



**Jobs for  
the Future**

# Credentials That Pay

## Designing pathways to tech careers

### AT A GLANCE

This brief examines the return on investment (ROI) of educational credentials in tech in order to support the design of equitable pathways that lead to quality jobs.

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# Acknowledgments

We are grateful to the many Jobs for the Future (JFF) staff members who contributed their expertise to this report. Sarah Bennett, Madeleine Chaisson, Lisa Eichel, Sara Lamback, Meena Naik, Amy Prince, Taylor Reese, and Felicia Sullivan provided a wealth of helpful information on short-term credentials. Julia di Bonaventura, Kyle Hartung, Nancy Hoffman, and Anna O'Connor contributed to thinking about credential outcomes in the context of pathways and how to design pathways with “No Dead Ends.” We also thank JFF’s Marketing & Communications team for their support for this publication.

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*The contents of this resource were developed under a grant from the U.S. Department of Education’s Education Innovation and Research program. However, those contents do not necessarily represent the policy of the U.S. Department of Education, and you should not assume endorsement by the federal government.*

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# Introduction

Pathways that lead to tech careers are a good bet for young people who hope to increase their earning potential and are concerned with job quality—but not all degrees and credentials in tech fields lead to equally positive outcomes. Pathways designed to lead to careers in the sector must be intentionally structured to offer young people opportunities to earn educational credentials offering a demonstrated return on investment (ROI).

The tech sector holds great promise as a destination for pathways. Jobs in the sector are plentiful; the U.S. Bureau of Labor Statistics projects that, over the next decade, employment in tech occupations will grow much faster than the average rate across industries. The median wage for these jobs, at \$104,420, is more than double the median wage across all occupations.<sup>1</sup> Tech jobs fare well on other measures of job quality, too, including in the categories of compensation, advancement, agency and culture, and structure outlined in the [Quality Jobs Framework](#) developed by Jobs for the

Future (JFF).<sup>2</sup> Tech workers typically enjoy comprehensive benefits packages, access to more than double the amount of paid leave available to workers across all industries, safe workplaces, and job security.<sup>3</sup> In addition, 70% of workers report satisfaction with their day-to-day work, and those in tech jobs are more likely than those in other industries to believe they have meaningful opportunities to provide input and to be satisfied with the career advancement opportunities available to them.<sup>4</sup>

But most tech jobs have high educational barriers to entry. A bachelor's degree is still a requirement for landing the majority of jobs in the industry.<sup>5</sup> Over 85% of software developers and just under 70% of information security analysts have a bachelor's degree or higher.<sup>6</sup> Nationally, only 16% of workers in the software field have less than a bachelor's degree, compared to 56% of workers across all industries.<sup>7</sup> About 25% of workers in the IT field have sub-baccalaureate credentials.<sup>8</sup> One of the most attainable tech jobs for workers without a bachelor's degree is computer user support specialist, a role in which just over half of workers have sub-baccalaureate degrees and credentials.<sup>9</sup> And while a bachelor's degree is required for many roles, there are nuances to take into account. For example, industry demand for specific credentials varies across regional labor markets. High-tech jobs are usually more plentiful in metropolitan areas, but there is also more competition, creating a need for increased formal education.<sup>10</sup> Other considerations include the role and type of employer, as the credential requirements for a digital job at a large tech company may look quite different from those for a role in the IT department at a large bank or hospital.

The intentional design of pathways can help to disrupt inequitable educational outcomes and occupational segregation in the tech sector. While tech credentials offer a high ROI overall, structural and systemic barriers prevent many learners and workers from accessing their benefits. Black workers make up just 7% of the high-tech workforce, while Latine workers account for 10% of the sector. Under a quarter of high-tech jobs are held by women, a proportion that has remained virtually unchanged over the last two decades despite the industry's tremendous growth over the same period.<sup>11</sup> Inequitable education systems lay the foundation for this occupational segregation. Career and technical education enrollment data shows that Black and Latine high school students are less likely than their peers to enroll in information technology and other STEM courses that lead to high-wage jobs and more likely to enroll in hospitality and human services programs associated with careers that offer lower wages than tech.<sup>12</sup> Similar disparities exist at the postsecondary level. Fewer than half of sub-baccalaureate IT programs enroll 10 or more Black learners, pointing to a clear need to identify and address roadblocks to program access and completion.<sup>13</sup> Educational attainment gaps are especially pronounced at the bachelor's degree level and beyond. In 2022, Black students earned 9% of all bachelor's degrees conferred in computer and information sciences, and Latine students earned 12%.<sup>14</sup> These disparities represent a major barrier for Black and Latine young people who seek to enter the tech industry, especially in light of data showing high educational barriers to entry. Core pathways strategies—including dual



enrollment, work-based learning, and career navigation supports—are essential elements of badly needed efforts to reimagine our education systems with the goal of ending occupational segregation.<sup>15</sup>

