

EXEMPLAR: RANDOMISED CONTROLLED TRIAL (RCT)

Project: Randomised Controlled Trial (RCT) to Evaluate the Impact of the CREST Silver Award Program on Science Attainment and Student Outcomes in the UK

Background

The CREST Award programme, administered by the British Science Association (BSA), offers Discovery, Bronze, Silver, and Gold levels to students to develop science, technology, engineering, and maths (STEM) skills and showcase their achievements through project work. Students initiate and conduct their own projects with guidance from educators, including teachers and club leaders.

This study builds on the previous evaluations of CREST by undertaking the first RCT of the program to evaluate the effectiveness of the CREST Silver Award when delivered to Year 9 students in schools with average or above average proportions of students ever eligible for free school meals (FSM) in the previous six years (everFSM). The RCT was designed to explore differential impact for subgroups based on prior evidence presented above.

The Intervention

The study focused on CREST Silver, aimed at Year 9 students (13–14-year-olds) who completed over 30 hours of project work. Science teachers supported students, and their projects were submitted online. The intervention spanned the 2017/2018 academic year, with the trial beginning in September 2017 and concluding with post-intervention testing of students in July 2018.

RCT Objective

A randomised control trial involving 2,810 students from 180 schools aimed to measure the impact of CREST Silver on science attainment. The primary outcome of interest for the trial was science attainment, as measured by the raw scores achieved in the Progress Test in Science (PTS), level 14 (GL Assessment).

Primary Hypothesis

- Participating in CREST after expressing interest in an extra-curricular science project improves academic science attainment, as measured in GL's Progress in Science Test and GCSE science results.

Secondary Hypotheses

- Participating in CREST improves soft outcomes, including confidence, attitudes to school, self-efficacy in science, and future aspirations in science.
- CREST participants will have higher science attainment than non-participants.
- CREST will have varying impacts on students eligible for free school meals (FMS) compared to those ineligible.
- CREST will have varying impacts on female and male students.
- CREST will have varying impacts based on program implementation (whole-class, after-school, or lunch-time club).

Methods

Trial Design

Trial type and number of arms		Two-armed cluster randomised controlled trial
Unit of randomisation		Schools
Stratification variable(s) (if applicable)		Percentage of pupils with everFSM status and percentage of pupils achieving 5+ A*-C or equivalents in both English and mathematics GCSEs in the 2016 academic year.
Primary outcome	variable	Science attainment
	measure (instrument, scale)	GL's Progress Test in Science
Secondary outcome(s)	variable(s)	Confidence, attitudes to school, self-efficacy in science, future aspirations in science
	measure(s) (instrument, scale)	These measures were collected at baseline and follow-up pupil surveys. These include confidence (from the National Citizenship Service baseline questionnaire), attitudes to school (from the Longitudinal Study of Young People in England), self-efficacy in science (from the Wellcome Trust Pathways survey), and future aspirations in science (from the Wellcome Trust Pathways survey).

Source: Hussain (2019)

Randomisation

Randomisation was done independently by NatCen Social Research using a three-level, two-armed, cluster-randomised controlled trial. The randomisation process involved controlling for randomisation strata at Level 3 while treating School (Level 2) and Students (Level 1) as random effects.

Schools were selected as the unit of randomisation because individual-level randomisation was not suitable due to the nature of the intervention. Although teachers identified eligible students, these students still had the opportunity to self-select for participation in CREST before randomization. It was anticipated that some individuals initially assigned to the control group might choose to participate in CREST projects because of their friends' involvement.

Five schools withdrew from the evaluation before randomisation, and the reasons for their withdrawal remain unknown. After accounting for these withdrawals, the remaining 180 schools participating in the trial were randomly assigned to one of two intervention conditions:

1. Group 1 (intervention schools) invited interested students to undertake a CREST project.
2. Group 2 (control schools) did not invite interested students but instead provided them with a £10 street voucher.

Randomisation was stratified based on the schools' proportion of students who had ever been eligible for free school meals (everFSM status) and their prior attainment, as measured by their average GCSE outcomes. Recruited schools were further divided into high and low groups on each dimension, based on the median of the schools in the sample.

This comprehensive approach ensured that the randomisation process accounted for important variables and potential sources of bias.

Sample

The study aimed to detect an effect size of 0.18 standard deviations and involved 2,810 students across 180 schools.

Students completed pre-intervention and post-intervention surveys to collect baseline and outcome data on students' non-cognitive outcomes such as self-efficacy, attitudes to school, career aspirations, and reasons for taking part in CREST Silver. It also gathered contextual information on STEM related extra-curricular activities that students had taken part in or could do in Year 9.

2,775 students completed the pre-intervention survey and 2,257 completed the post-intervention survey.

Analysis

The primary analysis used an intention-to-treat (ITT) approach, comparing science attainment between intervention and control groups. The primary outcome, GL's Progress in Science, was therefore the dependent variable in a multilevel model with students nested within schools.

Secondary analyses assessed outcomes related to attitudes, self-efficacy, confidence, and STEM career aspirations. Student confidence, attitudes, and self-efficacy are continuous measures aggregated from categorical responses to survey questions.

Results

- CREST Silver did not result in additional progress in science attainment compared to the control group.
- No evidence showed improvement in self-efficacy in science or increased interest in STEM careers.
- Some small positive impacts were observed in student confidence and attitudes toward school.
- Participation in CREST Silver did not impact science attainment differently for girls and boys.
- The delivery model of CREST may influence its impact on science attainment. Students participating outside of class time made two months' additional progress, while those participating during class time made three months' less progress.
- Limited time for CREST projects alongside other commitments may explain the low proportion of final submitted student projects.

Limitations

- High student attrition in the intervention group (26.6%) compared to the control group (16.2%) could bias effect estimates and impact internal validity.
- Recruitment was based on self-selection, limiting the generalisability of findings to only those students who self-selected to participate in CREST, not the entire student population.

Conclusion

The RCT evaluated the impact of the CREST Silver Award programme on science attainment and related outcomes among Year 9 students. While it found no significant improvement in science attainment, there were some positive effects on student confidence and attitudes towards school. The study also suggested that the delivery model of CREST might influence its impact on science attainment. However, the study had limitations related to attrition and self-selection bias that should be considered when interpreting the results.

Note

This example is based on the sources below. Please refer to the sources for a comprehensive understanding of the RCT and its protocol.

Hussain, F. (2019). *Trial Evaluation Protocol*. CREST Silver. NatCen Social Research. Education Endowment Foundation
https://d2tic4wvo1iusb.cloudfront.net/production/documents/projects/CREST_trial_protocol_ammended.pdf?v=1699590983

Hussain, F., Wishart, R., Attygalle, K., Averill, P., Ilic, N., and Mayer, M. (2019). *Evaluation Report. CREST Silver*. NatCen Social Research. Education Endowment Foundation.
https://d2tic4wvo1iusb.cloudfront.net/production/documents/projects/CREST_Silver.pdf?v=1699590983