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SOCIAL IMPACT BOND FEASIBILITY STUDY: STEM EDUCATION FOR GIRLS IN MEXICO

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Abstract

The gender gap in STEM careers poses significant societal and economic challenges in Mexico. This feasibility study, conducted during an internship with PYMO Hub, evaluates the potential of financing a STEM education program in Mexico through a Social Impact Bond (SIB). The intervention focuses on providing STEM education to public schools in semi-urban areas, aiming to encourage girls to pursue STEM careers and reduce the gender gap. By analyzing historical data and developing scenario analyses, the study concludes that the SIB model is viable, capable of delivering measurable social outcomes. Recommendations for implementation are also provided.

Key words: Social Impact Bond, Impact Investments, Feasibility Study, STEM Education for Girls

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1. Introduction

Social Impact Bonds (SIBs) have emerged as an innovative mechanism to finance preventive interventions that address social problems by transferring risk from the public sector to private investors. This approach benefits the public sector by reducing costs and preventing problems, while offering investors potential higher returns and diversified portfolios. As a result, SIBs serve as a powerful tool for tackling social issues, particularly those that involve preventive solutions.

The main objective of this work is to evaluate the feasibility of using a Social Impact Bond (SIB) as a financial mechanism to increase access to STEM education for girls in Mexico. Currently, only 33% of STEM students, and just 12.9% of people that hold positions in this field, are women. This disparity increases the gender income gap, since the lack of essential skills like problem-solving and critical thinking limits access to higher-paying opportunities (IMCO 2023, Beltrán 2024). Investing in STEM education for girls is crucial to bridging these gaps and preparing them for success in high-demand careers.

The goals of this study are to understand the specific challenges hindering girls' access to STEM education in Mexico, define measurable outcome metrics for the intervention and conduct financial modelling to assess potential public sector savings and the feasibility of the SIB.

The potential intervention was developed during an internship with PYMO Hub, building on the *STEM para Niñas* pilot project conducted in 2023. This pilot aimed to enhance girls' mathematical skills and overall learning abilities, positively impacting their academic performance by teaching them new ways to reason. This study was conducted using the methodology provided by Social Finance UK's Guide to Social Impact Bond Development, as well as the Government Outcomes Lab Technical Guidance from the University of Oxford, including data collected from the participating organisations and additional literature research.

2. Literature Review

a. Overview of SIBs

Social Impact Bonds (SIBs), have emerged as a response to financial limitations faced by both public sector and non-profit organisations when addressing social issues. Public sectors often have limited working capital to fund social initiatives, while non-profits relying on donations are frequently underfunded, hindering their ability to scale their impact. SIBs address this problem by providing working capital that the public sector may lack to deliver essential services.

SIBs and Impact Bonds[1] are financial instruments that aim to prevent a social problem that has a gap in provision. It works as a contract where an investor will lend money to an intermediary, which will be in charge of implementing a solution for the beneficiaries. The repayment will be made by a commissioner—usually the public sector—based on predefined outcome metrics. The primary focus of SIBs is to shift from reactive to preventive solutions for social issues, assuming that investing in preventive solutions will save costs for the public sector (Barclay and Symons 2013). Outcome payments by the government are typically made based on public sector savings, and by involving the private sector, the risk is transferred from the public sector to investors; by linking repayment to these outcomes, the impact of the intervention is better ensured.

[1] Impact Bonds encompass a broad category of financing models. Depending on the outcome payer and structure used, they may be referred to as Development Impact Bonds (DIBs), Social Outcome Contracts (SOCs), or domestic/international Impact Bonds (Government Outcomes Lab 2023).

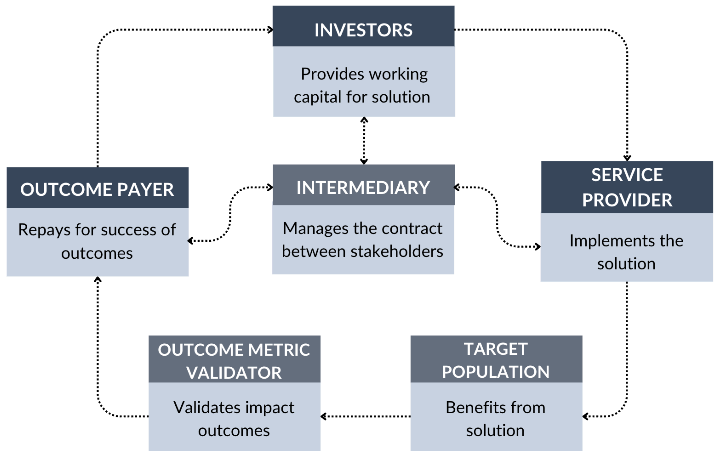

Figure 1. Social Impact Bonds Mechanism adapted from OECD (2016)

b. Impact and potential of SIBs

As previously stated, SIBs' main impact relies on providing financing solutions for social issues, and saving public resources allowing for the replication or scaling up of interventions in social policies. SIBs also attract private capital for societal projects, allowing for portfolio diversification and alignment of financial returns with measurable social impact.

SIBs are most effective in areas involving high-cost services that are crucial to the overall well-being of society, such as criminal justice, unemployment, healthcare and education. It is important to note that SIBs are only ideal for specific types of interventions that meet certain conditions. This includes potential for meaningful cost savings to the government, clear and measurable outcomes, properly structured contracts with multiple stakeholders, and the appointment of an effective coordinator (Nazari Chamaki, Jenkins, and Majid Hashemi 2018). Therefore, it is crucial to assess the feasibility of using SIBs to fund a specific intervention, ensuring that it will fully meet these conditions.

The first SIB was issued in the UK in 2010 which aimed to reduce reoffending from prisoners released from Peterborough Prison (Barclay and Symons 2013). Since then, SIBs have been applied to different sectors, including education, where they have demonstrated potential to improve outcomes for students and address educational disparities. This focus on education is particularly relevant to this evaluation, since it involves assessing the feasibility of a SIB to support education access for girls in Mexico. One notable example of a SIBs in the education sector is The Utah High Quality Preschool Program, which provided preschool education and claims to have generated approximately US$281,550 in cost savings for the state by reducing the need for special education services (CPI 2016). Another example is The Junior Code Academy SIB in Portugal, which aimed to improve logical thinking skills and school performance in primary students through computer programming, and managed to reskill 65 unemployed people as software developers (Anselmo 2022).

c. Challenges and risks related to SIBs

Despite the potential of SIBs to contribute to the improvement of social issues, there are also some challenges and risks related to the implementation of these. The biggest challenges found by different actors involved in the development of SIBs include complexity of the SIB structure, the lack of financial mechanisms in place, lack of favourable legal conditions and availability of monetizable and measurable outcomes (Gustafsson-Wright, Gardiner, and Putcha 2015).

