Pre-Analysis Plan:
Closing Indonesian Students' Mathematics Gap:
The High-Tech High Touch Pilot – Program MENGEJAR[1]

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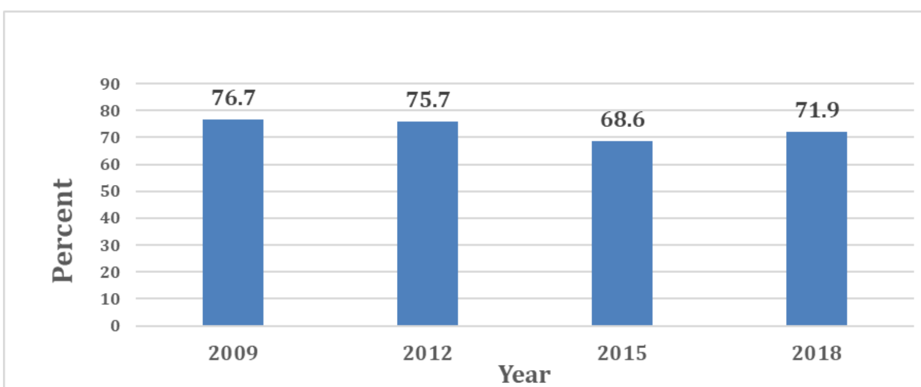
Abstract

We use a randomized evaluation to study the impact of high-tech and high-tech/high-touch interventions in improving mathematics skills in public junior high schools in Indonesia. The high-tech (HT) intervention introduces to seventh-grade students a computer adaptive learning software called *Surala Ninja!* to practice and strengthen their foundational mathematics skills. The high-tech/high-touch approach (HTHT) intervention combines the high-tech approach with a series of training for seventh-grade math teachers to improve their teaching competence to create a more stimulating environment for learning mathematics, which is expected to improve the students' higher order skills (i.e., the "high touch"). These interventions will be implemented in Semarang City, Kendal, Tegal, and Jakarta.

Introduction

The vast majority of Indonesian students continue to score low mathematics proficiency over the past few years. According to the 2019 Indonesian Students' Competency Assessment, Indonesia's longitudinal learning assessment, approximately 79 percent of 8th-grade students had sub-standard mathematics skills (*Pusat Penilaian Pendidikan, Balitbang Kementerian Pendidikan dan Kebudayaan Republik Indonesia*, 2019). Figure 1 shows that between 2009 - 2018, more than 60% of Indonesian students aged 15 failed to meet the minimum proficiency standards set by PISA.

Figure 1: Percentage of 15-year-old Indonesian students who did not meet the minimum proficiency standards set by PISA, 2009 - 2018 (OECD, various years)



Our study evaluates whether an adaptive learning technology – either alone or in combination with a teacher competency training – can improve students' mathematics skills. There is evidence that an adaptive learning technology (i.e., the "high tech") can improve students' foundational mathematics skills (Muralidharan et al., 2019; Bellinger, 2021). At the same time, this improvement may be higher if teachers are trained to emphasize higher-order thinking skills (a "high-touch" approach). We posit that there may be additional benefits to the student learning from training teachers to emphasize higher-order thinking skills in students through its effects on the interest and motivation. The approach is also complementary and may improve students' foundational and higher-order skills simultaneously.

Research Questions

This study examines the impact of high tech and high-tech/high-touch interventions on learning outcomes. We consider two treatment arms for the interventions, i.e.:

- **The High-Tech Only (HTO) treatment,** in which, at maximum, 120 students in the seventh-grade cohort will be given access to the computer adaptive learning software (*Surala Ninja!*), to be used during the mathematics lesson for, on average, 80 minutes each week. The software is used for students to learn and improve their foundational mathematics skills.
- **The High-Tech High-Touch (HTHT) treatment,** in which in addition to the high-tech interventions, at minimum of 2 mathematics teachers from the assigned schools will receive a series of teacher training sessions, aimed at improving the teachers' skills to facilitate a more stimulating environment for learning competence of delivering a mathematics learning, which is expected to improve the students' higher-order skills.

