Cal-Impact

Self-paced and interactive learning with computers: Does it effectively boost children's math skills?

Policy Brief — January 2020

Executive Summary

Education is an essential ingredient of sustainable development. While the world has experienced an impressive expansion of schooling in recent decades, the quality of teaching in many low- and middle-income countries remains inadequate.

In light of poor learning outcomes in Africa, Asia, and Latin America, the World Bank[1] has recently declared a "learning crisis". To address this crisis, it is crucial to understand what works to improve the quality of schools in developing countries. *Consciente* contributes to this ambitious endeavor by pursuing an evidence-based approach to promoting high-quality education in El Salvador.

This *policy brief* summarizes the main insights from the pilot phase of the computer-assisted learning (CAL) project Cal-Impact. Together with our partners from the University of Bern, we conducted an experimental evaluation with 198 school classes to compare the impact of three different implementation arms:

1. Supplementary math classes with learning software and led by a teacher
2. Supplementary math classes with learning software and guided by a supervisor
3. Supplementary math classes instructed by a teacher but without the use of computers

While the additional math lessons built around the use of CAL-software produced sizeable learning gains, pupils assigned to traditional math classes showed only modest advances in their math abilities. This suggests that technology-aided instruction can contribute to better learning outcomes in developing countries, especially in an environment with poorly trained teachers.

The evaluation builds a strong case in favor of expanding the Cal-Impact initiative, particularly concerning the use of learning software: Both CAL approaches achieved better cost-effectiveness than conventional teaching, despite additional outlays for setting up computer labs.

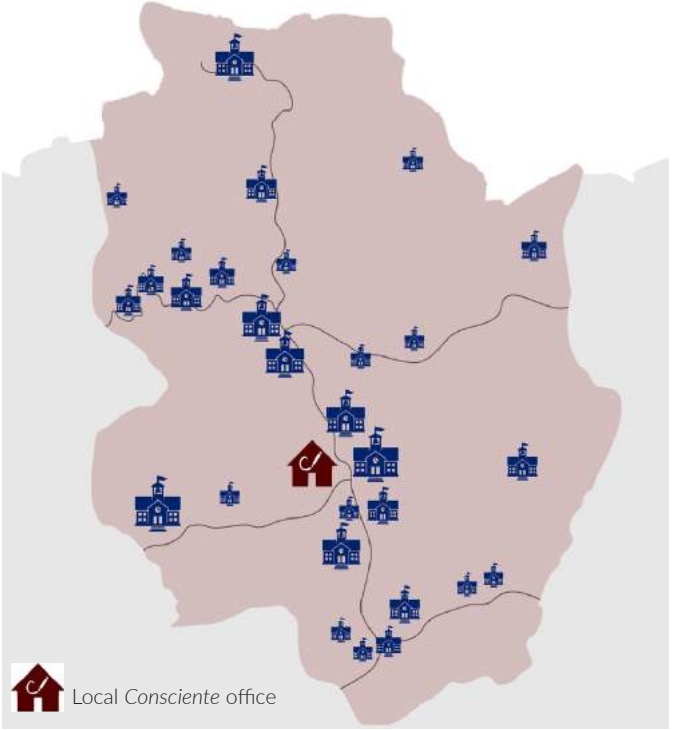
1 World Bank. 2018. *Learning — To Realize Education's Promise*. Washington D.C.: World Bank Group.

The Cal-Impact Project

Cal-Impact aims to improve math skills among third to sixth graders in the department of Morazán, El Salvador. For this purpose, *Consciente* developed an innovative teaching concept for remedial math lessons. It combines individualized learning with the computer software "Khan Academy" and interactive educational games.

During the pilot phase in 2018, we evaluated this approach together with our academic partners from the University of Bern. In the run-up to the program's launch, we contracted 38 young teachers and trained their pedagogical, mathematical, and technical skills. Computer labs in 29 partner schools throughout Morazán were equipped with 518 computers. During the six months of the pilot phase, more than 2'000 pupils in the selected classes had the opportunity to participate in two additional 90-minutes afternoon sessions per week.

Until recently, primary schooling in El Salvador has been confined to morning lessons. The Salvadorean Ministry of Education seeks to cooperate with NGOs in order to expand lessons to the afternoon and to promote innovative teaching. Cal-Impact nicely aligns with this strategy and therefore was actively supported by the local authorities.



