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A digitally-delivered, double-blind RCT investigating the effect of homework length on progress: why trial design matters

In the last three decades there has been a marked shift in favour of evidence-based practice in education, complemented by a sharp rise in the number of randomised controlled trials (RCTs) being conducted to discover 'what works'[1]. An RCT is a robust approach for testing the efficacy of an intervention: randomisation reduces the likelihood of selection bias in the sample, while including a control group ensures that any relative change in the outcome measure can be reliably attributed to the intervention. Unlike in clinical trials where individual randomisation is common, in educational contexts it is often schools or classes that are randomised as teaching interventions are normally provided to whole classes.

Effect sizes in educational interventions are generally moderately weak (<0.2 standard deviations)[2], and trials designed to detect weak effects require large sample sizes and research budgets, especially if cluster randomisation is chosen. The trial design must therefore be optimised to minimise implementation costs[3]. In this study we review the statistical analysis plans of 18 RCTs with cluster randomised designs funded by the Education Endowment Foundation (EEF) to evaluate mathematics interventions. For each trial, we aim to: i) test the reproducibility of sample size estimates; ii) obtain, where possible, a more optimised design; and iii) present the cost savings that could have been made if an individual randomised design had been feasible, with a resulting reduction in the required sample size of 30-80% in most cases.

Individual randomised designs require significantly reduced sample sizes compared with cluster randomised designs and do not have the added complexity of needing estimates for intra-cluster correlation in outcome measures at class and school level that, if erroneously low, can result in an underpowered trial. However, in the majority of RCTs funded by the EEF, an individual randomised design was not feasible, making a class the smallest possible unit in a trial arm. One way to facilitate individual randomisation in educational RCTs is to exploit the increasing use of digital platforms by schools to assign homework to pupils. Digital learning platforms offer the ability to control the design and delivery of content to pupils outside the classroom, where the risk of contamination between trial arms is low. To support this argument, we present results from an RCT that tested the effect of homework length on progress (measured by improvement in test scores), a hotly debated issue that, to our knowledge, has thus far not been investigated using a double-blind and individual randomised design with precisely controlled conditions in each trial arm[4]. 368 pupils from three schools in Devon were individually assigned to receive different amounts of algebra homework over four weeks using an online platform that delivers bespoke mathematics homework to each pupil. Progress scores on algebra skills for students in each of the four trial groups (0, 15, 30 and 45 minutes per week) were analysed in a one-way ANOVA with an *a priori* contrast to test for a linear effect. This revealed a very significant positive trend between amount of algebra homework and improvement in algebra ability.

In conclusion, individual randomised trial designs require substantially lower sample sizes compared with cluster randomised designs. Moreover, they allow the overall context of a learning environment to be preserved in both arms of the trial, thus minimising the risk of differences in outcome arising due to factors other than the intervention itself. Digital learning platforms are a promising tool for implementing such trials in situations where they would previously have been impractical. While they cannot support all types of interventions (e.g. where pupils must interact with physical objects or each other), there is a growing opportunity for researchers, educational technology developers and school leaders to collaborate to obtain robust and rigorous evidence of what works in education and explore how children learn.

References

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