SIBs have sometimes been described as high-risk instruments for social interventions, with concerns about the commodification of social interventions, the increased risk of mission drift of organisations, and the risk of opportunistic profiteering by investors (Verga Matos and Christopoulos 2023). However, these criticisms are commonly directed not only at SIBs, but at social enterprises in general and social impact interventions across the sector. SIBs have both benefits and challenges; the key lies in their proper design and implementation, as well as awareness of potential obstacles and pitfalls. Learning from previous SIBs can help to optimise future implementations and maximise their positive impact.

3. Problem Definition

a. Global perspective on the problem

The global underrepresentation of women in STEM (Science, Technology, Engineering and Mathematics) is evident, with only 28% of the workforce being female in 2023 (Piloto 2023). This poses limitations to both women and the STEM industry. For women, the lack of opportunities means lower wages and fewer career prospects. For the STEM industry, the lack of diversity and inclusion can result in missed opportunities, since the sector is not benefiting from female talent in innovation and technology, limiting its potential. The causes of these problems are a combination of cultural and societal factors, which include the lack of role models in the field, stereotypes and unequal access to resources in education for girls.

This is why it is essential to boost girls' education regarding STEM subjects, to end the stereotypes associated with these roles and increase girls' interest which will further develop their abilities that will help them thrive in various fields in their career. Global programs in STEM education such as Girls Who Can Code, Black Girls Code, and Million Women Mentors have been successful in proving that STEM education with gender focus has increased girls' interest and awareness in STEM fields, as well as improved their communication skills and boosted their self-confidence (Piloto 2023, CEPIS 2024).

b. Challenges in STEM education for girls in Mexico

STEM education for girls in Mexico is also falling behind, with only 33% female participation in STEM careers (IMCO 2023). In 2023, out of the 3.6 million STEM jobs in Mexico, only 12.9% were occupied by women (Beltrán 2024). It is important to understand the root causes of this problem, as well as the impacts and costs it may pose for individuals, society, the economy, and the government.

When examining the root causes, studies have found that the issue is a combination of several factors, starting in education. According to IMCO (2023), the gender gaps in STEM begin from childhood when girls lose confidence in their ability to develop in these subjects. Similarly, Movimiento STEM in collaboration with UNICEF conducted a study that aimed to analyse the STEM gender gap in Mexico through three different dimensions 1) access and participation in education, 2) factors that influence the choice of education programs, and 3) gaps in labour force participation. These studies found that the main gender gap in vocational and technical education in Mexico is not in access but in the choice of fields of study. Several factors influence the choice in the field of study: **Lack of vocational guidance:** many students lack early guidance, which could help nurture girls' talents and vocation towards STEM careers, and help fight gender stereotypes; **Cultural factors:** gender stereotypes and societal expectations influence choices, particularly in rural and indigenous areas; **Economic factors:** financial constraints can hinder access to higher education, especially for women; **Lack of teacher training:** teachers need better training in gender perspective and socio-emotional skills to support students effectively (Andrade 2023).

Regarding the labour force participation, it has been found that gender gaps begin to emerge after upper secondary education (ages 18-20). Women with technical or professional high school diplomas may outnumber men, but men often earn higher salaries. It was also noted that essential skills, particularly digital and transferable skills, are key to successfully transitioning from education to the labour market, and there is a growing need to strengthen socio-emotional skills in women (Andrade 2023).

c. Cost of the problem

All of these barriers in STEM education for women translate into different impacts that can lead to further costs and consequences in different dimensions:

Individual: lack of STEM education for women has a direct impact on their personal development and their overall wellbeing. This limits them to acquire essential skills to solve daily life problems and impacts them in their professional careers, since it implies lower income potential and missed career opportunities (Gras and Alí Fojaco 2021). According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), 75% of the future jobs will require STEM skills and specifically in Mexico the skills related to tech development are between the 20 most seeked by employers. Therefore, including women in STEM areas is crucial to close the gender gap and improve their wellbeing (Beltrán 2024).

Economy and society: gender inequality in STEM also has an effect on the country's economic development and innovation (Gras and Alí Fojaco 2021). Gender parity in STEM could boost GDP substantially, which indicates the economic opportunity lost from underrepresentation of women in STEM. Reports have found that 'Mexico could boost its annual economic activity by more than 25%, or $390.5 billion, if women participated in the labour force at the same rate as men' (Madry 2024).

Government: in 2024, 12 billion pesos (approximately $622 million USD) were allocated to support women in science. This funding is directed towards postgraduate scholarships, scientific research, and technological development initiatives. The scholarships budget is brought by the Consejo Nacional de Humanidades, Ciencias y Tecnologías (CONAHCYT), however it lacks gender equality indicators, beyond being a grant for women (Beltrán 2024). These investments in social welfare programs are a direct response to the economic challenges faced by women who lack STEM opportunities.

Other costs may also arise from the need for remedial education, alternative training, or other support services to address the gaps in girls' early STEM education. The IMCO (2023) has found that while there are some isolated efforts to increase the amount of women involved in STEM, there is no comprehensive and unified strategy that spans from childhood to higher education. One example is the PROIGUALDAD (Programa Nacional para la Igualdad entre Mujeres y Hombres) 2019-2024 program, which contemplates as priority to enhance the labour integration of women with specific punctual actions towards STEM, however, there is an absence of specific initiatives and budget targeted towards encouraging the participation of women and girls in STEM activities (Beltrán 2024).

While there are existing initiatives aimed at increasing girls' participation in STEM, they remain insufficient and do not specifically focus on addressing the gender gap in early education, where foundational skills and interest are developed. As demonstrated by the studies, investing in early education programs for girls is crucial, as it not only helps bridge the gender disparity but it can also mitigate the long-term societal and economic costs associated with this issue.

