Education Commission Asia
High Touch High Tech for All

Ceibal

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Transformative Teaching & Learning:

High Touch High Tech for Engaged and Adaptive Classrooms

The Need

The educational disruption caused by COVID-19 highlights the limitations of traditional teaching methods in which all students receive standardized education. It underscores the need for innovative, interactive, and learner-centered instructional approaches tailored to learners' different levels of knowledge and competency. These new approaches are essential for ensuring learning continuity, helping learners stay engaged, and equipping them with critical 21st-century skills, including critical thinking, communication, and collaboration.

Recognizing this need, CEIBAL, Uruguay's Center for Educational Innovation and Digital Technology, is committed to improving teaching and learning practices by actively using information and communication technology (ICT) and innovative pedagogies. In alignment with the National Education Policy Plan 2020-2025 and the Educational Development Plan 2020-2024, CEIBAL adopts high-tech adaptive learning systems and provides intensive support to teachers. This includes achieving synergic effects by integrating innovative technologies and active learning strategies across various subjects, such as mathematics and computational thinking.

Project Overview

The aim of the project was to understand the impact of a High Touch High Tech (HTHT) approach on student achievement and teacher capacity building in 5th-grade math and 7th-grade computational thinking.

Creating optimal learning environments for students and teachers has been challenging at all educational levels. Educators and policymakers have been striving to identify effective teacher interventions that enhance teaching quality and, in turn, improve student achievement outcomes.

From 2021 to 2024, CEIBAL and Education Commission Asia (ECA) funded by the Inter- American Development Bank, partnered to enhance teaching practices in Math and computational thinking (CT) in Uruguay. Inspired by the High Touch High Tech approach, the HTHT intervention in Uruguay provided teachers with a set of instructional resources, including HTHT lesson plans, teacher guides for project- based learning, and in-person and online teacher training workshops. CEIBAL also offered continuous support to teachers through mentoring, school visits, and classroom observation throughout the project to provide personalized feedback and guidance in teacher's classroom practices.

The 5th-grade Math program was implemented in 108 schools, involving 155 teachers and 2,709 students. The 7th-grade CT program was implemented in 141 schools, involving 122 teachers and 7,634 students. In addition to regular monitoring conducted by Ceibal, the independent impact evaluation was led by researchers from the University of Illinois (US) and the University of Glasgow (UK). The Education Commission, the Learning Generation Initiative at Education Development Center, and University Design Institute of Arizona State University provided a range of consultancy to support the design and implementation of HTHT.

Box - A High Touch High Tech (HTHT) Learning Approach

High Touch High Tech employs a holistic approach to skill development. Students first interact with AI-assisted educational technology (High-Tech) to remember and understand content. Then they apply, analyze, and evaluate this knowledge, culminating in creative activities facilitated by teachers and peer interactions (High-Touch). The high-tech component builds students' foundational skills, while the high-touch element fosters higher-order thinking skills and socio-emotional development.

HTHT learning aims to enhance learner success by personalizing support based on the data generated by AI-assisted adaptive learning technology and adopting more learner-centered teaching and learning methods. The approach redefines the role of teachers, enabling them to provide personalized support and facilitate higher-order skill-building activities for students. AI technology assesses each learner's learning progress, allowing teachers to tailor their support to meet individual needs.

Project Description

HTHT program for 5th-grade Math

HTHT Math In Class. Students used Matific, a game-based interactive math learning platform, as a high-tech learning tool. The platform offers playful activities, carefully organized and selected, that address a specific mathematical concept linked to the school curriculum. Teachers utilized data from Matific to track student progress, understand student needs, develop personalized lesson plans, and help students engage in project-based learning in the classrooms.

An example of the HTHT math class proceeded as follows: students first solved warm-up math problems to recall concepts from previous courses. Then, they learned and practiced new math concepts using Matific, played educational games on Matific, and used Scratch, an online block-based visual programming tool, to deepen their understanding. The Matific activities include short, interactive tasks (between 5 and 15 minutes) with several related practical lessons, gradually increasing in difficulty. Finally, they worked on math workbooks and participated in collaborative activities guided by HTHT instructional resources. For more details, please check here.

Teacher Professional Development.

Teacher training aimed to develop teachers' knowledge and skills to use Matific for personalized learning and adopt project-based learning to foster student 21st-century skills. Teachers were provided with a guide on how to develop a lesson plan and improve classroom practices using the HTHT approach.

