for FSM subgroup

Outcome	Raw means				n in model (int; control)	Effect size (95% CI)	p-value
	Intervention group		Control group				
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)			
Intrinsic value	565 (244)	5.54 (5.46; 5.63)	598 (228)	5.46 (5.38; 5.55)	1163 (565; 598)	0.138 (-0.08; 0.37)	0.23
Self-efficacy	565 (244)	5.03 (4.94; 5.12)	598 (228)	5.12 (5.03; 5.20)	1163 (565; 598)	-0.093 (-0.30; 0.12)	0.38
Test anxiety	565 (244)	3.75 (3.60; 3.89)	598 (228)	3.65(3.51; 3.79)	1163 (565; 598)	0.049 (-0.06; 0.15)	0.36
Self-regulation	563 (246)	4.74 (4.65; 4.84)	593 (233)	4.69(4.60; 4.78)	1156 (563; 593)	0.029 (-0.17; 0.23)	0.77

Missing data analysis

In this project, missing data affects outcome variables. Primary and secondary outcomes present a high percentage of missing data, mainly caused by schools dropping out from the project over time; as a consequence, we assess whether the missing data is 'missing completely at random' (MCAR). To do so, we create an indicator variable for each primary and secondary outcome in the impact model specifying whether the data is missing or not and use logistic regression to test whether the missing status can be predicted from the following variables: all variables in the precise model plus school average KS1 maths scores, gender, ethnicity, and eligibility for FSM (for secondary outcomes achievement at KS1 is also included).

The estimates of the logit models are presented in tables K1 and K2 in Appendix K. The results for primary outcomes show that the probability of cognitive test scores being missing is associated with ethnicity, previous achievement, FSM status, and the block indicators. Since missingness can be predicted by some of the variables used in the logistic regression, in particular FSM eligibility, ethnicity, and prior achievement, the implication is that the missing data could be missing at random (MAR). To obtain valid estimates it is then necessary to carry out an additional analysis where the variables predictive of non-response are included in the estimated model. These additional estimates are presented in Table K3: the results are not different from the ones based on complete data showing that the results are not biased by the presence of MAR data but they are underpowered.

The missingness for all secondary outcomes is consistently related to pupil gender, block indicators, and previous achievement, showing that missing data in these outcomes could be MAR. To reduce the bias introduced by missing data we carry out an additional analysis where the precise model is augmented with indicators for pupil gender and

previous achievement. Estimates from this additional analysis are reported in Table K4 and they do not diverge from the main results presented in Table 11, suggesting that there is no bias introduced by the presence of MAR data. However, the high proportion of missing secondary outcomes in the data reduces the informative value of this additional analysis.

Non-compliance

There was a low response rate to the fidelity survey administered to schools in the intervention group and therefore we could not observe the level of non-compliance to the intervention. As a consequence, it was not possible to conduct the initially planned analysis into the effect of non-compliance. Interestingly, the process evaluation and the control group survey reveal that many teachers in both groups of schools were familiar with the growing interest in mindset theory and had already adopted some of its principles in their everyday teaching style, such as rewarding their pupils for their effort rather than the outcome achieved.

Costs

The Growing Learners team at the University of Portsmouth offers to deliver the training at a school during an inset day.¹⁰ This delivery method allows all teachers in a participating school to be trained and, as it takes place during an inset day, schools would not incur in additional costs for covers. The cost of this training is £1,800 per school plus travel and accommodation costs for two trainers, if the school is located more than 20 miles outside of Portsmouth. This cost covers the mindsets intervention materials and a day of training in mindsets for all staff, which include:

- an introduction to mindsets;
- lesson plans for the six-week intervention for use with the children;
- a memory stick containing ready-to-use printable materials (poster displays, learning materials) and a PowerPoint presentation for other stakeholders; and
- a free Assessment Package for use with up to 300 pupils before and after the mindset intervention and 12 months' access to the team's advice and support service.

We derive the total cost over three years and the total cost per pupil over three years under the following assumptions: travel and accommodation costs for two trainers will be on average £500; teachers trained in the first year will stay in the school for at least another two years; schools have an average of 60 Year 6 pupils on roll each year; and that all pupils on roll in the school will benefit from the intervention. The cost for the school over three years will be £2,300 and the cost per pupil over three years will be £4.26. The cost per pupil and cumulative cost are summarised in Tables 16 and 17.

Table 16: Cost of delivering Changing Mindset

Item	Type of cost	Cost	Total cost over 3 years	Total cost per pupil per year over 3 years
Training	Start-up cost per school	£1,800	£1,800	
Travel and accommodation costs for two trainers	Start-up cost per school	£500	£500	
Total			£2,300	£2,300/180/3 = £4.26

Table 17: Cumulative costs of Changing Mindset

	Year 1	Year 2	Year 3
Changing Mindset Project	£2,300	£2,300	£2,300

¹⁰ The full set of intervention packages offered by the University of Portsmouth can be found here: <http://www2.port.ac.uk/department-of-psychology/community-collaboration/growing-learners/what-we-offer/#schools>

Implementation and process evaluation

The purpose of the implementation and process evaluation is to provide insights into participants' experience of implementing and delivering the intervention, as well as to bring greater clarity to the quantitative research findings and to understand the reasons behind any impact, or absence of proven impact. Specifically, this process evaluation set out to understand how the Changing Mindsets intervention programme was implemented and delivered in treatment schools, and to what extent this differed (if at all) from the intended delivery model. It also aimed to shed light on implementers' as well as pupils' responsiveness to the intervention, and the perceived impact the programme has had on those involved. Finally, the process evaluation sought to gather information on the activity of schools within the control group over the course of the trial period, and establish how far this differed from the intervention programme. The research methods used included the following:

- fieldwork visits to six treatment schools conducted from December 2016 to February 2017, which included:
 - semi-structured interviews with nine Year 6 teachers, three deputy/head teachers, and four teachers from other Year groups;
 - three focus groups with eight to ten Year 6 pupils receiving the intervention; and
 - three lesson observations of the final Changing Mindsets session;
- end of project survey, administered to treatment schools from January to February 2017;
- fidelity survey, administered to treatment schools over course of intervention from September 2016 to February 2017; and
- control group survey, administered in June 2017.

All activities were carried out by NIESR, with the exception of the fidelity and control group surveys, which were administered by Portsmouth University. The control group survey took the form of a paper questionnaire and was completed by attendees at the training days that were provided after programme implementation had finished at the end of academic year 2016/2017. This was forwarded to NIESR and incorporated into the external evaluation. All other surveys were administered and completed by respondents online.

It should be noted that the views and experiences presented here are not necessarily representative of all participating schools. The response rate to the fidelity survey decreased over the course of the intervention (from 49 to 9 respondents), while the end-of-project survey was completed by just over half of treatment schools (26 out of 50). However, steps were taken to ensure that the treatment schools visited as part of fieldwork included a variety of delivery contexts. We selected schools to include a range by key characteristics: Ofsted rating, proportion of FSM pupils, geographical location, and whether located in urban or rural settings. The project team provided NIESR with a full list of treatment schools from which we drew up a profile according to characteristics of interest and then aimed to achieve a good mix of schools within the sample of six. In two cases, schools were not responsive to our request for participation and alternatives were approached. The response rate to the control group survey was good in that it was completed by 37 out of 51 schools in this treatment allocation.

Implementation

The key factors for successful implementation of the Changing Mindsets programme are:

- training in mindset theory and principles—structure of the programme and delivery;
- access to the training manual;
- lesson plans with learning outcomes, activities, and materials including videos and posters;
- commitment from the school; and

- space in the timetable.

Familiarity and engagement with growth mindset approaches

The extent to which staff in treatment schools were already familiar, and had engaged, with approaches similar to those that informed the Changing Mindsets project is important in understanding their expectations for this work and subsequent experience of delivery. The findings from the process evaluation show that while many staff members were aware of similar approaches prior to their involvement in the project, few said they had used these within their own teaching practices. For example, findings from the survey of staff in treatment schools show that two thirds (21 out of 35 respondents) had read or heard about the concept of a growth mindset prior to the project by engaging with evidence on the topic. This took the form of written evidence, such as articles or books, or videos they had viewed online. Thirteen respondents had also attended meetings in which the theory of growth mindset was discussed. They included internal meetings within the school with other teaching staff, and external meetings or training days for schools within their local authority cluster.

However, only 7 out of 35 respondents said they had used, in their own teaching practices, approaches similar to those encouraged by the Changing Mindsets project in the past, while 11 reported that their school had. Where teaching staff had engaged with similar approaches, these included the use of online resources, or the adoption of specific growth mindset principles in their own teaching style such as rewarding pupils for their effort, not the outcome achieved; understanding that making mistakes is part of the learning process; and being knowledgeable of the difference between a fixed and growth mindset, and how this can affect pupil progress in their learning.

Interviewees from several of the schools that took part in fieldwork visits commented that they were already familiar with growth mindset approaches and were working to embed these principles into their school culture and/or value system prior to the start of the project.

'It was something we were already working on and something that we'd embedded into our set of school values.'

Deputy Head/Year 6 teacher, School 1.

Another school was already looking at how it could work these ideas and concepts into its teaching plans for the following academic year.

Responsiveness of teaching and learning staff to the intervention

Among all of the treatment schools visited as part of fieldwork, there was a high degree of buy-in from interviewees for the Changing Mindsets intervention programme. It was seen to address a recognised need among learners. Some interviewees commented that the project tied in well with the introduction of the new national curriculum, which was seen to be far more challenging for pupils at all levels of ability—that is, engagement with the project had helped pupils to learn coping strategies to help them progress in this new environment. Others spoke more generally of how it was necessary to get all pupils, even the high achievers, to reflect on the process by which they learn and become familiar with such coping strategies, given that all would encounter difficulties at some point in their education.

Staff from one school observed that their current cohort of Year 6 pupils was underperforming, and they were therefore encouraged to get involved in the project to improve the perseverance and resilience in learning of this group specifically:

'We've worked with them throughout the whole of Year 5 to try and plug the gaps, if you like, and we felt that this Changing Mindsets would be the extra layer to try and get them to think about their own learning.'

Deputy Headteacher, School 6.

Interviewees from another school commented that, after hearing the concept of growth mindset referred to by other staff, they undertook some background reading on this approach. They reported reading that while it had already been tried in a number of schools, it had not always been successfully implemented as not all staff had a clear idea of what it

was. The school concerned was, therefore, motivated to become involved in this project as it felt it would give all staff a clear understanding of the principles underpinning this approach, and also liked the fact the project would be evaluated in terms of its impact.

Experiences of the training

The delivery team for this project delivered one day's training for all treatment schools. This took place at the start of the academic year (September 2016). The results of the end-of-project survey show that the majority of respondents who attended the training (23 out of 30) were satisfied with the content of the training day, while seven were 'somewhat satisfied'. Responses to an open ended question about how the training day could have been improved included a preference for more practice with activities rather than the theoretical basis for growth mindset.

The findings from the fieldwork visits and end-of-project survey show some consistency in terms of how treatment schools felt the training could be improved. Most commonly, respondents wanted the training to focus less on the background and evidence base underpinning growth mindset approaches. As noted, many treatment schools had already engaged with evidence on this topic and were somewhat familiar with the background to this approach, while a few already had intentions to cultivate a growth mindset culture within their school and were therefore highly motivated to take part.

'They were preaching to the converted really [...] people were there because they wanted to get involved.'

Year 6 teacher, School 5.

As an alternative, some attendees observed that would have liked the training to have spent more time going through and discussing the intervention materials, such as the lesson plans, and to have had further opportunities to practice delivering some of the suggested activities and reflect on how they may best be applied in the classroom. While some time was spent during the training presenting the lesson plans for each session, some attendees did not feel that this element was very interactive.

In spite of this, most respondents (18 out of 30) to the end-of-project survey felt, to a great extent, that they were prepared for delivering the Changing Mindsets intervention as a result of the training day and the material. Only four said the training and materials had prepared them 'very little' and eight said they had done so 'somewhat'.

Fidelity

The Changing Mindsets intervention programme was designed to be delivered by teachers in the form of eight sessions. It was suggested that teachers deliver one session per week, over eight consecutive weeks, with each session lasting approximately two hours. The delivery team at Portsmouth University made clear, however, that the intervention was designed to be flexible, and treatment schools were free to deliver the sessions in shorter, more regular intervals if they preferred. Schools were also encouraged to adapt and modify the materials to suit the needs of their classes; the only consistency required was that the learning objectives set for each session were achieved by the children.