4. Intervention Design: *STEM para Niñas*

a. Identifying a strong intervention model

To identify a strong intervention model that contributes to tackling the STEM gender gap it is important to understand its root causes. As discussed in the last chapter, the STEM gender gap is a systemic issue stemming from various factors. According to a UNESCO study (2017), several factors can influence girls' and women's participation, performance and progression in STEM education. This study concludes that holistic interventions with a multisectoral perspective are necessary to achieve positive results which should involve individual, family, school and societal factors (UNESCO 2017).

The ecological model from the UNESCO study proposes a list of priority actions to increase girls' and women's interest and engagement in STEM education. Gras and Alí Fojaco (2021) adapted the UNESCO study to Mexico's context and proposed activities to achieve short- and long-term results. In the short term, it proposes to expand access to quality STEM education for vulnerable populations, particularly girls, and to inform public policies and programs with evidence-based, scalable gender-focused solutions. Long-term goals include building a regional framework for inclusive STEM education, improving OECD PISA test scores, empowering girls with confidence and decision-making tools, and increasing the number of women equipped with essential skills for future opportunities (Gras and Alí Fojaco 2021).

b. *STEM para Niñas*: Description of the pilot project

PYMO Hub is a Mexican social impact startup that connects donors with urgent social causes. They operate a marketplace of non-profit organisations with projects in areas such as waste management, renewable energy, gender issues, financial inclusion, and water conservation. Over seven years, PYMO Hub has funded more than 170 initiatives, impacting over 70,000 people across Mexico (PYMO Hub 2024).

STEM para Niñas was a collaborative pilot project by PYMO Hub and Lab4U, a company specializing in science education for young students. The intervention took place at Colegio Meyalli, aiming to equip 120 girls from first to third grade with tools for inquiry and experimentation to better understand science in everyday life and develop skills for the modern job market.

Throughout the 2022-2023 school year, students in Ixtapaluca, an underserved area in the State of Mexico, integrated experimentation into biology, physics, and chemistry. Using Lab4Biology, Lab4Physics, and Lab4Chemistry apps, which turn mobile phones into science tools with sensors for inquiry-based experiments, students conducted hands-on activities to apply classroom knowledge to real-world situations in an engaging and practical way. Colegio Meyalli's teaching staff, trained by Lab4U, facilitated these activities using Lab4U technology.

Outcomes for the *STEM para Niñas* pilot project were measured by comparing students' grades before and after the intervention. The results showed slight improvements in the girls' grades, along with increased interest and participation, as reported qualitatively by teachers. While this approach lacked comprehensive quantitative metrics, Lab4U conducted similar projects with more rigorous evaluations which show the potential impact of their interventions. One such project, implemented in eight schools in Chile, involved the Lab4Physics app. The study assessed changes in students' interest in physics, gender-specific effects, and graph comprehension. It found a significant increase in self-reported interest in physics among both girls and boys, as well as improved physics understanding for girls but not boys, highlighting Lab4U's effectiveness in enhancing STEM skills among female students (Carreño, Castro-Alonso, and Gallardo 2022).

The collaboration made by PYMO Hub, Colegio Meyalli and Lab4U, as well as the previous projects conducted by Lab4U are good examples of how an intervention of this type can contribute to addressing the STEM gender gap in Mexico. These interventions focus on early education, addressing the root cause of the issue, which begins at a young age when foundational skills and interests are formed. By targeting this crucial stage, the intervention ensures that girls develop a strong base in STEM subjects, and also increase their interest in the field, empowering them for future academic and career opportunities. As previously mentioned, strong intervention models for this issue should involve a holistic approach that cover different levels, which is one of the strengths of these types of programs, since they involve teachers through comprehensive training that equips them to better engage and support students.

c. Design of the intervention

The pilot project conducted by PYMO Hub in 2023, was a successful project, however replicating it for a SIB would be too small. Therefore, the intervention for this SIB was designed based on this project, but done on a larger scale.

The new intervention considers three main actors, PYMO Hub, Lab4U and UNETE, one of the non-profit organisations in PYMO Hub's marketplace. These three actors are fundamental for the success of the intervention in the following way:

PYMO Hub will serve as the intermediary taking care of the project management, structuring and evaluation of the intervention. PYMO Hub has served as an intermediary between non-profits and companies for 7 years, making outcome-based payments for the projects they manage with non-profits, while thoroughly measuring impact. PYMO Hub also evaluates non-profits through its Compliance and Sustainability Evaluation (CASE) certification, making sure they have legal structure, financial sustainability and impact effectiveness.

Lab4U will provide training to the teachers, as well as licences for real time experimentation of the students. Lab4U has done several projects in Latin America, including Mexico, and has worked with the Inter-American Development Bank (IDB), carrying out robust evaluation to prove that their interventions have the intended impact. They offer gender focused training to the teachers, which is one of the suggestions from previous studies mentioned.

The last and most important actor will be **UNETE**, a Mexican non-profit organisation focused on education, which will have contact with the schools and oversee the implementation. UNETE is a non-profit that is focused on providing education programs to schools from vulnerable areas in Mexico. According to Educate Girls study (Savell, Eddleston, and Luff 2024), a previous outcome-based education intervention, it is crucial to collaborate with local partners to strengthen long-term capacity and scale impact efficiently. It is also critical to involve the communities impacted to develop solutions, which is why working with UNETE that has first contact with schools and communities is of significant importance.

5. Modelling of SIB for *STEM para Niñas* Intervention

a. SIB scope

Target population: UNETE will work with five public schools with 250 - 500 high school students each, from ages 14-18. The schools will be located in semi-urban areas from Mexico where access to STEM education is not the most developed. However, the schools will need to have internet connection, and will be chosen purposefully by UNETE, based on previous projects that they have implemented, to ensure that the necessary adaptations can be made to the school model and curricula. In the pilot project done with Colegio Meyalli, all the students were girls, however, public schools in Mexico are hardly only girls. Therefore, the project will be implemented in mixed schools and the target outcomes will include a gender component.

Cohort design: The project will adopt a cohort based approach, grouping students by grade levels (1st to 3rd grade), where each cohort will receive the intervention for the corresponding subject of the grade (physics, biology or chemistry).

