CIBERISTAS REPORT 2025

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CSOFTMTY

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Ciberistas

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INTRODUCTION

CIBERISTAS

Ciberistas, is an educational program consisting of a sequence of workshops, designed to spark interest in Information Technologies and Engineering among children and youth from elementary to high school, while developing the skills and competencies required to thrive in an increasingly digital and globally connected world.

Throughout this initiative, participating students engage in two essential surveys: one at the commencement of the program and another at its conclusion. This document provides an overview of the statistical analysis, along with comments and observations gleaned from these surveys.

For the 2025 edition of the program, students were expected to dedicate between 20 to 25 hours of active participation each week for in-person workshops and up to 15 hours for online options. This particular cohort was active from November 2024 up to the date of this report. We made a cut in October 2025 in order to prepare this data.

PARTNERS LIST

Motorola Solutions Foundation, for four consecutive years, has allocated funds that enable the purchase of materials, equipment, and the provision of incentives to instructors.

Raspberry Pi Foundation, since 2023, chose Csoftmty as a growth partner, allowing the program to expand by sharing materials and globally validated expertise.

The following universities and organizations generously donate their spaces, in addition to providing instructors, professors, and volunteer university students:

- Tec de Monterrey, Campus Monterrey
- Universidad de Monterrey
- Universidad Autónoma de Nuevo León
- Universidad Regiomontana
- Universidad La Salle del Noreste
- Tec Milenio, Sonora
- Instituto Tecnológico de Sonora CUDDEC
- PROVAY
- Centro de Desarrollo Comunitario de La Salle
- Preparatoria Politécnica de Santa Catarina, UDEM
- Women in Technology, Tec de Monterrey, Campus Monterrey
- Women In Leadership Lenovo

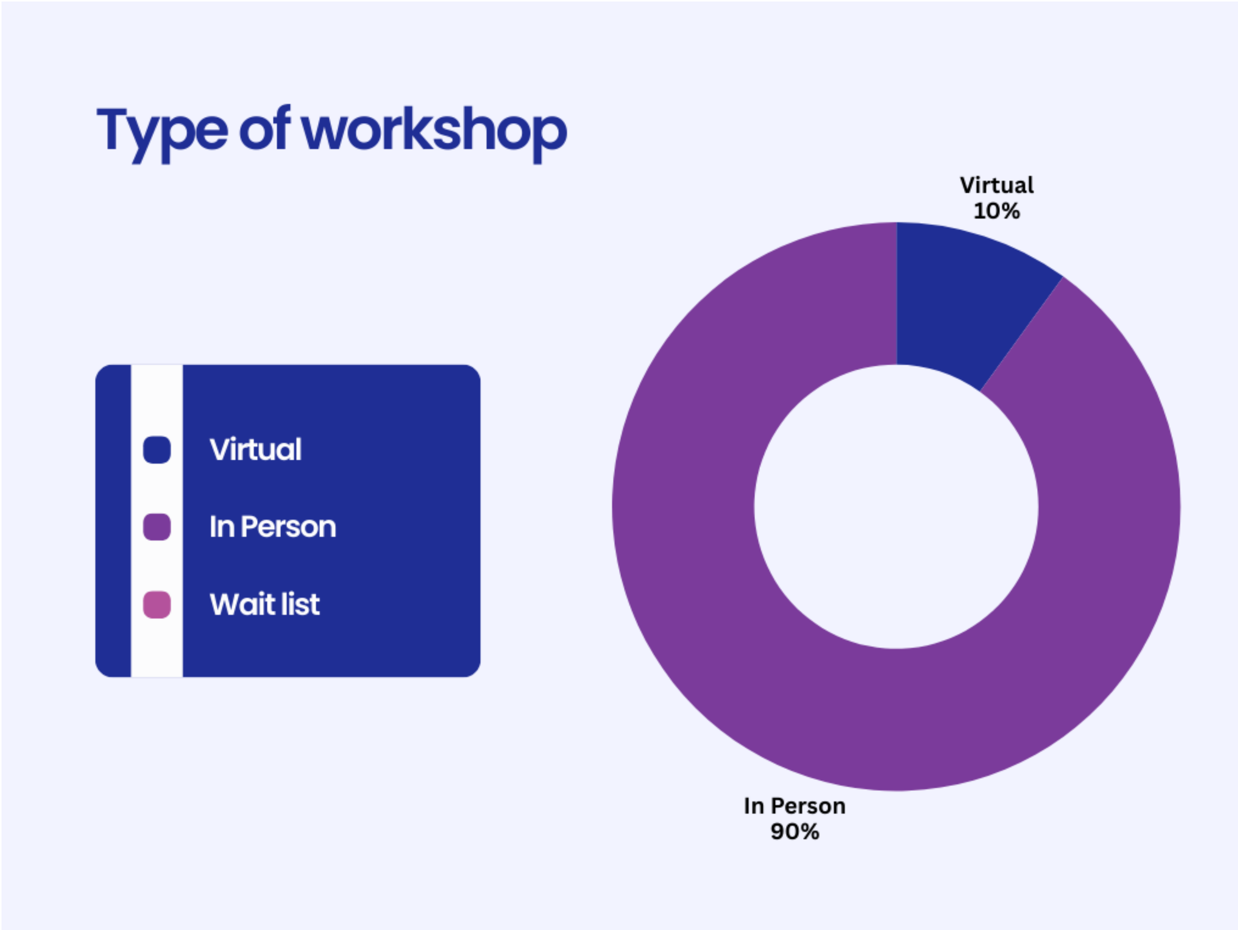
- Accenture
- ACM (Association for Computing Machinery) ,Chapter Monterrey, Tec de Monterrey

The following institutions and companies collaborate with volunteers, as well as promote the program:

- Softtek
- Lenovo (Women in Lenovo Leadership)
- Instituto de Innovación y Transferencia de Tecnología de Nuevo León
- Secretaría de Educación de Nuevo León
- Municipio de Monterrey
- Cheveinig alumni program (United Kingdom Embassy)

