

ecosystem

CRITICALITY OF COMPUTING AND THE ECOSYSTEM APPROACH

INTRODUCTION

Computing is the vanguard of American innovation, a key driver of the nation's economic growth, and fundamental to advances in healthcare, national security, and nearly every STEM discipline. Indeed, in 2022, 64% of U.S. patents issued for products, processes, and machines were related to software. Most of these patents were created by men, with the information technology patenting rate for women having grown very slowly from 2% in 1980 to 10% in 2020. Certain computing subfields are advancing quite rapidly, including artificial intelligence, quantum computing, and semiconductor chip design. For example, there are now 50 quantum technology master's degree programs and 180 universities with quantum-related research groups in the United States.

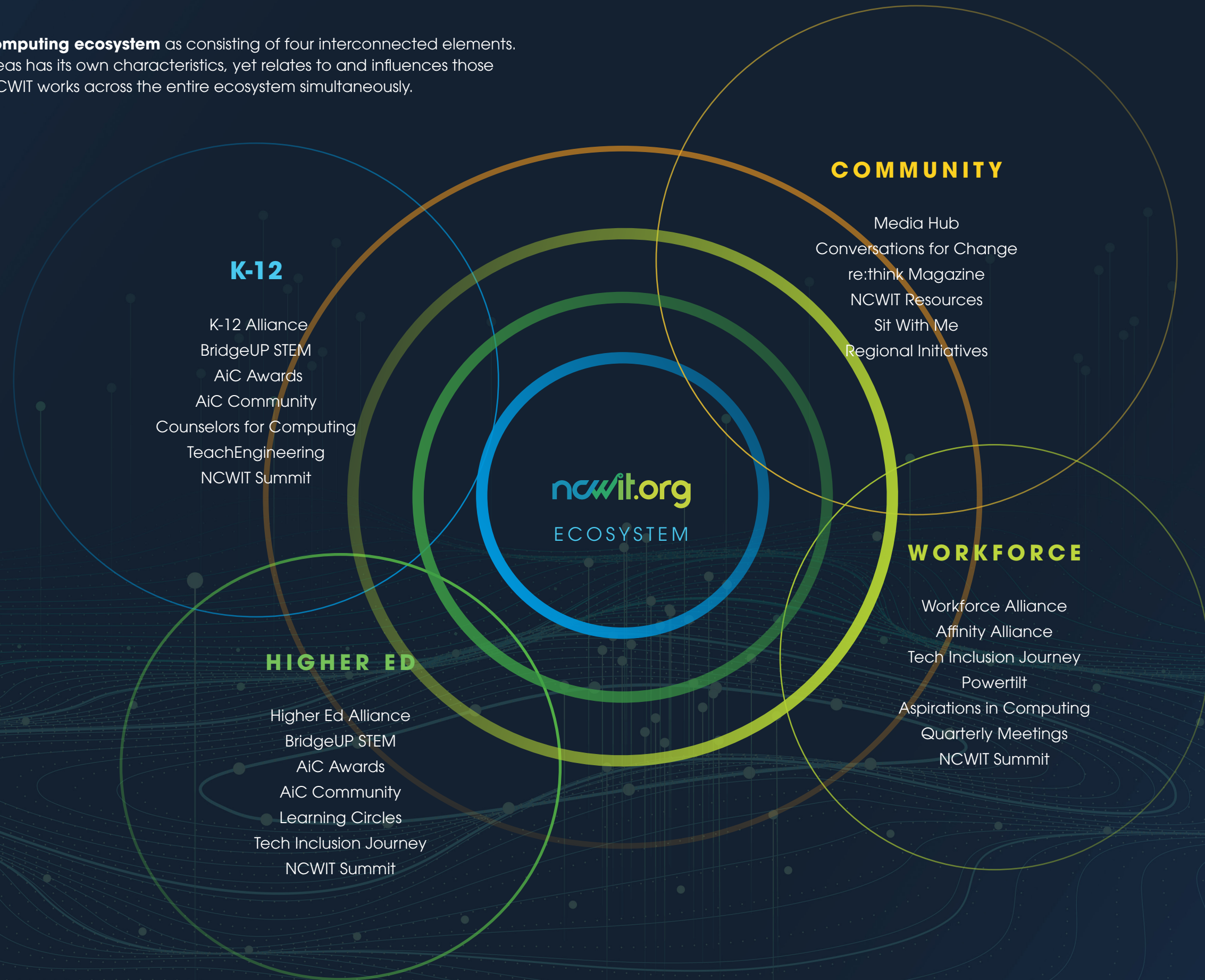


The number of students pursuing these fields is sure to rise, given the expected quantum computing market size of \$106 billion by 2040. However, the nation risks entry into the most rapidly advancing fields by a predominantly homogeneous group. Historically, the perceived opportunity and potential for high compensation within rapidly advancing fields tends to disproportionately encourage men's entry, as has computer science overall since the "enrollment boom" that began around 2013. Improving representation of minoritized groups in computing is critical to advancement and innovation. Scholarship is clear: When managed well, research teams that include members from minoritized groups are superior to homogeneous teams on a wide range of metrics. By contrast, low diversity negatively impacts research advancement by constraining the topics researched, the methods by which research is conducted, and societal outcomes achieved.