During the High Tech-focused training phase, CEIBAL provided two face-to-face teacher training workshops on the Matific system. The first workshop was an overview of the system, focusing on the structure, curriculum, content, and student experience. Understanding how students would experience Matific was crucial as teachers could anticipate and prepare for issues that might arise during the class. The second workshop focused on using student learning data generated by Matific to decide on lesson plans and class activities. Teachers learned how to use the student data to identify the learning progress and challenges at individual and class levels and adapt their lesson plans according to the needs.

During the High Touch-focused training phase, CEIBAL provided five webinars to help teachers understand the HTHT approach and create lesson plans that integrate Matific and project-based learning. Examples of lesson plans were given with specific themes, pedagogical objectives, and recommendations for Matific episodes. Following this, CEIBAL offered recommendations on how to "problematize" the theme in the classroom and how to read the reports to understand each student's progress. Based on these reports, CEIBAL gave additional recommendations for complementary Matific episodes to reinforce and support each student's learning according to their personal learning process.

Teacher Support.

The project involved additional teacher support groups and school visits to ensure the effectiveness and fidelity (i.e., the degree to which an intervention is delivered as intended) of the interventions.

Teacher peer groups were formed in CREA (Centro de Recursos para la Enseñanza y el Aprendizaje), CEIBAL's online platform to provide virtual classrooms, learning materials and communication tools, to facilitate teachers' participation in the HTHT training. These groups focused on delivering group activities for feedback from CEIBAL and created a forum where they could discuss questions, suggestions or concerns about Matific, the HTHT approach, and the implementation process.

CEIBAL conducted two school visits for class observations to ensure the effective implementation of the HTHT Math program. During the visits, teachers received individual and group consultations to systemically analyze their activities and develop expertise in improving their teaching practices.

In addition, CEIBAL sent three customised WhatsApp messages to participating teachers to support them in understanding the objectives of the HTHT approach and motivate them to implement it in the classrooms. CEIBAL also sent a letter to school principals to express appreciation to teachers for the extra effort they put into the project.

HTHT program for 7th-grade Computational Thinking

HTHT CT in Class. In class, teachers used RoboGarden, a game-based, interactive platform developing programming and problem-solving skills, to facilitate asynchronous online learning. As the students worked through the tasks on RoboGarden, they were exposed to basic concepts and principles of computational thinking, such as algorithms, abstraction, decomposition, and pattern recognition. With RoboGarden, teachers implemented interactive instructional methods to teach algorithms, programming, coding, and computational thinking. They customized lessons to meet student needs and gathered student data for individual and group feedback.

An example of a CT project in class proceeded as follows: In the first phase (120 minutes), students were introduced to the project and familiarized with CT tools. In the second phase (120 minutes), they learned basic computer languages and how they connect. In the third phase (120 minutes), students explored the use of variables in programming. They programmed the final game in the fourth phase (120 minutes). In the final phase (120 minutes), students shared their final products with peers and reflected on the lessons learned. For more details, please check here.

Teacher Professional Development.

Teacher training workshops aimed to develop teachers' knowledge and skills to use RoboGarden and deliver a new Computational Thinking curriculum.

CEIBAL held three face-to-face and two virtual workshops in which teachers were introduced to the new CT curriculum, RoboGarden, and sample pedagogical proposal. The pedagogical proposal included descriptions of CT challenges for students, guiding questions for group reflection in class, RoboGarden activities, and evaluative questions to solidify the knowledge worked on in class. During the final workshops, qualitative discussion tables were held so that teachers could learn from each other's expertise and knowledge and develop a sense of belonging to the teacher community.

Teacher Support. The project involved additional mentoring meetings and supplementary tools to help teachers throughout the project period.

CEIBAL created a CT expert mentoring team to accompany teachers in the class planning and the pedagogical implementation. Communication and community managers were in charge of following up with teachers and providing support for queries and supplementary pedagogical materials.

CEIBAL also developed a dashboard to monitor the activities of both teachers and students in RoboGarden and encouraged greater use of the technology. To support the pedagogical approach, ECA and CEIBAL created teacher training materials, including instructional guidebooks and videos. These materials provided an overview of the RoboGarden platform, sample pedagogical strategies for addressing in-class technical and instructional challenges, and sample lesson plans.