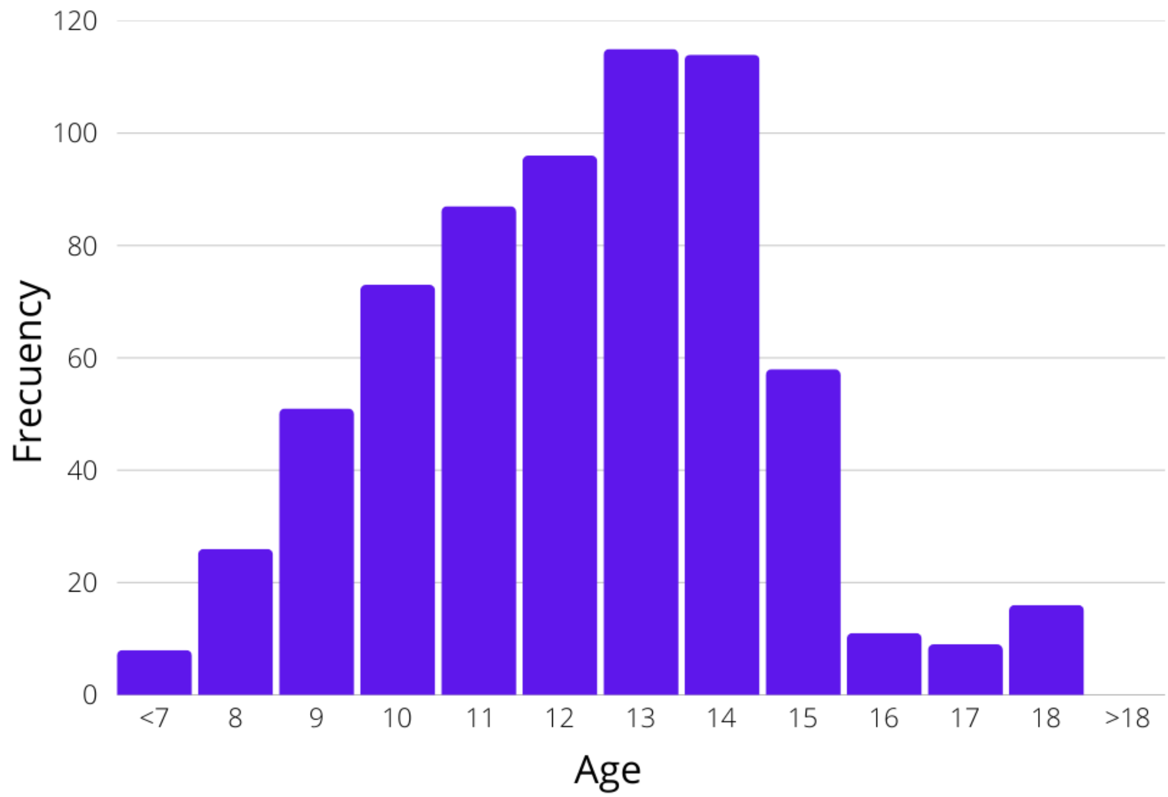
Population description

This report presents an overview of the participants registered in the workshop program, providing a descriptive profile of the students who engaged in the activities. In total, 1,194 students registered for the workshops, which were delivered across 40 sessions, combining both virtual and in-person formats. The vast majority of participants attended in-person workshops (90%), while a smaller proportion participated virtually (10%), as shown in graph 1. No registrations were recorded for waitlists or unregistered attendance, indicating a well-controlled enrollment process.



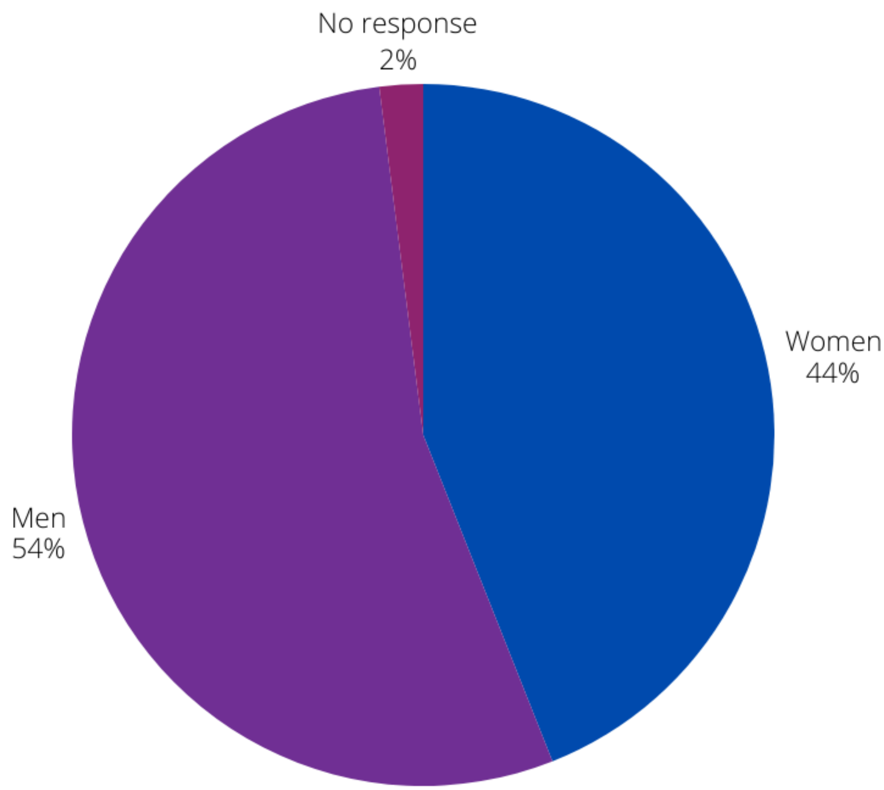
Graph 1. Composition by workshop type.

The participant population shows a broad age range, spanning from 6 to 18 years old, with the highest concentration between 11 and 14 years of age. Specifically, ages 11 to 14 account for a substantial portion of registrations, reflecting strong engagement among middle-school-aged students. Overall, age data were collected for 664 participants, enabling a detailed analysis of the age distribution within the program.