NCWIT was founded in 2004 to ensure that the perspectives and contributions of those who identify as women are meaningfully represented at all levels of computing. Every woman has multiple intersecting identities, including race, ethnicity, class, age, sexual orientation, adherence to beauty ideals, religion, family status, and ability status. Yet women share common challenges in a society teeming with negative stereotypes and prejudices about women. These implicit and explicit beliefs about what women can, should, and do contribute emerge into everyday practices and implicit policies about how women are to be treated. These beliefs create disparities for women in computing, including lower likelihood of being promoted, significant pay gaps, continued discrimination, and higher quit rates. Intersections with other marginalized identity categories exacerbate women's limited access to human, social, and economic capital. For example, the "mommy penalty" negatively affects women's promotion with career-spanning consequences; ageism is far worse for women than for men; women with disabilities are paid 20% less than disabled men; LGBTQ+ women earn 2% less than their non-LGBTQ+ women peers; and Black and Hispanic women earn 5% less than Asian women. Layer on the fact that over the past 35 years, computing has become increasingly masculinized, resulting in educational and work environments that better serve the needs of men than of women. In short, women are systematically disadvantaged in technical careers and pathways to technical careers, and the more marginalized identities a woman claims, the greater the disadvantage.

Solutions to this persistent issue must come in the form of a holistic, ecosystem-based approach, which is how NCWIT and our programs are structured. In the following pages, you will find information about each part of the computing ecosystem, and how we enact change through our own work, partnerships with others, and community-driven initiatives.

We define the **computing ecosystem** as consisting of four interconnected elements. Each of these areas has its own characteristics, yet relates to and influences those around it, and NCWIT works across the entire ecosystem simultaneously.





BUILDING THE
WORKFORCE OF THE FUTURE
BEGINS IN K-12

Two of NCWIT's flagship K-12 programs are Aspirations in Computing (AIC) and Counselors for Computing (C4C).

NCWIT's holistic approach, informed by decades of social science research, is unique. As an exemplar organization of the NSF, NCWIT has set the standard for evaluating impact and ensuring our programs are effective and efficient. By offering longitudinal support (K-12 through career), NCWIT provides encouragement that conquers isolation, builds in long-term motivation, opens doors—and changes lives. Research points to the necessity of providing such longitudinal, community-based support as a critical success factor in increasing participation and persistence of historically marginalized groups in any educational discipline. Although one-time episodic experiences are helpful, they are generally not sufficient to create large-scale systemic change.

Evidence shows that ongoing participation in NCWIT's K-12 programs increases diverse students' long-term persistence in computing.

Evidence shows that AiC is successfully changing the makeup of the workforce.

ASPIRATIONS IN COMPUTING

The NCWIT AiC program is, at its heart, a community of more than 29,500 people marginalized by gender who share a passion for tech. Students join AiC in high school or college, and once in the community, NCWIT and our 1,600 organizational members offer them opportunities that help them learn, grow, persist, and thrive, building the next generation of STEM professionals.

AiC members participate in award programs and get access to scholarships, internships, jobs, mentorship, webinars, hackathons, and more. Evidence shows that AiC is successfully changing the makeup of the workforce. The community is 13% more ethnically diverse than the U.S. technical workforce, and 89% of members report a major or minor in a STEM field, with 76% in a computing or engineering field specifically. This metric is a stark contrast to the 4% of all women who earn such degrees.

A key element of AiC is the suite of recognitions available to students and educators. These have been intentionally structured to encourage ongoing student achievement. Students participate in a tiered award system in high school, beginning with a local Rising Star in one of 84 locations, all the way to one of 40 National Winners. Once in college, they participate in the prestigious Collegiate Award. K-12 educators are also honored for their encouragement of students with the Educator Award. Community members who run their own coding experiences for younger students are eligible for the Impact Award, celebrating their efforts to give back and inspire others to follow in their footsteps.

