TECHNOVATION Girls Chile

<Tecnología /con nombre de: mujer>

MetLife Foundation

TECHNOVATION PROGRAM REPORT FOR THE METLIFE FOUNDATION 2021 - 2024

1. Introduction

The non-governmental organization Tecnología con Nombre de Mujer (TecMujer) has been developing the 21st Century Digital Skills program based on the Technovation Girls curriculum since 2018. The organization has systematically carried out measurements at educational institutions and in interschool workshops where the program has been implemented. Starting from 2021, we rethought the application and methodology of this measurement process and, as the Technovation Girls Chile team, developed a unified framework to shed light on the program's effects on STEM vocations, particularly considering the curriculum's influence.

This report presents the results of the impact measurement of the Technovation Girls Chile program, focusing on the educational institutions that have been supported by the MetLife Foundation. It builds upon the 2021-2023 longitudinal report and the 2024 report, both available on the Technovation website[1].

The main objective of TecMujer, through Technovation Girls Chile, is to foster STEM vocations among girls and young women. This program is held in more than 100 countries, each developing its implementation and evaluation processes independently while adjusting these guidelines to the local context, which allows a better alignment between the general objectives and the reality where the Technovation program is carried out.

In Chile, we use a "Project-Based Learning" model that is implemented at schools (high schools and colleges) that coordinate with the NGO on a voluntary basis. Teachers are trained in the program's curriculum that addresses various topics and methodologies of technology, problem definition, and project management. Students from these educational institutions participate in the program as part of a course (usually technology). This modality is called the 21st Century Digital Skills Development Program.

Several educational institutions participated thanks to the MetLife Foundation, whose support reached a total of 6322 first- and second-year high school students (I° y II° medio, equivalent to U.S. 9th and 10th grades) from 2022 to 2024.

Table 1.1 Participants and educational institutions in the program by year

Year	Educational Institutions MetLife	Students METLIFE
2022	5	1.490
2023	6	2.088
2024	11	3.057

*In 2024, figures were estimated for institutions whose data had not been updated by MINEDUC (Ministry of Education of Chile)

[1] https://technovation.cl/impacto/#programas

2. Impact Measurement: Methodology

a) Approach and objectives

During the program, we survey participants at the start and end of the program. For analysis, only the subset of students who responded to both surveys is taken into account to ensure data comparability[2]. **A longitudinal comparison (measurement of the same group over time) can be considered more accurate** than assessing evolution (improvement or change) by measuring solely at the end of the process, which can lead to recall biases and reliability concerns.

The survey tracks the following variables: career interests, attitudes toward technology, perception of self-efficacy across multiple dimensions, and "technological thinking" defined as skills related to technology projects, including:

- understanding of basic technological concepts and technology project management methodologies;
- problem-solving of logical challenges through "systems thinking" (the use of sequence logic, hierarchical reasoning, and selection of relevant variables).

In 2024, we added new questions to assess conceptual understanding, business-problem and design-problem solving, with emphasis on user-centered processes.

During the measurement process, we continually adjusted the phrasing of certain questions and implemented improvements so as to maximize participants' engagement in both the baseline and endline measurements and to improve measurement accuracy.

Within the program, the main focus is to keep track of the development of **inductive learning**[3] of "technological thinking." Learning is considered inductive because participants engage deeply with content by executing real-world projects and because knowledge emerges as a by-product of project immersion rather than memorization. This approach aligns with deep learning[4] (which emphasizes building skills to apply knowledge to real-world situations and to solve novel problems)[5].

---

[2] This methodological definition has a counterpart or "trade-off" since there is a participation bias (or unitary attrition) because the goal is to achieve census representation rather than sample representation.

[3] Prince, M. J., & Felder, R. M. (2006, November). The many faces of inductive teaching and learning. Journal of College Science Teaching.

[4] The concept of "deep learning" referred to algorithms used in artificial intelligence has been distinguished from the concept of "deep learning" that occurs in students.

[5] Chin, C., & Brown, D. E. (2000). Learning in science: A comparison of deep and surface approaches. Journal of Research in Science Teaching, 37(2), 109–138.

b) Study Population

For this study, we conducted a census of all individuals enrolled in the program for the entire period (even if they did not necessarily submit projects).