Outcomes. We are interested in evaluating how these interventions affect the following student and teacher outcomes:

- Primary outcome:
    - students' foundational and higher-order mathematics skills
- Secondary outcomes:
    - students' non-cognitive skills and interest in learning mathematics
    - teacher motivation, teaching practice, and teacher efficacy

Contributions

The vast growth of opportunities brought by educational technology (EdTech) in developing countries remains an interesting field to explore. The currently available literature stated that EdTech that emphasizes self-led learning–interventions that enables independent learning by students through direct device or software-enabled direct content delivery–are amongst the most effective at raising learning outcomes (Araya et al. 2019, Buchel et al. 2020, Muralidharan et al., 2019; as cited in Rodriguez-Segura, 2021, pp20-22). Given the potential, there are still room to not only evaluate the impact of EdTech products that are based on self-led learning principles, there are also gaps in literature to further explore the impact of these products that are *adaptive* to each students' needs (i.e., computer adaptive learning) to the students' learning outcomes, especially in developing countries.

Rapid improvements in educational technology (EdTech) present an opportunity to overcome learning deficits in low- and middle-income countries (LMICs). Existing literature suggests that EdTech that self-led learning–to wit, interventions that enables independent learning by students through direct device or software-enabled content delivery – are the most effective interventions to improve learning outcomes (Araya et al. 2019, Buchel et al. 2020, Muralidharan et al., 2019; as cited in Rodriguez-Segura, 2021, pp20-22). One of the most promising interventions is the use of computer adaptive learning technologies to supplement teacher instructions. An example of such interventions would be *Mindspark,* which was initially tested in Delhi and later expanded across Rajasthan (Muralidharan et al. 2019; Muralidharan and Singh, 2020.

Previous studies that looked at the impact of computer adaptive learning technologies identified the importance of paying attention to the adequacy of the infrastructure and integrating the learning technology with existing learning approaches and systems (Snilstveit et al., 2016) . Various studies emphasized the need for an adaptive technology to address the heterogenous capabilities of each student in one classroom (Muralidharan et al., 2019; Ganimian et al., 2020; de Barros et al., 2021). For example, Muralidharan et al. (2019) found a significant impact of access to *Mindspark,* an interactive computer adaptive learning software on math and Hindi scores to students in several Delhi schools. Ferman et al. (2019), on the other hand, argue that the positive impacts of CAL implementation depend on the availability of supporting infrastructure, such as consistent internet connectivity and a sufficient number of devices for each student in one learning session.

On the other hand, improving teachers' human capital is seen as another avenue to overcome learning deficits in LMICs. Existing studies reported the positive impact of teacher capacity building towards better teacher motivation and teaching quality. However, rigorous evaluations of teacher professional development programs find mostly small effects (Popova et al., 2022). In addition, the evidence so far focuses on training teachers to teach foundational skills. Beg et al. (2021) found that in Ghana, training teachers on differentiated learning teaching methods and training school principals on management techniques to support differentiated learning teaching methods increased teacher instructional practices and student learning outcomes by 30% of a learning year. Furthermore, one year after implementation, the impact had persisted on management quality; while two years later, the gains of student learning outcomes also persisted. It remains unclear how to train teachers to teach higher order skills.

Our study contributes to the question of complementarity between technology and (teacher's) human capital on student learning, especially when the teacher training is tailored to focus on improving higher-order thinking skills. Furthermore, our study will provide evidence on pedagogy intervention – in the form of teaching at the right level (TaRL) (Banerjee et al., 2016) – that focuses on junior high school students, which is relatively rare compared to studies in elementary schools. Both the HTO and HTHT treatment arms aim to create a differentiated learning experience for students. The HTHT approach translates the principles of TaRL by combining the best features of a tech-based intervention and the unique qualities and strengths of teachers towards a holistic and personalized active learning program for both students and teachers (Bellinger, 2021).

Previous studies in Vietnam and India have reported the positive impacts of using adaptive technology, mainly computer adaptive learning software, in improving the student learning outcomes (Bellinger, 2021; Muralidharan et al., 2019). But, the study in Vietnam is limited to a small number of high-performing private schools, and the study in India uses after-hours learning centers away from schools. In contrast, the adaptive learning software in our study is implemented during school hours, by teachers, and in a public school setting. These differences are key to understanding whether education technology can be implemented in the setting where the majority of children in developing countries are studying, with all their constraints. As an example, problems with Indonesia's public school teachers – such as low teaching competence and poor incentive systems – have been well documented (Kesuma et al., 2018; Suryahadi & Sambodho, 2013). As the pilot is implemented in such a context, it has a much higher chance of being scaled up by the government.