SIB duration: The contract will be structured over a 3-year period to ensure that at least one cohort completes all three years of the intervention. During this time, a total of five cohorts will participate in the program: one cohort will complete the full three years, two cohorts will participate for two years, and two cohorts will participate for one year. This design also enables an analysis of whether the duration of participation influences the benefits and overall outcomes of the project.

b. Definition of outcome metrics

The definition of the outcome metrics is essential in the design of a SIB, since these metrics build the foundation of the contract between the public sector and investors (Barclay and Symons 2013). According to the Social Finance Guide to Social Impact Bond Development (2013), the key is to identify outcome metrics that are both measurable and objective, and at the same time can safeguard against perverse incentives, developing comprehensive solutions.

In education focused SIBs, outcome metrics commonly include indicators that directly reflect the effectiveness of the educational intervention, such as grades or school attendance. For example, the SIB for the UBBU: Learn to Code project in Portugal, which involved a computer science and coding training programme to address digital exclusion, included an outcome metric of achieving a 70% rate of participants with basic or advanced digital skills (Government Outcome Labs 2024). Similarly, the Quality Education India Development Impact Bond, prioritised improving learning outcomes, defined as the difference between baseline and endline scores on a standardised test, which they would apply at the beginning and end of the school year (Government Outcome Labs 2022).

Effective outcome metrics will incentivise services that genuinely improve outcomes for the beneficiaries, tackling the root causes and ensuring that the focus remains on generating meaningful impact. It is important to have a theory of change to understand which are the outcomes that the intervention is trying to achieve and if these are connected to the intended impact. Appendix 1 shows the theory of change for the intervention, illustrating the relationship between inputs, activities, outcomes, and the overall impact of the project.

According to the Government Outcomes Lab's checklist for setting and measuring outcomes (2020), it is important to consider metrics that have been previously measured in similar projects, as this ensures that the outcomes are feasible to assess. Therefore, the outcomes measured in previous studies by Lab4U can serve as a foundation for designing the metrics for the *STEM para Niñas* intervention. These can then be adapted to align with the intervention's goals, following best practices. Additionally, the chosen outcome metrics should emphasize the pressing issues that need to be addressed and clearly demonstrate their connection to the desired impact.

It is also common practice to establish a counterfactual; a baseline to ensure that the results would have not occurred if it wasn't for the intervention. This is necessary to ensure investors and donors that resources are not being wasted and actually creating the desired impact (Bridges Impact+ 2014).

The following output and outcome metrics were chosen for the intervention:

1. **Increased participation of students in the subject (output metric):** it is common for SIBs to have a blended output and outcome structure, where both types of metrics complement each other (Gustafsson-Wright, Massey and Osborne 2020). In this case participation was chosen as a metric to incentivise a certain level of implementation of the intervention. **Measurement:** Total number of experiments completed by students in the semester. No baseline will be set since it is an output metric.
2. **Improved understanding on the subject matter (outcome metric):** it is important because, as previously mentioned, there are still gender gaps in performance of STEM

subjects. Measuring understanding can also be a way to measure the improvement of STEM skills, which are crucial for the jobs of the future. **Measurement:** Questions about the content seen in class during the experiments. Baseline will be set according to a pre-test and compared against a control group.

3. **Improved interest in STEM careers (outcome metric)**: it is a relevant metric since girls lose interest in STEM subjects, especially between first and last years of adolescence (Gras and Alí Fojaco 2021). Reducing the loss of interest in these crucial stages of development for girls is essential for the prevention of this issue. **Measurement**: Self-reported interest in pursuing a career related to STEM subjects. Baseline will be set according to a pre-test and compared against a control group.

c. Pricing the outcomes

According to the Government Outcomes Lab Technical Guidance on pricing outcomes (2021), best practice to price outcomes involves first estimating an upper bound based on the **value**, then determining a lower bound by factoring in the **costs**, and finally establishing an efficient **price** within the range between these two bounds. The estimates for this SIB were done on a per-outcome level to better understand the specific costs and benefits associated with each individual outcome and ensure accurate pricing within the defined range.[2]

i. Estimating the value

The value of outcomes can be subjective, varying by payer, perspectives within governing bodies, and over time. It can be estimated in two ways: by understanding the intrinsic economic benefit of achieving certain outcomes, which supports cases for new spending or departmental

[2] All amounts are given in USD

collaboration, or by calculating cost savings, which justifies future budget reductions for specific departments or governments (Government Outcomes Lab 2021).

In the case of this SIB, there are no direct cost savings to any entity, making it necessary to determine an intrinsic value for the intervention. To establish the upper bound of this value, the Mexican government's public spending on education was used as a reference, specifically the $2,166[3] budget per student for upper secondary education (IMCO 2023). However, using the entire education budget as the value for the intervention would likely overstate its relevance to this specific context.

To adjust this value, several factors can be considered, such as the proportion of the budget allocated to STEM subjects and the resources these subjects require compared to others. Due to a lack of detailed cost data for individual subjects in the Mexican education system, a U.S. university study on field-specific costs was used as reference (Hemelt et al. 2018). The average costs from this study were adapted to align with Mexico's curriculum ("Programas de Estudio para la Generación 2023-2026 y Subsecuentes.", n.d.), estimating the percentage of the budget attributable to STEM subjects. The resulting figure, 27.67% of the total education budget, represents the proportionate cost of STEM subjects (see Appendix 2 for details). This calculation adjusted the upper bound of the intervention's value to **$599 per student.**

ii. Gathering the costs

To have a full picture of the intervention costs several factors need to be specified such as the exact location of the schools and the number of students. For the purpose of this study, a general budget was defined where each one of the actors gave an estimated input of the cost of their activities, which will have to be refined and adapted to the model once the details are known.

[3] Average USD - MXN exchange rate of 2024 as of November 24, 2024 ("Historial 2024 del tipo de cambio del dólar estadounidense (USD) al peso mexicano (MXN)", 2024)

The total project cost is estimated at **$693,700** over three years, impacting **2,500 students** across five schools. This results in an average cost of **$154 per student per year** and **$277 per student impacted** over the project duration The total breakdown of costs of service per actor are shown in Appendix 3.

The cost structure is divided among the three key actors: **Lab4U's** key costs include the teacher training sessions ($2,800 per school), the app licenses ($7,500 per school) and project management ($10,000 annually); **UNETE's** key costs include coordination and project monitoring with schools ($1,300 per year per school), internet connectivity ($1,000 per year per school) and mobile phones for students ($45,000 one-time cost); **PYMO Hub's** key costs include staff salaries for coordination ($14,400 annually), evaluation and data analysis ($10,000 one-time cost) and administrative structuring costs ($25,000 one-time cost).