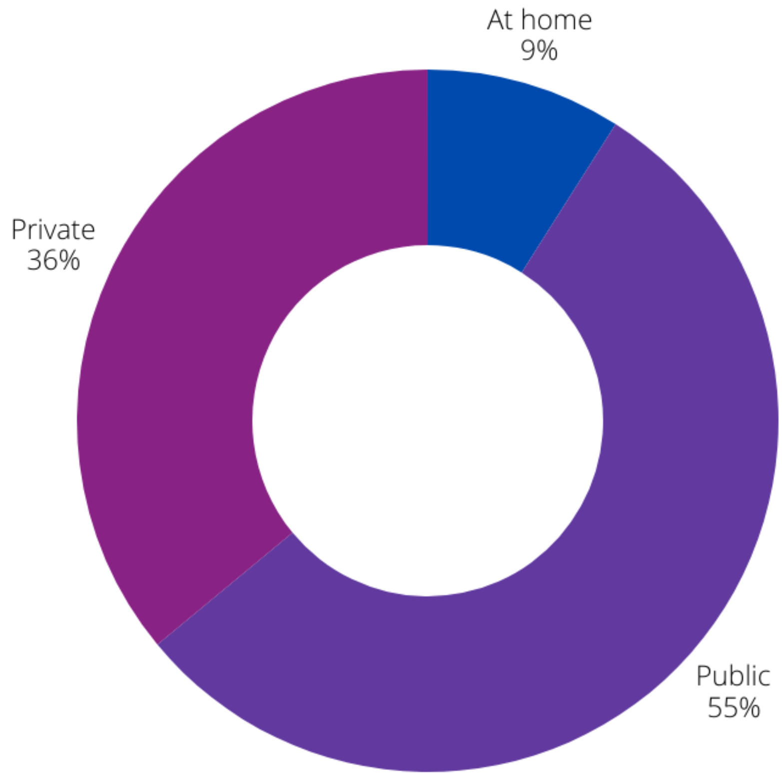
Graph 2. Age

In terms of gender representation, the program achieved a relatively balanced distribution. Of the 1,054 students who reported gender information, 54% identified as male and 44% as female, with no participants selecting the option not to disclose. This distribution suggests meaningful participation from students of different genders, though continued efforts toward equity remain important.



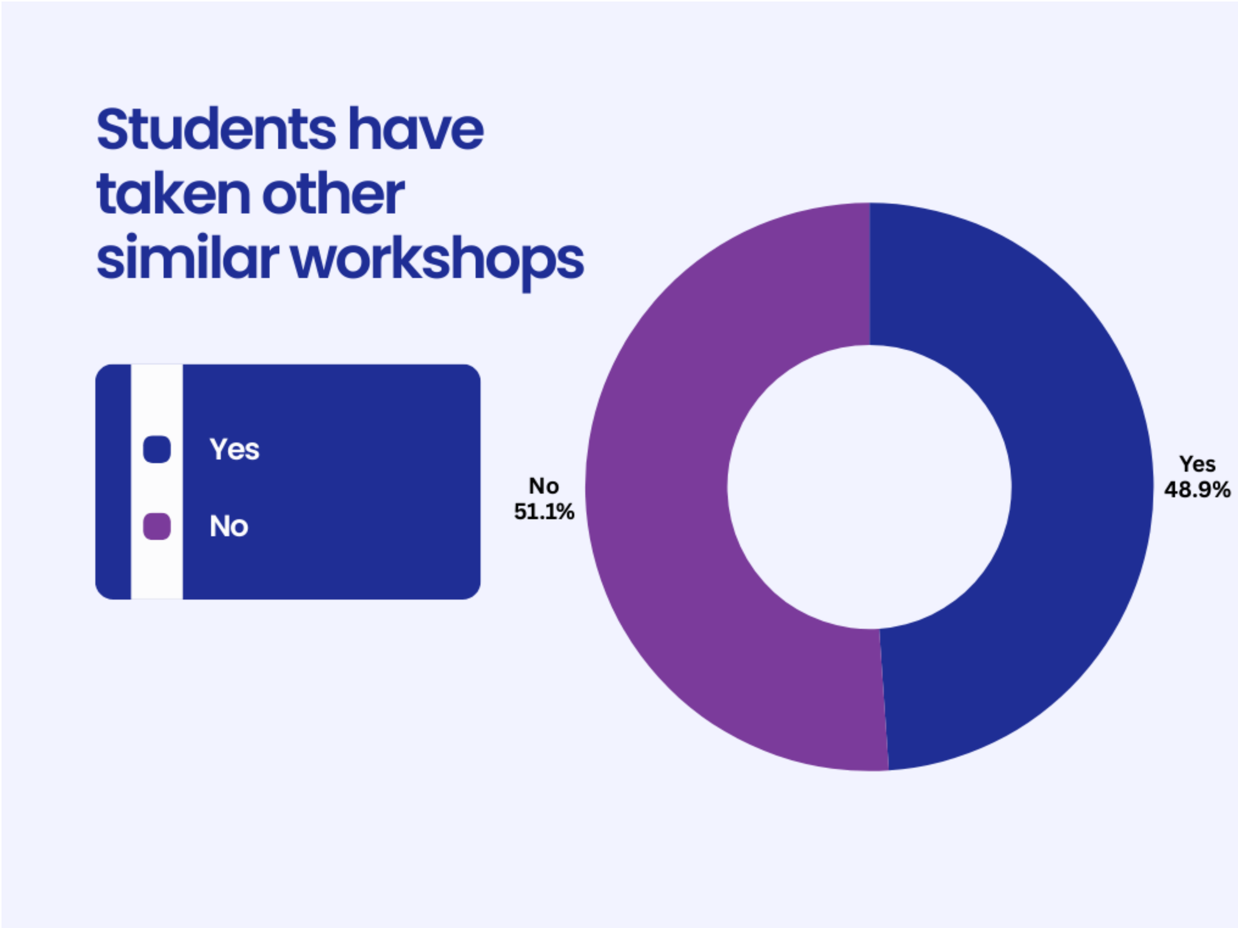
Graph 3. Gender division

Regarding educational background, participants came from diverse schooling contexts. More than half of the students (55%) attended public schools, while 36% were enrolled in private institutions, and 9% reported being educated at home. This diversity highlights the program's reach across multiple educational settings.



Graph 4. Education institution

Finally, nearly half of the participants (48%) indicated that they had attended workshops previously, while 50% reported no prior participation. This balance suggests that the program successfully attracted both returning students and newcomers, supporting both continuity and expansion of engagement. Additionally, 854 students completed post-workshop activities, enabling the collection of outcome and impact data for a large proportion of registered participants.



Graph 5. Similar workshop taken

Together, these data provide essential context for interpreting the findings presented in the remainder of this report, particularly those related to engagement, learning outcomes, and retention across the workshop program.

Program Statistics

Through the utilization of registration forms, surveys, and roll calls, we gain insights from our students. It is important to note that for students to be recognized as fully participating in the program, they need to complete just one workshop out of the various options available to them. In table 1, we have a summary of the workshops available.