For this report, we included every participant from MetLife-supported educational institutions (schools) in the study population. All participants were contacted to respond to the survey, but not everyone did so, and some only responded to the workshop's baseline survey. Table 2.1 shows the number of MetLife-supported schools and students, the weighted average School Vulnerability Index (SVI), and the number of respondents who completed both the baseline and endline surveys.

Table 2.1 Participation of Educational Institutions and Students in the Program

Year	Educational Institutions MetLife	Students MetLife	Weighted Average SVI[6]	Respondents MetLife
2022	5	1.490	88,6%	128
2023	6	2.088	83,4%	691
2024	11	3.057	88,3%	1.057

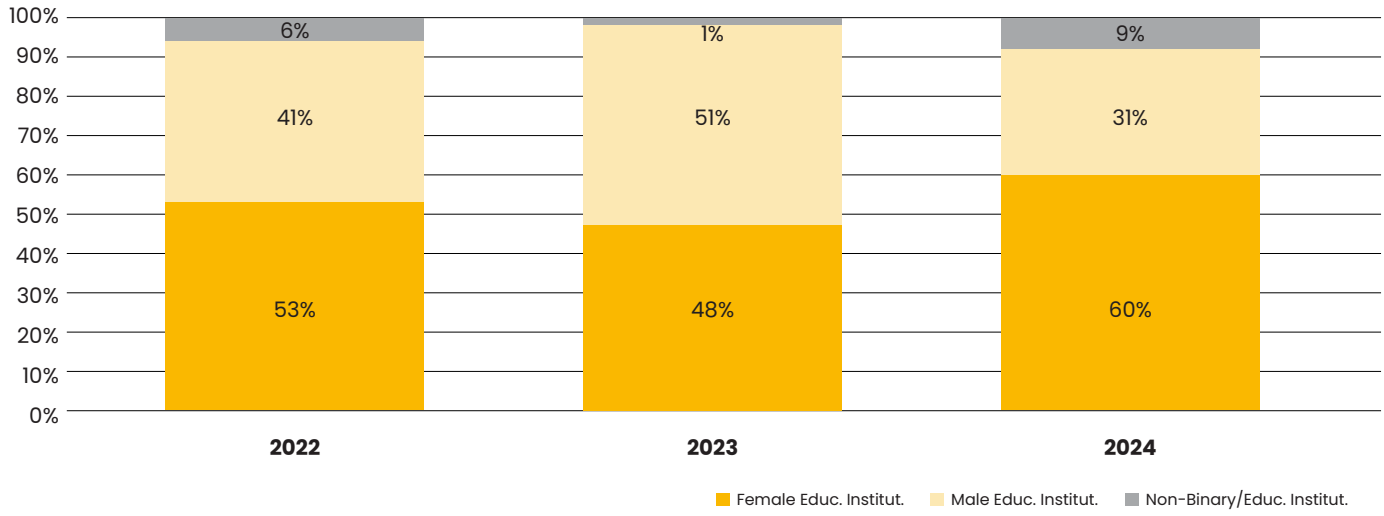
In Table 2.2, the number of respondents is presented by gender, and Graph 2.1 displays the percentage distribution by gender. In 2024 specifically, more all-female institutions were included in the program, which explains the higher number of female respondents.

Table 2.2 Respondents by Educational Institution and Year

Year	Female Educational Institutions	Male Educational Institutions	Non- binary* Others Educational Institutions
2022	68	52	8
2023	332	349	10
2024	635	329	93

[6] The School Vulnerability Index (SVI) is an indicator used in JUNAEB's School Feeding Programs (PAE) to approximate a school's risk of student dropout through a socioeconomic assessment of its students. It is calculated for basic and secondary education students and serves as a criterion for the allocation of PAE resources. The SVI is constructed from data provided by the National Equity-Based Allocation System (SINAE), producing values from 0 to 1 (percent) that reflect the **percentage of the total number of students at an educational institution who have priority to receive the School Feeding.**

Graph 2.1 Respondents – Distribution by Gender



3. Analysis of results of MetLife-supported Educational Institutions

In this section, we analyze METLIFE-supported institutions. The analysis will focus on:

- Identifying the evolution of technological thinking, both in conceptual understanding and systems thinking, using the same questions from the 2021-2023 study.
- Identifying the evolution of project-planning aspects, in particular design and user-centered processes (applied only in the 2024 version).
- Identifying the evolution of the "impact of digital technology on my future occupation" variable as an approximation—since, given the program's setup at educational institutions, participants' career choices are largely determined before the program begins (e.g., families select the available degrees). Thus, this variable is used to assess interest in digital technology related to the future career choice of the program's participants.