To date, AiC has conferred 32,388 high school awards, 152 collegiate awards, 1,290 educator awards, and 130 impact awards.

13%

The community is 13% more ethnically diverse than the U.S. technical workforce

89%

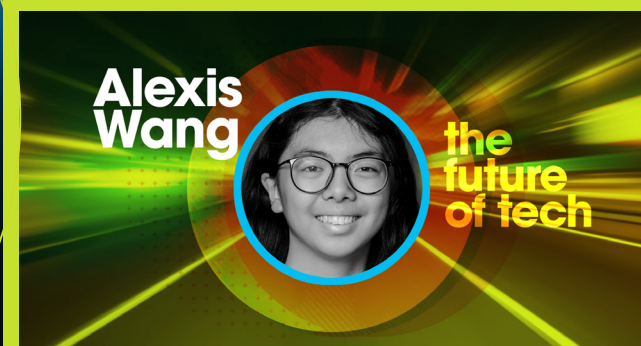
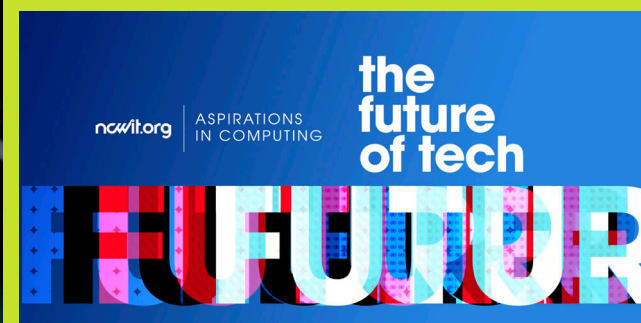
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In 2023, NCWIT was thrilled to launch AiC Stories, an initiative that highlights the journeys of women, genderqueer, and nonbinary individuals from the AiC community. We recently shared the stories of Doreen Joseph, Emily Mendoza, Alexis Wang, and Santoya Martinez.

Watch their stories:
aspirations.org/aic-stories-ambassadors



“Every week, I look forward to the AiC community email that is filled with a number of opportunities to just learn even more about technology, as well as bond with my fellow members. Most of all, winning this award has given me the confidence to know that I can make a positive and lasting change in this world, and I’ve got a whole community of women in technology supporting me.”

“Being an award recipient made me realize that I can be in the computer science field. So many times, I would feel inadequate or like I didn’t fit in. AiC showed me that isn’t true”.

“Becoming a part of AiC and the NCWIT community has been a transformative experience. I am blown away by not only the brilliance and passion of the girls and women I’ve been meeting, but also the way they help and uplift one another on projects, ideas, career advice, and recommendations is unlike anything I’ve experienced before. This community is not only a gateway to an awesome future, but it also provides a sense of belonging and healing that many of us have been seeking our entire lives.”



NCWIT rebranded the AiC program in 2023, launching a new campaign called What the World Needs, designed to highlight that youth of today have a deep sense of social justice, want to solve world problems, and how computing is a viable path to solving them. With this campaign, we seek to emphasize the diverse voices within the AiC community.



COUNSELORS FOR COMPUTING

School counselors are uniquely positioned in the K-12 ecosystem. They are influencers and critical allies, well positioned to be social justice advocates who work at both the individual and systemic levels to help students access available opportunities. Through advising best practices and encouragement, counselors can inspire students to consider computational thinking and transformative computing careers. If underrepresented students are to get the exposure and encouragement they need to pursue computing, it is essential that counselors be up to date on the knowledge and resources necessary to guide effectively.

However, research shows that counselors face barriers when it comes to advising about computing education and careers. In a recent study conducted by NCWIT, approximately half of the respondents reported that the lack of awareness of computer science careers and the limited number of computer science classes, labs, and/or teachers have been barriers to their counseling practices.

NCWIT fills this gap with our Counselors for Computing (C4C) program. C4C participants not only encourage students to pursue computing education pathways, but they also encourage high school women, genderqueer, and nonbinary students to participate in the AiC community.

C4C has diversified its offerings to meet the changing needs of the K-12 educational system. For example, C4C now offers one-hour, three-hour, six-hour, and multi-day training options to accommodate educators' needs. C4C also works with many State Departments of Education—such as California, Alabama, Massachusetts, Texas and Pennsylvania—to offer continuing education credits for participants. Additionally, C4C has implemented a "Take Action" toolkit to help school counselors create a detailed plan with next steps in order to make changes in their schools and with their students.

200

In a three-year span, C4C held more than 200 national and state/regionally specific programs

10,000

Training nearly 10,000 counselors, with the potential to reach more than 4.2 million students

538

In 2023 alone, NCWIT trained 538 counselors and shared resources with more than 800 educators.