The findings from the fidelity survey administered by the delivery team show that, according to teacher self-reports, many treatment schools were able to meet these requirements. As Table 18 shows, over the course of the programme, most respondents were able to deliver sessions that were one to two hours in duration, although data is missing from many schools for later sessions. Most commonly, respondents were able deliver sessions that lasted from one and a half to two hours, as recommended by the delivery team. Year 6 teachers were also asked to note the date and time of each session, and from this it appeared that the majority of respondents opted to deliver one session per week in a single block, rather than splitting the eight sessions into shorter, more regular lessons.

Table 18: Length of session

Session no.	1	2	3	4	5	6	7	8
30 minutes–1 hour	6	3	3	-	-	-	-	-
1–1.5 hours	17	12	10	5	6	1	6	4
1.5–2 hours	21	19	15	16	15	9	7	4
2 hours or more	4	-	-	3	-	2	3	1
N	49	34	28	26	21	12	16	9

Among the treatment schools that took part in the fieldwork visits, while all were aiming to deliver a single, weekly session, the length of these varied from between 40 minutes to close to two hours. For those delivering shorter sessions, the main reason was that pupils were used to working in 40- to 60-minute slots and teachers believed they would struggle to maintain concentration over a longer period. In these cases, it was clear from the interviews and lesson observations that fewer activities were being delivered than suggested in the lesson plan as a result of the shortened session time.

Concerns over pupil concentration were also expressed among a few teachers delivering sessions that lasted longer than one hour. However, they opted to deliver longer sessions so they could attempt to complete all the suggested activities. Some interviewees who expressed this view did not feel it was possible to deliver more regular, shorter sessions as an alternative due to pressures to deliver the necessary aspects of the school curriculum.

Those schools that participated in fieldwork had managed to deliver most of the sessions on consecutive weeks, though a few mentioned that they had been unable to deliver sessions during some weeks due to day-trips or other events within the school calendar in which all Year 6 pupils were participating. When this happened on more than one occasion, schools had to complete the final few sessions after the Christmas holiday period, at the beginning of the Spring term.

In spite of variations in the reported length of the sessions, their regularity, and the number of suggested activities Year 6 teachers were able to get through, the results of the fidelity survey show that, for most sessions, the majority of respondents agreed that the key learning outcomes provided in the training manual had been met. However, we cannot be sure this is true of the final few sessions since the response rate to the fidelity survey fell during the final few weeks of implementation: data was received from only a small proportion of the treatment sample. An alternative summative measure of pupils' achievement in learning through the intervention programme is provided by the end-of-project survey. This was completed by just over half of all participating treatment schools. It found that the overwhelming majority of respondents (21 out of 24) who were involved in delivering these sessions felt that pupils had understood the ideas and concepts they had been taught.

As mentioned, the achievement of the stated learning outcomes for each session was the main aspect of the treatment model that schools were asked to adhere to. These findings therefore suggest that the necessary conditions for trial fidelity were largely met.

In the small number of instances where teachers did not agree that some or all of the learning outcomes for a given session had been achieved, the reasons for this were not always made explicit by respondents. Where explanations were provided, this was attributed to difficulties in accessing online resources or the time-consuming nature of some of the suggested activities, which left respondents with little time to get through all of the content they intended to cover.

View and use of project resources

As indicated in the preceding section, Year 6 teachers' experience of delivering the Changing Mindsets intervention programme was influenced by their use of the resources provided by the delivery team: namely, the training manual, in which the lesson plans for the eight sessions were contained, and the online videos that accompanied the sessions supplied by Positive Edge Education.

With regards to the training manual: as highlighted, treatment schools differed in how many of the suggested activities they attempted to deliver for each session. The fieldwork visits showed that teachers based this decision on how long they believed their pupils would be able to concentrate in lessons and progress through the suggested content, as well

as how much of this they felt they had to deliver to meet the requirements of the project in terms of fidelity and achieve the stated learning outcomes.

In line with the guidance issued by the delivery team at Portsmouth University, teachers also altered the content and nature of the activities they chose to deliver. The end-of-project survey showed that most of these changes, however, were minor, with the majority of respondents (16 out of 24) involved in delivery reporting that they had changed the content of the lessons very little. In some cases, this involved small tweaks to the content to enhance its relevance to pupils, or to make the activity more practical or engaging for pupils to complete. This included relating the content to pupils' upcoming SATS exams and turning whole class exercises into paired or group exercises where more children had the opportunity to contribute their thoughts or ideas to the task at hand. In a few cases, teachers skipped some of activities entirely where they did not believe they were challenging or engaging enough for their class. One example related to the multiplication and division tricks covered in session six, which the teacher believed were below the ability level of their Year 6 pupils. Another found that pupils did not engage with the character animations that were used in some of the sessions, and so the teacher concerned found their own video clips and examples to illustrate the same points in subsequent lessons.

While some treatment schools made small changes to the content of the lessons, the results of the end-of-project survey showed that all respondents found the training manual overall to be useful. Several positive comments were made on its content during the fieldwork visits with treatment schools. Some teachers felt that the manual was very comprehensive, and all the materials and resources were there that they needed to deliver the sessions with very little preparation required. Other teachers that were delivering shorter sessions than recommended (that is, 40–60 minutes) commented that there was a wealth of content to choose from. This group were pleased that the lessons plans could be used flexibly and that they could pick and choose what activities were most relevant and appropriate for their students.

'We always had the opportunity to select what we wanted to use. It was never under resourced.'

Year 6 teacher, School 2.

'The lesson plans are really clear, quite flexible as well, so quite easy to adapt to your own children.'

Deputy Head, School 6.

While a few teachers criticised the amount of content included in the lesson plans and observed that there was too much to get through, even in a two-hour period, not all of these individuals had attended the training day delivered by the delivery team. As a result, it may be some of these teachers may not have been made as acutely aware that the intervention was designed to be flexible, and that they were free to modify and adapt the materials as they saw fit.

Another resource that teachers were provided with access to as part of the intervention programme were the online videos supplied by Positive Edge Education. This was paid content, which schools were provided with individual licences to access. Year 6 teachers were required to activate these licences and log-in to an online system every time they wanted to view the videos. They were referenced throughout the lesson plans, and teachers were encouraged to make use of particular videos to help emphasise key points. The videos were made available on a timed release format: teachers could only view the next video 24 hours after the previous one had finished. At the end of each video, a series of multiple-choice and long-answer questions were presented for teachers to work through with pupils to check their comprehension of the ideas presented. Teachers needed to complete this form before they could start the timed release of the next video. Even if they did not wish to answer the questions, they were required to select 'skip' for those that were multiple choice or write some text in the box for the long-answer questions in order for the next video to be released.

The findings from the process evaluation show that, overall, the content of the videos was generally well received. For example, the end-of-project survey showed that the vast majority (26 out of 29) of respondents found the videos to be useful, with over half (18) rating them as very useful. Similarly, during fieldwork with treatment schools, several teachers remarked how the pupils had generally enjoyed the content of the PPE videos. Some teachers felt they were a useful in keeping pupils engaged with the content of the session and having the questions at the end helped to encourage

pupils to maintain their concentration throughout the duration of the video. Others stated that the content of some of the videos (for example, the story of Charles Darwin's early life) tied in nicely with the cross-curricular topics they were studying in Year 6, and provided real-life examples of where growth mindset approaches had worked, which pupils related to better than the character animations:

'The famous failures videos [...]—they can actually see that hugely successful people are using this, whether they call it growth mindset or not, that's what they're doing.'

Year 6 teacher, School 5.

However, a few teachers commented that the content of particular videos was too advanced and not age-appropriate for Year 6 pupils (for example, the Einstein explainer video that discussed the structure of the brain). Another criticism was that the videos could also be too long in duration, with some lasting up to 20 minutes. These factors combined meant that teachers felt that pupils, on occasions, had struggled to pay attention and recall all of the content presented.

'There was such a discrepancy between the pitch of those videos and then the pitch of some of the activities that actually for the children to then be able to summarise what the film was about, you know, or answer the questions about what was in the film, it was too long and they'd forgotten. I wasn't even sure I knew the right answer.'

Deputy Head/Year 6 teacher, School 6.

The findings from the lesson observations showed that some Year 6 teachers were selective about how much of the video content they presented to pupils in order to get key points across. This again illustrates that Year 6 teachers differed in how comfortable they felt in modifying the content of the intervention programme to suit the needs of their class.

By far the most common criticism of the PPE videos, however, was the process for accessing them. Teachers expressed their frustration that they had to log-in every time they wished to view the videos, and that they were unable to get a sense of their content at the beginning of implementation due to the time release format, which would have helped them to better plan their delivery. Teachers also recounted how they had not always been able to access the videos they needed for each session as, in error, they had not started the timed release process. This was attributed to not having completed viewing the previous video to the end of the running time or provided responses to the entire series of questions that followed. This impacted on teachers' ability to get through all the content they intended for the session and, as mentioned, in a few cases, their ability to meet the stated learning objectives.

Pupil responsiveness to intervention

The findings from the fidelity questionnaire, detailed in Table 19, show that pupils appeared to respond well to the Changing Mindsets sessions with the majority of respondents agreeing that pupils were engaged throughout. Further, as highlighted in Table 20, only a minority of respondents noted that pupils were disruptive in these sessions to such a degree that their behaviour negatively impacted on others.

Table 19: 'Pupils were engaged throughout the session' (fidelity questionnaire)

Session no.	1	2	3	4	5	6	7	8
Strongly agree	13	8	8	7	6	3	3	5
Agree	27	18	11	11	7	6	8	3
Mostly agree	7	4	5	5	5	2	4	1
Mostly disagree	2	2	3	1	1	1	1	-
Disagree	-	1	1	1	2	-	-	-
Strongly disagree	-	1	-	1	-	-	-	-
N	49	34	28	26	21	12	16	9

Table 20: ‘Some pupils were disruptive to such a degree that the session was negatively impacted for others’ (fidelity questionnaire)

Session no	1	2	3	4	5	6	7	8
Strongly agree	2	-	-	-	-	-	-	-
Agree	1	3	4	2	-	-	1	1
Mostly agree	-	3	1	2	4	1	-	-
Mostly disagree	1	-	-	1	1	1	1	-
Disagree	13	6	7	5	6	6	4	1
Strongly disagree	32	22	16	16	10	4	10	7
N	49	34	28	26	21	12	16	9

Overall, in their delivery, several teachers and pupils noted during the fieldwork visits that the sessions were largely discursive and reflective in nature. Pupils in one school commented that this format had made the sessions fun and interesting.

‘After the video we have a massive talk and everyone just gives ideas and examples.’

Year 6 pupil, School 5.

Year 6 teachers were similarly positive about this format, although one school did note that having a lot of class discussions and group work did mean that occasionally some children coasted in the session and did not make much of a contribution to these activities. This behaviour was noted during a few of the lesson observations where group work was being completed.

Teachers in one school felt that pupils also exhibited a high level of engagement due to the content, which was focused on how they learn, and was therefore very practical for them. The interviewees contrasted this to pupils’ level of participation in Personal Social and Health Education lessons, which followed a similar format, yet tended to be very low. However, some pupils from a different school found the process of writing down or presenting their ideas on the content of the sessions each week quite repetitive and wanted to undertake more practical activities. Their Year 6 teacher supported this, arguing that while pupils had learnt the theory underpinning growth mindset through the sessions, not all had yet had chance to apply it. They commented that this applied in particular to the high-achievers in their class who did not find their school work especially challenging. The teacher concerned suggested that the sessions should, therefore, include more practical activities where pupils are encouraged to learn a new skill that none of them have tried before. They themselves had taken the time to teach pupils how to juggle during the first few sessions, which the class had enjoyed enormously.

Whole-school approach

As part of the training that treatment schools received in preparation for delivering the intervention, the delivery team recommended that in order for the programme to be most effective, it was necessary for staff to work embedding a growth mindset culture or ethos across the whole school. As mentioned, a few treatment schools that participated in fieldwork were already looking to cultivate a more supportive learning environment informed by the theory of growth mindset prior to their involvement in this project. Following the training day, most of this group had therefore used this formal opportunity to cascade some or part of what they had learnt and the resources they had received to other teachers within the school. The end-of-project survey supported this finding and showed that most respondents (19 out of 30) had disseminated the ideas they gained from the training day to other teachers in the school.

The most widespread change in practice that this encouraged was altering the nature of the feedback and praise that teachers provided to pupils. This included omitting any fixed mindset language that is person- and/or ability-centred, such as ‘clever boy!’ and focusing instead on praising the process by which pupils complete a particular task, and their progress in learning, as opposed to the end result. Some schools had also attempted to integrate these priorities into their school value system by assessing pupils’ work according to the effort put into it.