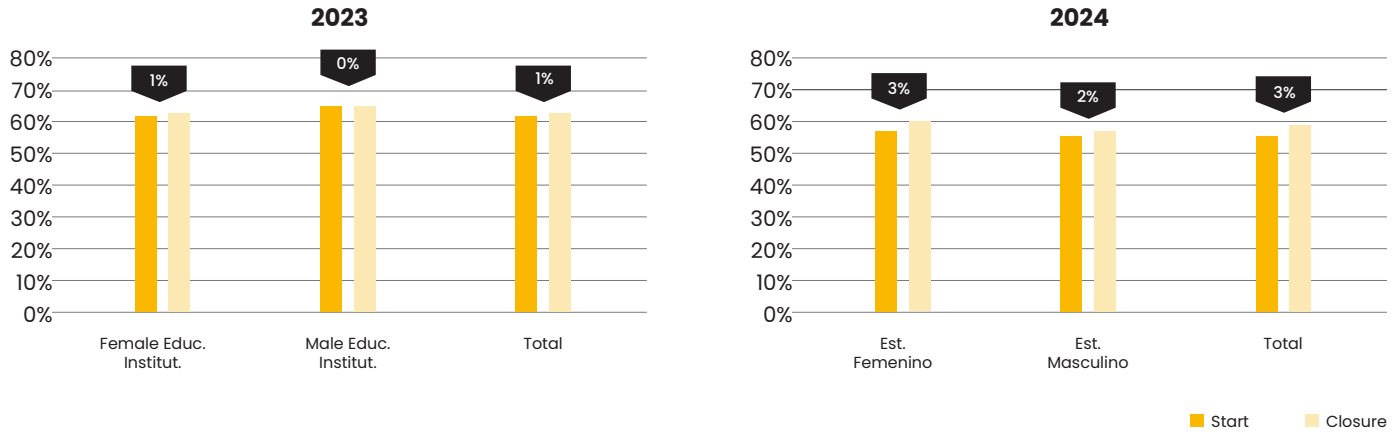
Given participation rates, we chose to focus the analysis on 2023 and 2024 data since in these years, we witnessed the highest response rates among MetLife-supported educational institutions (33% and 35%, respectively).

It is also important to note that the graphs do not display the evolution of the non-binary gender group due to its small sample size.

In addition to response rate considerations, it should be considered that the study population of educational institutions changed significantly, so comparing results between the years is not recommendable (only two schools participated in both measurements). This shift led to substantial variations in participation by gender and, as shown in Table 2.2, to a higher average vulnerability index for educational institutions in 2024 compared to 2023.