Schools participating in the Cal-Impact project

- 150 and more pupils
- 100-149 pupils
- 50-99 pupils
- less than 50 pupils

Individualized computer-assisted learning

The software "Khan Academy" offers a comprehensive line-up of Spanish learning videos and exercises across different subjects and grade levels, including basic math for primary school children. During CAL lessons, children can progress at their speed and the program offers instant feedback through short assessments. Moreover, teachers have plenty of time to answer questions individually and to tailor explanations to the specific abilities of each child.

Interactive educational games

To live up to the social component of learning, a comprehensive manual for educational games and group work was developed by *Consciente*. The manual explains simple techniques to promote collective learning and to foster pupils' motivation. All teachers were instructed to actively employ the outlined games and group activities in their classes to make CAL-IMPACT a joyful experience for every participant.

10'000 lessons conducted

2'262 pupils instructed

518 computers donated

38 teachers trained

Evaluation Approach

To evaluate the effectiveness of the Cal-Impact project, our partners from the University of Bern conducted a Randomized Controlled Trial during the pilot-phase in 2018. Their evaluation design required that school classes are randomly assigned to either the control group or to one of three treatment groups, that were offered:

1. Additional math lessons based on computer-assisted learning software and instructed by qualified teachers

2. Additional math lessons based on computer-assisted learning software and conducted by supervisors

3. Additional math lessons taught by qualified teachers but without software

Each group participated in a standardized math assessment before and after the project. Based on these assessments, the impact of the project on the children's math abilities can be estimated by comparing the performance of children in treatment classes to the performance of children in the control classes (see illustration in Figure 1).

To examine if the program had a broader impact on the educational quality within schools, two kinds of control groups were used: Classes within project schools and classes in schools, where we did not implement the project. A comparison between these two types of control classes allows assessing if the project also had a positive effect on the non-participating pupils in our partner schools via so-called "externalities".

Main questions addressed in the evaluation of the Cal-Impact project:

1. Does the project improve children's math skills?
2. Which project version is the most cost-effective?
3. Does the project have a broader impact on school performance?