Teachers also attempted to adopt a growth mindset in terms of how they viewed their own intelligence. It was recognised that teaching staff had to model the behaviour they wanted to see if they were going to avoid passing on fixed mindset ideas and messages to pupils. To help encourage this change in attitude, interviewees from some schools spoke of

how they had put up growth mindset displays or the 'my favourite mistakes' board in the staff room to prompt teachers to reflect on and challenge their own approach to learning.

With regards to the training manual and lesson plans provided to all treatment schools, Year 6 teachers spoke of how some teachers had taken ideas for discreet activities that they then delivered to their own class. In other cases, teachers remarked how staff from other year groups were in the process of slowly building up their own age-appropriate resources for teaching these ideas and concepts to other pupils within the school. In a few instances, teachers also spoke of plans to discuss these topics during school assemblies to further support their dissemination.

The end-of-project survey showed that, in the view of the majority (17 out of 24) of respondents, other teachers within the school had been very willing to incorporate growth mindset approaches into their own practice. This was supported by the findings from the fieldwork visits: teachers mentioned that while some members of staff were initially resistant to these ideas, as they learnt more about this approach and came to see its potential benefit for pupils, they became receptive to changing their working practices.

Outcomes

Impact on pupils

The fieldwork visits took place towards the end of the programme's implementation when teachers were delivering the final Changing Mindsets lesson, or just after. At this point, many interviewees were uncertain about whether the project could have a positive impact on attainment among Year 6 pupils. This was due to the short-term nature of the intervention delivered to pupils, and the ability of pupils to retain the key ideas and concepts they had learnt over the rest of the school year after the sessions had ended.

A number of interviewees observed that the principles underpinning the programme could take time to embed, and cited several examples where, over the course of implementation, their pupils had struggled to make links between the content of different lessons and had to be prompted by teachers to help recall what they had covered previously. Interviewees commented that for this approach to be effective pupils needed to be making these connections and applying these concepts to their own learning spontaneously, with little or no input from teachers. They therefore observed that it might be necessary for pupils to be taught the ideas and concepts contained within the programme over a number of years in order for these changes, and any knock-on impact on attainment, to manifest.

Similarly, it was recognised that the key messages from the programme had to be reinforced at home by pupils' parents as well as at school if the intervention was to have any long-term impact on their progress and attainment. Teachers recalled previous conversations with the parents of pupils in their class who had exhibited a fixed mindset. In their view, this had the potential to undo all the school's work to date to cultivate a different and more positive attitude towards learning.

'What happens is that we do stuff here and it gets undone again at home because parents haven't changed their approach or attitude. I sit with children who are finding maths really hard and Mum says, "I can't do maths either". Those sorts of things, [...] that's what you want to stop.'

Headteacher, School 5.

In spite of these challenges to the effectiveness of the intervention, most treatment schools visited did perceive softer, short-term changes in pupils' attitudes, enthusiasm, and perseverance in their own learning that they attributed to the programme. Some commented that this had the potential to eventually improve pupil attainment if it could be maintained. For instance, a few Year 6 teachers noted how over the course of the intervention, when pupils were presented with a difficult task in other lessons, they appeared more determined to complete it and responded positively to the challenge, rather than giving up. Examples included being faced with a difficult set of problems within a maths lesson or setting the pupils a code-breaker challenge in relation to the project they were completing on World War 2. Comments from pupils showed that they also appeared to have internalised the messages about persevering with the task at hand.

'If I had given them [the code breaker challenge] last year, I honestly don't think they would have been determined.'

Year 6 teacher, School 4.

'Don't give up. That's the main lesson.'

Year 6 pupil, School 5.

'You're not supposed to say you can't do it because you need to learn how to say, "Okay, right, so I need to get on with this and I don't know how to do it, but I just need to keep trying." [... or] "If you think someone is born with it, and you give up, you'll never be as good as them, but if you keep practicing they'll just keep on practicing and then you'll eventually be as good as them.'"

Year 6 pupil, School 1.

The interviews and focus groups highlighted how pupils were now more comfortable in making mistakes in class and acknowledging this in front of their peers. In the teachers' view, the content of the sessions as well as the adoption of a 'my favourite mistakes' board in class had helped pupils to recognise that mistakes are a natural part of the learning process. It was felt that this change in pupils' attitudes had also been further reinforced by disseminating these ideas throughout the whole school and encouraging other staff to alter the nature of the feedback and praise that they provide to pupils.

'I do think there has been a noticeable difference there: "We are okay to make mistakes, we are okay to fail.'"

Year 6 teacher, School 4.

'I've noticed with the children that if they make a mistake now, they are not afraid to say.'

Year 6 teaching assistant, School 1.

'I can see it in our numeracy lessons, especially the ones that didn't like making a mistake and had that attitude of, "Oh, I've got it wrong." But now they see it as okay: "I can improve, it's my first step, it's a challenge, I want to get further.'"

Year 6 teacher, School 3.

'Learn from your mistakes. It's okay if you get it wrong. If you get it wrong, try again. People who never make a mistake never try anything new.'

Year 6 pupil, School 5.

Both teachers and pupils also identified examples of where pupils had repeated these messages to their family and friends, demonstrating a good awareness of the difference between the concepts of a fixed and growth mindset, and the language that cultivates these approaches to learning:

'Parents have been saying to me that their children have been coming home and telling them that they had to not give up [...] and mistakes make your brain grow. They've been getting a real lecture at home.'

Deputy Head/Year 6 teacher, School 1.

'Whenever my brother says, "I can't do it", I always say that he can't do it yet.'

Year 6 pupil, School 5.

In terms of the groups of pupils for whom the intervention was judged to have worked best, some interviewees perceived the most progress among those with previously low levels of attainment or those with special educational needs. As

one interviewee highlighted, the way in which pupils had been taught to focus more on their individual progress in learning and the amount of effort they put into a task as opposed to the end result had helped this group to stop comparing their performance with that of their peers. As a result, pupils gained greater confidence in their ability to improve in school and 'grow' their own intelligence.

In contrast, several teachers felt that the high-achievers in their class had found these concepts most difficult to grasp. The delivery team at Portsmouth University had made teachers aware at the training day that this might be the case. Interviewees commented that these individuals had found everything in school easy up to that point and did not see a need for these approaches having not experienced failure very often. However, they emphasised that it was crucial that high-achievers still engage with and learn from the content of the sessions. This is to avoid the negative emotional impact and damage to pupils' self-confidence that they will experience when they do encounter a set of challenges that are too great, which the Year 6 teachers perceived as inevitable.

Impact on teaching staff

Many Year 6 teachers also perceived a positive change in how they view their own intelligence and approach learning as a result of participating in the programme, which they intended to carry forward. In teaching these sessions, several remarked how they had become more aware of the areas of their life where they tended to adopt a fixed mindset. They recognised the importance of challenging these ideas about their own intelligence and adopting more of a growth mindset if they were going to successfully convince pupils of the validity of this approach and encourage them to do the same. Teachers spoke of how they had relayed their own examples to the class in order to model the behaviour they wanted to see—something that was encouraged at the beginning of implementation by the delivery team.

Involvement in the programme was also seen to have had a positive impact on how staff within treatment schools provided praise and feedback to pupils. Some interviewees spoke of how they are now far more conscious of what they say to pupils and whether their comments cultivate a view that intelligence is a fixed and innate quality, or whether it is something that is malleable and can grow with the right learning strategies, effort, and perseverance. Teachers were now far more aware of how their own feedback could put limits on what pupils believe they are capable of achieving and how they respond to challenges. Some spoke of how they now focused on praising the process by which pupils achieved a particular outcome, rather than the outcome itself, which does not always acknowledge pupils' progress in learning. In a few cases, treatment schools had updated their marking and feedback policy for all staff to reflect this shift in focus.

'I think we moved away from [rewarding] the end products and more on the effort and hard work and the perseverance, and the children are recognising that as well.'

Deputy Headteacher, School 6.

Impact on the delivery of other lessons

As part of the fieldwork visits, several Year 6 teachers spoke of how they had been bringing what pupils had learnt in the standalone Changing Mindset sessions into particular subjects, most commonly, English or maths.

'Within maths lessons we make lots of links [...] the part about making mistakes [...] in my numeracy lessons [we make] a big deal about this fantastic mistake.'

Year 6 teacher, School 3.

Teachers commented on how it complemented the introduction of the new national curriculum and the introduction of the concept of 'mastery' in mathematics (that is, that all pupils are capable of reaching the same level of achievement, they just have to find the learning strategy that best works for them). Others had tried to encourage pupils to transfer what they had learnt to these subjects, for instance, by placing pupils in the same pairings in both Changing Mindsets sessions and maths lessons.

However, a few teachers were concerned that the time commitment required to deliver the Changing Mindsets sessions had a detrimental impact on pupils' progress through other elements of the curriculum. Various, teachers spoke of

how their involvement in the intervention had taken a significant amount teaching time away from certain lessons, such as the Year 6 cross-curricular topic, history, and ICT/computing. One teacher was particularly concerned about being unable to catch-up on this content over the rest of the academic year and, 'losing' these aspects of the curriculum that also needed to be taught and delivered. However, many were aware of the time commitment the intervention would require when they first registered their interest to be part of the project and were accepting of this fact.

Formative findings

Treatment schools involved in the fieldwork visits and those responding to the end-of-project survey identified several ways in which the intervention could be improved. By far the most widely discussed was the development of a school-wide programme, with appropriate resources provided for each year group. As mentioned, Year 6 teachers felt that the ideas and concepts taught as part of the programme would take time to embed. They observed that reinforcing and building on this content year on year would therefore help enhance the effectiveness of the approach as the learning strategies taught become more instinctive for pupils. Ideally, they believed that teaching should start at an early age, from nursery and reception, when pupils are potentially more receptive having limited learning experience and therefore less of a fixed idea about their own intelligence.

'I think it's quite unusual with my four-year-olds for children to go, "I can't do that". Mostly, they will just have a go, but that stops quite quickly so by the age of seven, probably, that approach has changed and they are back to, "well you haven't shown me how to do this so I can't possibly and this is really hard".'

Headteacher, School 5.

Other suggested improvements included greater linkages between the content of programme and the teaching of particular subjects, such as English or maths. As shown, while teachers were already bringing the content of the Changing Mindsets sessions into other lessons, several wanted a more tailored programme that taught these concepts in the context of other subjects as opposed to standalone sessions.

A few teachers also suggested that the sessions should be designed to be shorter in length, perhaps spread over the course of the academic year instead of a single term. Others felt that they could be broken down into short activities delivered throughout the day, in 10- to 20-minute slots, or adapted and integrated with other lessons. As highlighted, some teachers that opted to deliver longer sessions were concerned about pupils' level of concentration and how much information they were able to retain, as well as the potentially deleterious impact this was having on their ability to deliver elements of the school curriculum.

Further improvements put forward were an easier system for accessing the Positive Edge Education videos with no timed release format, corrections to some of the materials provided for delivery, which included spelling errors and incorrect answers, and using real life examples of individuals who have exhibited a growth mindset when faced with challenges across a greater variety of cultural and religious/faith-based backgrounds.

Future plans

All of the treatment schools visited as part of fieldwork had plans to reinforce the key messages from the Changing Mindsets programme over the rest of the academic year and for engaging pupils' parents in this approach. As highlighted, teaching staff were aware that the effectiveness of the project would be limited in the medium- to long-term if pupils were unable to retain what they had learnt and/or if they continued to be exposed to fixed mindsets language at home.

With regards to reinforcing the main ideas and concepts that informed the programme, Year 6 teachers planned to continue to link and refer back to the content of Changing Mindsets sessions in other subjects, such as English and maths, so pupils had the opportunity to apply what they had learnt. Some teachers also planned to repeat a few of the activities that featured in the lesson plans and tie them in with the cross-curricular topics pupils were covering the following term. Others planned to continue to use classroom features developed for the programme, such as the 'my favourite mistakes' board. A few teachers had found more resources online that they planned to work into individual

lessons the following term, while some spoke of holding individual discussion groups (circle time) with pupils on the topic.

Further ahead, some interviewees commented that they had plans to implement the approach more widely and hold individual sessions on growth mindset approaches during the following academic year in other year groups. For some schools, this was conditional on the intervention having been shown to have a positive impact on pupil attainment, while others planned to press ahead regardless as engaging in the sessions, in their view, was not having an adverse impact on pupils and was worth continuing.