The focus on junior secondary students (Grade 7) also departs from most studies that focus on primary school students. Since increasingly more students are left behind relative to the math curriculum higher grades, the variation in students' mathematics skills in the same classroom at this level is large (Beatty et al., 2021; Rodriguez-Segura, 2021). Therefore, education technology, especially those that are adaptive to each student, is likely to be an effective way to enable students to catch up at this level.

Study Design

District Selection

We implement these interventions in Central Java (Semarang, Kendal, and Tegal) and Jakarta (East Jakarta, West Jakarta, and Central Jakarta) in districts with established partnerships with Tanoto Foundation[7], one of our partners in this project. We target these districts for two reasons:

1. The established partnership between the districts and Tanoto Foundation simplifies the process to obtain local government support, a key element for a successful implementation (Education Commission, 2020); and
2. The existing partnership allows us access to schools with adequate supporting infrastructure that satisfies the technical requirements stipulated by one of our implementing partners, Surala[8], which provides the computer adaptive technology software, *Surala Ninja!*.

Sample Selection

We target the seventh-grade students and their mathematics teachers in the selected public junior high schools in three districts/cities in Central Java: Semarang City, Kendal, Tegal, and in Jakarta (East, West, and Central Jakarta). The public junior high schools that we are targeting must fulfill the following criteria:

1. The public junior high school must not be a participant of the *Sekolah Penggerak*[9] Cohort 1 program
2. The public junior high school must not be a partner school of Tanoto Foundation and does not implement Tanoto Foundation's PINTAR program;[10]
3. The schools must also have adequate supporting infrastructure to implement the CAL software (*Surala Ninja!*), which are:

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[7] Tanoto Foundation operates across many provinces and districts in Indonesia. Access https://www.tanotofoundation.org/en/about-us/where-we-operate/ for further information regarding this matter.

[8] Surala is a Japanese-based educational technology company focusing on adaptive learning technology in mathematics. In Indonesia, they operate under the name PT Surala Suluh Karsa. Access https://surala.jp/en/services/surala/ (Japanese parent company) and https://surala.co.id/ (Indonesia-based company) for further information.

[9] *Sekolah Penggerak* is one of the Indonesian Ministry of Education, Culture, Research, and Technology's flagship programs aimed at improving the students' literacy and numeracy learning outcomes holistically by providing trainings and monitored guidance for principals and teachers for selected schools in Indonesia (Ministry of Education, Culture, Research, and Technology, n.d.)

[10] PINTAR Program is the flagship program by Tanoto Foundation aimed at improving Indonesia's basic education quality through improving the school's teaching and learning competence and transforming the school's leadership strategy. Further information: https://www.pintar.tanotofoundation.org/tentang-pintar/

i. Average internet download speed of at least 50 Mbps
ii. Adequate number of functioning PCs/laptops for, at minimum, 50% of students in one classroom to individually use the device (i.e., no device sharing necessary for at least half of the students in one classroom)

Our power calculation (described in the next section) requires a total of 150 public junior high schools that fit our eligibility criteria. In each school, we plan to include, at maximum, 120 seventh-grade students (approximately 3-4 classrooms) and at minimum, 2 mathematics teachers who are responsible to teach the chosen seventh-grade classrooms. In the case where the schools only have one mathematics teacher for the seventh-grade students (which is often the case in some smaller eligible schools), we will include (in hierarchical order):

- Mathematics teachers responsible for the eighth-grade or ninth-grade students, **or**
- Teachers from STEM subjects, like science or ICT teachers, **or**
- School counselors/counseling teachers

Thus, we expect to include at maximum 18,000 seventh-grade students, and at minimum 300 seventh-grade (mathematics) teachers in this study. We will also include students with physical and/or intellectual disabilities in the implementation of our interventions.

We will also conduct a baseline survey of 60 seventh-grade students and 2 mathematics teachers in each school. Thus, we expect to include at maximum 9,000 seventh-grade students and 300 seventh-grade mathematics teachers in the baseline survey. After one academic year of interventions, we will also conduct an endline survey on all seventh-grade students in the target schools. We plan to include a larger sample size in our endline survey to measure spillovers.

With regards to students with physical and/or intellectual disabilities, we include them in the baseline survey if said student belongs to the randomly chosen classroom for the baseline study. However, we are still determining whether we will include the information that we obtained from them in our analysis because we want to see their responses in the baseline survey.