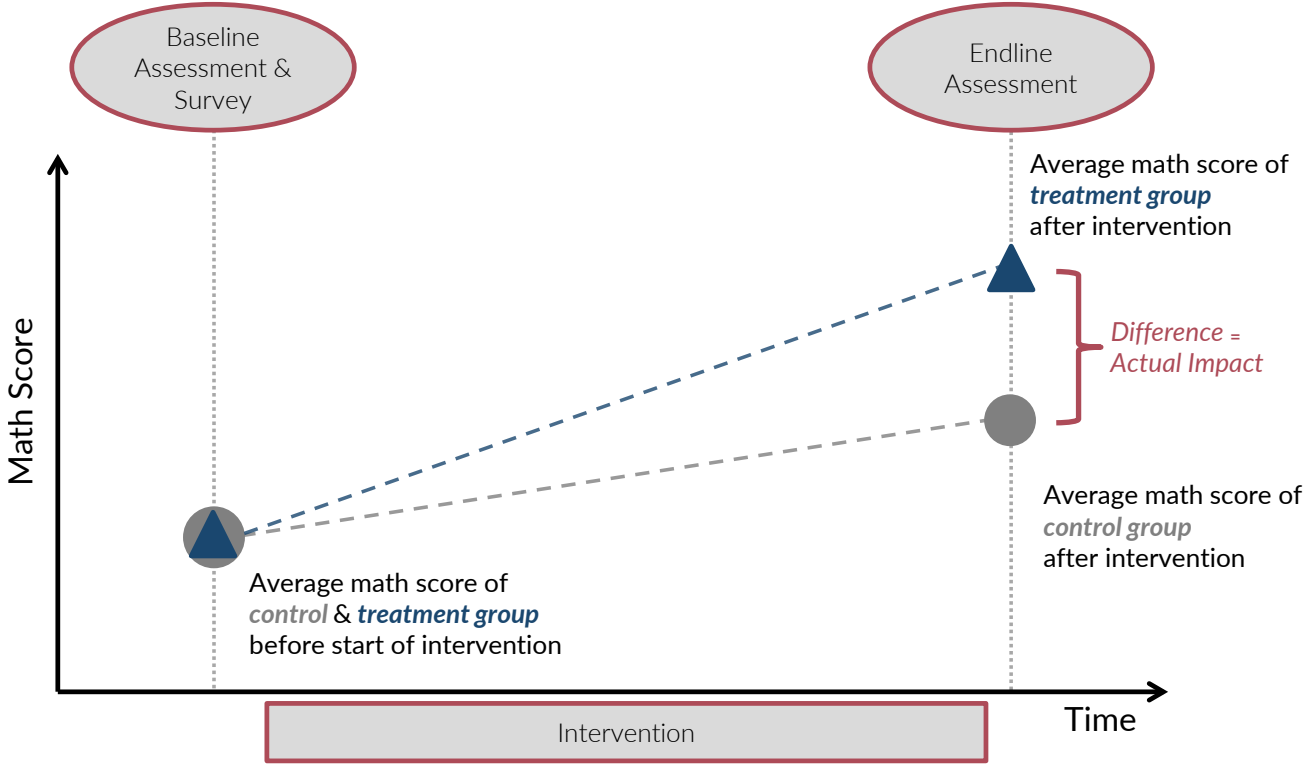


Figure 1: Illustration of the evaluation design that was used to quantify the impact of the CAL-IMPACT program. *Baseline Assessment*: February 2018, *Start of Intervention:* April 2018, *Endline Assessment*: October 2018.

Main Evaluation Results

1. Does the project improve pupils' math skills?

The evaluation shows a substantial and statistically highly significant impact of the project on pupils' math skills: Participating children achieved better assessment scores than those assigned to control classes. For the average beneficiary, the learning gains obtained through CAL lessons correspond to additional math skills accumulated during more than half a school year.

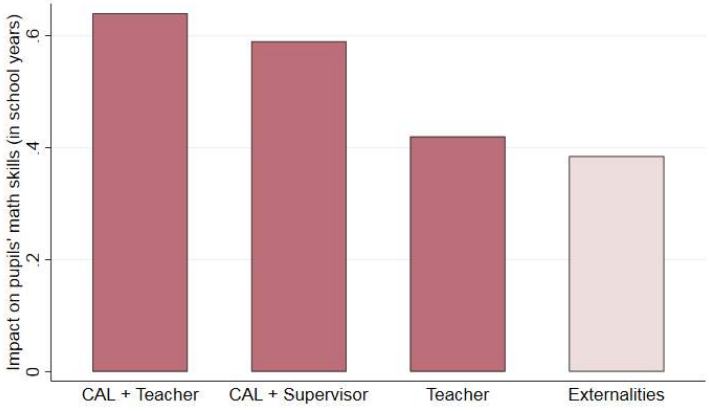


Figure 2: Impact estimates (measured in school years) for the different intervention arms of CAL-IMPACT. All impact estimates are at least statistically significant at the 5 percent level.

2. Which project version is the most cost-effective?

Both types of CAL lessons had a larger impact than the math lessons following a traditional approach. Since the additional learning gains outweigh the additional costs of setting up and maintaining computer labs, technology-aided instruction proved more cost-effective than conventional teaching.

A comparison between CAL lessons conducted by a qualified teacher and CAL lessons led by a supervisor suggests that these two approaches are equally cost-effective. Teachers equipped with CAL-software achieved a slightly stronger impact than supervisors, but this comes at the expense of proportionally higher labor costs.

3. Does the project have a broader impact on school performance?

The evaluation also uncovers significant positive externalities in *Consciente*'s partner schools. Children that were assigned to control classes in program schools experienced a measurable increase in math skills compared to children in geographically separated control classes.

Additional Insights

Class cancellation and class attendance

Monitoring operations revealed that 25% of regular school lessons were canceled, compared to only 10% of Cal-Impact lessons. Due to the voluntary nature of the extra math lessons, student attendance proved to be an issue: Eligible pupils only attended 59% of the additional Cal-Impact lessons compared to an attendance rate of 80% in regular (and mandatory) classes. Estimates suggest that the effectiveness of the project would benefit considerably if attendance rates can be improved.