As mentioned, teaching staff in treatment schools also spoke of plans to engage parents with the project over the following term—also one of the recommendations that was made by the delivery team at the outset of the project to enhance impact. While a few schools planned to provide parents with more information on the theory underpinning the project and why it is important in pupils' learning, they had not yet decided what format this would take. Several schools, however, had alternative approaches in mind for informing parents about the project that they felt would be more interesting for this audience. This included the delivery team's recommendation that the school hold an 'expert-led' workshop in which children lead the proceedings and tell parents what they have learnt. Other planned approaches were more interactive and included parents completing some of the practical activities they had covered in the sessions with pupils, as well as receiving background information on the topic.

Control group activity

Information was gathered from the control group of schools on their activity during the trial via a short questionnaire. As this study used a waitlist control, the survey was issued at the training days held for control schools on how to deliver the Changing Mindsets intervention, which were held at the end of the trial period (June 2017). It was completed by 96 respondents, representing 37 out of 51 control group schools.

Overall, the survey showed a presence of both knowledge of growth mindset approaches and the implementation of related teaching strategies. Whilst just three participants reported that they were familiar with growth mindset approaches 'to a great extent', the majority of respondents reported that they were 'somewhat' familiar (72 out of 96). Half of the 'somewhat' respondents said they had previously attended training days where interventions based on growth mindset approaches and/or the theories of Carol Dweck and others like Hymer, Duckworth, and Fleetham were taught. Thirteen stated that they had engaged with independent research on the topic, including reading online articles and participating in relevant Facebook group conversations with fellow teachers, and, in one case, buying members of staff a growth mindset pocketbook. Additionally, eight respondents claimed they were taught about growth mindset approaches, or the work of Carol Dweck, at university or through Teach First training. The three teachers that reported familiarity of growth mindset 'to a great extent' attributed this to multiple training days and personal research, including one dissertation using early primary examples of Dweck's theories.

The control group survey also asked respondents to what extent growth mindset approaches had been implemented in their school. The three participants who previously reported a 'great extent' of familiarity with the approach also stated the methods had been implemented 'to a great extent' in their schools and classrooms. Forty-three respondents said growth mindset had been implemented 'somewhat' and 39 reported 'very little', highlighting a variation of activity. The majority of participants responded that their school had used approaches similar to growth mindset in the past (44 out of 96) whilst just 18 responded that they had used these approaches in their own classroom. More than 20 other similar approaches were named with Class Dojo, Purple Polishing Pens, and Guy Claxton's BLP being the most common.

Finally, the questionnaire sought to gauge whether teachers were employing teaching strategies similar those encouraged in growth mindset theory and practice, regardless of their knowledge or awareness of this approach. The findings show that a high number of respondents employed similar teaching strategies. Most commonly, respondents reported that:

- they all set high expectations for learning effort, persistence, and eventual attainment (96/96 respondents);
- they taught or encouraged pupils to see mistakes as part of the learning process (91/96 respondents); and
- they praised pupils' efforts rather than their intelligence (89/96 respondents).

There was an almost even split amongst teachers celebrating mistakes in class with 41 employing this tactic against 51 who did not. A less frequently used approach by control schools was helping pupils to see that they can change how intelligent they are, which had been employed by just 37 out of 96 respondents. These findings indicate that some of the core messages of Changing Mindsets were also used by control schools. While control schools were not delivering a specific growth mindset programme, it is likely that pupils were also being exposed to the same messages on a regular basis and that it had a positive impact on their learning.

Conclusion

Key conclusions

1. Pupils in schools that received the intervention did not make any additional progress in literacy nor numeracy—as measured by the national Key Stage 2 tests in reading, grammar, punctuation, and spelling (GPS), and maths—compared to pupils in the control group. This finding has high security.
2. This evaluation also examined four measures of non-cognitive skills: intrinsic value, self-efficacy, test anxiety, and self-regulation. The evaluation did not find evidence of an impact on these measures for pupils in schools that received Changing Mindsets. A positive impact was found for the intrinsic value measure, but the impact was small and was not statistically significant.
3. Among pupils eligible for free school meals ('FSM pupils'), those in schools that received the intervention did not make any additional progress in literacy nor numeracy—as measured by the national Key Stage 2 tests in reading, GPS, and maths—compared to FSM pupils in schools that did not receive the intervention.
4. One explanation for the absence of a measurable impact on pupil attainment is the widespread use of the growth mindset theory. Most teachers in the comparison schools (that did not receive the intervention) were familiar with this, and over a third reported that they had attended training days based on the growth mindset approach.

Interpretation

In this Changing Mindsets effectiveness trial we evaluate the causal effect of a greater scale intervention that—like the pilot studied by Rienzo and al. (2015)—partly differs from the 'growing mindset' interventions considered by Carol Dweck and her co-authors: the subjects of the Changing Mindsets interventions are younger pupils who are introduced to the idea of incremental intelligence by their teachers over several sessions. Unlike the other trials relating to growth mindset in the literature, our analysis found that the Changing Mindsets intervention had no impact on literacy and numeracy overall, and that this applied across all pupils, including those eligible for FSM. Results from the analysis of non-cognitive skills show that the intervention had a small, positive, but not statistically significant effect on a measure derived from the Motivated Strategies for Learning Questionnaire, namely the 'intrinsic value' subscale. The magnitude of this positive effect is higher among FSM pupils, however, none of these effects are statistically significant. The positive effect overall is, however, encouraging since the intrinsic value scale measures attitudes towards learning from mistakes and enjoyment of classroom learning.

In theory, there are three possible reasons why the intervention's measured impact was not statistically significant:

- the programme was not delivered as intended, or was too short, so that pupils did not take on its messages and change their attitudes, behaviours, and, consequently, their performance;
- control schools were also using growth mindset approaches, and the treatment schools had already been using it to some extent; and
- the pupils were too young and that older children are much better able to use growth mindsets to improve their performance, particularly as reflected in tests.

Explanation 1: The programme was not delivered as intended

We can rule out this explanation using evidence obtained at various points by the IPE. The evaluation indicates a good level of fidelity with limited adaptations to the programme. The programme was very well received with a high degree of buy-in from schools and teachers. It was seen to address a recognised need to change pupils' views of their own intelligence and approach to learning.

The programme was of relatively short duration, at eight weeks. However, each session was generally two and a half hours long and involved repeated delivery of key messages. Teachers also said they reinforced the messages in other lessons. Teachers reported good levels of understanding among pupils about the messages of the programme and this was evident in interviews carried out with pupils by the evaluation team. Despite the absence of a measurable impact, teachers reported softer, short-term changes in pupils' attitudes, enthusiasm, and perseverance in learning that they

attributed to the programme. The interviews and focus groups for the IPE found evidence that pupils were comfortable with the idea of making mistakes in class and acknowledging this in front of peers. Teachers also reported that the programme had influenced their thinking about their own intelligence, which may have improved their own practice. Such changes are difficult to measure.

The programme appears to have been popular among pupils and teachers. As an indication of its popularity, teaching staff in treatment schools planned to implement the approach more widely, including for younger pupils, at whole-school level, and to engage parents. It is possible that these longer-term strategies would increase the impact of the programme. This could involve starting the programme in earlier year groups so that pupils incorporate its messages naturally and consistently into their work.

Explanation 2: Control and treatment schools were already using growth mindset to some degree

Schools that had already delivered a growth mindset programme were excluded from the trial. Findings from the survey of staff in treatment schools shows that few had used this approach in their own teaching practices, although some also said their schools had done so. However, two thirds report knowledge of growth mindset prior to the project by engaging with evidence on the topic. Interviewees from several schools that took part in fieldwork visits commented that they were already familiar with growth mindset approaches and had been working to embed the principles into their school culture and/or value system prior to the start of the project. These findings suggest that some teachers may have been using growth mindset approaches to an extent before the programme, thereby affecting the extent to which it could add value.

In relation to control schools, the process evaluation found a high degree of familiarity with growth mindset theories with many respondents having attended training days where interventions based on the theory or the work of Carol Dweck and other exponents were taught. Other ways in which teachers in control schools had become familiar with growth mindset were through reading research material on the subject or engaging in discussions with colleagues. Moreover, around half of control group respondents said it had been 'somewhat' implemented in their schools, while a small number also said it had been implemented to a 'great extent'. A little over a third said it had been used 'very little' in their school. The survey of control school teachers also found that schools operated growth mindset principles even if they did not label them as such. These results suggest a high degree of awareness of the approach, which we cannot be certain did not affect the teaching and learning practices of control schools. If this happened, then pupils in control schools would also have been applying growth mindset principles to their work, for example, through being willing to try difficult tasks. The implication is, therefore, that our study is likely to understate the overall effect of the Changing Mindsets intervention because it is only a comparison of a 'structured package', as described in the intervention section, to approaches based on the same theoretical underpinnings, and not a comparison of the intervention to the counterfactual of no growth mindset approach at all.

We are also aware, more widely, from our visits to schools for other research projects, that Growth Mindset principles and messages often form part of schools' ethos, delivered in statements, posters, and other forms of messaging.

Explanation 3: The pupils were too young or that results are longer term rather than short term

A further explanation could be that the pupils were too young to embed and achieve results, and that these could only be achieved in the longer term. Some support for this explanation is found in interviews with teachers who said the programme should start at a younger age before pupils take on a fixed mindset. It is also possible that, at age eleven, pupils may be too young to self-direct their learning in a way which is possible for older pupils and that the programme takes longer to impact on academic performance. There may be intermediate steps between adopting a growth mindset and improving academic achievement which younger pupils are less able to utilise. These may include, for example, understanding strengths and weaknesses, when to seek help, how to express the help they need, and then to listen and process the feedback. These abilities may require a degree of maturity and self-understanding which may not be possible for children of primary school age. This would then explain why other studies based on U.S. and Norwegian data find positive effects of a growth mindset approach in older students.

Teachers expressed the view that the principles underpinning the programme could take time to embed and cited examples where pupils had struggled to make links between the content of different lessons and had needed to be prompted to recall their earlier learning. Some teachers were, therefore, of the view that it might be necessary for pupils to be taught growth mindset concepts and messages over a number of years for an impact on attainment to be achieved. It was also felt important that the messages are reinforced at home, which may not have been achieved during the life of the project.

Finally, it might be speculated whether good performance in SATS is less dependent on attitude and mindset and more directly on the quality of teaching. Therefore, while, in theory, a child with a growth mindset might compensate for poorer teaching than one without, this requires understanding of gaps in knowledge and skills which a child of ten or eleven is unlikely to have. Therefore, having a growth mindset, while benefitting learning, may not improve SATS results. Older children, in comparison, are more likely to self-direct their learning in and out of school through reading and engagement in learning outside of the classroom in ways which improve test performance.

Limitations

The implementation and process evaluation provides insights into the limitations of the evaluation which are related to the design of the intervention. The first is that the intervention might be found to have a longer-term impact on pupil performance as the messages become embedded and influence attitudes, behaviour, and learning. In particular, growth mindset might have more potential to affect the learning behaviour of older pupils who take more responsibility for their own learning, are more able to identify their strengths and weaknesses and seek help to improve their performance.

The experiences of implementing the programme, its effects on staff, and its perceived impact on pupils were found to be fairly similar between schools and were very positive. This reflects the findings of the earlier project which also found that growth mindset was fully understood and well received. Therefore, on balance, we feel its limited impact is largely due to the ubiquitous nature of either growth mindset or its messages. The trial excluded schools that had delivered a growth mindset programme but was not able to exclude schools and teachers who were at least reasonably aware of its messages, and had almost certainly been using them with pupils. It is possible that it might have a stronger impact on schools where awareness of growth mindset is very low but, because of its popularity and appeal, these may be hard to find.

Future research and publications

This is the second EEF project on growth mindset; neither of the evaluations found an impact on pupil attainment overall. However, both were relatively short term interventions and pupil attainment was measured within a relatively short period following the end of the programme. It is possible that a more prolonged and in-depth intervention, with regular reinforcement, may yield stronger impacts in the longer term. At the same time, growth mindset is now a well-known theory which is likely to have been adopted by many schools and teachers, so that establishing a counterfactual is likely to be difficult. Before further growth mindset projects are commissioned, it would be advisable to carry out a survey of schools to establish the extent to which it is used either by teachers or in whole-school approaches.

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Appendix A: EEF cost rating

Cost ratings are based on the approximate cost per pupil per year of implementing the intervention over three years. More information about the EEF's approach to cost evaluation can be found [here](#). Cost ratings are awarded as follows:

Cost rating	Description
£ £ £ £ £	<i>Very low:</i> less than £80 per pupil per year.
£ £ £ £ £	<i>Low:</i> up to about £200 per pupil per year.
£ £ £ £ £	<i>Moderate:</i> up to about £700 per pupil per year.
£ £ £ £ £	<i>High:</i> up to £1,200 per pupil per year.
£ £ £ £ £	<i>Very high:</i> over £1,200 per pupil per year.