Counselors for Computing
Recent participating counselors were surveyed and the results show the program has lasting impact.

90%+

More than 90% of survey respondents indicated that they have provided resources about computer science or advocated for more computer science courses “a lot” or “a great deal” since participating in C4C.

40%

40% of survey respondents noted an increase in the enrollment of students who identify as women in their Computer Science Principles courses.

25%

Approximately 25% of respondents reported an increase in students from minoritized groups and students eligible for free/reduced lunch in the Computer Science Principles and Computer Science A courses.

“I am so happy that I made the decision to attend a C4C event. It has been awesome learning and sharing the knowledge I have obtained.”

All of the survey respondents “strongly agree” or “agree” that they are equipped to talk to students, teachers, or counselors about computer science, feel more comfortable leading C4C workshops, and know where to get resources on computer science for students. Importantly, schools are seeing enrollment changes in CS classes.

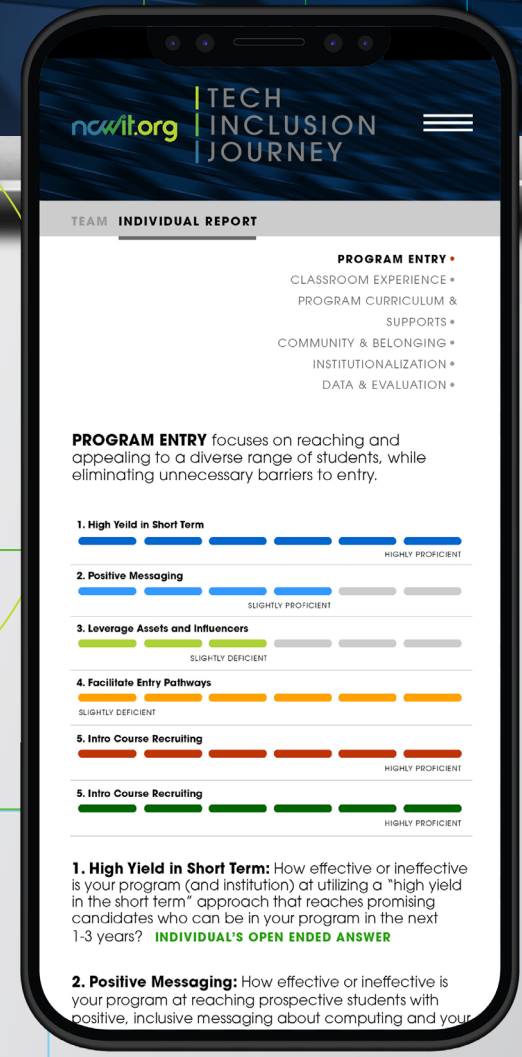
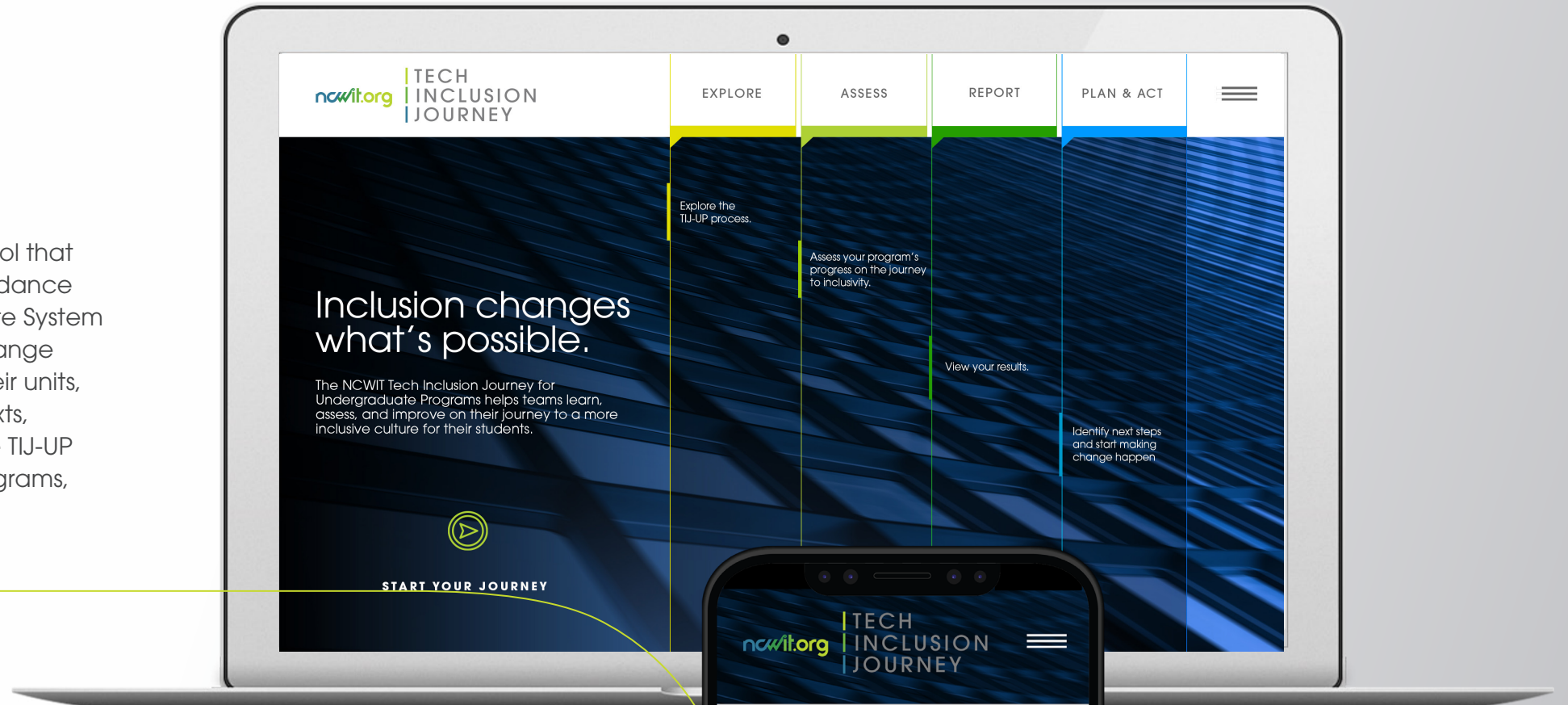
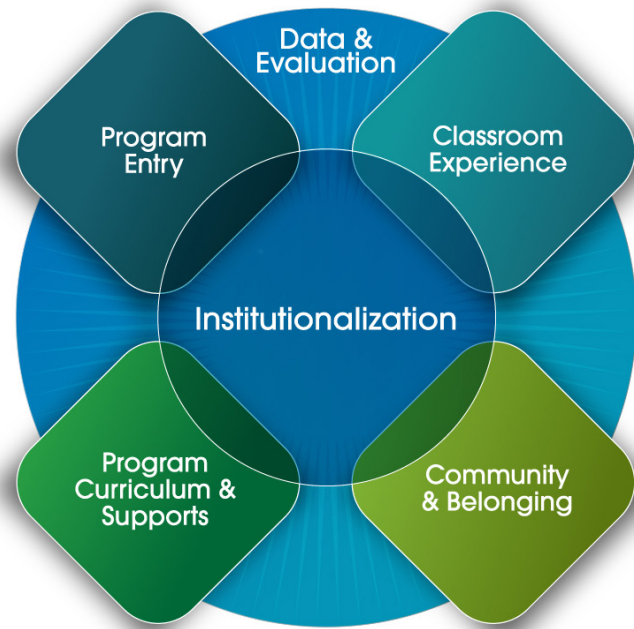
HIGHER EDUCATION FUELS AMERICA'S INNOVATION ENGINE