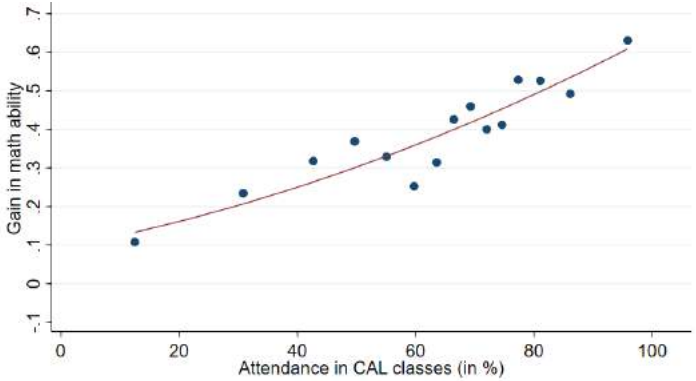


Figure 3: Correlation between attendance in CAL lessons and net gain in math ability between baseline and endline assessment.

Teacher ability

To examine the limited effectiveness of traditional teaching methods, all our contract teachers, as well as a random sample of regular math teachers, were invited to participate in a math assessment. The results are alarming: Many of the officially certified teachers employed by the NGO had great difficulties with the math contents taught in Salvadorean primary schools. However, they still performed better than the regular math teachers in Morazán: On average, the regular teachers could answer less than 50% of the second to sixth-grade questions. This finding suggests that the effectiveness of regular math classes may be even more curtailed by the teachers' content-related deficits.

Qualitative feedback

The feedback from teachers, children, and educational authorities shows that Cal-Impact was perceived very favorably. Its interactive and playful approach to teaching was an exciting experience for everyone. When asked about his opinion on the Cal-Impact project, one of the contracted teachers responded: *"I have come to understand something crucial: learning does not have to be boring."*

Lessons Learned and Recommendations

Overall, the evaluation builds a strong case in favor of continuing and expanding the Cal-Impact initiative. Specifically, the evaluators from the University of Bern derived five recommendations based on their findings which may prove valuable for *Consciente*'s future work, but also the Salvadorean Ministry of Education and other actors in the field of basic education:

"Cal-Impact nicely demonstrates the benefits of rigorously evaluating projects before pursuing a scale-up. It was a pleasure to cooperate with Consciente, an innovative NGO committed to learning how the effectiveness of its programs can be systematically improved."

Prof. Dr. Aymo Brunetti, External Evaluator from the University of Bern, Switzerland.

1. The computer-assisted learning approach offers a new and motivating stimulus that demonstrably improves math learning outcomes of primary school children.

2. From a cost-effectiveness perspective, hiring teachers or (less-qualified) supervisors to conduct computer-assisted lessons is about equivalent.

3. Simply providing additional math lessons taught by a local teacher seems a rather ineffective way to improve learning outcomes.

4. Indirect (positive) effects of the NGO's presence at schools – even on those children not directly targeted – are a strong additional argument in favor of expanding the project to new schools.

5. Deficits in the content knowledge and pedagogical skills of teachers are a significant source of inefficiencies in math lessons at Morazán's primary schools. Measures to mitigate these deficits, such as specifically tailored teacher training programs, could be an effective strategy towards sustainable improvements in the quality of education.

About Consciente

Consciente is an NGO committed to making high-quality education accessible to everyone. To pursue this goal, we run three programs:

- ***The Scholarship Program*** promotes equal access to education irrespective of socio-economic background.
- ***The Education Innovation Program*** improves the quality of education in local schools. This program includes Cal-Impact.
- ***The Sustainability Education Program*** promotes the discussion of important social and environmental issues.

Address:
Verein Consciente
Granatweg 13
3004 Bern

Web:
www.consciente.ch

Contact:
Martina Jakob
martina.jakob@consciente.ch

About the Evaluation

The impact evaluation was conducted by researchers from the Department of Economics (Chair: Aymo Brunetti) and the Institute of Sociology (Chair: Ben Jann) at the University of Bern. It was financed with the *Impact Award* prize money awarded to *Consciente* by NADEL (ETH Zurich) and the Swiss Agency for Development and Cooperation.

This policy brief is based on a detailed evaluation report handed to *Consciente* in April 2019, see:

Büchel, Konstantin, Martina Jakob, Christoph Kühnhanss, Daniel Steffen & Aymo Brunetti. 2019. *Expanding School Time and the Value of Computer-Assisted Learning: Evidence from a Randomized Controlled Trial in El Salvador.* Evaluation Report, published online: www.consciente.ch.

Address:
University of Bern
Hochschulstrasse 6
3012 Bern

Web:
www.vwi.unbe.ch
www.soz.unibe.ch

Contact:
Dr. Konstantin Büchel
konstantin.buechel@vwi.unibe.ch