The cost per outcome that will be taken as the lower bound for pricing will be the **$277 per student impacted.** This cost can be benchmarked against similar initiatives to evaluate its efficiency. For example, the 'Junior Code Academy' program in Portugal incurred a cost of approximately $960 per student per year, highlighting that *STEM para Niñas* is a relatively cost-effective initiative per beneficiary (Anselmo 2022).

iii. Setting the Price

To achieve value for money and ensure the intervention's viability, the price should fall between the cost (lower bound) and the value (upper bound), as suggested by Government Outcomes Lab (2021). The selected price must balance providing a reasonable return for investors while also generating savings for the commissioner. To determine this, three internal rates of return (IRRs) were tested: a minimum IRR starting at the cost, a maximum IRR that still ensured savings, and a midpoint IRR. These IRRs were then adjusted for inflation[4]. The resulting savings are summarized in Figure 2, with full calculations provided in Appendix 4.

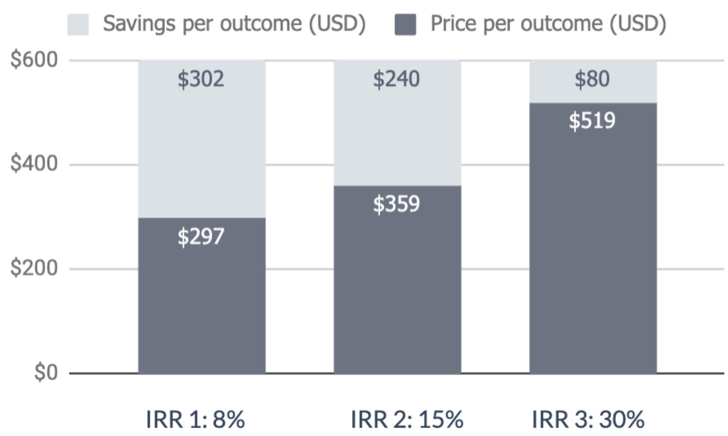

Figure 2. Savings vs Price per Outcome with different IRRs

This demonstrates that as the IRR for investors decreases, the savings per outcome increases, and vice versa. It also highlights the broad range of IRRs this SIB can sustain while still generating savings.

IRR 2 was chosen and analysed across various scenarios to determine the conditions under which a SIB model would be feasible for the intervention, setting the price at **$359 per student**. This can be further seen in the scenario analysis.

d. Payment structure

The payment structure for the intervention was designed with tailored approaches for each metric, with payments dependent on meeting specific thresholds. For the output metric (Metric 1), a per capita payment structure was selected, where payments are made for each participant who meets the threshold. For the outcome metrics (Metrics 2 and 3), which are measured in a cohort basis, payments will be made for achieving a specified increase in the metric for the

[4] Inflation used for the calculation was Mexico's average inflation for the past 4 years ("Mexico Inflation Rate 1960-2024 | MacroTrends", n.d.)

cohort, compared to a control group. Additional payments may be done for exceeding the initial threshold, rewarding greater improvements in outcomes. Payments for outcome metrics will follow the shown structure:

Table 1. Payment Mechanism for Metrics 2 & 3

% above/below threshold	Payment
>10% above threshold	120% repayment
+/-10% threshold	100% repayment
10%-20% below threshold	60% repayment
<20% below the threshold	40% repayment
20%-50% below the threshold	20% repayment
>50% below the threshold	No repayment

The following thresholds were established to guide these payment structures:

Table 2. Metrics thresholds

Outcome/output metric	Threshold
Increased participation of students in the subject	Completing more than 6 experiments in a semester
Improved understanding on the subject matter	Improved understanding 10% higher than control group (proportional % should be girls)
Increased interest in STEM career	Increased interest in studying 14% higher than the control group (proportional % should be girls)

The thresholds were set based on Lab4U results from the studies where similar metrics were measured (Carreño, Castro-Alonso, and Gallardo 2022, Sáenz-Zulueta and Pombo 2018). Since the intervention will be applied to both boys and girls, the outcomes will be measured for all students, with some thresholds incorporating a gender component. For the outcome metrics the gender composition of the group will determine the threshold. For example, if 60% of the group are girls, then 60% of the improvement in understanding must come from girls. This approach ensures fairness regardless of the class's gender mix and prevents perverse incentives by avoiding penalising boys' progress while still ensuring meaningful improvement for girls.

e. Scenario analysis

The scenario analysis aimed to explore how different circumstances might impact the success of the intervention and assess whether the SIB would still provide returns under these varying conditions. It also evaluated the actual cost per student impacted in each scenario, in the case that not all targeted students would benefit. The objective was to determine the real IRR in these scenarios, and whether investors, despite the actual IRR, would still achieve savings compared to the value (upper bound).

Before defining the scenarios, weights were assigned to each metric to calculate the intended payment per student for each metric. Table 3 presents these weightings, as well as the intended payment per metric considering that the total payment would be **$359**.

Table 3. Outcome Weightings and Intended Payment

Outcome/output metric	Weight	Reasoning for weighting	Intended payment per success
Increased participation of students in the subject	45%	Participation is foundational to the program's success and directly influences the other outcomes.	$161
Improved understanding on the subject matter	30%	Understanding reflects the depth of the impact and aligns with the goal of building STEM skills.	$108
Increased interest in STEM career	25%	Interest ties to the long-term objective of fostering STEM career aspirations, but is more subjective.	$90

Success rates and repayment percentages were set for each metric to build the scenarios: **Metric 1:** 50% success rate when half or less of the students meet the threshold, 80% success rate when students meet the threshold but accounting for average dropout rate[5], and 100% success rate

[5] Average dropout rate from STEM study in 2017 was used (Sáenz-Zulueta and Pombo 2018) and adapted to current upper secondary education dropout rate in Mexico in 2022 (IMCO 2022).

when the students meet the threshold and there are no dropouts. **Metrics 2 and 3:** 40% of repayment for being 20% below the threshold, 100% of repayment when the increase falls between +/-10% within the threshold, 120% if the threshold is exceeded for more than 10%.

The worst, base and best case scenarios were analysed by combining these success rates, to understand the real IRR in each case.