3.1 Evolution of Conceptual Understanding:

Graph 3.1 Technology Conceptual Understanding

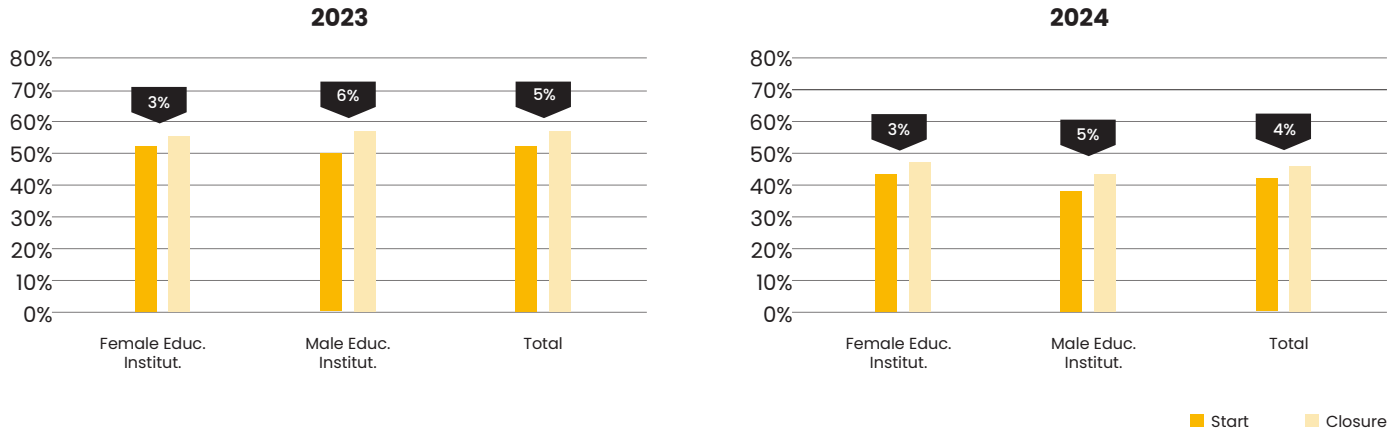


In 2023, this measure started at a high baseline level (64%), which typically means there is little room for improvement by the endline measurement. Indeed, there was only minimal change. That year, the baseline gender gap (4% lower for female participants) narrowed by 1%.

In 2024, the baseline level of the measure was lower (56%), with virtually no gender gap (57% for females vs. 56% for males). By the endline measurement, female participants exhibited a 3% increase, which is slightly higher than a 2% increase seen among male participants.

3.2 Systems Thinking

Graph 3.2 Systems Thinking



In terms of systems thinking, in the 2023 baseline measurement, we observed a slight gender gap favoring female participants (53 % vs. 51 % for males). By the endline measurement, males showed a larger gain (6 % for males vs. 3 % for females), bringing both groups to nearly the same level (56 %).

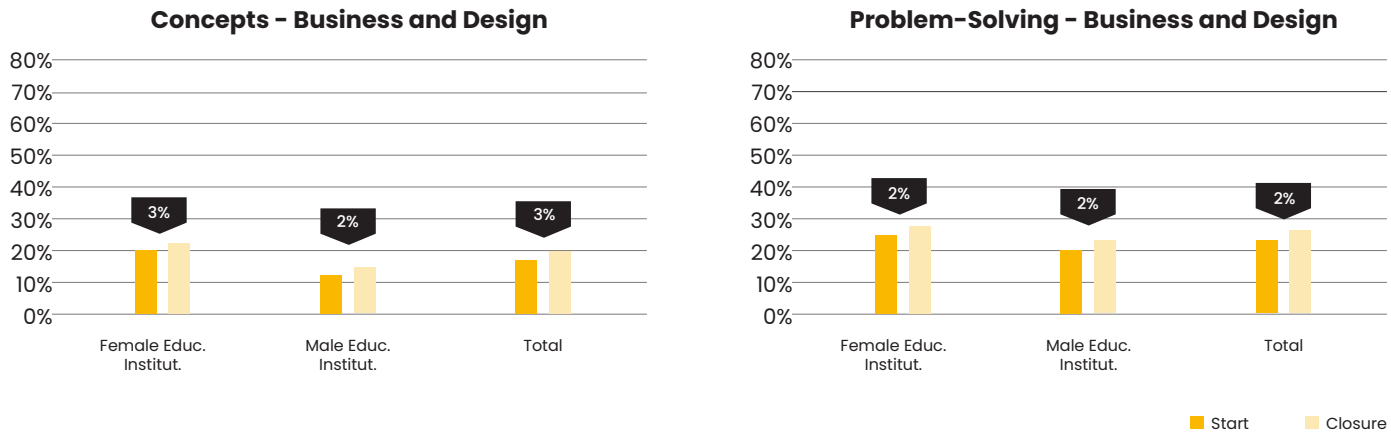
In 2024, overall performance in these variables began at a lower level than in the previous year's measurement (reflecting different educational institutions with higher vulnerability). In the baseline measurement, there was a significant 6 % gender gap in favor of females (44 % for females vs. 38 % for males). In the endline measurement, females accounted for 47 % whereas males represented 43% in this parameter.

3.3 Business Thinking and User-Centered Design

As mentioned above, the Technovation's program is defined by learning through projects. Therefore, the technological aspects are complemented by those that give meaning to the project; particularly, the project development process includes iterations and validations so as to increase the likelihood of adoption and impact among potential users.

Given that, in 2024, we added question modules covering both elements under the dimension "Business Thinking and User-Centered Design," which includes questions on conceptual understanding and solving business problems or logical challenges.