Table 1. Workshop summary

	Format	Partner	Workshop
1	In-person	Tec de Mty	Scratch
2	In-person	Tec de Mty	Diseño web
3	In-person	Tec de Mty	Micro bit
4	In-person	Tec de Mty	Code club
5	In-person	Accenture	Coder dojo vanzado
6	In-person	UDEM	UDEM-Grupo 1
7	In-person	UDEM	UDEM-Grupo 2
8	In-person	UDEM	UDEM-Grupo 3
9	In-person	UDEM	UDEM-Grupo 4
10	In-person	UDEM	UDEM-Grupo 5
11	In-person	UDEM	UDEM-Grupo 6
12	In-person	ITSON	Automatiza y crea
13	In-person	ITSON	Phyton (programación para robótica)
14	In-person	Tec de Mty WIT	Scratch
15	In-person	Tec de Mty WIT	Diseño web
16	In-person	Scratch-Instituto Tecnológico de Sonora-CUDDEC ITSON - Provay	Scratch
17	In-person	Instituto Tecnológico de Sonora	Unity1
18	In-person	Instituto Tecnológico de Sonor	Unity2
19	In-person	Instituto Tecnológico de Sonora	Robokids

20	In-person	Instituto Tecnológico de Sonora	Roboteens
21	In-person	Tec de Mty ACM	C++
22	Virtual	Tec de Mty ACM	C++
23	In-person	Tec de Mty ACM	Python
24	Virtual	Tec de Mty ACM	Python VIRTUAL Tec de Mty ACM
25	In-person	Tec de Mty ACM	Scratch PRESENCIAL-Tec de Mty ACM
26	Virtual	Tec de Mty ACM	Scratch VIRTUAL Tec de Mty ACM
27	In-person	Tec de Mty ACM	WEB PRESENCIALTec de Mty ACM
28	Virtual	Tec de Mty ACM	WEB VIRTUAL Tec de Mty ACM
29	In-person	Lenovo+Universidad del norte	Scratch
30	In-person	Lenovo+Universidad del norte	Python
31	In-person	UANL	UANL
32	In-person	UERRE	UERRE
33	In-person	Tecmilenio CUMBRES	Python
34	In-person	Tec de monterrey SS	IA1
35	In-person	Tec de monterrey SS	IA2
36	In-person	SS Tecmilenio Cumbres	Python
37	In-person	SS Tecmilenio Cumbres	Scratch
38	In-person	SS Tecmilenio Cumbres	Unity

39	In-person	Tec de monterrey SS	Scratch 2
40	In-person	Tec de monterrey SS	Micro bit 2

ACTIVATION RATE

The activation rate (also referred to as the *show-up rate*) captures the extent to which registered participants actually begin a workshop. In this program, activation is calculated for each workshop as the proportion of subscribed students who attended Session 1 (Day 1), expressed as a percentage.

This metric is especially useful because it separates *initial engagement* from later attrition: a workshop may have strong enrollment but low activation if many students do not attend the first session. Reporting activation alongside retention metrics provides a clearer picture of participation dynamics, helping distinguish challenges related to recruitment/registration from those related to sustained attendance throughout the workshop.

Table 2. Activation rates per workshop

	Partner	Workshop	Suscrribed	day 1	Activation Rate(%)
1	Tec de Mty	Scratch	29	22	75.86
2	Tec de Mty	Diseño web	21	19	90.48
3	Tec de Mty	Micro bit	27	22	81.48
4	Tec de Mty	Code club	19	17	89.47
5	Accenture	Coder dojo vanzado	24	20	83.33
6	UDEM	UDEM-Grupo 1	28	28	100.00
7	UDEM	UDEM-Grupo 2	28	28	100.00
8	UDEM	UDEM-Grupo 3	28	28	100.00
9	UDEM	UDEM-Grupo 4	28	28	100.00

10	UDEM	UDEM-Grupo 5	28	28	100.00
11	UDEM	UDEM-Grupo 6	28	28	100.00
12	ITSON	Automatiza y crea	30	26	86.67
13	ITSON	Phyton (programación para robótica)	30	30	100.00
14	Tec de Mty WIT	Scratch	41	10	24.39
15	Tec de Mty WIT	Diseño web	38	26	68.42
16	Instituto Tecnológico de Sonora- CUDDEC ITSON - Provay	Scratch	22	21	95.45
17	Instituto Tecnológico de Sonora	Unity1	23	21	91.30
18	Instituto Tecnológico de Sonor	Unity2	19	17	89.47
19	Instituto Tecnológico de Sonora	Robokids	19	19	100.00
20	Instituto Tecnológico de Sonora	Roboteens	21	20	95.24
21	Tec de Mty ACM	C++	26	26	100.00
22	Tec de Mty ACM	C++	20	19	95.00
23	Tec de Mty ACM	Python	27	27	100.00
24	Tec de Mty ACM	Python VIRTUAL Tec de Mty ACM	21	22	104.76
25	Tec de Mty ACM	Scratch PRESENCIAL-Tec de Mty ACM	25	25	100.00

26	Tec de Mty ACM	Scratch VIRTUAL Tec de Mty ACM	19	19	100.00
27	Tec de Mty ACM	WEB PRESENCIALTec de Mty ACM	28	24	85.71
28	Tec de Mty ACM	WEB VIRTUAL Tec de Mty ACM	20	20	100.00
29	Lenovo+Universidad del norte	Scratch	16	7	43.75
30	Lenovo+Universidad del norte	Python	11	7	63.64
31	UANL	UANL	35	23	65.71
32	UERRE	UERRE	31	12	38.71
33	Tecmilenio CUMBRES	Python	15	7	46.67
34	Tec de monterrey SS	IA1	25	14	56.00
35	Tec de monterrey SS	IA2	38	23	60.53
36	SS Tecmilenio Cumbres	Python	17	13	76.47
37	SS Tecmilenio Cumbres	Scratch	21	15	71.43
38	SS Tecmilenio Cumbres	Unity	15	9	60.00
39	Tec de monterrey SS	Scratch 2	28	13	46.43
40	Tec de monterrey SS	Micro bit 2	29	22	75.86

Across the 40 workshops included in the program, activation rates show considerable variability, but overall indicate strong initial engagement in most cases. A substantial number of workshops achieved very high activation, with many reaching 100% show-up rates, particularly among institutional partners such as UDEM, ITSON, Instituto Tecnológico de Sonora, and Tec de Monterrey ACM. These results suggest effective coordination, clear communication with participants, and strong commitment among registered students.

Most workshops exhibited activation rates above 80%, reflecting that the majority of enrolled participants effectively transitioned from registration to active participation. This trend was consistent across both in-person and virtual formats, although virtual workshops occasionally exceeded 100% activation, likely due to late or unregistered participants joining the first session. Such cases highlight the need to interpret activation values above 100% as indicators of open access or flexible attendance rather than over-enrollment.