Appendix B: Security classification of trial findings


Outcomes: KS2 Maths, KS2 Reading, KS2 Grammar, Punctuation and Spelling

Rating	Criteria for rating			Initial score	Adjust	Final score
	Design	Power	Attrition ¹¹			
5	Well conducted experimental design with appropriate analysis	MDES < 0.2	0-10%			
4	Fair and clear quasi-experimental design for comparison (e.g. RDD) with appropriate analysis, or experimental design with minor concerns about validity	MDES < 0.3	11-20%	4	Adjustment for Balance [0]	4
3	Well-matched comparison (using propensity score matching, or similar) or experimental design with moderate concerns about validity	MDES < 0.4	21-30%			
2	Weakly matched comparison or experimental design with major flaws	MDES < 0.5	31-40%		Adjustment for threats to internal validity [0]	
1	Comparison group with poor or no matching (E.g. volunteer versus others)	MDES < 0.6	41-50%			
0	No comparator	MDES > 0.6	over 50%			

- **Initial padlock score:** lowest of the three ratings for design, power and attrition = This was a well randomised design with MDES at randomisation of 0.19. Attrition rates for the primary outcomes were 11.24% for Maths, 11.58% for Reading, and 11.36% for Grammar, Punctuation and Spelling.
- **Reason for adjustment for balance** (if made): baseline imbalance in pre-tests for the sample as randomised were small ranging between 0 (Reading) and -0.06 (Writing). In the sample as analysed, these differences were also small ranging between -0.03 (Writing) and 0.03 (Reading). These are accounted for analytically in the ANCOVA model.
- **Reason for adjustment for threats to validity** (if made): No substantive threats to validity are reported, but both the control and intervention group were acquainted with the theoretical underpinning of the “Changing Mindsets” approach, with the majority of the schools suggesting they had used similar approaches in the past (See Section on “Control group activity”). This implies that the intervention was compared with a relatively active business as usual. This does not affect the security of the finding, but should be considered carefully for its interpretation (See Section on “Interpretation”)
- **Final padlock score:** initial score adjusted for balance and internal validity = 4 padlock

¹¹ Attrition should be measured at the pupil level (even for clustered trials) and from the point of randomisation to the point of analysis.

Appendix C: Extract from the training material



Changing Mindsets Project

Autumn Group:
September 2016



Overview

1. **Background**
 - Theories of intelligence
 - Exploring the evidence (US and UK)

Refreshments (Marion Clist article)
 2. **How to promote a Growth Mindset**
 - Everyday practice

Lunch
 3. **How to promote a Growth Mindset**
 - Language and Praise
 4. **Growing Learners Mindset Intervention**
 - Evaluation tool
 - Positive Edge Education
 - 8-week pupil programme

Refreshments (scenarios)
 5. **Supporting Change and Next Steps**
- End and opportunity for questions**
- 

Professor Carol Dweck

We have different implicit theories of intelligence (mindsets)

Fixed Mindset **Growth Mindset**




What are Mindsets?

Growth Mindset

- Belief that intelligence is malleable and can develop.
- Success takes effort and persistence, learning from mistakes and challenges.

Fixed Mindset

- Belief that intelligence is something you are born with.
 - Can't change it much.
- 


Can our brains get 'smarter'?




8 Week Pupil Programme

- Materials and Manual
 - Identifying your pupils' mindsets and learning orientations
 - Positive Edge Education
 - Week by week sessions
 - Other activities and ideas
- 
- 

8 Week Pupil Programme

- Materials and Manual
 - Identifying your pupils' mindsets and learning orientations
 - Positive Edge Education
 - Week by week sessions
 - Other activities and ideas
- 

Materials and Manual

- **Manual**
 - Overview of academic literature for you and your teachers
 - Mindset questions and the Your Learning Questionnaire (pupil learning orientations with norm data) and scoring instructions for both
 - Lesson plans and materials for each of the weeks described
 - **USB stick**
 - Electronic versions of all materials
 - Mindsets questions and Your Learning Questionnaire
 - Powerpoint for your teacher briefing
 - Powerpoint for a parents briefing
 - **Positive Edge Education**
- 

Appendix D: Consent forms



Department of Psychology

King Henry Building, King Henry I st.

PORTSMOUTH, PO1 2DY

Principal Investigator: Professor Sherria Hoskins

Telephone: 023 9284 6321

Email: sherria.hoskins@port.ac.uk

Dear Head Teacher,

Many thanks for your interest in the Changing Mindsets project, funded by the Education Endowment Foundation (EEF) and run by a team of researchers located in the Department of Psychology at the University of Portsmouth. As part of this project we are also working with a team of researchers at the National Institute of Economic and Social Research (NIESR) who have been recruited by the EEF to evaluate the success of the project. Although you have already expressed your interest to take part, we now need to ask for your formal, informed consent to progress with the project.

The Project

We are asking that you and some of your teachers attend one of a number of training sessions across the UK. In these sessions, we will be training staff to understand the concept of 'Mindsets', pioneered by Professor Carol Dweck. We are interested in whether a teacher training approach combined with specially designed learning resources and activities can enhance pupils' mindsets and increase educational attainment.

Dweck suggests that it is not ability that predicts resilience and perseverance in the face of challenge and failure; rather it is the individual's belief about the nature of ability (their mindset). Research identifies two types of intelligence belief, namely **growth mindset** and **fixed mindset**. Individuals with a growth mindset believe that they can develop their intelligence, while individuals with a fixed mindset believe that their intelligence is innate (i.e. "I was born this way/this is what I am").

The growth mindset approach has been widely researched in the US and has been linked to increased attainment and improved pupil motivation, classroom behaviour and reports of life-satisfaction. It is very popular in the US and widely implemented, but despite this, there has been limited systematic research on mindsets in the UK. As such, we are interested to see whether an approach that is so widely used in the USA can have an impact when delivered directly by teachers in the UK.

During the training session, teachers will be: introduced to mindset theory and evidence; shown how to embed the approach into their classrooms; and given materials to run an 8 week intervention programme of weekly lessons (approximately 2 hours each).

Format of the Project

Half of the schools involved in the project will receive teacher training in September 2016, and carry out the programme in the autumn term with their Year 6 pupils; they will act as the 'intervention group'. The remaining schools will be invited to attend training days in the Summer term of 2017; they will act as the 'waiting control group' and carry out the programme in the summer term with their Year 5 pupils (or Year 4 pupils if mixed Y5/Y6 classes). All schools (regardless of group) will be collecting data from Year 6 pupils only. Schools cannot be given the option of attending the training in the autumn term or summer term; this will be decided at random by NIESR and is critical to the scientific design of this trial.

Assessing the Project

To determine whether the project has been a success we will be comparing the difference between pupils' Key Stage 1 and Key Stage 2 SATs results in schools that have and have not received Mindset training. For the attainment, we will be focusing on numeracy and literacy. Attainment data will be gathered via an application to the Department for Education's National Pupil Database (NPD).

We are also interested in the impact of the project on pupils' mindset and approach to learning (e.g. their motivation, effort and help seeking behaviours). To do this, we are using two questionnaires; you will find a copy of these questionnaires in your Welcome Pack and we ask that you administer them to your current Year 5 (next year's Year 6) pupils now and in April 2017 and return them to us on completion. Please don't worry about what to do when; we will guide you through this throughout the project.

Data

All data will be stored and managed in accordance with Data Protection regulations. We ask that before sending pupils' questionnaires to us, you replace their names with their Unique Pupil Number. This will allow us to collate data without being able to identify individual pupils, ensuring confidentiality. Data will be entered into a password-protected, encrypted file and hard copies will be stored in a locked cabinet in a locked archive room within the Department of Psychology at the University of Portsmouth for 10 years after any publications associated with it. After this period, all raw data will be destroyed.

The research project team at the University of Portsmouth will have ownership of the data, while the project evaluators (NEISR) and EEF will have access to it. Our grant agreement with the EEF requires us to share data with them and NIESR. However, the data will be shared in accordance with Data Protection regulations (as above) and will be moved to them in encrypted files. Data collected and any

other pupil data will be treated with the strictest confidence. No individual school or pupil will be identified in any report arising from the research.

Along with NIESR, we will be making a shared application to the National Pupil Database to access some archive data (e.g. Key Stage 1 SATs, Key Stage 2 SATs, gender, free school meal status). Again, this will not include pupils' names. It will be matched to the questionnaire data by the UPN. This ensures that at all times the data will be confidential and unidentifiable to any pupil by a third party.

Parental Information

We require that parents are fully informed about the project and will be given the chance to contact the research team or you with any concerns. They will also be given the opportunity to opt their child out of data collection and project evaluation. You will find a copy of this letter in your Welcome Pack; we ask that you send this home to parents and sign below to confirm doing so. If a parent expresses concerns about the project we will withdraw their child from the project evaluation and data sharing.

Support and Debriefing

You can discuss the project at any point with the Changing Mindsets team at the University of Portsmouth. In addition NIESR will evaluate the project as it progresses and collect your views on the project via interviews and questionnaires. Further, there will be a debriefing session open to all staff after all data has been collected, in the form of a free day long wash up conference.

Many thanks for your assistance with this project.



Dr Sherria Hoskins

Changing Mindsets Lead (University of Portsmouth)

I(print name and role) give consent for the Changing Mindsets Project to take place at

(name of school) and do so knowing that:

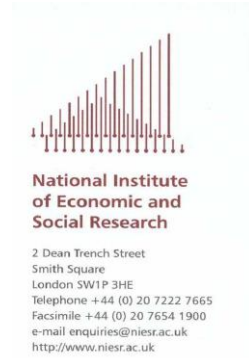
- We are free to withdraw our school from the intervention at any point.
- Pupil questionnaire data will not contain pupils' names; the school will provide Unique Pupil Numbers for each pupil, ensuring their data remains confidential and unidentifiable to a third party.

- All data will be stored and shared securely and will be handled in accordance with the Data Protection Act.
- The research project team at the University of Portsmouth will have ownership of the data, while the project evaluators (NEISR) and EEF will have access to it. This will be stored securely for 10 years after any publications associated with it. After this period, all raw data will be destroyed.
- Parents will be fully informed about the assessments and data sharing and will be given the chance to discuss their concerns and ultimately withdraw their child from the data collection phase of the project if they wish.
- A shared application from University of Portsmouth and NIESR will be made to the National Pupil Database to access archive data such as Key Stage 1 and Key Stage 2 results, gender, and free school meals status. This data will be matched to questionnaire data via Unique Pupil Identifier provided by us. At no stage, will University of Portsmouth, EEF and NIESR identify any pupils taking part in this project.

Please sign if you give your consent:

.....

Please return the signed informed consent to Dr Frances Warren at the postal address above or via email (indicating in the email that you give consent) to changingmindsets@port.ac.uk



Date

Dear Parent

I am writing to you about research we are doing on the *Growth Mindsets* lessons that are taught at [name of school]. I am attaching a short description of the main ideas informing these lessons and the results they aim to achieve.

Along with my colleagues at the National Institute of Economic and Social Research (NIESR) I am carrying out additional research to measure the impact of the *Growth Mindsets* programme. I am interested in how pupils have understood and engaged with the content of these lessons, and what they liked and disliked about them. We believe it is important that the research takes account of pupils' views and experiences of the lessons.

We are planning to talk to pupils in small groups called focus groups. The focus groups will involve a few, simple activities to be completed in pairs, with follow-up questions. Your child has been selected through randomised methods to take part, along with other pupils from year 6. To keep their identity anonymous, teachers have randomly selected pupils from the class register. At no point in the research will we ask for pupils' full names and they will remain anonymous throughout. I am leading the focus groups in all the schools involved in *Growth Mindsets*. The views of pupils across all of the schools will be combined with the other findings in a report to the Education Endowment Foundation who are funding the project.

At the start of the focus group, which will happen at the same time as a normal lesson, I will explain the purpose to your child and the others in the group and check they are happy to take part. They can decide at any time that they no longer wish to take part. I will also let them know that I will not pass on what they say to anyone in the school or to you their parent. I will use what they say to write the report to the Education Endowment Foundation, but will never refer to them by name in anything I write.

If you have any questions about *Growth Mindsets* or the research, please contact me on 020 7654 1929 or [name of lead at the school].

If you are happy for your child to participate in the focus group for this part of the research please complete and return the section below to your child's form tutor.