Graph 3.3 Business Thinking and User-Centered Design

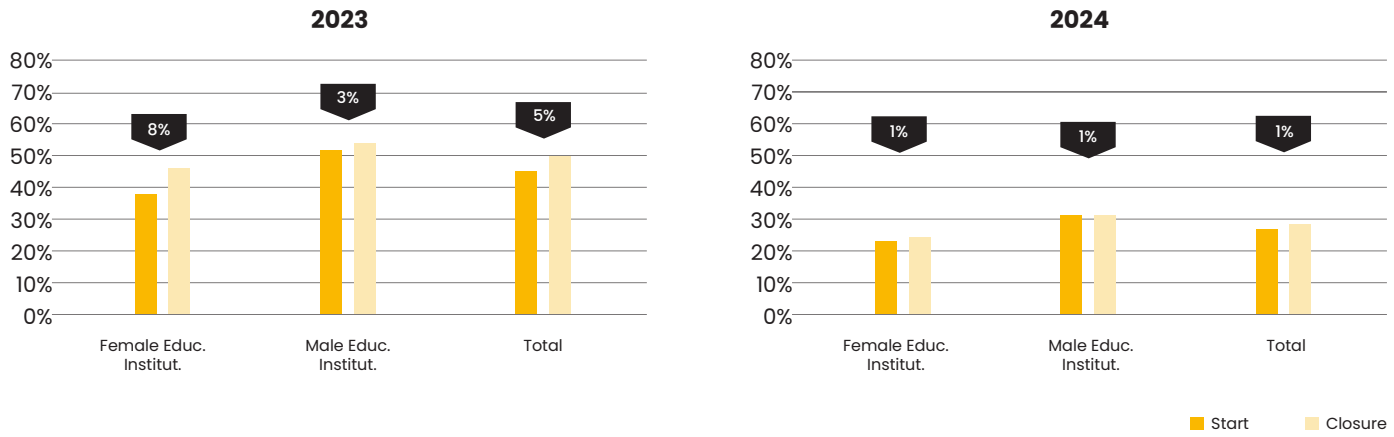


In both categories, it is noteworthy that female participants started and finished at levels comparable to their male counterparts. In terms of conceptual understanding, females outperformed males by 7% in the baseline measurement (20% for females vs. 13% for males) and achieved a slightly greater improvement in the endline measurement (3% gain for females vs. 2% gain for males).

3.4 Impact of Technology on Future Career

As part of the program's objectives is to encourage all participants to consider STEM fields in their future careers. For schools and educational institutions, we use the question on the perceived impact that digital technology will have on their future profession.

Graph 3.4 Attitude: Impact of Digital Technology on my Area of Interest



The bars reflect the % of values 4 and 5 (the highest) on the axis "agree" or "very much" with the proposed statement.

In 2023, this perception began with a substantial gender gap: 51 % of male participants believed that technology would impact their future career, which was 13 % more than their female counterparts: 38 % of females thought similarly. By the endline measurement, women increased that perception by 8 %, compared with a 3 % improvement among men, narrowing the baseline gap by 5 %

In 2024, given a different, larger cohort with higher vulnerability indices, the overall level of this indicator was substantially lower (28 %), and the baseline gender gap was smaller (25 % of females vs. 35 % of males believing technology would impact their future occupation). In the endline measurement, both genders showed only slight improvement, leaving the gap practically unchanged.