However, a smaller subset of workshops showed lower activation rates, particularly some sessions associated with specific outreach contexts (e.g., Tec de Monterrey WIT and certain school-based programs), where activation dropped below 50%. These cases point to potential barriers at the registration-to-attendance transition stage, such as scheduling conflicts, competing commitments, or differences in participant expectations.

Overall, the activation rate analysis reveals that while initial engagement was generally strong across the program, targeted strategies could further improve activation consistency in workshops with lower show-up rates.

PARTICIPANT RETENTION RATE

Retention relative to enrollment provides insight into the proportion of registered students who sustained participation through the required number of sessions. Across the program, retention rates calculated over enrolled participants reveal moderate to strong persistence, with noticeable variation depending on workshop length, institutional context, and delivery format.

Table 3. Retention rate

	Format	Partner	Workshop	Registered	Sessions	Retention (%)
1	In-person	Tec de Mty	Scratch	29	6	58.62
2	In-person	Tec de Mty	Diseño web	21	6	57.14
3	In-person	Tec de Mty	Micro bit	27	6	70.37
4	In-person	Tec de Mty	Code club	19	6	78.94
5	In-person	Accenture	Coder dojo vanzado	24	11	41.66
6	In-person	UDEM	UDEM-Grupo 1	28	5	57.14
7	In-person	UDEM	UDEM-Grupo 2	28	5	57.14

8	In-person	UDEM	UDEM-Grupo 3	28	5	57.14
9	In-person	UDEM	UDEM-Grupo 4	28	5	57.14
10	In-person	UDEM	UDEM-Grupo 5	28	5	57.14
11	In-person	UDEM	UDEM-Grupo 6	28	5	57.14
12	In-person	ITSON	Automatiza y crea	30	5	90
13	In-person	ITSON	Phyton (programación para robótica)	30	5	86.66
14	In-person	Tec de Mty WIT	Scratch	41	5	19.51
15	In-person	Tec de Mty WIT	Diseño web	38	5	44.73
16	In-person	Scratch-Instituto Tecnológico de Sonora- CUDDEC ITSON - Provay	Scratch	22	5	100
17	In-person	Instituto Tecnológico de Sonora	Unity1	23	5	100
18	In-person	Instituto Tecnológico de Sonor	Unity2	19	5	100
19	In-person	Instituto Tecnológico de Sonora	Robokids	19	5	100
20	In-person	Instituto Tecnológico de Sonora	Roboteens	21	5	95.23
21	In-person	Tec de Mty ACM	C++	26	5	100
22	Virtual	Tec de Mty ACM	C++	20	5	90
23	In-person	Tec de Mty ACM	Python	27	5	77.77

24	Virtual	Tec de Mty ACM	Python VIRTUAL Tec de Mty ACM	21	5	76.19
25	In-person	Tec de Mty ACM	Scratch PRESENCIAL-Tec de Mty ACM	25	5	96
26	Virtual	Tec de Mty ACM	Scratch VIRTUAL Tec de Mty ACM	19	5	57.89
27	In-person	Tec de Mty ACM	WEB PRESENCIALTec de Mty ACM	28	5	67.85
28	Virtual	Tec de Mty ACM	WEB VIRTUAL Tec de Mty ACM	20	5	90
29	In-person	Lenovo+Universidad del norte	Scratch	16	2	43.75
30	In-person	Lenovo+Universidad del norte	Python	11	2	63.63
31	In-person	UANL	UANL	35	5	68.57
32	In-person	UERRE	UERRE	31	5	32.25
33	In-person	Tecmilenio CUMBRES	Python	15	5	66.66
34	In-person	Tec de monterrey SS	IA1	25	5	48
35	In-person	Tec de monterrey SS	IA2	38	5	42.10
36	In-person	SS Tecmilenio Cumbres	Python	17	5	52.94
37	In-person	SS Tecmilenio Cumbres	Scratch	21	5	61.90

38	In-person	SS Tecmilenio Cumbres	Unity	15	5	80
39	In-person	Tec de monterrey SS	Scratch 2	28	4	53.57
40	In-person	Tec de monterrey SS	Micro bit 2	29	4	65.51

For workshops requiring four sessions to meet the minimum attendance threshold, retention rates commonly ranged between 55% and 90%, with several workshops achieving full retention among enrolled participants. In particular, multi-session programs delivered in structured institutional settings (such as university-affiliated workshops) tended to show higher retention over enrollment, suggesting that stable schedules and institutional support play an important role in sustained participation.

Workshops with longer durations (e.g., six or more sessions, and especially those extending to ten or eleven sessions) exhibited a wider spread in retention outcomes. While some long-format workshops maintained retention levels above 70%, others experienced sharper declines, with retention falling closer to 40–60% of enrolled participants. This pattern reflects the increased challenge of sustaining engagement over extended periods, particularly when participants face competing academic or personal commitments.

Overall, the retention-versus-enrollment analysis highlights that while initial activation was generally high, sustained engagement presents a greater challenge, especially in longer workshops. These findings underscore the importance of adaptive instructional design, consistent communication, and flexible attendance strategies to support participant persistence and maximize completion among enrolled students.

Completion Rate

Estimated completion rates provide a bounded approximation of the proportion of enrolled students who likely met the minimum attendance requirement to complete a workshop. Because individual-level attendance data were not available, completion was estimated using a conservative range defined by a minimum and a maximum value. The minimum estimate is based on sustained attendance in the final sessions, while the maximum estimate reflects the highest plausible number of participants who could have met the attendance threshold given observed session-level participation.

Table 4. Completion rate

	Format	Partner	Workshop	Registered	Sessions	Min number of sessions to complete	Completion rate % (min)	Completion rate % (max)
1	In-person	Tec de Mty	Scratch	29	6	5	58.62	89.66
2	In-person	Tec de Mty	Diseño web	21	6	5	57.14	85.71
3	In-person	Tec de Mty	Micro bit	27	6	5	70.37	81.48
4	In-person	Tec de Mty	Code club	19	6	5	78.95	84.21
5	In-person	Accenture	Coder dojo vanzado	24	11	9	41.67	58.33
6	In-person	UDEM	UDEM-Grupo 1	28	5	4	57.14	92.86
7	In-person	UDEM	UDEM-Grupo 2	28	5	4	57.14	92.86
8	In-person	UDEM	UDEM-Grupo 3	28	5	4	57.14	92.86
9	In-person	UDEM	UDEM-Grupo 4	28	5	4	57.14	92.86
10	In-person	UDEM	UDEM-Grupo 5	28	5	4	57.14	92.86
11	In-person	UDEM	UDEM-Grupo 6	28	5	4	57.14	96.43
12	In-person	ITSON	Automatiza y crea	30	5	4	90.00	90.00
13	In-person	ITSON	Phyton (programación para robótica)	30	5	4	86.67	96.67