Power Calculation

Our power calculation assumes a statistical test of size 0.05 and a 0.8 power to detect a minimum detectable effect size of at least 0.13 SD for each treatment arm relative to the control group. To conduct the power calculation, we use the results of a mathematics aptitude survey among junior secondary students in Yogyakarta, collected in 2019 (Berkhout et al., 2022). Our power calculation yields a sample of about 50 schools for each treatment arm under the assumption of 60 students in each school.

Treatment Assignment

Schools are assigned to the control/treatment arm using a stratified-random assignment. We stratify all eligible schools based on their district and whether the school average of their national exam (from 2019) was above or below the district median. Schools are then randomly assigned into each treatment/control arm from each of the strata. Within each school, we chose two teachers that teach seventh-grade mathematics to participate in our high-touch training and intervention. For the high-tech intervention, we choose the participating class and students based on the selected teachers, and randomly select two classrooms from the selected high-tech classrooms for the baseline survey[11].

Data Collection

Survey Instruments

During the baseline, we employ a set of written tests and questionnaires to the students and teachers. Additionally, we also have one-on-one interviews with the teachers and distribute a questionnaire for the principal about the school's facility maintenance. Each instrument covers the following indicators:

a. **Instruments for teachers:**
    i. **Interview:** Teacher's educational background, employment status, teaching experience and responsibilities
    ii. **Content Knowledge Test:** Teacher's knowledge about mathematics up to junior high school level curriculum
    iii. **Pedagogical Content Knowledge Test:** Teacher's knowledge to explain mathematics concept to seventh-grade students
    iv. **Questionnaire on Teacher Efficacy:** Teacher's ability to integrate technology into mathematics lesson plan and using it to teach meaningful and interactive math lessons to students
    v. **Questionnaire on Belief of Student-Centered Learning:** Measuring the teacher's belief on a learning experience that is focused on the students' capabilities

[11] A note that more students in each school receive access to *Surala Ninja!* software than our baseline survey sample.

vi. **Questionnaire on Growth Mindset**[12]**:** Measuring the teacher's belief on a growth-oriented mindset

b. **Instrument for students**

i. **Questionnaire on Students:** Student's socioeconomic background, learning habits, experience in using technology in everyday learning activities.

ii. **Questionnaire on Growth Mindset:** Measuring the student's belief in a growth-oriented learning process and mindset

iii. **Numeracy Test:** Assessing the student's capabilities to understand mathematical and numeracy questions. The materials covered in this test will be those from grades one to seven

iv. **Literacy Test:** Assessing the student's capabilities to understand literacy (in Bahasa Indonesia) questions. The materials covered in this test will be those from grades one to seven

c. **Instrument for the school (i.e., principal)**

i. **Form of school information:** Providing information about the school's infrastructure and facility maintenance

Instruments were developed by the research and baseline survey team from an Indonesian research institute that has worked intensively in education. The instruments were a mix of existing sample questions from the institution's question item bank and questions from the assessments for Trends in International Mathematics and Science Study (TIMSS).[13] All example questions from TIMSS are contextualized further to suit the needs of this project. The instruments contain numeracy and literacy materials that are taught to students in grades six and seven; 50% of the questions cover materials taught in grade 6, and 50% cover materials taught in grade 7. In terms of skill set being tested in the instruments, approximately 50% of the questions will test foundational skills and 50% will test higher-order thinking skills.

The instruments were pre-tested during our instrument pilot/trial in Kendal, Central Java, during 10 -16 June 2022. We conducted the pilot in four schools that will not participate in our baseline, interventions, or endline surveys. After pre-testing the instruments, we edited the teacher and student questionnaires

[12] The growth mindset is a term developed by psychologist Carol Dweck. Individuals with a growth mindset believe that their talents can be developed through hard work, good strategies, and input from others. The opposite of a growth mindset is a fixed mindset, in which individuals believe otherwise. Further information of the growth mindset can be read here: https://hbr.org/2016/01/what-having-a-growth-mindset-actually-means

[13] TIMSS provides reliable and timely trend data on the mathematics and science achievement of U.S. students compared to that of students in other countries. https://nces.ed.gov/timss/

on-site, after the instrument pilot was completed. For the students and teachers' tests, the instruments were revised after the collected data was analyzed. Based on the results of the data analysis, we shortened the instruments and adjusted the difficulty level based on the results of the pilot.