Measuring Impact for High Touch High Tech Math and CT

The project used an experimental design (i.e., clustered randomized controlled trials) to measure the impact of HTHT intervention by comparing student performance between control groups (following standard education curriculum) and treatment groups (following the HTHT curriculum). HTHT treatment groups were divided into two - soft and hard. HTHT soft groups were led by teachers who received training and mentoring. HTHT hard groups were led by teachers who received additional individualized teaching feedback on top of training and mentoring.

The CEIBAL evaluation team collaborated with an external evaluation team to conduct an objective and comprehensive evaluation of the HTHT approach in Math and CT. The evaluation research hypothesized that the HTHT approach would improve student performance and teacher effectiveness.

Evaluation of HTHT Math. Data were collected from teachers and students to assess educational constructs related to learning and teaching behavior and students' mathematics performance, which was measured by the computer-assisted national standardized assessment (SEA+). The data collection occurred in two phases: a baseline in April 2022 and a post-intervention phase in October 2022. The study included data from 99 schools, 114 teachers, and 2,002 students who participated in both baseline and endline assessments.

Evaluation of HTHT CT. To evaluate the impact of the HTHT CT project on teacher effectiveness and student learning outcomes in CT, data were collected at two intervals: a pre-test in May 2023 and a post-test in October 2023. The final analytical sample comprised 91 teachers and 3,927 students.

The study used Bebras, an international assessment measuring informatics and skills, to assess student performance. To create the Bebras assessment in this project, 15 items were sampled from Bebras to assemble separate baseline and endline assessments; overall Bebras performance was calibrated using item response theory (IRT), following standard assessment estimation and calibration protocols. Student surveys included questions about their perceptions of learning computational thinking and using ICTs in class, self-efficacy, and GRIT. Teacher surveys included questions about their perceptions of the HTHT, use of ICT and RoboGarden in class, self-efficacy in computer science, perceptions of RoboGarden, attitudes toward computational thinking and technology-based learning, school environment, and teacher efficacy.

High Touch High Tech Math

- **HTHT increased the individualized use of EdTech-mediated learning by 47%.** Students in HTHT Intervention groups had significantly greater completion rates for Matific episodes.
- **HTHT with higher use of Matific improved student math achievement by 0.33 standard deviation(SD) units.** On average, the intervention had a null effect on students' math performance after accounting for students' initial achievement and socio-demographic characteristics (0.02 SD). However, the average effects masked important heterogeneous impacts. The intervention had a medium-to-large positive effect of 0.33 SD for students with higher use of Matific, who completed more Matific episodes at school. Notably, treatment students in the highest Matific use group outperformed their control counterparts by 0.76 SD. HTHT intervention had much smaller effects of 0.12 SD for students with lower Matific use and null effects for students who did not complete any Matific episode.
- **HTHT significantly improved teacher perceptions of new pedagogical approaches combining EdTech and project-based learning.** Teachers' views and perceptions on the HTHT approach, school data systems, technology-related curriculum access, and professional environment show significant improvement among teachers who participated in the HTHT intervention.
- **The HTHT intervention integrating synergistic components of "High Touch" and "High Tech" improved student performance.** Digital personalized learning or teacher professional development alone does not independently lead to better student performance. A combined strategy utilizing digital personalized learning tools and active learning strategies demonstrated improvements in the teaching and learning process.

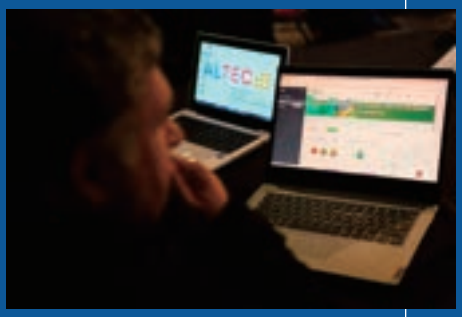
"It is possible to level each child's progress according to the specific learning objectives set for each child or specific subgroup."

- Teacher, Uruguay

"The training sessions helped me to work better with the platform. I learned that I could divide the group and assign activities according to the levels, and that allowed me to provide more personalized learning for my students. It showed me the one more advanced to continue advancing and the one lagging behind"