14	In-person	Tec de Mty WIT	Scratch	41	5	4	19.51	36.59
15	In-person	Tec de Mty WIT	Diseño web	38	5	4	44.74	63.16
16	In-person	Scratch-Instituto Tecnológico de Sonora-CUDDEC ITSON - Provay	Scratch	22	5	4	100.00	100.00
17	In-person	Instituto Tecnológico de Sonora	Unity1	23	5	4	100.00	100.00
18	In-person	Instituto Tecnológico de Sonor	Unity2	19	5	4	100.00	100.00
19	In-person	Instituto Tecnológico de Sonora	Robokids	19	5	4	100.00	100.00
20	In-person	Instituto Tecnológico de Sonora	Roboteens	21	5	4	95.24	100.00
21	In-person	Tec de Mty ACM	C++	26	5	4	100.00	100.00
22	Virtual	Tec de Mty ACM	C++	20	5	4	90.00	90.00
23	In-person	Tec de Mty ACM	Python	27	5	4	77.78	88.89

24	Virtual	Tec de Mty ACM	Python VIRTUAL Tec de Mty ACM	21	5	4	76.19	104.76
25	In-person	Tec de Mty ACM	Scratch PRESENCIAL-Tec de Mty ACM	25	5	4	96.00	100.00
26	Virtual	Tec de Mty ACM	Scratch VIRTUAL Tec de Mty ACM	19	5	4	57.89	68.42
27	In-person	Tec de Mty ACM	WEB PRESENCIALTec de Mty ACM	28	5	4	67.86	82.14
28	Virtual	Tec de Mty ACM	WEB VIRTUAL Tec de Mty ACM	20	5	4	90.00	100.00
29	In-person	Lenovo+Universidad del norte	Scratch	16	2	2	43.75	43.75
30	In-person	Lenovo+Universidad del norte	Python	11	2	2	63.64	63.64
31	In-person	UANL	UANL	35	5	4	68.57	68.57
32	In-person	UERRE	UERRE	31	5	4	32.26	35.48
33	In-person	Tecmilenio CUMBRES	Python	15	5	4	66.67	66.67
34	In-person	Tec de monterrey SS	IA1	25	5	4	48.00	68.00

35	In-person	Tec de monterrey SS	IA2	38	5	4	42.11	55.26
36	In-person	SS Tecmilenio Cumbres	Python	17	5	4	52.94	64.71
37	In-person	SS Tecmilenio Cumbres	Scratch	21	5	4	61.90	66.67
38	In-person	SS Tecmilenio Cumbres	Unity	15	5	4	80.00	80.00
39	In-person	Tec de monterrey SS	Scratch 2	28	4	3	53.57	57.14
40	In-person	Tec de monterrey SS	Micro bit 2	29	4	3	65.52	75.86

Across the program, estimated completion rates show substantial variability, reflecting differences in workshop length, context, and delivery conditions. In many short- and medium-length workshops, estimated completion rates fall between 60% and 90% of enrolled participants, with several workshops reaching or approaching full completion in the maximum estimate. These cases are most commonly observed in institutionally embedded workshops and those with strong activation and retention profiles, indicating a clear alignment between enrollment, attendance persistence, and successful completion.

In contrast, longer or more logistically demanding workshops display wider gaps between minimum and maximum estimates, with minimum completion rates sometimes dropping to 40–50% of enrolled students.

Confidence with STEM concepts

From this point forward, we only worked with the data of students who completed the pre-test (1082 students) and the post-test (854 students). This year, we continued with the use of a simplified form. For the confidence question, we have three questions instead of five. The questions were:

- Do you feel confident using new applications or programs on the computer?
- Do you think you can create computer programs?
- Do you have the skills to solve technology problems, like creating a game on the computer?

In Table 7, we can see the percentage responses for these questions.

Table 7. Confidence in STEM concepts

Confidence with STEM concepts	Percentage					
	Pre			Post		
	Agree	Undecided	Desagree	Agree	Undecided	Desagree
Do you feel confident using new applications or programs on the computer?	77%	22%	1%	86%	12%	2%
Do you think you can create computer programs?	50%	42%	8%	80%	18%	2%
Do you have the skills to solve technology problems, like creating a game on the computer?	28%	47%	25%	69%	27%	4%
Average	52%	37%	11%	78%	19%	2%

The results show a clear and significant increase in students' confidence with STEM-related concepts from the pre-test to the post-test. Initially, an average of 52% of students felt confident in their ability to use technology, create programs, or solve computing problems. After the intervention, this confidence rose to 78%.

The most notable improvement appears in students' belief that they can create computer programs: agreement increased from 50% to 80%, indicating a strong boost in perceived technical ability. Confidence in solving technology problems—such as creating a computer game—also rose sharply, from 28% to 69%, more than doubling. Even in the area of using new applications, which already had a high initial confidence level (77%), scores increased further to 86%.

The inference analysis shows that the intervention produced statistically significant improvements in students' confidence for the "Agree" responses across all three questions.

For the item *"Do you feel confident using new applications or programs on the computer?"*, the p-value for the Agree category ($p = 2.44\times10^{-7}$) indicates a statistically significant positive impact. However, the Undecided and Disagree categories show no significant change, suggesting that the main shift occurred specifically among students who moved toward agreement.

A similar pattern appears in the question *"Do you think you can create computer programs?"* The Agree category shows a highly significant result ($p = 5.39\times10^{-43}$), confirming a strong impact on students' perceived ability to program. Again, changes in the Undecided and Disagree categories are not statistically significant.

The strongest effect is found in the question *"Do you have the skills to solve technology problems, like creating a game on the computer?"*, where the Agree category yields an extremely significant p-value ($p = 7.73\times10^{-73}$). As with the other items, no significant changes occurred in the Undecided or Disagree categories.

Overall, the statistical results indicate that the intervention significantly increased the proportion of students who agree that they possess key STEM-related skills, while responses in the Undecided and Disagree categories remained statistically unchanged. This reinforces the conclusion that the educational experience had a meaningful and measurable positive impact on students' confidence in their technological abilities.

INTEREST IN STEM

We used three questions to evaluate the perception of students before and after the workshops, quite the same number as in previous years. The questions were:

- Do you enjoy participating in technology projects, such as making robots or applications?
- Does the idea of designing and building new technologies, like robots or games, excite you?
- Would you like to study something in the future to build robots or create computer programs?

