Individual participant data meta-analysis: pooled effect of EEF funded educational trials on low baseline attaining group

Uwimpuhwe G.[1], Singh A.[1], Akhter N.[1], Ashraf B.[1], Coolen-Maturi T.[1], Robinson T.[12], Higgins S.[1], Einbeck J.[1]

[1] Durham University, Durham, United Kingdom
[2] London School of Economics and Political Science, London, United Kingdom

E-mail for correspondence: germaine.uwimpuhwe@durham.ac.uk

Abstract: The Education Endowment Foundation (EEF), a charity aiming to break the link between socioeconomic disadvantage and pupil attainment, has commissioned over 200 randomised controlled trials. The collection of data from these trials, the 'EEF Data Archive', forms a rich repository. It is vital to understand the overall impact of EEF-funded interventions on disadvantaged pupils' attainment, as well as the 'attainment gap' to their peers. The EEF Data Archive allows gaining such understanding. This study utilized individual-level pupils' data from 100 trials available in this archive, with disadvantaged pupils being indicated by students belonging to the lowest tertile of the baseline scores for each trial. A Bayesian multilevel IPD meta-analysis was applied to the standardised outcome measures (mathematics and literacy) to estimate the pooled effect size and the attainment gap. The preliminary analysis revealed that EEF-funded interventions improved low-attaining pupils' attainment for literacy (effect size: 0.033, 95% CI: 0.011, 0.055) and mathematics outcomes (effect size: 0.019, 95% CI: -0.001, 0.038). Overall, the results align with the EEF mission of increasing the attainment of disadvantaged pupils and closing the attainment gap.

Keywords: IPD meta analysis; multilevel models; effect size; educational interventions

1 Introduction

Raising the attainment of pupils from disadvantaged backgrounds, commonly defined in terms of family socioeconomic status, can help all pupils in achieving their potential (Macleod et al., 2015). This is the main mission

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of the Education Endowment Foundation (EEF), an independent charity who sponsor education trials. For example, Higgins et al. (2016) found that an EEF-funded mastery learning intervention is a promising strategy for narrowing attainment gaps. Similarly, Gorard et al. (2014) demonstrated that pupils with low attainment prior to an EEF-funded reading intervention showed greater positive results. These individual results are promising, but only tell a partial story of the global impact EEF interventions have had on reducing attainment gaps.

In this study, we investigated the pooled effect of EEF-funded interventions on disadvantaged pupils' attainment. We estimated the attainment gaps between middle/high and low attainers using a new three-category indicator called the Baseline Attainment Group (BAG), created from the tertiles of standardised prior attainments. For each project, pre-test scores were z-standardised and then categorised into three equal groups. Tertiles of the standardised pre-test scores were created and defined as low, middle, and high attainers' groups. The lower tertile of this measure identifies low attainers at baseline, allowing us to represent the subgroup of disadvantaged pupils. Specifically, we investigate the following research questions: RQ1) What is the overall effect of EEF-funded interventions on low attainers' literacy and mathematics attainment? RQ2) Does the effect of EEF-funded interventions on literacy/mathematics attainment differ between low attainers and their peers?

2 Models and estimation

To summarise the intervention effect on low attainers, we applied the simplified meta-analysis method detailed in Ashraf et al. (2021). Specifically, to answer both research questions, we estimate the model:

$$Y^s_{ijk} = \begin{cases} \beta_{0k} + \beta_{1k}\text{Pret}^s_{ijk} + \beta_{2k}T_{ijk} + S_{jk} + \epsilon_{ijk}, \text{ for RQ1} \\ \beta_{0k} + \beta_{2k}T_{ijk} + \beta^l_{3k}\text{BAG}^l_{ijk} + \beta^l_{4k}T_{ijk}\text{BAG}^l_{ijk} + S_{jk} + \epsilon_{ijk}, \text{ for RQ2,} \end{cases}$$