This brief examines employer demand for and the potential ROI of educational credentials in tech in order to support the design of equitable pathways that lead to quality jobs. Tech degrees consistently have a high ROI, especially in comparison with similar credentials in other industries. But education and workforce leaders need to be attentive to the stackability of credentials and permeability of education and training programs to support opportunities for economic advancement in tech careers. Ensuring that all young people who wish to do so can access the benefits of tech jobs requires pathways that are designed with no dead ends and provide options to earn multiple types of educational credentials.





# Understanding Return on Investment for Tech Credentials

The payoff associated with tech degrees and credentials varies by level of education, though credentials in the field generally offer a higher ROI than similar credentials in other industries.<sup>16</sup> Bachelor's degrees are the credential most strongly correlated with high wages, while the payoff for an associate's degree is smaller. However, associate's degrees in tech provide a better ROI than those in other fields; tech jobs make up a quarter of the top 20 highest-paid occupations for associate's degree holders.<sup>17</sup> Master's degrees also have a strong ROI, though in many cases, it is comparable to that for a bachelor's degree. The ROI of short-term credentials (e.g., boot camps or certificates) is less clear due to a lack of data on employment outcomes, though there are indications that some credentials lead to positive outcomes. A challenge in the analysis is the lack of disaggregated ROI data. There is a clear need for more research into potential differences in ROI based on learners' race, ethnicity, gender, socioeconomic status, and other categories, particularly in light of the available data on inequities in education and training programs and occupational segregation in the tech industry.

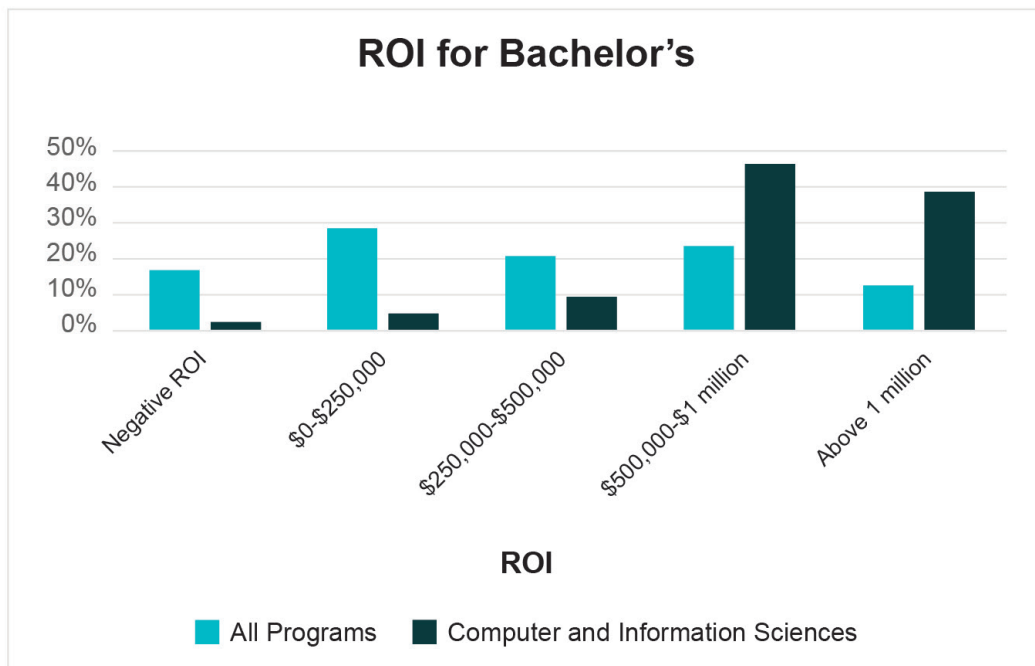




These high wages yield returns that make a bachelor's degree in a tech field worth the investment, even considering the high price tag of bachelor's degrees compared to most associate's degrees and some credentials. A study from the Education Data Initiative showed that while the median return on investment (defined as the lifetime cost of a degree compared to lifetime earnings) for a bachelor's degree is 287.7%, computer and information science degrees have a 716.6% return on investment and are also the most cost-efficient degrees.<sup>21</sup> Computer science bachelor's degree holders can expect average lifetime earnings of \$5.29 million.<sup>22</sup> Forty-six percent of computer and information science bachelor's degrees have an ROI of \$500,000 to \$1 million, and 38% have an ROI above \$1 million.<sup>23</sup> While 16% of all bachelor's degree programs have a negative ROI, only 2% of computer and information science degree programs do.<sup>24</sup> Engineering is the only field of study with a greater ROI.