Child's name:

Child's class Teacher:

I agree to my child taking part in the focus group

Parent name (BLOCK CAPITALS)

Parent signature:

Date

Yours sincerely



Jonathan Buzzeo

What is the Growth Mindsets programme?

The *Growth Mindsets* project is to do with the theories that children hold about their intelligence, in particular whether it is a "fixed entity" or has a "malleable" quality that can develop and improve.

It has been argued that teachers can help children to adopt a growth mindset by praising them for their effort and persistence, rather than their innate intelligence. Research evidence mainly from the US has found that the use of these techniques by teachers can have a positive impact on student test results and performance.

This approach is now being tested in UK schools through the Growth Mindsets project. It was developed by a team at the University of Portsmouth and is being funded by the Education Endowment Foundation. The aim is to see whether this change in the teachers' classroom practice will positively affect pupils' attainment.

To enable them to deliver the project, Year 6 teachers in your child's school have been introduced to the theory and evidence informing this approach, supported to embed the approach in their classroom, and provided with material to run *Growth Mindsets* lessons in their school this term.

Appendix E: Mindset measure questions, MSLQ questions and subscales

Scoring of the 'Mindset measure' – Section 1

All items of the 'Mindset measure' are scored from 1-6, with 1 indicating 'Strongly disagree' and 6 indicating 'Strongly agree'

Mindset measure	Max possible score
1) You have a certain amount of intelligence, and you really can't do much to change it.	
2) Your intelligence is something about you that you can't change very much.	
3) You can learn new things, but you can't really change your basic intelligence.	
Maximum possible score on Mindset measure=	

Scoring of the 'School Questionnaire' – Section 2

All items on the adapted version of the MSLQ are scored from 1-7, with 1 indicating 'Strongly disagree' and 7 indicating 'Strongly agree'. (NB 3 items on the self-regulation scale need reversing before totalling the sub-scale score and the total score).

Sub-scales (Intrinsic value, self-efficacy, test anxiety and self-regulation) are then calculated as a mean score.

Intrinsic value	Max possible score
1) I prefer class work that is challenging so I can learn new things.	
4) It is important for me to learn what is being taught in class.	
5) I like what I am learning in class.	
7) I think I will be able to use what I learn in one class in other classes.	
10) I often choose class and homework activities I will learn something from even if they require more work.	
14) Even when I do poorly on a test I try to learn from my mistakes.	
15) I think that what I am learning in class is useful for me to know.	
17) I think what we are learning in class is interesting.	
21) Understanding school subjects is important to me.	
Maximum possible score on intrinsic value=	

Self-efficacy	Max possible score
2) Compared with other pupils in class, I expect to do well.	
6) I'm certain I can understand the ideas taught in class.	
8) I expect to do very well in class.	
9) Compared with others in class, I think I am a good pupil.	
11) I am sure I can do an excellent job on the problems and tasks given in class.	
13) I think I will receive a good mark in class.	
16) My learning skills are excellent compared with others pupils in class.	
18) Compared with other pupils in class I think I know a great deal about the subject.	
19) I know that I will be able to learn the information in class.	
Maximum possible score on self-efficacy=	

Test anxiety	Max possible score
3) I am so nervous during a test that I cannot remember facts I have learned.	
12) I have an uneasy, upset feeling when I take a test.	
20) I worry a great deal about tests.	
22) When I take a test I think about how poorly I am doing.	
Maximum possible score on test-anxiety=	

Self-regulation	Max possible score
23) I ask myself questions to make sure I know the information I have been learning.	
24) When work is hard I either give up or learn only the easy parts.*	
25) I do extra work and practice exercises even when I do not have to.	
26) Even when lessons are dull and uninteresting, I keep working until I finish.	
27) Before I begin school work, I think about the things I will need to do to learn.	
28) I often find that I have been reading but I do not know what it is all about.*	
29) I find that when the teacher is talking I think of other things and do not really listen to what is being said.*	
30) When I am reading, I stop once in a while and go over what I have read.	
31) I work hard to get a good mark even when I don't like a subject.	
Maximum possible score on self-regulation=	

* Reversing required – the raw scores on these 3 items must be reversed before totaling the sub-scale or total score.

Appendix F: Code for randomisation

```
gen randSeq=uniform()

gen block=.

replace block=1 if newLoc==1 & tertileAdj==1
replace block=2 if newLoc==2 & tertileAdj==1
replace block=3 if newLoc==3 & tertileAdj==1
replace block=4 if newLoc==4 & tertileAdj==1
replace block=5 if newLoc==5 & tertileAdj==1
replace block=6 if newLoc==1 & tertileAdj==2
replace block=7 if newLoc==2 & tertileAdj==2
replace block=8 if newLoc==3 & tertileAdj==2
replace block=9 if newLoc==4 & tertileAdj==2
replace block=10 if newLoc==5 & tertileAdj==2
replace block=11 if newLoc==1 & tertileAdj==3
replace block=12 if newLoc==2 & tertileAdj==3
replace block=13 if newLoc==3 & tertileAdj==3
replace block=14 if newLoc==4 & tertileAdj==3
replace block=15 if newLoc==5 & tertileAdj==3

#delimit ;

lab def block

1 "Midlands, lower"
2 "North East, lower"
3 "North West, lower"
4 "South East, lower"
5 "South West, lower"
6 "Midlands, mid"
7 "North East, mid"
8 "North West, mid"
9 "South East, mid"
```

```
10 "South West, mid"  
11 "Midlands, upper"  
12 "North East, upper"  
13 "North West, upper"  
14 "South East, upper"  
15 "South West, upper";  
  
#delimit cr  
  
lab val block block  
  
lab var block "Randomisation block"  
  
sort block randSeq  
  
gen T=randSeq>.5  
  
replace T=1-T[_n-1] if _n>1  
  
lab def T 0 "Control" 1 "Treated"  
  
lab val T T  
  
lab val T "Treated"
```

Appendix G: Effect size from simple models

Table G1: Effect size from the simple model for primary outcomes

Outcome	Raw means: standardised variables						Effect size (95% CI)	p-value
	Intervention group			Control group				
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)			
KS2 maths	2273 (62)	103.82 (103.51;104.13)	2181 (68)	104.07 (103.77;104.36)	4454 (2273;2181)	-0.01 (-0.04; 0.02)	0.46	
KS2 reading	2263 (72)	103.82 (103.49;104.16)	2174 (75)	103.70 (103.35;104.05)	4437 (2263;2174)	-0.00 (-0.02; 0.02)	0.87	
KS2 grammar punctuation spelling	2266 (69)	105.87 (105.56;106.18)	2182 (67)	105.76 (105.45;106.07)	4448 (2266;2182)	0.00 (-0.03; 0.03)	0.96	

Table G2: Effect size for secondary outcomes

Outcome	Raw means: standardised variables						Effect size (95% CI)	p-value
	Intervention group			Control group				
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)			
Intrinsic value	1714 (621)	5.55 (5.50;5.59)	1726 (523)	5.50 (5.45;5.54)	3440 (1714;1726)	0.07 (-0.12; 0.26)	0.47	
Self-efficacy	1714 (621)	5.11 (5.06;5.16)	1726 (523)	5.17 (5.12;5.22)	3440 (1714;1726)	-0.06 (-0.22; 0.09)	0.43	
Test anxiety	1714 (621)	3.45 (3.36;3.53)	1726 (523)	3.50 (3.42;3.58)	3440 (1714;1726)	-0.00 (-0.08; 0.07)	0.9	
Self regulation	1711 (624)	4.77 (4.72;4.82)	1716 (533)	4.72 (4.67;4.78)	3427 (1711;1716)	0.03 (-0.13; 0.19)	0.68	

Table G3: Effect size for primary outcomes – FSM subgroup

Outcome	Raw means: standardised variables						Effect size (95% CI)	p-value
	Intervention group			Control group				
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)			

KS2 maths	782 (27)	101.81 (101.28;102.34)	797 (29)	102.24 (101.75;102.74)	1579 (782;797)	0.00 (-0.03; 0.03)	0.97
KS2 reading	780 (29)	101.46 (100.91;102.02)	794 (32)	101.40 (100.82;101.98)	1574 (780;794)	0.01 (-0.02; 0.03)	0.59
KS2 grammar punctuation spelling	779 (30)	103.82 (103.29;104.36)	797 (29)	104.13 (103.61;104.64)	1576 (779;797)	0.00 (-0.03; 0.04)	0.92

Table G4: Effect size for secondary outcomes – FSM subgroup

Raw means: standardised variables							
Outcome	Intervention group			Control group		Effect size (95% CI)	p-value
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)		
Intrinsic value	565 (244)	5.54 (5.46;5.63)	598 (228)	5.46 (5.38;5.55)	1163 (565;598)	0.085 (-0.14; 0.30)	0.45
Self-efficacy	565 (244)	5.03 (4.94;5.12)	598 (228)	5.12 (5.03;5.20)	1163 (565;598)	-0.119 (-0.31; 0.08)	0.23
Test anxiety	565 (244)	3.75 (3.60;3.89)	598 (228)	3.65 (3.51;3.79)	1163 (565;598)	0.047 (-0.05; 0.14)	0.34
Self regulation	563 (246)	4.74 (4.65;4.84)	593 (233)	4.69 (4.60;4.78)	1156 (563;593)	0.008 (-0.18; 0.20)	0.93

Appendix H: Code for the analysis of primary outcomes

This code was used to produce Table 5. It is a slightly modified version of the code provided by Crawford et al. (2016) in their report "Magic Breakfast: Evaluation Report and Executive Summary."

```

glo in "data"

glo out "data\final"

glo log "log"

use "$out\dataCM.dta", clear

*Main table

tempname file

file open `file' using `maintable_primary.csv', write text replace

file write `file' "Table A: Headline academic outcomes" _new

file write `file' " , Raw means: standardised variables, , , Effect size, , " _new

file write `file' " , Intervention group, , Control group, , , " _new

file write `file' "Outcome, n (missing), Mean (95% CI), n (missing), Mean (95% CI), n in model
(intervention; control), Effect size (95% CI), p-value" _new

loc k1 " k1attain2 k1attain3 k1attainmiss"

foreach yvar in ks2_matscore ks2_readscore ks2_gpsscore {
if "`yvar'" == "ks2_matscore" local name = "KS2 maths"
if "`yvar'" == "ks2_readscore" local name = "KS2 reading"
if "`yvar'" == "ks2_gpsscore" local name = "KS2 grammar punctuation spelling"

sum `yvar' if dropout==0 & treated == 1

cii mean r(N) r(mean) r(sd)

local tN = trim("` : display %6.0f r(N)")

local tmean = trim("` : display %6.2f r(mean)")

local tcilo = trim("` : display %6.2f r(lb)")

local tcihi = trim("` : display %6.2f r(ub)")

count if drop == 0 & treated == 1

local tmiss_temp = r(N) - `tN'

local tmiss = trim("` : display %6.0f `tmiss_temp'")

sum `yvar' if dropout==0 & treated == 0

```

```

cii mean r(N) r(mean) r(sd)
local cN = trim("": display %6.0f r(N)""")
local cmean = trim("": display %6.2f r(mean)""")
local ccilo = trim("": display %6.2f r(lb)""")
local ccihi = trim("": display %6.2f r(ub)""")
count if drop == 0 & treated == 0
local cmiss_temp = r(N) - `cN'
local cmiss = trim("": display %6.0f `cmiss_temp'""")
local totN = trim("": display %6.0f `cN'+`tN'""")
local paro (
local parc )
local semicn ;
local col2 `tN' `paro`tmisss`parc'
local col3 `tmean' `paro`tcilo`semicn`tcihi`parc'
local col4 `cN' `paro`cmiss`parc'
local col5 `cmean' `paro`ccilo`semicn`ccihi`parc'
local col6 `totN' `paro`tN`semicn`cN`parc'
mixed `yvar' `k1' treated i.block || ks2_urn_treatment : , reml /*1*/
loc cilo="": display %6.2f _b[treated]-invttail(e(N)+e(df_m)+1,0.025)*_se[treated]"
di `cilo'
loc cihi="": display %6.2f _b[treated]+invttail(e(N)+e(df_m)+1,0.025)*_se[treated]"
di `cihi'
estat recovariance
mat V=r(Cov2)
loc tau=V[1,1]
estat icc
loc icc=r(icc2)
di `icc'
loc es="": display %6.2f _b[treated]/(`tau'/`icc')""
di `es'
loc escilo="": display %6.2f `cilo'/(`tau'/`icc')""
di `escilo'

