Pre-Analysis Plan

The About TIME project explores how providing technology and similar non-digital learning materials improves young children's math skills compared to business-as-usual.

The analytical sample for estimation includes children who are:

(1) enrolled in the study until the end of the intervention.
(2) not reported/observed to have a learning disability that prevents them from being assessed.
(3) assessed at both baseline and follow-up stages, passing the screening stage and completing the assessments.

The intent-to-treat (ITT) model is

$$Y_i = \beta_0 + \beta_1 T_{1i} + \beta_2 T_{2i} + \alpha X_i + \epsilon_i$$

where Y_i is the math skills of child i as measured by Woodcock-Johnson IV Tests of Achievement; T_{1i} is an indicator of the child i assigned to the treatment arm 1; T_{2i} is an indicator of the child i assigned to the treatment arm 2; X_i is baseline math skills as measured by the Woodcock Johnson assessment; and ϵ_i is an error term. Because the omitted group is the control group, the coefficients of T_{1i} and T_{2i} estimate the average treatment effects of the treatment arms 1 and 2 for the child i. We also plan to control any unbalanced variables to increase the precision of the estimates.

The robustness checks of the ITT estimates include:

(1) Apply quantile regressions at every decile to investigate the change in math skills' distribution between baseline and follow-up.
(2) Apply randomization inference to compute the empirical p-values.

We plan to estimate heterogeneous treatment effects (HTE) in three baseline characteristics: the child's baseline scores, parental education, and household income. Specifically, we plan to separate the child's baseline scores to the median of the test score distribution and by thirds of the distribution. We will use parental education as a categorical variable and also divide the sample at cut points determined by the distribution of parental education. We will treat household income as a continuous variable and also divide the sample at cut points determined by the distribution of income. The HTE model is

$$Y_i = \beta_0 + \beta_1 T_{1i} + \beta_2 T_{2i} + \theta_1 T_{1i} * Z_i + \theta_2 T_{2i} * Z_i + \alpha X_i + \epsilon_i$$

where Z_i is the baseline characteristic; the coefficients θ_1 and θ_2 show the difference in treatment effects by the baseline characteristic; X_i is a vector of controls including the indicated baseline characteristic, the unbalanced variables, and the interaction between the treatment arms and these control variables.

We are also interested in measuring the treatment effects on secondary outcomes collected from the parental survey, which mainly covers parents' psychological characteristics, parental beliefs and motivation behind parenting, barriers against parenting, time investment in their children,

and use of intervention materials. This exploratory analysis will provide suggestive evidence of potential mechanisms for any detected treatment effects on math skills at the end of the intervention.