Additionally, 55% of computer and information science bachelor's degree holders fully recovered the cost of college five years after graduation, and 92% did 10 years after graduation. For all bachelor's programs across majors, only 18% of graduates had recovered the cost five years after graduation, and 47% 10 years after graduation.<sup>25</sup>

Given rising concerns about student loan debt, it's important for young people to understand that for some fields, like tech, their education is truly an investment, and not a gamble, that they will be able to pay back due to high earnings. A 2024 study by the American Education Research Association showed that computer science majors see a rate of return on their investment of over 13%, outpacing the rate of return they could expect through investments in the stock market.<sup>26</sup>



Source: Preston Cooper, *Is College Worth It? A Comprehensive Return on Investment Analysis*

## Master's Degrees

Master's degrees in tech, like bachelor's degrees, offer a strong positive ROI. Data from about 35,000 students enrolled in master's degree programs in computer science and mathematics shows only 7% see a negative ROI, lower than the 16% of tech bachelor's degree programs with a negative ROI. Seventeen percent of computer science and mathematics master's degree holders see an ROI of \$300,000 or less, 22% see an ROI between \$300,000 and \$600,000, 17% see an ROI between \$600,000 and \$900,000, and 38% see an ROI over \$900,000.<sup>27</sup> Master's degrees in tech fields compare favorably to master's in other fields. Only 9% of all master's degree holders see an ROI of over \$900,000, and 43% of all master's programs have a negative ROI.<sup>28</sup>

However, master's degrees in tech do not necessarily yield better wage and employment outcomes than bachelor's degrees in the field. Thirty-four percent of master's degree holders in computer science and mathematics see an ROI above \$1 million, while 38% of bachelor's degree holders in the field do so.<sup>29</sup> Additionally, 46% of bachelor's degree holders in computer and information sciences see an ROI between \$500,000 and \$1 million, while only 34% of master's degree holders do so.<sup>30</sup> The reasons for this variation are unclear, but they may include the high cost of master's degree programs, which reduces ROI. In addition, some master's degree holders may have majored in a different undergraduate field with a lower ROI prior to returning to graduate school.

Ultimately, it is unclear whether the additional time and expense required to earn a master's degree in a tech field are worth it for those considering doing so with an eye to potential financial and career benefits. Learners and workers who wish to pursue more education to earn higher wages should work closely with industry leaders to figure out what type of continuing education could best support career advancement and wage increases. In some cases, a master's degree may be worth it, but in other cases, bachelor's degree holders may benefit more from shorter-term skill development through other credentials, like certificates, that lead to increased wages with less time and money invested than a master's degree. Of course, there are other nonfinancial benefits of pursuing a master's degree, including increased knowledge and skills, expanding your network, and personal satisfaction of achieving a high level of formal education.