We plan to use a similar set of instruments during our endline activities, with an additional module covering classroom observation activities to document the teaching practice after the intervention period. The endline instruments are currently still under design and development.

Timeline and Implementation

The baseline data collection was conducted in the third week of July 2022 until the third week of August 2022. After the baseline data is collected, the high-tech intervention will start in August 2022, followed by the high-touch intervention in September 2022. After one academic year of both interventions, we will collect end line data in April or May 2023.

During the baseline data collection, we will use the instruments that we have previously explained to get the information on each variable that we are targeting. Participating students will be asked to fill out the student questionnaires while being guided by the enumerators and to work on the numeracy and literacy tests independently. The teachers will also be asked to fill out the questionnaires and tests independently, and the interview process will be led by the enumerators.

Data management

Data Security and Confidentiality. The project team will use the following procedures to maintain the security of the collected data:

1. No one outside of the project team (i.e., the research team from ADBI, J-PAL SEA, and The SMERU Research Institute) will have access to the raw data that still has any personally identifiable information (PII) of the participants
    a. PII (e.g., name, date of birth, classroom name) will only be used solely to track the participants after the baseline survey, so the same students and teachers will join the endline survey at the end of interventions. **It will not be used in the data processing, analysis, or reporting stages of the study.**
2. Upon completion of the baseline survey, the data will be directly cleaned to remove any unnecessary PII for data processing and analysis
    a. Any data containing the participants' personally identifiable information will be kept for five years after the baseline data collection process (until August 2027) to track participants in preparation for the endline data collection and possible follow-up surveys in the future.

b. Any data containing the participants' personally identifiable information will be kept for five years after the endline data collection process is completed (until June 2028).
c. The raw data containing any PII will be encrypted and kept in a secure Dropbox/OneDrive folder, only accessible to the research team.

The processed data will be owned by ADBI and Tanoto Foundation, as these organizations fund the project activities. They will be used as the basis for any future publications related to this study, be it working papers, conference materials, and journal articles.

Empirical Analysis

Outcome Variables

Our **primary outcomes of interest** in this study are the students' numeracy and literacy skills. We also want to understand the impact of the interventions towards their motivation and interest in mathematics. The primary outcomes of interest are the grade-adjusted standardized scores from the student learning assessments (SLA) results for numeracy and literacy.

Our **secondary outcomes of interest** in this study are:

1. Student's motivation towards learning and interest in math, measured through: study habits, ability to use technology as a learning tool, and belief in a growth-oriented mindset.
2. Results (scores) of teachers' assessments in mathematics knowledge up until grade 7 level
3. Results (scores) of teachers' pedagogical skills in teaching mathematics
4. Teachers' belief in a student-oriented learning progress
5. Teachers interviews on teaching practices and experience.
6. Teacher's classroom practice

Heterogeneity Analysis. We are also interested in conducting a heterogeneity analysis by gender, student's socioeconomic status, baseline learning outcomes (above v. below median), and the school's baseline quality (mean of student learning outcomes at the school level). For the teachers, we will examine these effects by teachers' socioeconomic status, initial tech-efficacy, and initial mathematics and pedagogical skills level.

Empirical Specification

We will estimate the following base specification to estimate the intent to treat (ITT) for outcomes with both endline and baseline measures:

$$Y_{it} = \alpha + \beta_1 T_{HT} + \beta_2 T_{HTHT} + Y_{i0} + X\delta + \eta_s + \varepsilon_{it}$$

where the Y is the outcome variable; T is the treatment status for HT and HTHT; *i* and *t* indexes individual and time (where t=0 in the baseline period); and η_s is the strata fixed effects. X is a vector of control variables that will include exogenous and predetermined variables of the sex and age (for all), parents education (for students), and completed education (for teachers and parents). Standard errors will be clustered at the school level for the analysis of students' outcomes.