```



```
loc escihi="": display %6.2f `cihi/(`tau/`icc)'"
di `escihi'

local epval = "": display %6.2f 2*(1-normprob(abs(_b[treated]/_se[treated])))"
if `epval' <= 0.10 local sigstars = "*"
if `epval' <= 0.05 local sigstars = "***"
if `epval' <= 0.01 local sigstars = "****"
if `epval' > 0.10 local sigstars = ""

di `epval'

local col7 `es' `paro`escilo`semicn`escihi`parc'
local col8 `epval`sigstars'

file write `file' "`name" ", " `col2" ", " `col3" ", " `col4" ", " `col5" ", " `col6" ", " `col7" ", " `col8" _new
}

log close
```

Appendix I: Histograms of post-test outcomes

Figure I1: Distribution of KS2 maths scores for the pupils in the Changing Mindsets intervention schools

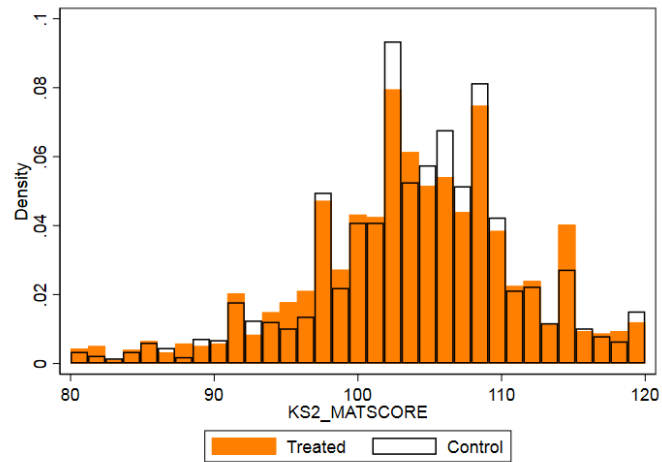


Figure I2: Distribution of KS2 reading scores for the pupils in the Changing Mindsets intervention schools

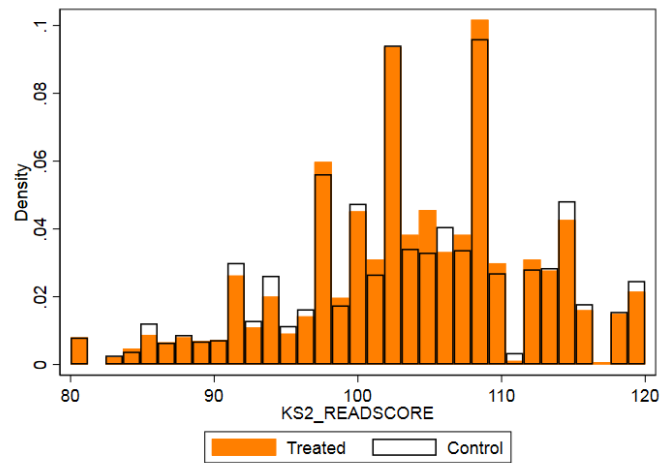


Figure I3: Distribution of KS2 GPS scores for the pupils in the Changing Mindsets intervention schools

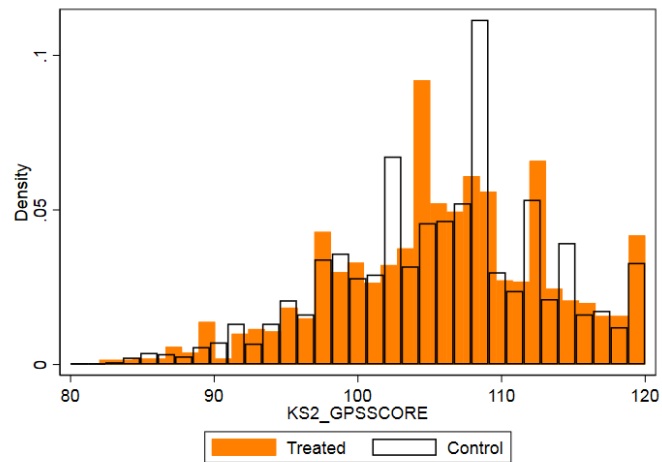


Figure I4: Distribution of intrinsic value post-test subscale for the pupils in the Changing Mindsets intervention schools

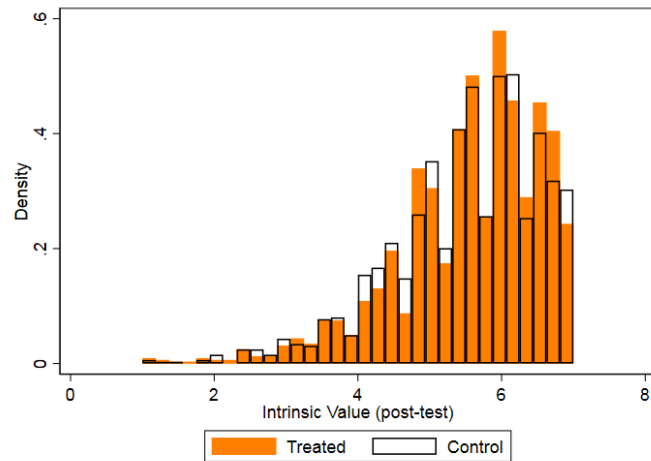


Figure I5: Distribution of self-efficacy post-test subscale for the pupils in the Changing Mindsets intervention schools

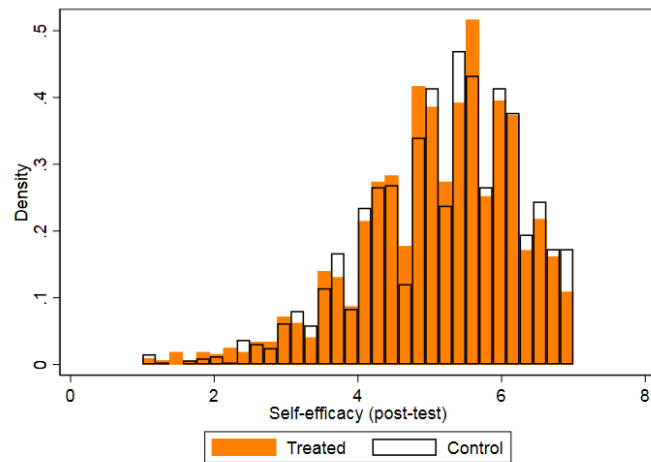


Figure I6: Distribution of anxiety post-test subscale for the pupils in the Changing Mindsets intervention schools

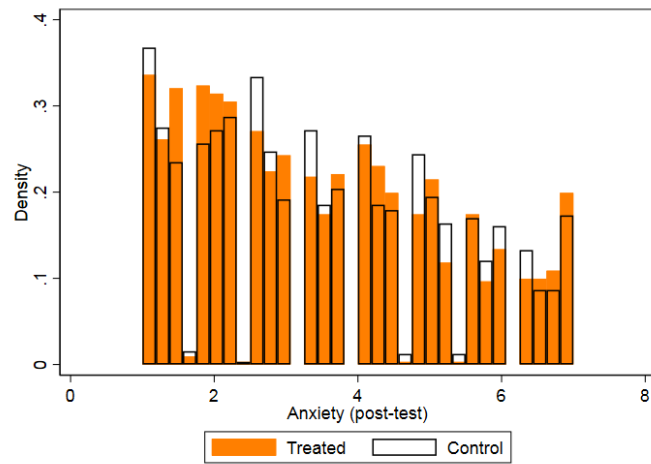
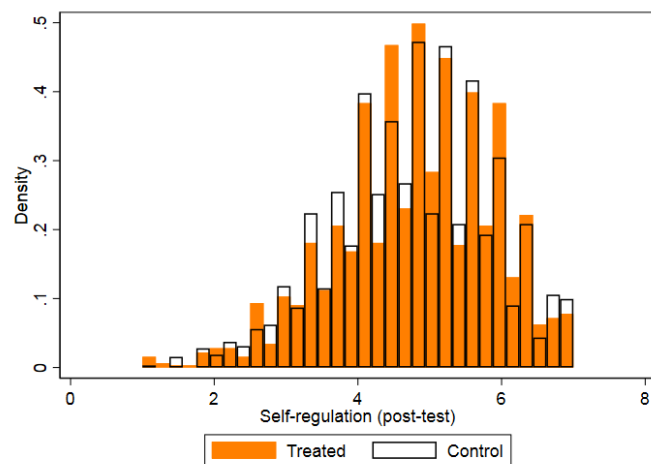


Figure I7: Distribution of self-regulation post-test subscale for the pupils in the Changing Mindsets intervention schools



Appendix J: Additional subgroup analysis

In this appendix we present the results of separate analysis for three subgroups: females, males and pupils with fixed mindset in the pre-trial tests. These analyses were not pre-specified in the protocol nor in the SAP and as such they are exploratory attempts to understand whether the intervention had an effect on groups that showed promising results in other studies. The results of these exploratory analyses show that there is no evidence of an impact of the Changing Mindset intervention on the tested cognitive and non-cognitive outcomes of Year 6 students in these subgroups.

Table J1: Effect size of the intervention on literacy and numeracy among females

Raw means: standardised variables							
Outcome	Intervention group			Control group		Effect size (95% CI)	p-value
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)		
KS2 maths	1129 (21)	103.48 (103.07;103.89)	1061 (18)	103.65 (103.24;104.05)	2190 (1129;1061)	-0.00 (-0.03; 0.03)	1
KS2 reading	1123 (27)	104.39 (103.94;104.84)	1058 (21)	104.52 (104.01;105.03)	2181 (1123;1058)	-0.00 (-0.02; 0.02)	0.85
KS2 grammar punctuation spelling	1125 (25)	106.62 (106.21;107.04)	1061 (18)	106.65 (106.22;107.09)	2186 (1125;1061)	0.00 (-0.02; 0.03)	0.74

Table J2: Effect size of the intervention on literacy and numeracy among males

Raw means: standardised variables							
Outcome	Intervention group			Control group		Effect size (95% CI)	p-value
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)		
KS2 maths	1144 (41)	104.15 (103.70;104.60)	1120 (50)	104.46 (104.03;104.89)	2264 (1144;1120)	-0.02 (-0.05; 0.01)	0.26
KS2 reading	1140 (45)	103.26 (102.78;103.75)	1116 (54)	102.92 (102.44;103.41)	2256 (1140;1116)	-0.00 (-0.02; 0.02)	0.93
KS2 grammar punctuation spelling	1141 (44)	105.12 (104.67;105.58)	1121 (49)	104.91 (104.47;105.35)	2262 (1141;1121)	-0.00 (-0.03; 0.03)	0.86

Table J3: Effect size of the intervention on literacy and numeracy among pupils with fixed mindset

Raw means: standardised variables							
Outcome	Intervention group			Control group		Effect size (95% CI)	p-value
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)		
KS2 maths	504 (12)	102.33 (101.69;102.96)	436 (10)	102.91 (102.27;103.56)	940 (504;436)	-0.01 (-0.05; 0.02)	0.52
KS2 reading	502 (14)	102.27 (101.60;102.95)	433 (13)	101.99 (101.23;102.74)	935 (502;433)	0.01 (-0.03; 0.04)	0.75
KS2 grammar punctuation spelling	502 (14)	104.45 (103.81;105.08)	436 (10)	104.70 (104.05;105.36)	938 (502;436)	-0.01 (-0.05; 0.03)	0.71

Table J4: Effect size of the intervention on non-cognitive skills among females

Raw means: standardised variables							
Outcome	Intervention group			Control group		Effect size (95% CI)	p-value
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)		
Intrinsic value	864 (286)	5.64 (5.58;5.70)	853 (226)	5.57 (5.51;5.64)	1717 (864;853)	0.110 (-0.13; 0.34)	0.35
Self-efficacy	864 (286)	5.09 (5.02;5.16)	853 (226)	5.14 (5.06;5.21)	1717 (864;853)	-0.008 (-0.20; 0.19)	0.94
Test anxiety	864 (286)	3.79 (3.67;3.91)	853 (226)	3.78 (3.67;3.90)	1717 (864;853)	-0.013 (-0.11; 0.08)	0.78
Self regulation	863 (287)	4.85 (4.78;4.92)	849 (230)	4.79 (4.71;4.86)	1712 (863;849)	0.077 (-0.11; 0.26)	0.41