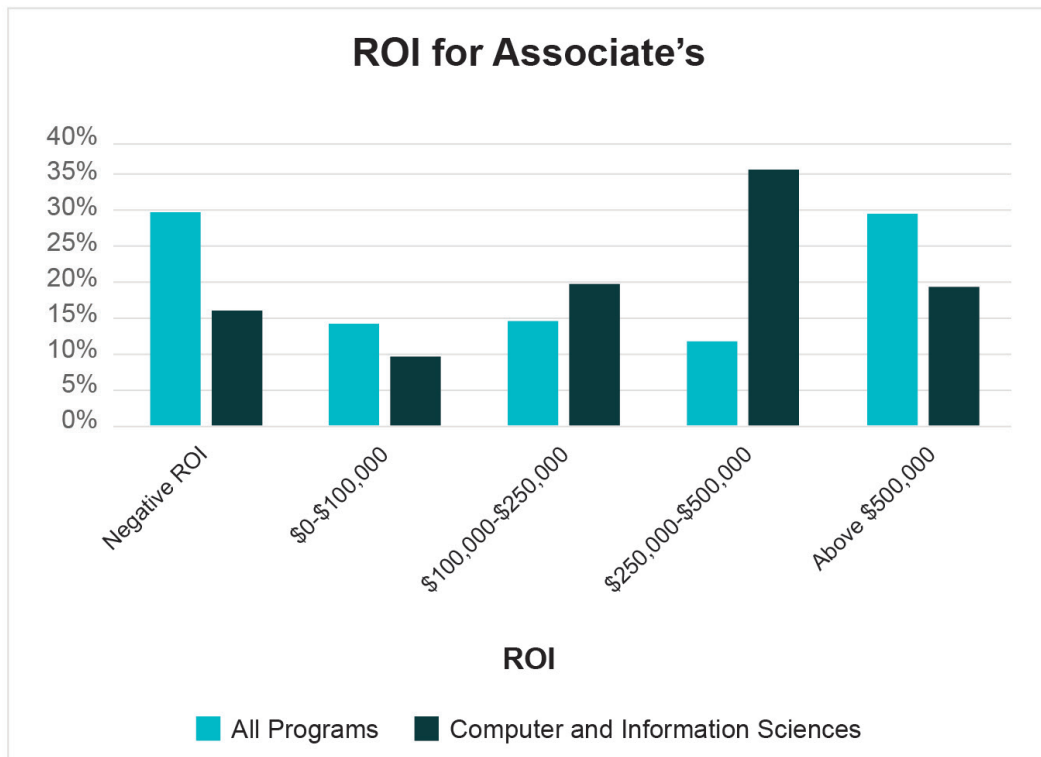
# Associate's Degrees

Associate's degrees in tech may not have a payoff as great as that for bachelor's degrees, but they are associated with higher wages than most other associate's degree options, and the number of job opportunities for associate's degree holders is growing. The Georgetown University Center on Education and the Workforce projects that the number of good jobs in computer and mathematical science occupations available to those with sub-baccalaureate degrees and credentials will increase by 291,000 by 2031, while the share of good jobs in the field that are available to those with associate's degrees will increase from 14% to 18%.<sup>31</sup> According to Payscale's college salary report, five of the top 20 highest-paying two-year degrees, or 25%, are in tech:<sup>32</sup>

Major	Early-career pay	Mid-career pay	Rank (across all majors)
Software engineering	\$67,200	\$112,400	2
Network engineering	\$60,200	\$95,500	8
Management information systems	\$53,900	\$95,000	9
Software development	\$62,400	\$93,500	11
Information technology management	\$49,300	\$92,000	16



Most associate's degrees in tech yield a positive ROI, and returns compare favorably to those of associate's degrees in many other fields. While 29% of all associate's degrees have a negative ROI, only 17% of computer science and engineering associate's degrees do. A study of nearly 17,000 associate's degrees and certificate programs found associate's degree programs had a median ROI of \$167,000.<sup>33</sup> But more than a third of computer science and engineering associate's degree holders see a substantially higher ROI of between \$250,000 and \$500,000, and one in five sees an ROI of more than \$500,000.<sup>34</sup> At the associate's level, tech lags behind fields such as nursing and mechanic/repair technology in terms of ROI, but it remains a better bet than most programs of study.<sup>35</sup>