4. Teamwork

a) Importance of Teamwork

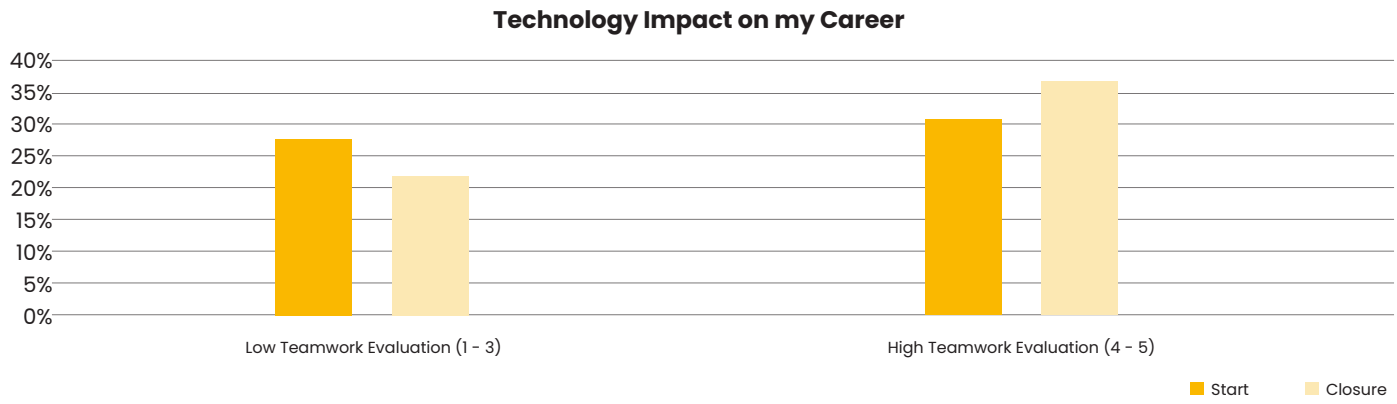
One of the main lessons from the 2023 Technovation study is that the teamwork experience is strongly associated with changes in key variables, such as the perceived importance of technology and the understanding of digital technology projects.

In this section, we compare participants who rated their teamwork poorly at the end of the program (scores from 1 to 3) with those who rated it well (scores from 4 to 5) to see how these parameters evolved.

In Graph 4.1, both evaluated groups started the program with similar levels of perceived technological impact on their future career (28 % for the low-rating group vs. 31 % for the high-rating group). In the endline measurement, the low-rating group's perception fell by 6 % (reaching 22 %) while the high-rating group's perception rose by 6 % (reaching 37 %).

In other words, a positive teamwork experience during the project development improved participants' perception of technology's relevance to their future career choice.

Graph 4.1 Correlation between Teamwork Evaluation and Perception of Technology's Impact

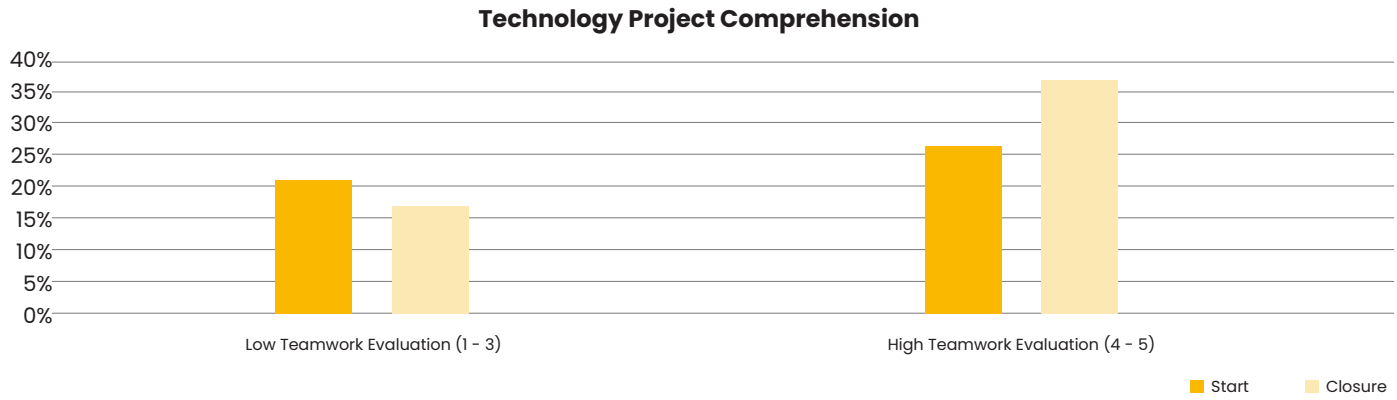


Bars reflect % of answers 4 and 5 in the question "How much do you think you will be affected by digital technology?" (where 1 is "not at all" and 5 is "a lot")

On the other hand, teamwork experience has also been shown to significantly affect participants' self-perception of their skills related to technology projects, as reflected in the statement "In general, I understand well what it means to do a digital technology project."

In Graph 4.2, those who had a poor teamwork experience began with a 21 % self-perception of understanding and finished with a slight 4 % decline (17 % in the endline measurement) whereas those who had a positive experience started the workshop with a 26 % self-perception of understanding, which suggests that self-perception may help explain a better teamwork experience, and finished the program with a substantial 11 % increase (37 % in the endline measurement).