For outcomes without baseline measures, i.e. teaching practice, we will estimate the same model but exclude Y_{io}, as written below:

$$Y_{it} = \alpha + \beta_1 T_{HT} + \beta_2 T_{HTHT} + X\delta + \eta_s + \varepsilon_{it}$$

The heterogeneity analysis will be conducted by interacting the treatment variables with each of the heterogeneous variables described previously, namely:

$$Y_{it} = \alpha + \alpha_H HetVar + \beta_1 T_{HT} + \beta_1 (T_{HT} \times HetVar) + \beta_2 T_{HTHT} + \beta_2 (T_{HTHT} \times HetVar) + \\ + Y_{i0} + X\delta + \eta_s + \varepsilon_{it}$$

where all other variables are as above, and *HetVar* is the heterogeneity variable. Standard errors will be clustered at the school level for the analysis of students' outcomes.

Research Team

Principal Investigators

The principal investigators of this study are (written in alphabetical order):

- **Arya B. Gaduh** (Co-Principal Investigator). Arya is currently an Associate Professor of Economics at the Sam M. Walton College of Business, University of Arkansas, Fayetteville. He is also a research associate at the National Bureau of Economic Research (NBER) and an affiliated professor of The Abdul Latif Jameel Poverty Action Lab (J-PAL).
- **Takiko Igarashi** (Co-Principal Investigator). Takiko is currently a Project Consultant at the Asian Development Bank Institute (ADBI).
- **Milda Irhamni** (Co-Principal Investigator). Milda was the Associate Director of Research and Research Fellow at The Abdul Latif Jameel Poverty Action Lab Southeast Asia (J-PAL SEA - LPEM FEB UI). She is currently an independent researcher.
- **Gumilang Aryo Sahadewo** (Co-Principal Investigator). Gumilang is currently a Research Fellow at The Abdul Latif Jameel Poverty Action Lab Southeast Asia (J-PAL SEA - LPEM FEB UI) and an Assistant Professor at the Department of Economics, Gadjah Mada University.

- **Daniel Suryadarma** (Lead Principal Investigator). Daniel is currently a Research Fellow at the Asian Development Bank Institute (ADBI).

Research Assistants

As of the latest draft of this pre-analysis plan, the research assistants who were and are currently involved in this study are (written in alphabetical order):

- **Abdul Latif Jameel Poverty Action Lab Southeast Asia (J-PAL SEA)**
    - **Ari Ratna Kurniastuti** (April 2021 - June 2022), Independent Qualitative Researcher contracted to facilitate and assist in the data collection of the exploratory study.
    - **Terry Muthahhari** (August 2021 - March 2022), Research Manager (former), The Abdul Latif Jameel Poverty Action Lab Southeast Asia (J-PAL SEA - LPEM FEB UI)
    - **Indriani Pratiwi** (July 2022 - present), Research Manager, The Abdul Latif Jameel Poverty Action Lab Southeast Asia (J-PAL SEA - LPEM FEB UI)
    - **Miranda Aisha Putri** (January 2022 - present), Research Associate, The Abdul Latif Jameel Poverty Action Lab Southeast Asia (J-PAL SEA - LPEM FEB UI)

- **The SMERU Research Institute (for baseline study)**
    - **Arjuni Rahmi Barasa** (March 2022 - present), Junior Researcher, RISE Indonesia team based at the SMERU Research Institute
    - **Luhur Bima** (March 2022 - present), Quantitative Research Coordinator on the RISE Indonesia team based at the SMERU Research Institute
    - **Fauzan Kemal Musthofa** (August 2022 - present), Junior Researcher, The SMERU Research Institute
    - **Risa Wardatun Nihayah** (March 2022 - present), Researcher, The SMERU Research Institute
    - **Niken Rarasati** (March 2022 - August 2022), Senior Researcher, RISE Indonesia team based at the SMERU Research Institute
    - **Asri Yusrina** (March 2022 - present), Senior Researcher, RISE Indonesia team based at the SMERU Research Institute

Team members might change as the project enters its next steps.

References

Banerjee, A., Banerji, R., Berry, J., Duflo, E., Kannan, H., Mukherji, S., Shotland, M., & Walton, M. (October, 2016). *Mainstreaming an effective intervention: Evidence from randomized evaluations of "teaching at the right level" in India.* (NBER Working Paper Series No. 22746). https://www.nber.org/papers/w22746

Beg, S., Fitzpatrick, A., Lucas, A. (2021). *Complementarity Between Public Sector Worker and Management Training.* Department of Economics, University of Delaware.

Bellinger, A. (2021). *High Touch High Tech Learning Prototype in Vietnam*. Presentation, Regional Conference on Teachers and Equitable Education: All for Education in Southeast Asia.