NCWIT HIGHER ED ALLIANCE MEMBERS HAVE CONSISTENTLY AVERAGED HIGHER GROWTH RATES THAN NON-MEMBERS IN THE PERCENTAGE OF WOMEN COMPLETING COMPUTING DEGREES.

NCWIT's work to date has advanced both the numbers and percentage of women earning computing degrees—even in the face of enormous increases in total degrees granted. For example, women's share of computing bachelor's degrees advanced to 23% in 2022. Computing departments that join NCWIT perform better than their non-member peers and, combined, graduate a higher percentage of women (24%) than the national average (21%). In addition, since 2006, NCWIT Higher Ed Alliance members have consistently averaged higher growth rates than non-members in the percentage of women completing computing degrees. Two to three years after joining, 54% of members experience increases in their percentage of women degree earners. Additional years of membership and participation in systemic change programs increase women's share of computing degrees even more, with veteran members averaging 6% more than their relatively new peers.

TECH INCLUSION JOURNEY

The Tech Inclusion Journey® is an assessment- and decision-support tool that scales the successful, but labor-intensive, one-on-one customized guidance that NCWIT historically provided. Integrating the NCWIT Undergraduate System Model, the TIJ-UP is a comprehensive, self-guided, online tool that change teams use to build shared vision, assess strengths and needs within their units, and then identify and adapt appropriate actions to their local contexts, conditions, and resources. As a national resource, the freely available TIJ-UP can help many more departments independently transform their programs, thus promoting both scalability and sustainability.