Graph 4.2 Correlation between teamwork evaluation and perceived understanding of digital technology projects.



Bars reflect % of answers 4 and 5 in the statement "In general I understand well what it means to do a digital technology project." (where 1 is "strongly disagree" and 5 is "strongly agree").

b) Teamwork Dimensions

As a result of these findings, in 2024, we incorporated some teamwork dimensions to the survey based on the tool "Teamwork Skill Assessment for "Cooperative Learning"[7] (Strom P. & Strom R., 2011) to identify which aspects should be improved or addressed in future versions of the program.

Table 4.1 summarizes teamwork experience assessment by gender and it can be observed that:

- There were no major gender differences in the overall evaluation of the teamwork experience, except for the non-binary gender group, whose score was substantially lower.
- The highest-rated aspects are: a.- good relationships (considering criticism in a friendly, respectful manner), b.- good communication (willingness to share opinions and listen to others) and c.- ability to evaluate evidence and the logic of different viewpoints.

[7] Strom, Paris S.; Strom, Robert D., "Teamwork Skills Assessment for Cooperative Learning"; en revista "Educational Research and Evaluation", v17 n4 p233-251, 2011.

- There are no large gaps in these evaluations between male and female participants, with the largest difference being 4%.

Table 4.1 Evaluation of Teamwork Experience and Teamwork Dimensions

Teamwork Dimensions	Female Educational Institutions	Male Educational Institutions	Non- binary* Others Educational Institutions	Total
Overall evaluation of teamwork experience	46%	48%	27%	45%
Evaluate your team: Fulfillment of assigned roles and responsibilities	45%	45%	35%	44%
Evaluate your team: Willingness to seek and share information	45%	43%	32%	43%
Rate your team: Willingness to share opinions and listen to other points of view	51%	49%	34%	49%
Evaluate your team: Keeping good treatment (courtesy and respect)	55%	52%	50%	53%
Evaluate your team: Ability to evaluate evidence and logic of different opinions	49%	50%	39%	49%

c) Analysis of the Importance of Teamwork Dimensions

To identify which dimension is more important for teamwork, we performed two analyses:

i. In the initial survey, we asked participants to evaluate each of these dimensions in teamwork from 1 (the most important) to 5 (the least important), resulting in an intentional ranking or **conscious or explicit importance ranking**.

ii. In the final survey, we asked participants to evaluate their team first and then to evaluate each of the dimensions of teamwork. We then performed a linear correlation analysis[8], from which we could identify an **implicit importance** ranking based on the real experience of teamwork.

[8] A general linear model was performed, treating each dimension as an independent variable. The model resembles an equation in which the overall teamwork evaluation equals the sum of each dimension's score weighted by its correlation coefficient—where a larger coefficient indicates greater importance. Model quality was assessed by the standardized R^2 value of 0.41, which is considered good, as it explains 41% of the variance in the overall evaluation. All dimensions were statistically significant in the model with $p = 0.000$, except for "Treatment," which had $p = 0.056$

Tabla 4.2.: Importance of Teamwork Dimensions

Dimension	Explicit Priority*	Implicit Priority / Correlation**	Difference
Seeking and sharing information	27,2%	24,5%	-2,7%
Communicating and listening to opinions	23,7%	15,2%	-8,5%
Fulfilling assigned roles and tasks	23,7%	42,0%	18,3%
Respectful treatment (accepting criticism kindly)	15,8%	2,8%	-13,1%
Evaluating evidence and logical reasoning	9,5%	15,2%	5,7%

* Percentages represent the proportion of times that dimension was placed in the first place of importance.

** The percentages represent the proportion of the overall evaluation that is explained by that dimension, taking as total the sum of the standardized coefficients of each dimension.

From Table 4.2 we observe the following:

- The variable that has the largest difference between the explicit prioritization (what students value most before doing the project) and the correlation is "fulfillment of role and work assigned by the group," which becomes the most important variable in the implicit prioritization.
- This means that, from the beginning of the process, teams that develop the habit of giving feedback on the fulfillment of commitments and workload distribution in addition to monitoring these aspects by a facilitator tend to have a better experience.
- The variable "seeking and sharing information" is the highest ranked in the baseline measurement (explicit priority) and ranks second most important by correlation; therefore, it is recommended to provide self-study materials on strategies and tools for information search.
- The variable least cited as an explicit priority—but showing a large discrepancy with its statistical importance/correlation with the overall evaluation—is "ability to evaluate evidence and logical reasoning." Because of this gap, we also recommend dedicating program time to teaching how to assess the quality of information and arguments, within a framework of cordiality and objectivity.
- The variable least mentioned as an explicit priority, yet showing a large difference in the significant importance / correlation with overall evaluation is "the ability to evaluate evidence and logic." Because of this difference, it is also recommended to dedicate time during program implementation to teaching how to evaluate the quality of information and arguments, within a framework of cordiality and objectivity.