Berkhout, E., Dharmawan, G., Beatty, A., Suryadarma, D., Pradhan, M. (2022). *Who Benefits and Loses from Large Changes to Student Composition? Assessing the Impacts of Lowering School Admission Standards in Indonesia*. RISE Working Paper 22/094. Oxford: Research on Improving Systems of Education. Retrieved 31 August 2022 from https://riseprogramme.org/sites/default/files/2022-04/Who_benefits_loses_large_changes_student_composition_.pdf

de Barros, A., Ganimian, A. J., & Venkatachalam, A. (2021). Which students benefit from independent practice? Experimental evidence from a math software in private schools in India. *Journal of Research on Educational Effectiveness*, *15*(2), 279–301. https://doi.org/10.1080/19345747.2021.2005203

Education Commission. (2020). *High Tech High Touch Learning Vietnam*. Education Commission. Retrieved from https://educationcommission.org/wp-content/uploads/2020/07/2020-EC-Country-Report-Vietnam-ENG.pdf

Education Commission. (2021). *Transforming Learning: High Touch High Tech*. Education Commission Asia. Retrieved from https://educationcommission.org/wp-content/uploads/2020/12/Transforming-Learning-HTHT.pdf

Ferman, B., Finamor, L., & Lima, L. (2019). Are Public Schools in Developing Countries Ready to Integrate EdTech into Regular Instruction?. *MPRA Paper*, (109063). Retrieved 18 September 2021, from https://mpra.ub.uni-muenchen.de/109063/.

Ganimian, A. J., Vegas, E., & Hess, F. M. (2021, January 6). *Realizing the promise: How can education technology improve learning for all?* Brookings. Retrieved September 20, 2022, from https://www.brookings.edu/essay/realizing-the-promise-how-can-education-technology-improve-learning-for-all/

Kesuma, R., Utz, A., Bodrogini, P., & Purnama, R. (2018). *Efficient Deployment of Teachers: A Policy Note.* The World Bank. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/32397/Efficient-deployment-of-teachers-a-policy-note.pdf?sequence=1&isAllowed=y

Muralidharan, K., Singh, A., & Ganimian, A. (2019). Disrupting Education? Experimental Evidence on Technology-Aided Instruction in India. *American Economic Review*, *109*(4), 1426-1460. https://doi.org/10.1257/aer.20171112

Muralidharan, K., & Singh, A. (2020). Evaluation of a technology-aided instruction platform (Mindspark) in government schools in Rajasthan. *AEA Randomized Controlled Trials.* https://doi.org/10.1257/rct.2546

Popova, A., Evans, D. K., Breeding, M. E., & Arancibia, V. (2022). Teacher professional development around the world: The gap between evidence and Practice. *The World Bank Research Observer*, *37*(1), 107–136. https://doi.org/10.1093/wbro/lkab006

Pradhan, M., Suryadarma, D., Beatty, A., Wong, M., Gaduh, A., Alisjahbana, A., & Artha, R. (2014). Improving Educational Quality through Enhancing Community Participation: Results from a Randomized Field Experiment in Indonesia. *American Economic Journal: Applied Economics*, *6*(2), 105-126. https://doi.org/10.1257/app.6.2.105

Pusat Penilaian Pendidikan, Balitbang Kementerian Pendidikan dan Kebudayaan Republik Indonesia. (2019). *Laporan Hasil Asesmen Kompetensi Siswa Indonesia 2019*. Ministry of Education, Culture, Research, and Technology, Republic of Indonesia. Retrieved from https://aksi.puspendik.kemdikbud.go.id/laporan/

Rodriguez-Segura, D. (2021). EdTech in developing countries: A review of the evidence. *The World Bank Research Observer*, *37*(2), 171–203. https://doi.org/10.1093/wbro/lkab011

Snilstveit, B., Stevenson, J., Phillips, D., Vojtkova, M., Gallagher, E., & Schmidt, T. et al. (2016). *Interventions for improving learning outcomes and access to education in low-and-middle income countries: a systematic review*. London: International Initiative for Impact Evaluation. Retrieved from https://www.3ieimpact.org/sites/default/files/2019-05/SR24-education-review_2.pdf

Suryahadi, A. & Sambodho, P. (2013, December). *Assessment of policies to improve teacher quality and reduce teacher absenteeism.* https://bookshop.iseas.edu.sg/publication/1852