Table 8. Interest in STEM

Interest in STEM	Percentage	
	Pre	Post

	Agree	Undecided	Desagree	Agree	Undecided	Desagre e
Do you enjoy participating in technology projects, such as making robots or applications?	80%	16%	3%	60%	16%	3%
Does the idea of designing and building new technologies, like robots or games, excite you?	88%	10%	2%	67%	9%	3%
Would you like to study something in the future to build robots or create computer programs?	62%	26%	12%	46%	22%	11%
Average	77%	18%	6%	58%	16%	6%

The results for Interest in STEM reveal a different pattern compared to the confidence-related measures. While students' confidence in STEM concepts increased after the intervention, their expressed interest in STEM activities and future STEM study showed a noticeable decline from pre- to post-test.

Across the three items, the percentage of students who agree decreased from an average of 77% before the intervention to 58% afterward. For example, agreement with *"Do you enjoy participating in technology projects, such as making robots or applications?"* dropped from 80% to 60%, although the proportions of undecided and disagreeing students remained essentially unchanged.

Similarly, excitement about designing and building new technologies declined from 88% to 67%, and interest in studying STEM fields in the future decreased from 62% to 46%. While these decreases are notable, the Undecided and Disagree categories did not shift dramatically, suggesting that the change reflects a reduction in strong enthusiasm rather than a rise in negative attitudes.

The inference results show that none of the changes in students' interest in STEM are statistically significant. For all three questions, the p-values across the Agree, Undecided, and Disagree categories remain well above conventional significance thresholds (e.g., $p < .05$). This means that even though the descriptive percentages show a decrease in agreement from pre- to post-test, these shifts cannot be attributed to a meaningful or reliable impact of the intervention.

For the question *“Do you enjoy participating in technology projects, such as making robots or applications?”*, the Agree category has a p-value of 0.995, indicating no statistically significant effect. Although agreement dropped from 80% to 60%, the statistical test suggests that this observed change could be due to random variation. The Undecided and Disagree categories also show non-significant results.

A similar pattern appears for the item *“Does the idea of designing and building new technologies, like robots or games, excite you?”*. Despite the decrease in agreement from 88% to 67%, the p-value for the Agree group (0.927) again indicates no significant impact. Undecided and Disagree categories likewise show no statistically meaningful change.

The final question—*“Would you like to study something in the future to build robots or create computer programs?”*—also yields non-significant p-values across all categories (Agree p = 0.926), confirming that the differences between pre- and post-test responses are not statistically reliable.

Overall, while the descriptive statistics show a downward trend in students' reported interest in STEM, the inference analysis clearly indicates that these changes are not statistically significant. Therefore, there is no evidence that the intervention meaningfully increased or decreased students’ intrinsic interest in STEM, contrasting with the significant gains observed in their confidence toward STEM skills. Overall, the data indicate that although students gained confidence in their STEM abilities, this did not translate into increased interest. This contrast suggests that confidence and interest may be influenced by different factors, and that future interventions may need to more explicitly foster or sustain excitement and motivation toward STEM.

UNDERSTANDING OF STEM CAREER PATHWAYS

We used two questions to evaluate the perception of students before and after the workshops. The questions where:

- Do you know what computer programmers do?
- Do you think the work of engineers and computer programmers is interesting?

Table 9. STEM Career Pathways

Understanding of STEM Pathways	Percentage					
	Pre			Post		
	Agree	Undecided	Desagree	Agree	Undecided	Desagree
Do you know what computer programmers do?	31%	48%	21%	58%	18%	3%

Do you think the work of engineers and computer programmers is interesting?	79%	18%	3%	62%	14%	3%
Average	55%	33%	12%	60%	16%	3%

The results for Understanding of STEM Pathways show mixed patterns, with some improvement in students' awareness of what STEM professionals do, but a decline in their interest in those careers.

For the question *"Do you know what computer programmers do?"*, agreement increased substantially from 31% to 58%, while the percentage of undecided students dropped from 48% to 18%. This suggests that after the intervention, more students felt they had a clearer understanding of the role of computer programmers.

In contrast, agreement with *"Do you think the work of engineers and computer programmers is interesting?"* decreased from 79% to 62%, although the proportion of students who disagreed remained stable at 3%. This indicates that while students may have gained a more concrete understanding of STEM careers, this did not necessarily translate into increased perceived interest or excitement about those roles.

When averaged across items, agreement rose slightly from 55% to 60%, and undecided responses dropped from 33% to 16%, suggesting an overall improvement in clarity and knowledge about STEM pathways. However, the change reflects greater understanding rather than a stronger interest in pursuing these fields.

For the item *"Do you know what computer programmers do?"*, the p-value for the Agree category is extremely small ($p \approx 3 \times 10^{-77}$), providing strong statistical evidence that the intervention meaningfully increased students' understanding. This aligns with the descriptive data, where agreement rose from 31% to 58% and undecided responses fell sharply. The Undecided and Disagree categories, however, show no statistically significant change.

In contrast, the question *"Do you think the work of engineers and computer programmers is interesting?"* shows no statistically significant differences across any response category (Agree $p \approx 0.576$). This indicates that although agreement decreased from 79% to 62%, this shift is not statistically reliable and cannot be interpreted as an impact of the intervention.

Overall, the inference results suggest that the intervention was effective in clarifying students' understanding of STEM roles, particularly the work of computer programmers. However, it did not significantly influence students' interest or enthusiasm toward these careers. This distinction highlights that improved knowledge about STEM pathways does not automatically translate into increased motivation to pursue them. Overall, the data indicate that the intervention helped students better recognize what computer programmers do, but their level of interest in STEM careers did not increase correspondingly.

Global Thematic Analysis

The thematic analysis was conducted using an iterative, mixed-methods qualitative coding process. Responses from the PRE and POST surveys were aggregated separately and analyzed, highlighting conceptual development, student misconceptions, emotional responses, and the overall impact of the workshop experience.

Below are the major themes extracted from both phases, followed by a comparative interpretation.

Theme 1: "I don't know" — High Uncertainty in PRE

A dominant theme in the PRE dataset was a strong sense of uncertainty or lack of prior knowledge about what programmers or engineers do.

Common expressions included:

- "no se / no sé / nose"
- "no lo sé"
- "pues no sé"

All similar expressions to "I don't know." This theme appeared hundreds of times, indicating that many students entered the workshop with minimal or no prior understanding of STEM roles. During the analysis of the Post answers, this theme persisted but decreased slightly. Students were still unsure, but fewer responses reflected a total lack of knowledge. Instead, ambiguity shifted toward short or incomplete descriptions, suggesting partial conceptual development.