LEARNING CIRCLES

Higher Ed Learning Circles are founded on a previous NCWIT initiative: Extension Services. NCWIT has effectively engaged 169 post-secondary computing department change teams in systemic change efforts through single institution consulting and small group-based Learning Circles. Participating departments have been remarkably successful. Comprising just 10% of U.S. institutions that awarded bachelor's degrees in computing in 2022, past participants were responsible for generating 38% of all computing degrees that were awarded to women nationally.

Having generated only 15% of women's BS degrees in computing in 2015, this is a remarkable impact. First piloted in 2017, the group-based Learning Circle approach was established to accomplish economies of scale, expanding the reach of the single institution consultation model. Learning Circles provide a peer-based community for learning about Broadening Participation in Computing (BPC) systemic change and its implementation. To date, 88 departments have participated in Learning Circles with high interest, engagement, and positive effect.

Learning Circles

38%

Past participants were responsible for generating 38% of all computing degrees that were awarded to women nationally.

DIVERSE TEAMS ARE THE MOST INNOVATIVE

COMPANIES WITH ABOVE-AVERAGE DIVERSITY
ON MANAGEMENT TEAMS GENERATE 19% HIGHER
INNOVATION REVENUE THAN COMPANIES WITH
BELOW-AVERAGE LEADERSHIP DIVERSITY.

As people move into the workforce, addressing subcultures and practices within corporations and other employers becomes a critical factor in our ability to see improvements in the numbers of underrepresented people in computing and technology jobs. For this reason, NCWIT focuses on the systemic nature of change within organizations through our resources, tools, and programs. Within the Workforce Alliance, NCWIT's efforts in 2023 were centered on creating meaningful connections, sharing knowledge, and empowering our members through various initiatives and programs.

This year, our member organizations requested content and materials to help them manage anti-DEI rhetoric and policies, improve talent intake, manage hybrid-flexible remote work policies, and provide inclusive leadership. These topics emerged as important areas of emphasis across companies.

Additionally, the NCWIT Career Fair, in collaboration with the AiC community was a success. The fair connected students with potential employers and internships. Approximately 215 students and representatives from 11 member companies attended. 100% of surveyed organizations indicated they are likely to attend again next year.

Amongst over 650 individual PowerTilt respondents, the most commonly reported characteristic that influenced decision-making was Subject Matter Expertise.



40% of people reported a team decision-making style that was in the two most centralized categories.

The most commonly reported behavior that influenced decision-making was frequently speaking up.

POWERILT

NCWIT launched the PowerTilt assessment tool in 2023. This tool helps teams and their leaders identify 1) the primary ways power operates in their team culture, and 2) patterns in who might be favored or disadvantaged by the current culture of influence, particularly in terms of intersectional identities related to gender, race, class, and age.

- 1) **Team Decision-Making Distribution Typology** – identifies a team’s decision-making style and how power is distributed or concentrated.
- 2) **Team Influence Profile** – identifies the characteristics and behaviors that are the most influential within a given team’s culture.
- 3) **Individual Influence Profile** – identifies how powerful and influential individual team members perceive themselves to be in their team’s decision making.

Once these influence patterns have been identified, the tool guides technical teams through the process of having important conversations about these patterns using a data visualization dashboard that can be presented for a single team or aggregated for many teams.

BROADENING REACH, BUILDING COMMUNITY

OUR WEBINARS OFFER THE ABILITY TO LEARN INTERACTIVELY, HIGHLIGHTING RESEARCH, INSIGHTS, AND IDEAS THROUGHOUT THE ENTIRE COMPUTING ECOSYSTEM.



NCWIT's role as a thought leader with respect to gender in tech includes contributing knowledge and inspiration to those within our direct community as well as those who are less familiar with the related challenges and opportunities. To accomplish this goal, NCWIT's communications team creates and shares materials that are relevant to a wide variety of audiences. For example, NCWIT publishes re:think Magazine, which takes a reader-friendly approach to sharing research-backed promising practices, inspirational stories from people in our community, and expertise from others. We also create videos that are shared widely amongst educators, students, and professionals. Our webinars offer the ability to learn interactively, highlighting research, insights, and ideas throughout the entire computing ecosystem. In 2023, we expanded our distribution channels, growing followers across platforms. NCWIT will continue to share resources, information, and expertise to raise awareness and increase knowledge among organizations and individuals in the computing ecosystem as well as the general public.