Table 4. Scenarios and Resulting IRRs

	S1.1: Worst Case	S1.2: Worst Case	S2: Base Case	S3: Best Case
Success rate metric 1	50.00%	80.00%	80.00%	100.00%
Success rate metric 2	40.00%	40.00%	100.00%	120.00%
Success rate metric 3	40.00%	40.00%	100.00%	120.00%

Real IRR				
Outcome/output metric	**S1.1**	**S1.2**	**S2**	**S3**
Repayment per student (USD)	$160	$208	$326	$398
Total payment	$399,000	$520,045	$815,932	$995,258
Real IRR	**-16.84%**	**-9.16%**	**5.56%**	**12.79%**

The scenario analysis shows that a SIB would be feasible for this intervention under scenarios 2 and 3, where outcome metrics are successfully achieved or exceeded. This highlights the critical importance of meeting the outcome thresholds, having a design that prioritises payment returns based on tangible impact. The IRRs for the base (5.56%) and best (12.79%) scenarios fall within the common range for Social Impact Bonds (1.3-20%), reflecting realistic returns while aligning with typical SIB benchmarks (Gustafsson-Wright, Massey, and Osborne 2020).

Finally, a cost analysis was conducted for each scenario to determine the cost per student to the investor (see Appendix 5 for detailed calculations). In Scenario 1.2, even with a negative IRR, the investor's cost does not exceed the value ($599).

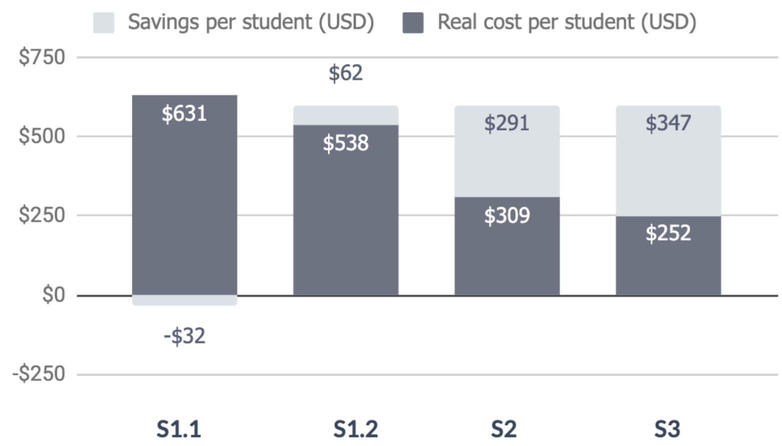

Figure 3. Savings vs Price per Outcome in Different Scenarios

6. Limitations and recommendations

Although the SIB has been proven to be feasible, there are some factors that should be carefully analysed and discussed between all stakeholders to understand the risks and decide on the final design of this SIB.

Cost savings data limitations: Since this intervention cannot demonstrate direct cost savings, an alternative approach was adopted, comparing cost and price to an approximation of education spending per student. While this method has its limitations—such as differences in resource investments (e.g., teacher salaries, technology, and infrastructure) between U.S. and Mexican education systems, as well as the lack of data on time allocation for specific subjects—it offers a reasonable estimate based on the available information. Future research, including direct consultations with schools to better understand cost distribution by subject, could further refine these findings.

Service limitations: A key concern with SIBs is the risk of perverse incentives, such as "cherry-picking", where service providers prioritize individuals most likely to achieve outcomes over those most in need (Gustafsson-Wright, Massey, and Osborne 2020). UNETE will choose certain schools where they have previously implemented programs. While leveraging UNETE's experience and focusing on schools where adaptations are feasible is practical, this approach may favor schools with a track record of success in prior projects, which could lead to a bias toward better-performing or easier-to-implement settings. Therefore, it is recommended to be very transparent about the selection of schools by clearly communicating why certain schools are chosen and providing data showing that the selected schools still represent disadvantaged populations.

Funder limitations: Potential funders for this SIB include the Mexican government and international development organisations. The government could fund the intervention as it aligns with national goals of addressing the STEM gender gap and preventing future societal costs. However, limitations could include budget constraints and the fact that SIBs are not a widely known or utilised funding structure in Mexico. Development organisations are strong candidates due to their focus on measurable impact and gender equity, however, the structure could not align with their funding cycles and strategic objectives.

Similarly, further recommendations can be made which can create a more compelling case for all stakeholders.

Real costs and exchange rate: Since the intervention has not been defined in detail yet, some of the costs were approximate values. The model should be adapted once the real costs are known, to ensure the scenarios are still valid. Similarly it should be considered that most of the costs are budgeted in the country's currency. If the investment is made in a foreign currency, a deeper analysis of exchange rates should be conducted to assess effectiveness. Alternatively, the model can be translated into MXN to better reflect scenarios closer to reality.

Incentive scheme: Bonus schemes could be introduced, where additional payments above the threshold are split between stakeholders (e.g., 50% to investors and 50% to service providers). This would help align incentives among stakeholders and encourage the achievement of better outcomes.

Gender threshold bonus: A bonus threshold could be included to reward exceeding gender-specific outcome targets. Efforts should be made to ensure the design avoids creating perverse incentives, such as prioritising girls over boys.

7. Conclusion

The STEM gender gap in Mexico is a critical issue with significant consequences and societal costs. Addressing this challenge requires a holistic approach involving multiple stakeholders, but one of the most impactful strategies lies in tackling it through education. The proposed intervention by PYMO Hub, in collaboration with Lab4U and UNETE, is particularly relevant as it focuses on prevention, aligning with both the goals of reducing the STEM gender gap and the core purpose of SIBs, to invest in solutions that prevent future problems.

This feasibility study demonstrated a broad price range within which a SIB can be designed to generate cost savings compared to public education spending in Mexico, while still delivering a return on investment. It also showed a payment structure that is outcome-driven, ensuring accountability and measurable impact while prioritising the encouragement of girls to pursue STEM careers.

Funding this intervention through a SIB will contribute to closing the STEM gender gap in Mexico while showcasing an innovative financing mechanism in a country with only one other SIB. This initiative could inspire broader stakeholder engagement and pave the way for more outcomes-based approaches to tackling social challenges.