Theme 2: Programming = Making Games, Apps, and Websites

In both PRE and POST, many students described programming as:

- "making games"
- "creating apps"
- "building web pages."

This indicates a strong product-based mental model, where students associate programming with visible digital products they consume. We observed a shift in the answers. During the PRE responses were simple (e.g., "make games"), whereas during the POST responses were slightly more elaborated, sometimes adding verbs related to process (e.g., "create games and fix errors" or "make programs for robots").

However, the association remained highly stable and continued to dominate student conceptualizations.

Theme 3: Early Conceptual Growth in POST — Problem Solving and Error Correction

One of the clearest improvements appeared in POST, where students began introducing higher-level concepts such as:

- solving problems
- fixing errors or “bugs”
- giving instructions to a computer
- designing algorithms
- logical thinking

Examples from POST:

- “they fix errors and solve problems”
- “they design algorithms”
- “they give instructions so the computer works”

These ideas were almost absent in PRE, showing that the workshop successfully introduced deeper computational thinking concepts.

Theme 4: Career Interests (PRE Only) — Mixed STEM and Non-STEM Aspirations

The PRE question about future studies revealed:

- Strong representation of STEM fields (engineering, programming, robotics).
- Strong presence of health sciences (medicine, veterinary studies).
- Considerable interest in arts, sports, and general fields (music, chef, teacher).

This distribution shows that students have diverse aspirations, though many could articulate STEM areas despite not yet understanding them.

Since this question did not appear in the POST survey, no direct comparison is available.

Theme 5: Emotional Shift — Neutral PRE vs. Positive POST

PRE responses to STEM concepts were emotionally neutral or uncertain.

POST responses showed:

- enthusiasm (“I liked everything,” “fun,” “I like programming”)
- engagement with hands-on tasks
- empowerment (“I learned to make programs,” “now I understand”)

This emotional shift suggests increased confidence, engagement, and positive affect toward STEM content.

OTHER FINDINGS

In this section, we describe other interesting findings visualized in the results of the different surveys and data that we generated during the time span of the program.

STUDENT APPRECIATION

Students' responses to the questions about what they liked most revealed strong engagement with the hands-on and creative components of the workshop. The majority highlighted activities such as programming, making games, and interacting with computers or robots. Many students also emphasized the enjoyment of learning something new, indicating that the workshop successfully stimulated curiosity and a sense of discovery. A smaller but meaningful subset mentioned the social dimension—working with peers, receiving help, and collaborating—suggesting that the learning environment supported positive interpersonal interactions.

Graph 7. Student learning word cloud

Responses regarding what students liked least exposed several opportunities for refinement. Some participants noted that certain tasks felt difficult, particularly writing or handling large amounts of code. Others expressed frustration with the pacing, indicating that activities were sometimes perceived as too slow or too fast. These comments point to differences in prior experience and comfort levels with technology-based tasks. Notably, a substantial portion of students reported that there was nothing they disliked, reinforcing the overall positive emotional tone of their experience. Together, these insights highlight both the strengths of the workshop—engaging, creative, and enjoyable—and the need for differentiated support to accommodate a range of learner needs.

Graph 8. Student opinion about dislikes in the program

Category	Theme	Representative Student Expressions	Interpretation
Most Liked	Enjoyment of programming and creation	“making games,” “programar,” “hacer robots,” “creating things”	Students were highly motivated by hands-on, creative production tasks.

	Learning new things	“learning new stuff,” “I learned how to program,” “trying something new”	The workshop effectively introduced new concepts and tools.
	Social/collaborative aspects	“working with friends,” “helping each other”	Peer interaction enhanced engagement and enjoyment.
Least Liked	Perceived difficulty	“too many codes,” “it was difficult,” “writing is hard”	Some students struggled with cognitive load and syntax.
	Pacing concerns	“they go too slow,” “too fast sometimes”	Variation in learner readiness suggests need for adaptive pacing.
	Nothing disliked	“nada,” “nothing,” “everything was good”	Many students had an overall positive experience.

Conclusion

Overall, the workshop program demonstrated strong reach, broad accessibility, and meaningful educational impact. With 998 registered students across 40 sessions, participation was predominantly in-person (90%), and the program served a diverse population in terms of age (6–18, concentrated between 11–14), schooling background (public, private, and homeschool), and prior experience (roughly balanced between returning and first-time participants). Additionally, the completion of post-workshop activities by 854 students enabled a robust assessment of outcomes for a large portion of participants.

Program engagement metrics indicate that initial participation was generally strong, with activation rates frequently above 80% and several partners achieving 100% show-up rates, particularly in structured institutional contexts. However, activation also varied substantially across workshops, with a small subset showing low attendance on Day 1, suggesting barriers between registration and first-session attendance in certain outreach settings. Retention relative to enrollment showed moderate to strong persistence, but—as expected—workshops with longer durations exhibited greater challenges in sustaining participation. Estimated completion rates further reflect this pattern: many workshops fell within a 60–90% completion range, while some longer or more logistically demanding formats showed lower minimum completion estimates and wider uncertainty bands. These findings reinforce the importance of strong coordination, clear expectations, and flexible support strategies, especially for longer programs, to maximize sustained engagement.

In terms of learning outcomes, the quantitative pre/post survey results show that the program had a statistically significant positive effect on students' confidence in STEM-related skills, particularly around creating programs and solving technology problems. At the same time, reported interest in STEM decreased descriptively, but changes were not statistically significant, suggesting that fluctuations may reflect variability in student attitudes rather than a measurable program effect. For STEM career pathways, students showed a significant improvement in knowing what computer programmers do, while interest in STEM careers did not increase significantly. Highlighting that improved understanding does not automatically translate into higher motivation to pursue STEM fields. The qualitative thematic analysis supports these findings: students entered with limited and product-focused ideas (e.g., "making games/apps"), but post responses increasingly referenced process-oriented concepts such as problem solving, debugging, and giving instructions to computers, indicating early growth in computational thinking. Finally, student appreciation data emphasize the program's strengths—hands-on creation, learning new skills, and positive engagement—while also identifying areas for refinement, especially around perceived difficulty and pacing. Taken together, the results suggest that the program effectively builds confidence and foundational understanding, and future iterations can strengthen long-term motivation by pairing skill development with explicit strategies that sustain excitement, personalize pacing, and connect workshop activities to real-world STEM pathways.