EXPANDING ACCESS

Resources

Resources are the cornerstone of helping create systemic change, and NCWIT offers hundreds of free, research-based resources to help change leaders take effective action. In 2023, NCWIT partnered with experts to improve our information architecture and user experience on our resource page. In early 2024, a new resource landing page was launched, featuring faceted search, to make it easier for community members to find the resources they need to make a difference.

The social scientists added several new items to the library and updated many others. Highlights are:

Gearing Up for Change

This resource supports the success of change initiatives in undergraduate computing programs by helping departmental teams understand their organization’s current context, take a systems perspective, and establish readiness for change.

Communicating for Change

Change leaders and teams can inspire, energize, and generate support for broadening participation in computing by designing and using intentional, persuasive messages for departmental and institutional colleagues throughout the organizational change process. Effective communication is a long-term process that involves the distinct and necessary communication steps outlined in this resource.

Tech Inclusion Journey for Undergraduate Programs Resource Collection

This new resource collection from the Higher Ed Alliance is organized around the NCWIT Undergraduate System Model. The model depicts the six interdependent components of undergraduate computing programs, each of which must be addressed to promote and sustain broadening participation in computing efforts.



Media Hub

With generous funding from Wells Fargo, NCWIT built and launched a new Media Hub in 2023. This one-of-a-kind site gives viewers the opportunity to explore multimedia content that inspires, educates, and encourages them in their change leadership activities. The Hub was intentionally structured to engage viewers in a wide variety of content types. From research-backed webinars to inspirational stories in our Aspirations in Computing Community, the Hub encourages exploration and engagement. In the first four months since launch, NCWIT had nearly 1,000 unique visitors.

ELEVATING CONVERSATIONS FOR CHANGE

THE SUMMIT

NCWIT community members are invited to the annual in-person Summit, which includes a broad and diverse range of prominent speakers, and promotes intersectionality in all sessions, regardless of topic. The Summit fosters community and helps members establish shared goals. Attendees learn about important issues related to correcting underrepresentation in computing, as well as practical ways to become more effective change leaders within their home institutions.

The 2023 NCWIT Summit took place in Denver, CO, in a hybrid virtual/in-person format. This was our first in-person Summit since the pandemic. In our first year back, we decided to try something new. To ensure that all attendees felt welcome and engaged, Summit content was arranged by topic-area, giving attendees an opportunity to take a deep dive into the issues that mattered most to them. Each track had three main components—learning from NCWIT, learning from each other, and action planning. Plenary speakers included Ijeoma Oluo, Brad McLain, and Khalia Braswell.

PLENARY SPEAKERS INCLUDED
IJEOMA OLUO,
BRAD MCLAIN,
KHALIA BRASWELL.

WORKSHOPS

BIAS AND BELONGINGNESS:
MOVING BEYOND BIAS MITIGATION TO
CREATE TRULY INCLUSIVE CULTURES

POWERTILT: POWER & INFLUENCE IN TECH –
WHO HAS IT? WHO DOESN'T? AND HOW TO
DISTRIBUTE IT INTENTIONALLY?

HIDDEN IN PLAIN VIEW: CONFRONTING
SYSTEMIC INEQUITY IN K-12 CS EDUCATION

RECRUITING AND RETAINING MORE BIPOC
STUDENTS IN COMPUTING

INCLUSIVE LEADERSHIP AT EVERY LEVEL:
TACKLING DIFFICULT TOPICS AND LEADING
ORGANIZATIONAL CHANGE

UNMASKING THE MANOSPHERE:
CONNECTIONS BETWEEN THE GENDER
BINARY, VIRAL MASCULINITY, AND
TECHNICAL CULTURE/COMMUNITIES

USING INCLUSIVE PEDAGOGIES AND
TECHNOLOGIES TO IMPROVE STUDENT
PERFORMANCE AND EXPERIENCE



Ijeoma Oluo
KEYNOTE SPEAKER

THE PURSUIT OF RACIAL EQUITY



Dr. Sharmaine Jackson
DIRECTOR OF RACIAL EQUITY

In 2023, NCWIT took bold strides in its pursuit of racial equity, marking a year of transformative growth and action. At the heart of this journey was the Racial Equity Committee, whose dedication and efforts paved the way for a groundbreaking achievement: the appointment of NCWIT's first Director of Racial Equity, Dr. Sharmaine Jackson. This step not only underscored NCWIT's resolute commitment to systemic change, but also signaled a new era of leadership and accountability in advancing NCWIT's equity endeavors.