- Teacher, Uruguay

High Touch High Tech Computational Thinking



- **Students in the intervention group had modest but significant improvement in their CT performance,** with a standardized score increase of 0.10 SD ($p<0.001$)[1].
- **HTHT with higher completion of Robogarden episodes improved student CT performance by 0.23 SD** ($p<0.001$). With respect to the usage of RoboGarden, there were notable differences in total mission completed, total progress made, and total mean time spent using the RoboGarden platform between the HTHT treatment and control groups. This difference was expected since the control group did not receive specific information or guidance on the use of a new platform in the educational system. The effect of HTHT intervention for students with high progress in Robogarden (i.e., higher use of Robogarden showing significant progress in completing CT-related tasks) is nearly twice as greater than students with low progress in Robogarden (i.e., lower use of Robogarden showing slower progress in completing CT-related tasks).
- Students who participated in the high-fidelity HTHT intervention classroom, where teachers were more engaged in the HTHT instructional design proposed by the Ceibal CT team, performed better than students in the low-fidelity HTHT intervention classroom.
- There were consistent treatment effects regardless of school location, school type, and school SES quintiles. Interestingly, boys who participated in the HTHT intervention showed more significant improvement in CT performance (0.15 SD) than girls.

1. In 2023, CT curriculum, educational technology (RoboGarden) and assessment tool (Bebras) were newly introduced with the project. The result should be interpreted in consideration of teachers' and students' lack of familiarty with CT subject.

"The project was an innovative experience for me. My students were very engaged and I was provided with all helpful materials to support them. The platform is very accessible for kids of that age."

- Teacher, Uruguay

"The platform provided learning contents, ranging from simple to more complex problems, and it helped my students to complete the missions more easily."

- Teacher, Uruguay

"I used the student reports to motivate my students to do the computational thinking activities on the platform. (...) I have a group of 30 students and they participated passionately to be in the top ten."

- Teacher, Uruguay

Lesson Learned

Lesson 1: Synergic Effects of EdTech and Innovative Pedagogical Approaches

Technology alone cannot generate learning. Yet, motivated and well-trained teachers can leverage EdTech to design personalized learning experiences and implement active learning strategies in the classrooms. Findings from the HTHT project in Uruguay highlight that the integration of EdTech in the classroom should prioritize supporting teachers in adopting innovative pedagogical approaches. Establishing a clear link between 'High Tech' and 'High Touch' and providing step-by-step guidance to improve instructional design for personalized and collaborative learning is critical. Offering structured teacher guides, interactive training, and continuous support for teachers and school leaders are important factors for successful program implementation that generate positive and significant impacts on students' learning outcomes.

Lesson 2: Continuous Support for Teachers' Motivation and Professional Development

The HTHT intervention focused on creating a professional learning community for teachers through open communication and regular feedback. To motivate teachers to implement the HTHT approach, CEIBAL promptly responded to teachers' questions, sent them messages for encouragement, and continuously followed up on their progress. Teachers often face multiple challenges in designing lesson plans and utilizing data analytics from digital learning platforms, but continuous support offered by HTHT intervention helped teachers identify and resolve issues, fostering a supportive learning environment and keeping teachers engaged. Effective communication ensures that teachers feel valued and supported, which in turn positively impacts their commitment and changes in classroom practices.

Lesson 3: Piloting and Experimentation

The HTHT intervention in Uruguay is yet another reminder of how vital it is to invest time and energy on experimentation and piloting for the improvement of educational policies. Pilots allow testing new ideas and approaches providing valuable insights on how a determined policy can be implemented. This iterative process helped to adapt the HTHT methodology to the Uruguayan context and curriculum for teaching math. Specifically, we discovered that teachers needed more support in recognizing the potential of integrating tools like Matific into their classrooms. Embracing experimentation as a core component of our policy development can ensure continuous improvement and adaptation to the unique needs of educators and students.

Moreover, it is crucial to sustain the implementation of these programs over time. Changes and results in education often take time to emerge, especially when aiming to transform classroom practices. Providing consistent support and allowing sufficient time for the initiatives to generate tangible results and evidence is essential.

Moving Forward

Looking ahead, it is important to consider deepening support for teachers in the meaningful integration of technology in the classroom. This includes reflecting on the implications of scaling these efforts and enhancing the support and training provided to teachers. These initiatives could equip teachers with the necessary tools and knowledge to effectively incorporate technology into their teaching practices, thereby improving educational outcomes and fostering a more personalized learning experience. By fostering a collaborative network of teachers, sharing best practices, and continually refining instructional strategies, we aim to create a dynamic and supportive learning environment.

By committing to a strategic and evidence-based expansion of the HTHT approach, we are poised to make a substantial impact on the educational landscape of Uruguay. Through careful planning, continuous support, and rigorous evaluation, we will ensure that the benefits of this innovative teaching and learning model are accessible to all students and teachers at all levels.

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