8. References

- Andrade Baena, Gina. 2023. *Informe sobre la Brecha de Género en STEM en la Formación Técnico Profesional (EFTP) en México.* Mexico City. Movimiento STEM, OIT, and UNICEF. https://www.unicef.org/mexico/informes/informe-sobre-la-brecha-de-genero-en-stem-en-la-formacion-tecnico-profesional-en-mexico
- Anselmo, Margarida. 2022. "Maze and Social Impact Bonds: a 7-year journey". Maze Impact. 2022. https://maze-impact.com/blog/sibs-a-7-year-journey
- Barclay, Lisa and Tom Symons 2013. *A Technical Guide to Developing Social Impact Bonds.* London. Social Finance. https://www.socialfinance.org.uk/insights/a-technical-guide-to-developing-social-impact-bonds
- Beltrán Castillo, Tania. 2024. *Mujeres en la Ciencia y Tecnología: Presupuesto para los Desafíos del Mercado Laboral.* Mexico City: Centro de Investigación Económica y Presupuestaria, A.C. (CIEP). https://ciep.mx/wp-content/uploads/2024/03/Mujeres-en-la-Ciencia-y-Tecnologia.-Presupuesto-para-los-desafios-del-mercado-laboral..pdf
- Bridges Impact+. 2014. *Choosing Social Impact Bonds: A Practitioner's Guide*. London. Bridges Ventures LLP. https://www.bridgesfundmanagement.com/2014/10/31/choosing-social-impact-bonds-practitioners-guide/

- Carreño, María José, Juan C. Castro-Alonso, and María José Gallardo. 2022. *Interest in Physics After Experimental Activities with a Mobile Application: Gender Differences.* Int J of Sci and Math Educ 20, 1841–1857. https://doi.org/10.1007/s10763-021-10228-4
- Centre For Public Impact (CPI). 2016. "Social impact bonds for early childhood education in Utah". Centre For Public Impact. April 7, 2016. https://www.centreforpublicimpact.org/case-study/social-impact-bonds-early-childhood-education-utah
- Council of European Professional Informatics Societies (CEPIS). 2024. "Best Practice in the Spotlight: Million Women Mentors". Council of European Professional Informatics Societies. June 25, 2024. https://cepis.org/best-practice-in-the-spotlight-million-women-mentors/
- Government Outcomes Lab. 2015. Academia de Codigo Junior (Junior Code Academy). https://golab.bsg.ox.ac.uk/knowledge-bank/indigo/impact-bond-dataset-v2/INDIGO-POJ-0063/
- Government Outcomes Lab. 2020. Toolkit - Technical Guidance - Setting and measuring outcomes. https://golab.bsg.ox.ac.uk/toolkit/technical-guidance/setting-measuring-outcomes/
- Government Outcomes Lab. 2021. Toolkit - Technical Guidance - Pricing Outcomes. https://golab.bsg.ox.ac.uk/toolkit/technical-guidance/pricing-outcomes/
- Government Outcomes Lab. 2023. Impact Bonds. https://golab.bsg.ox.ac.uk/the-basics/social-impact-bonds/
- Government Outcomes Lab. 2024. UBBU: Learn to code. golab.bsg.ox.ac.uk/knowledge-bank/indigo/impact-bond-dataset-v2/indigo-poj-0209/

- Government Outcomes Lab. 2022. Quality Education India Development Impact Bond. https://golab.bsg.ox.ac.uk/knowledge-bank/case-studies/quality-education-india-dib/
- Gras, Marlene, and Carolina Alí Fojaco. 2021. *Estrategia Educación STEM para México. Visión de Éxito Intersectorial del Eje Estratégico: Educación STEM - Inclusión con Perspectiva de Género y Foco en Mujeres*. Mexico City: Movimiento STEM. https://movimientostem.org/wp-content/uploads/2022/01/Estrategia-Educacion-FINAL.pdf
- Gustafsson-Wright, Emily, Meg Massey, and Sarah Osborne. 2020. *Measuring the Success of Impact Bonds: Are Impact Bonds Delivering Outcomes and Paying out Returns?*. Global Economy and Development at Brookings. https://www.brookings.edu/articles/are-impact-bonds-delivering-outcomes-and-paying-out-returns/
- Gustafsson-Wright, Emily, Sophie Gardiner, and Vidya Putcha. 2025. *The Potential and Limitations of Impact Bonds: Lessons from the First Five Years of Experience Worldwide.* Brookings Institution. https://www.brookings.edu/wp-content/uploads/2016/07/Impact-Bondsweb.pdf
- Hemelt, Steven, Kevin Stange, Fernando Furquim, Andrew Simon, and John Sawyer. 2018. *Why is Math Cheaper than English? Understanding Cost Differences in Higher Education*.
- "Historial 2024 del tipo de cambio del dólar estadounidense (USD) al peso mexicano (MXN)." 2024. exchange-rates.org. Accessed November 24, 2024. https://www.exchange-rates.org/es/historial/usd-mxn-2024.

- Instituto Mexicano para la Competitividad (IMCO). 2022. "Bachillerato, el escalón frágil de la educación". IMCO Centro de Investigación en Política Pública. October 13, 2022. https://imco.org.mx/bachillerato-el-escalon-fragil-de-la-educacion/
- Instituto Mexicano para la Competitividad (IMCO). 2023. "Falta presupuesto para atender los retos educativos". IMCO Centro de Investigación en Política Pública. November 7, 2023. https://imco.org.mx/falta-presupuesto-para-atender-los-retos-educativos/
- Instituto Mexicano para la Competitividad (IMCO). 2023. "Mujeres en STEM en los estados". IMCO Centro de Investigación en Política Pública. February 9, 2023. https://imco.org.mx/mujeres-en-stem-en-los-estados/
- Madry, Kylie. 2024. "Mexico could boost GDP by $391 billion if most women worked, report finds". Reuters. August 2024. https://www.reuters.com/world/americas/mexico-could-boost-gdp-by-391-billion-if-most-women-worked-report-finds-2024-08-20/
- "Mexico Inflation Rate 1960-2024 | MacroTrends." n.d. Macrotrends. Accessed November 24, 2024. https://www.macrotrends.net/global-metrics/countries/mex/mexico/inflation-rate-cpi.
- MAZE, Calouste Gulbenkian Foundation, and Lisbon City Council. Learnings and Outcomes of the Pilot Project "Social Impact Bond - Junior Code Academy." April 2018. https://golab.bsg.ox.ac.uk/documents/Lisbon_SIB_Executive_Summary.pdf
- Nazari Chamaki, Foroogh, Glenn Paul Jenkins, and Majid Hashemi. 2018. "Social Impact Bonds: Implementation, Evaluation, and Monitoring." International Journal of Public Administration 42 (4): 289–97. doi:10.1080/01900692.2018.1433206.