Sharmaine brings a dynamic blend of passion and expertise to NCWIT in advancing racial equity across our organization. With an academic foundation that spans a PhD in Sociology, a JD, and a BA in Women's Studies, she has spent 20 years dedicated to enhancing diversity, equity, and inclusion. Her approach effectively combines theoretical knowledge with practical measures to cultivate a strong sense of belonging. In stepping into her new role at NCWIT, Sharmaine's focus is to guide us toward a future where inclusivity is woven into the fabric of our organizational culture, enriching and uplifting our shared experience.

From the outset, Sharmaine set in motion the development of a comprehensive strategic plan to embed racial equity throughout NCWIT's culture and operations. This four-phased plan is a multifaceted blueprint, reaffirming NCWIT's dedication through public declarations of support, continuous training programs to elevate our collective understanding and application of racial equity principles, and fostering partnerships to widen our impact in the realms of computing, technology, and STEM education.

NCWIT continues its commitment to embed the ideals of inclusion and belonging into the core of our culture, daily operations, and community interactions. Together, we are actively building a future where equity thrives, ensuring that diversity is an integral part of our organizational identity and collective achievements.

WHAT'S NEXT IN 2024?

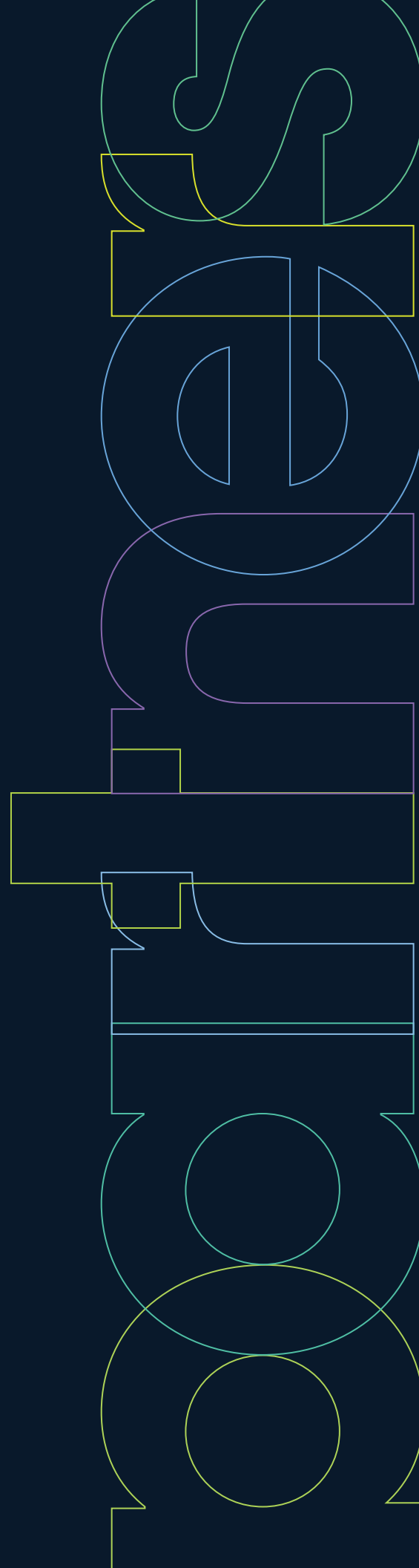
CONTINUED IMPACT, EXPANDED REACH

2024 promises more exciting developments from NCWIT. BridgeUP STEM at Georgia Tech continues to prove successful. We are finishing up our second cohort of students this spring, and in the fall we will be kicking off cohort three. High school students, undergraduates, grad students, and faculty continue to thrive - learning, teaching, and inspiring each other. In 2023, 100% of participating seniors were admitted into four-year degree programs.

We are additionally thrilled to welcome TeachEngineering into the NCWIT family. TeachEngineering is a free digital library for K-12 educators. University engineering faculty, graduate students and K-12 teachers across the nation developed and classroom tested the contents of the TeachEngineering collection, which is built on equity. The collection promotes "engineering on a shoestring budget" and features hands-on activities that use easily accessible, low-cost materials.

Stay tuned for more details about these programs and others in our next Partner Report!

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Amazon

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DoDSTEM

Jane Street

Wells Fargo

**THE
IDEA YOU
DON'T
HAVE** **IS THE
VOICE
YOU
HAVEN'T
HEARD.**

Support Students Who Are the Future of Tech

Aspirations in Computing (AiC) engages, inspires, and supports thousands of high school and college students who want to change the world, and you can help them realize their dreams!

A monthly donation of \$25 will fund their participation in our Community and give them access to opportunities like scholarships, internships, mentorships, jobs, and more.

aspirations.org/sponsor