1°B
Inicio sesión

5. Conclusions

- In general, many indicators began at higher baseline levels in 2023 than in 2024, which was the year when MetLife-supported educational institutions reached a larger and more vulnerable student population.
- In terms of the main variables of technological thinking, we can observe that:
  - In relation to conceptual understanding, in both years a greater endline improvement is observed for females than for males, and in the 2024 endline measurement females had a higher score than their male counterparts.
  - Regarding systems thinking, in both years, females outperformed their male peers in the baseline measurement. Likewise, in both years there was a consistent overall improvement by 5% in 2023 and 4% in 2024.
- As for business thinking and user-centered design implemented in 2024, it is observed that in two dimensions (conceptual understanding and problem solving) females had higher baseline levels than their male peers, and overall had a gain of 3% in conceptual understanding and 2% in problem solving.
- Regarding the valuation of technology's impact on the future career choice, it can be seen that in both years an initial gender gap was in favor of males, and in 2023, there was a considerable improvement by 8%, particularly among women, which implied narrowing in that initial gap.
- In terms of teamwork variable, it can be observed that one of the themes identified in 2023, which was the importance of teamwork experience, is a factor strongly associated with its evolution: in 2024, those who had a good teamwork experience increased by 6% their perception that technology would affect their future career whereas those who rated the teamwork experience poorly decreased that perception by 6% in the endline measurement.

- Thus, the importance of improving the teamwork experience to maximize the program's activities is reaffirmed, since it determines the evolution of perceived impact/importance and of understanding what it means to carry out a digital-technology project. In that sense, the main adjustment relative to initial expectations would be to address aspects of the distribution and fulfillment of roles and tasks within groups. Therefore, it becomes very relevant that instructors monitor each student's fulfillment of the commitments they make to their team—an aspect valued even more highly than simply getting along well.

Annex:
Educational Institutions supported by the MetLife Foundation

Year / Educational Institutions	Participants	Vulnerability (SVI)
2022	**1.490**	**89%**
Colegio ACHIGA COMEDUC	124	84%
Liceo Comercial Temuco Bicentenario de excelencia	232	94%
Liceo Comercial Vate Vicente Huidobro	210	97%
Liceo José María Narbona Cortes	270	92%
Liceo Politécnico Andes DUOC Renca	654	84%
2023	**2.088**	**83%**
ISCA Instituto Superior de Comercio Gerardo Muñoz Campos A-12	406	84%
Liceo A-1	320	82%
Liceo Bicentenario de Excelencia Polivalente San Nicolás	385	82%
Liceo Bicentenario Domingo Santa Maria	289	84%
Liceo Bicentenario Rafael Donoso Carrasco - Coreduc	348	89%
Liceo Minero B-10 (Calama)	340	78%
2024	**3.057**	**88%**
Bicentenario Nuevo Mundo, Mulchén	276	96%
Colegio ACHIGA COMEDUC	124	82%
Colegio Bicentenario Miguel de Cervantes	280	90%
Colegio Comercial de Peñaflor	334	94%
Liceo Bicentenario de Excelencia Comercial Instituto Superior de Comercio (INSUCO)	490	93%
Liceo Bicentenario de Excelencia Polivalente San Nicolás	385	84%
Liceo Bicentenario de Niñas Maipú	331	68%
Liceo Bicentenario Tecnico de Rancagua	149	91%
Liceo José María Narbona Cortes	270	87%
Liceo Técnico Clotario Blest Riffo - Pedro Aguirre Cerda	204	94%
Liceo Técnico Profesional Patricio Aylwin Azócar, La Granja	214	93%
Total general	**6.635**	**87%**

TECHNOVATION Girls Chile

<Tecnología /con nombre de: mujer>

MetLife Foundation

www.technovation.cl