- OECD. 2016. *Understanding social impacts bonds*. OECD Local Economic and Employment Development (LEED) Papers, No. 2016/06, OECD Publishing, Paris, https://doi.org/10.1787/7e48050d-en.
- Piloto, Carla. 2023. "The Gender Gap in STEM: Still Gaping in 2023". Massachusetts Institute of Technology. March 13, 2023. https://professionalprograms.mit.edu/blog/leadership/the-gender-gap-in-stem/
- "Programas de Estudio para la Generación 2023 - 2026 y Subsecuentes." n.d. DGB. Accessed December 7, 2024. https://dgb.sep.gob.mx/programas-de-estudio.
- PYMO Hub. 2024. Impacto social y ambiental en un sólo lugar - PYMO Hub. https://PYMOhub.com
- Sáenz-Zulueta, Claudia and Cristina Pombo, 2018. *¿Y esto para qué sirve? La indagación científica como clave de la enseñanza de competencias STEM para el siglo XXI.* Ciudad de México:BID.
- Savell, Louise, Chloe Eddleston, and Rebecca Luff. 2024. *Lessons Learnt from Educate Girls' Project Maitri: Outcomes based approaches to locally led development.* London. Social Finance International. https://golab.bsg.ox.ac.uk/knowledge-bank/resource-library/Lessons-Learnt-from-Educate-Girls-Project-Maitri/
- United Nations Educational, Scientific and Cultural Organization (UNESCO). 2017. *Cracking the code: Girls' and women's education in science, technology, engineering and mathematics (STEM)*. Paris, France: UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000253479

- Verga Matos, Pedro. And Tania Pereira Christopoulos. 2023. *Social Impact Bonds: A Review of their Strengths and Weaknesses.* European Review of Business Economics II(2): 83-103; DOI: https://doi.org/10.26619/ERBE-2022.2.2.4.

9. Appendices

Appendix 1. Theory of change of *STEM para Niñas* intervention

Inputs	Activities	Outputs	Outcomes	Long-Term Impact
What we have, our resources invested to carry out activities.	What we do with the resources to achieve the objectives.	The metrics. The direct product and immediate results of the activities.	What results from the output, the medium-term impact that affects beneficiaries.	Long-term results that contribute to the desired social or environmental impact.
Funding	Program managing	Adoption of the app in class by teachers	**Improved attitude of girls towards STEM subjects**	Increased chance of girls choosing STEM careers
Trained teachers	Teacher training with gender focus	Science experiments made in class	**Increased interest of girls in STEM fields**	Greater representation of women in STEM fields
Phones	Teaching through Lab4U apps	Participation and engagement of girls in experiments	**Stronger understanding in STEM subjects for girls**	Improved economic opportunities for women in STEM
Lab4U apps and team			**Enhanced STEM skills for girls**	

Appendix 2. Calculations for proportionate cost of STEM subjects

Proportionate Cost of STEM subjects

Mexico's Secondary Education Curricula	Costs according to Delaware Cost Study (USD)
First Year	
Mathematics	167
Ethics	176
Reading and Writing Workshop	201
Computer Science	240
English	201
Chemistry	241
Research Methodology*	208

Second Year	
Mathematics	167
Physics	283
Biology	225
History of Mexico	196
Literature	201
English	201
Total	**2,707**
STEM subjects (Biology, Physics, Chemistry)	**749**
Weighted Distribution of STEM subjects	**27.67%**

*An average of all was used since there's no similar subject to match

Appendix 3. Estimated budget of intervention *STEM para niñas*

Assumptions

Number of schools	5
Average number of students per school (1st, 2nd and 3rd grade)	300
Duration of the project (years)	3
Total students impacted	2500

Cost per year (USD)	$231,233
Total project cost (USD)	$693,700
Cost per student per year (USD)	$154
Cost per student impacted (USD)	$277

Cost Structure

Actor	Cost Components	Unit of cost	Unit	Cost per unit	Cost per school	Cost per school per year	Cost per year	One time cost
Lab4U	Teacher training sessions	Training costs per school	4	$700	$2,800	-	-	
	Training sessions expenses	Travel expenses per person	2	$2,000	-	-	-	$4,000
	App licenses for student use	License fees per student	300	$25	-	$7,500	-	
	Project management	Salary of PM per month	10	$1,000	-	-	$10,000	
UNETE (NGO)	School coordination and communication	Salary per month	10	$650	-	$6,500		
	Mobile phones	Mobile phones cost	300	$150	$45,000	-	-	
	Implementation oversight	On-site monitoring costs per month	10	$650	-	$6,500		
	Internet connectivity and maintenance of schools	Internet setup and monthly fees	10	$100	-	$1,000	-	
PYMO (Intermediary)	Staff salaries for project coordination and reporting	Salaries per month	12	$1,200	-	-	$14,400	
	Evaluation and data analysis	Costs for evaluation	1	$10,000	-	-	$10,000	
	Legal structuring and capital raising	One time cost	1	$25,000	-	-	-	$25,000
					$47,800	**$21,500**	**$34,400**	**$29,000**

Appendix 4. Cost saving calculations with different IRR

IRR	IRR 1	IRR 2	IRR 3
Intended return to investors	7.00%	15.00%	20.00%
Inflation past 4 years	5.57%	5.57%	5.57%
Inflation adjusted return rate	1.40%	9.00%	13.70%
Outcome payment: Government expenses savings (commissioner savings)	**IRR 1**	**IRR 2**	**IRR 3**
Total payment return (USD)	$723,245	$898,362	$1,019,655
Value per outcome (USD)	$599	$599	$599
Cost per outcome (USD)	$277	$277	$277
Price per outcome (USD)	**$289**	**$359**	**$408**
Savings per outcome (USD)	**$310**	**$240**	**$191**

Appendix 5. Real cost per student in each scenario

Real cost per student: What each student would cost to the investor in each scenario (investors savings)				
Outcome/output metric	**Cost per student**	**Cost per student**	**Cost per student**	**Cost per student**
Increased participation of students in the subject	$250	$156	$156	$125
Improved understanding on the subject matter	$208	$208	$83	$69
Increased interest in STEM career	$173	$173	$69	$58
Real cost per student (USD)	**$631**	**$538**	**$309**	**$252**
Savings per student (USD)	**-$32**	**$62**	**$291**	**$347**