Table J5: Effect size of the intervention on non-cognitive skills among males

Raw means: standardised variables							
Outcome	Intervention group			Control group		Effect size (95% CI)	p-value
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)		
Intrinsic value	850 (335)	5.45 (5.38;5.52)	873 (297)	5.42 (5.35;5.49)	83 (41;42)	0.090 (-0.11; 0.29)	0.39
Self-efficacy	850 (335)	5.13 (5.06;5.21)	873 (297)	5.21 (5.14;5.28)	83 (41;42)	-0.092 (-0.27; 0.08)	0.31
Test anxiety	850 (335)	3.09 (2.98;3.20)	873 (297)	3.23 (3.12;3.34)	83 (41;42)	-0.028 (-0.13; 0.07)	0.59
Self regulation	848 (337)	4.69 (4.61;4.76)	867 (303)	4.66 (4.59;4.73)	83 (41;42)	0.047 (-0.12; 0.22)	0.59

Table J6: Effect size of the intervention on non-cognitive skills among pupils with fixed mindset

Raw means: standardised variables							
Outcome	Intervention group			Control group		Effect size (95% CI)	p-value
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)		
Intrinsic value	375 (141)	5.51 (5.41;5.61)	341 (105)	5.45 (5.34;5.56)	716 (375;341)	0.180 (-0.07; 0.42)	0.16
Self-efficacy	375 (141)	5.07 (4.96;5.18)	341 (105)	5.06 (4.94;5.17)	716 (375;341)	0.067 (-0.16; 0.29)	0.55
Test anxiety	375 (141)	3.65 (3.46;3.83)	341 (105)	3.81 (3.62;4.00)	716 (375;341)	-0.029 (-0.16; 0.10)	0.66
Self regulation	375 (141)	4.71 (4.59;4.82)	338 (108)	4.64 (4.53;4.76)	713 (375;338)	0.078 (-0.14; 0.30)	0.48

Appendix K: Results of the missing data analysis and additional estimates

Table K1: Logistic regression analysis of missing data in primary outcomes

	Maths score	Reading Score	GPS score
Ever FSM	-0.479* (0.246)	-0.518** (0.236)	-0.451* (0.250)
	0.052	0.028	0.071
Female	-0.081 (0.145)	-0.059 (0.137)	-0.068 (0.139)
	0.576	0.669	0.623
Ethnicity group: Asian	1.240 (1.092)	0.925 (0.881)	0.961 (0.871)
	0.256	0.294	0.269
Ethnicity group: Black	0.946 (1.031)	0.710 (0.845)	0.610 (0.814)
	0.359	0.401	0.453
Ethnicity group: Chinese	1.548 (1.643)	1.988 (1.371)	1.117 (1.522)
	0.346	0.147	0.463
Ethnicity group: Mixed	1.924* (1.118)	1.506 (0.940)	1.460 (0.921)
	0.085	0.109	0.113
Ethnicity group: Unclassified	1.815 (1.402)	1.422 (1.244)	1.387 (1.227)
	0.195	0.253	0.258
Ethnicity group: White	2.329** (1.136)	1.989** (0.949)	1.962** (0.929)
	0.040	0.036	0.035
Treatment allocation==1	-1.098* (0.640)	-1.019 (0.625)	-0.983 (0.634)
	0.086	0.103	0.121
North East, lower	-0.223 (0.416)	-0.531 (0.425)	-0.540 (0.484)
	0.592	0.211	0.265
North West, lower	-1.201 (1.128)	-0.351 (0.471)	-1.316 (1.102)
	0.287	0.457	0.232
South East, lower	1.611** (0.807)	1.406* (0.765)	1.566** (0.772)
	0.046	0.066	0.043
South West, lower	-	-1.486 (1.147)	-1.257 (1.112)
	-	0.195	0.258
Midlands, mid	2.773*** (0.982)	2.493*** (0.966)	2.573*** (0.989)
	0.005	0.010	0.009
North East, mid	-0.227 (0.447)	-0.537 (0.517)	-0.347 (0.518)

	0.612	0.299	0.503
North West, mid	-0.520 (0.753)	-0.823 (0.753)	-0.657 (0.752)
	0.490	0.274	0.383
South East, mid	2.658* (1.605)	2.330 (1.593)	2.456 (1.610)
	0.098	0.144	0.127
South West, mid	-0.859* (0.512)	-1.148** (0.518)	-0.985* (0.539)
	0.093	0.027	0.068
Midlands, upper	-0.591 (0.816)	-1.130 (0.998)	-0.977 (1.022)
	0.469	0.257	0.339
North East, upper	2.681** (1.172)	2.377** (1.166)	2.481** (1.190)
	0.022	0.041	0.037
North East, upper	-	-	-
	-	-	-
South East, upper	2.573* (1.517)	2.157 (1.542)	2.286 (1.562)
	0.090	0.162	0.143
South West, upper	-0.413 (0.953)	-0.324 (0.960)	-0.182 (0.986)
	0.665	0.736	0.854
School-level KS1 mean achievement	-0.297 (0.523)	-0.252 (0.520)	-0.223 (0.538)
	0.570	0.628	0.678
KS1 (11-14.99 points)	-1.506*** (0.332)	-1.639*** (0.323)	-1.547*** (0.335)
	0.000	0.000	0.000
KS1 (15-16.99 points)	-1.760*** (0.355)	-1.904*** (0.355)	-1.774*** (0.363)
	0.000	0.000	0.000
KS1 (>=17 points)	-1.733*** (0.330)	-1.875*** (0.320)	-1.734*** (0.327)
	0.000	0.000	0.000
KS1 missing	0.020 (0.312)	0.105 (0.297)	0.196 (0.329)
	0.948	0.724	0.552
Observations	4,651	4,728	4,728

The table reports estimates, standard errors (in parenthesis) and p-values of logistic regressions.

Table K2: Logistic regression analysis of missing data in secondary outcomes

	Test anxiety	Self-regulation	Intrinsic value	Self-efficacy
Pre-test second tertile	-0.063 (0.126)	-0.013 (0.096)	-0.185* -0.108	-0.079 -0.079
	0.620	0.891	0.085	0.317
Pre-test third tertile	0.150 (0.115)	0.007 (0.101)	-0.15 -0.133	-0.024 -0.12
	0.193	0.948	0.259	0.841
Pre-test second missing	1.096*** (0.338)	1.050*** (0.321)	0.953*** -0.341	1.027*** -0.328
	0.001	0.001	0.005	0.002
Ever FSM	0.022 (0.133)	0.036 (0.133)	0.03 -0.134	0.028 -0.135
	0.871	0.789	0.821	0.838
Female	-0.148** (0.073)	-0.136* (0.076)	-0.128* -0.073	-0.132* -0.074
	0.043	0.075	0.081	0.074
Ethnicity group: Asian	0.395 (0.422)	0.411 (0.430)	0.36 -0.429	0.377 -0.426
	0.348	0.339	0.402	0.377
Ethnicity group: Black	-0.164 (0.354)	-0.163 (0.354)	-0.21 -0.348	-0.183 -0.348
	0.644	0.645	0.546	0.598
Ethnicity group: Chinese	0.257 (0.601)	0.251 (0.605)	0.208 -0.611	0.232 -0.605
	0.669	0.678	0.734	0.702
Ethnicity group: Mixed	0.244 (0.532)	0.233 (0.532)	0.197 -0.53	0.223 -0.528
	0.647	0.661	0.71	0.672
Ethnicity group: Unclassified	0.078 (0.592)	0.042 (0.589)	0.019 -0.592	0.043 -0.592
	0.895	0.943	0.974	0.942
Ethnicity group: White	-0.047 (0.534)	-0.041 (0.535)	-0.086 -0.534	-0.06 -0.529
	0.930	0.939	0.872	0.91
Treatment allocation==1	0.212 (0.411)	0.202 (0.407)	0.213 -0.411	0.214 -0.411
	0.607	0.620	0.604	0.602
North East, lower	-1.503** (0.652)	-1.431** (0.657)	-1.481** -0.65	-1.488** -0.65
	0.021	0.029	0.023	0.022
North West, lower	-1.082** (0.501)	-1.116** (0.496)	-1.081** -0.498	-1.087** -0.5
	0.031	0.024	0.03	0.03
South East, lower	0.009 (0.683)	0.041 (0.676)	0.009 -0.685	0.011 -0.683
	0.989	0.952	0.99	0.987
South West, lower	-0.867 (0.663)	-0.881 (0.662)	-0.863 -0.66	-0.883 -0.664
	0.191	0.183	0.191	0.184
Midlands, mid	1.017	1.041	1.029	1.024

	(0.799)	(0.792)	-0.798	-0.797
	0.203	0.189	0.197	0.199
North East, mid	-0.616	-0.617	-0.607	-0.622
	(0.718)	(0.718)	-0.719	-0.72
	0.391	0.390	0.399	0.388
North West, mid	-0.123	-0.129	-0.122	-0.125
	(0.660)	(0.660)	-0.657	-0.66
	0.852	0.845	0.852	0.85
South East, mid	0.174	0.183	0.179	0.175
	(0.790)	(0.783)	-0.787	-0.788
	0.826	0.815	0.82	0.824
South West, mid	-2.277***	-2.267***	-2.276***	-2.271***
	(0.521)	(0.518)	-0.519	-0.522
	0.000	0.000	0	0
Midlands, upper	-0.555	-0.527	-0.557	-0.563
	(0.745)	(0.735)	-0.745	-0.744
	0.457	0.474	0.455	0.449
North East, upper	-0.175	-0.169	-0.168	-0.172
	(0.681)	(0.681)	-0.681	-0.68
	0.797	0.804	0.805	0.8
North East, upper	-1.438**	-1.437**	-1.440**	-1.440**
	(0.713)	(0.709)	-0.716	-0.712
	0.044	0.043	0.044	0.043
South East, upper	-0.721	-0.727	-0.733	-0.728
	(0.905)	(0.903)	-0.899	-0.903
	0.426	0.421	0.414	0.42
South West, upper	1.490	1.506	1.502	1.498
	(1.149)	(1.154)	-1.151	-1.153
	0.195	0.192	0.192	0.194
School-level KS1 mean achievement	0.189	0.188	0.185	0.188
	(0.249)	(0.248)	-0.25	-0.25
	0.448	0.447	0.459	0.452
KS1 (11-14.99 points)	-0.394**	-0.384**	-0.393**	-0.398**
	(0.161)	(0.160)	-0.161	-0.161
	0.014	0.016	0.015	0.013
KS1 (15-16.99 points)	-0.353**	-0.376**	-0.354**	-0.364**
	(0.155)	(0.156)	-0.157	-0.155
	0.023	0.016	0.024	0.019
KS1 (>=17 points)	-0.296*	-0.331**	-0.304**	-0.316**
	(0.153)	(0.152)	-0.153	-0.151
	0.053	0.029	0.047	0.037
KS1 missing	-0.052	-0.067	-0.056	-0.063
	(0.180)	(0.179)	-0.181	-0.181
	0.772	0.708	0.756	0.728
Observations	4,875	4,875	4,875	4,875

The table reports estimates, standard errors (in parenthesis) and p-values of logistic regressions.

Table K3: Primary analysis with additional variables

Raw means							
Outcome	Intervention group			Control group			p-value
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)	Effect size (95% CI)	
KS2 maths	2273 (62)	103.82 (103.51;104.13)	2181 (68)	104.07 (103.77;104.36)	4454 (2273;2181)	-0.01 (-0.04; 0.01)	0.32
KS2 reading	2263 (72)	103.82 (103.49;104.16)	2174 (75)	103.70 (103.35;104.05)	4437 (2263;2174)	-0.00 (-0.02; 0.02)	0.66
KS2 grammar punctuation spelling	2266 (69)	105.87 (105.56;106.18)	2182 (67)	105.76 (105.45;106.07)	4448 (2266;2182)	-0.00 (-0.03; 0.02)	0.87

Table K4: Secondary analysis with additional variables

Raw means							
Outcome	Intervention group			Control group			p-value
	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)	Effect size (95% CI)	
Intrinsic value	1508 (827)	5.54 (5.49;5.59)	1409 (840)	5.51 (5.46;5.56)	2917 (1508;1409)	0.09 (-0.10; 0.29)	0.39
Self-efficacy	1507 (828)	5.13 (5.08;5.18)	1409 (840)	5.21 (5.15;5.26)	2916 (1507;1409)	-0.06 (-0.23; 0.11)	0.51
Test anxiety	1507 (828)	3.46 (3.37;3.55)	1409 (840)	3.46 (3.37;3.55)	2916 (1507;1409)	-0.01 (-0.09; 0.06)	0.72
Self-regulation	1501 (834)	4.77 (4.72;4.82)	1398 (851)	4.74 (4.69;4.80)	2899 (1501;1398)	0.05 (-0.11; 0.22)	0.54

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