where Y^s_{ijk} and Pret^s_{ijk} are standardised post-test and pre-test scores for pupils i in school j from trial k; β_{0k} is a fixed intercept, β_{1k} is a fixed gradient between the standardised post-test and pre-test scores, and β_{2k} is the average effect of the intervention in trial k; BAG^l is 0 if BAG $= l$ and 1 otherwise, using the notation $l = 1$ for middle and $l = 2$ for higher attainers categories of BAG, with low attainers forming the reference level. The parameters β^l_{4k} represent the attainment gap, i.e., the difference in the average effect of the interventions between BAG pupils (low attainers and pupils belonging to level l) in trial k; $S_{jk} \sim N(0, \omega^2_{jk})$, with ω_{jk} capturing between-school variability in trial k, and $\epsilon_{ijk} \sim N(0, \sigma^2_k)$, with σ_k capturing between-pupil variability in trial k.

Note, the pre-test variable was ignored in the attainment gap model since it forms the basis of the BAG variable and could lead to non-identifiabilities if both were included. Only the low attainers subgroup was considered to answer the first research question (RQ1). The effect of EEF-funded intervention on low attainers was then compared separately to that of middle and high attainers to answer the second research question (RQ2) regarding the attainment gap.

The pooled effect size for subgroup analysis and attainment gap can be calculated by:

$$\phi = \frac{\sum_{k=1}^{K} W_k \theta_k}{\sum_{k=1}^{K} W_k},$$

where $W_k = (\omega_{jk}^2 + \sigma_k^2)^{-1}$ captures within-trial variability, given that between-trial variability was pre-scaled to 1, with $\theta_k = \beta_{2k}$ for subgroup analysis and $\theta_k = \beta_{4k}$ for the attainment gap model.

A Bayesian framework with vague priors was used to fit the required multilevel models, from which the pooled estimates of effect sizes were computed. Credible intervals were obtained as 2.5% and 97.5% quantiles from posterior distributions of the pooled effect size estimates. All analyses were performed with manual implementations in the R package `R2jags`.

3 Results

At the time of the analysis (end of 2021) 100 projects were available in the EEF Data Archive through the Secure Research Service (SRS) environment. Since some trials have both maths and literacy outcomes, in total 52 trials with maths outcomes and 85 with literacy were available. The assessment of eligibility criteria resulted in 45 trials with literacy and 35 trials with maths outcomes to use in the final analysis. The results of the subgroup analysis are shown in Table 1, where positive effect size estimates mean that the EEF interventions has a positive effect on low attainers. Table 2 shows the attainment gap estimates, where positive estimates mean that due to the EEF interventions, lower attainers perform better than their peers.

TABLE 1. Overview of pooled effect sizes for maths and literacy outcomes on low attainers.

Outcome	Trials	Low attainers	ES (95% credible interval)
Literacy	45	70,819	0.033 (0.011, 0.055)
Maths	38	116,031	0.019 (-0.001, 0.038)

TABLE 2. Overview of the attainment gaps between low attainers and middle/high attainers. The estimates are the pooled attainment gaps and their 95% credible interval in parenthesis

Outcome	Trials	All pupils	Low vs *Middle* attainers	Low vs *High* attainers
Literacy	45	179,312	-0.001 (-0.020, 0.019)	0.003 (-0.017, 0.023)
Maths	38	270,979	0.010 (-0.007, 0.027)	-0.001 (-0.021, 0.020)

4 Discussion

The results indicate that EEF-funded interventions improved low attaining pupil's literacy outcomes with an effect size of 0.033 (0.011, 0.055). The improvement in the mathematics outcomes of low attainers was less pronounced, with an effect size of 0.019 (-0.001, 0.038). For both outcomes, there was no indication that EEF-funded interventions would widen the attainment gap. The evidence from this study can be used to support EEF stakeholders in assessing 'what worked' for these specific disadvantaged pupils.

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