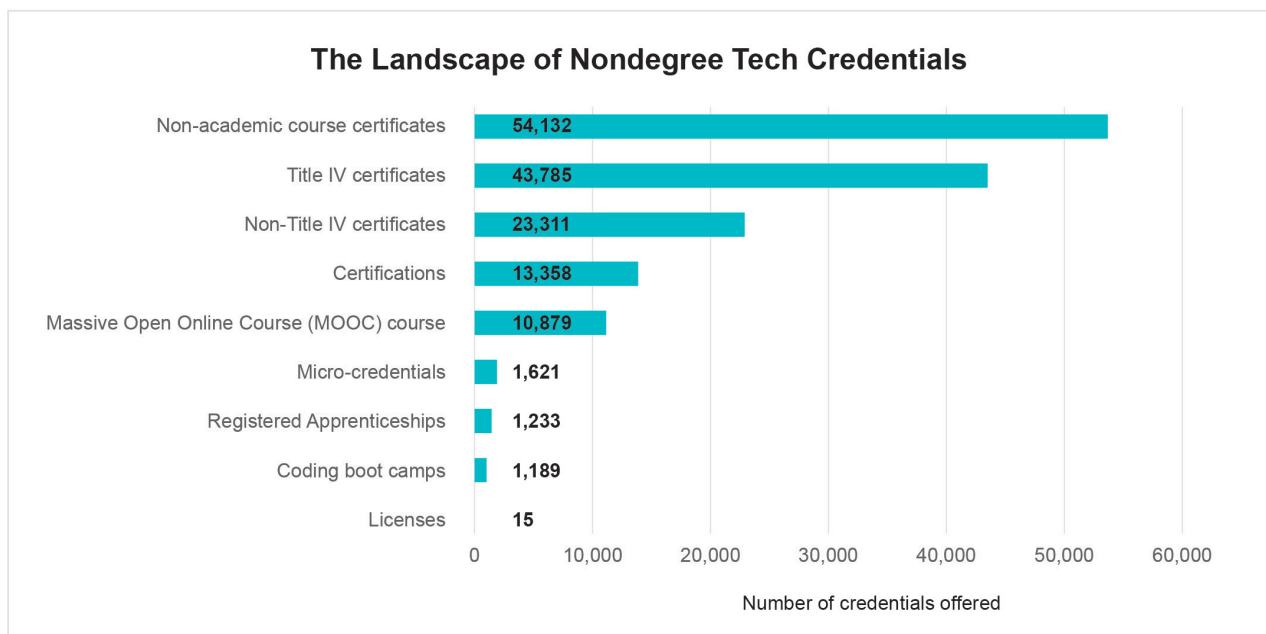
Source: Preston Cooper, *Is Community College Worth It? A Comprehensive Return on Investment Analysis*

## Short-Term Credentials

The landscape of [short-term credentials](#) in tech is vast and complex, and there is considerable variability in credential quality and the availability of data on employment outcomes, making it challenging to generalize or make a determination about the potential return on investment of tech credentials as a broad category.<sup>36</sup> According to Credential Engine, approximately 150,000 tech credentials that are not part of formal degree programs are offered in the United States. These include certificates offered by accredited educational institutions (i.e., Title IV schools) and by nonacademic providers, certifications, micro-credentials, and coding boot camps.<sup>37</sup>

With so many credentials available, it can be challenging for learners and workers to navigate the available options and for pathways leaders and education and training providers to know which credentials to offer. It is thus perhaps unsurprising that there is an alarming mismatch

between credentials conferred and labor market needs. In over half of U.S. labor markets, more than 50% of credentials are conferred in fields not aligned to labor market demand.<sup>38</sup> Most metro areas produce enough credential earners to fill high-wage middle-skill roles in STEM fields, including tech roles like computer systems analysts and computer and information systems managers, but nationwide there are not enough STEM credential holders to meet demand.<sup>39</sup> The issue of tech credentials that are misaligned to demand is particularly acute at the high school level. Among the 10 tech certifications most commonly earned by high school students in the United States, eight appeared in zero job postings nationwide, and a ninth appeared in only 38 postings. The 10th was requested in just over 2,500 postings. By comparison, the certification most frequently sought by employers appeared in more than 83,000 job postings.<sup>40</sup>



Source: Credential Engine



Determining how to embed tech credentials within pathways is made particularly difficult by a lack of data on educational or employment outcomes for those who earn credentials. Labor market information and other measures of employer demand for tech credentials provide some indication of which credentials are most likely to help a jobseeker land employment, but outcomes data is relatively rare. Surveys conducted by both credential providers and third parties can help assess whether credential holders believe they pay off. For example, 75% of those who earned Google Career Certificates reported career advancement, including promotions, salary increases, and new jobs.<sup>41</sup> And Skillsoft's annual survey of IT professionals attempts to match salaries to the credentials respondents say they have earned.<sup>42</sup> But this type of data is not provided in a centralized location, nor is it available for every credential.

Rigorous research on outcomes is even more difficult to find. The research that does exist, including two randomized controlled trials of the tech boot camp-style model developed by Per Scholas, a nonprofit training provider, suggests that earning a credential leads to higher wages—or an additional \$4,000 to \$6,000 in annual earnings for Per Scholas program participants.<sup>43</sup> But because the data is so scarce, it is difficult to quantify the return on investment of short-term credentials in tech as a broad category or to recommend specific credentials. And getting outcomes data remains a major barrier. A report by the Organisation for Economic Co-operation and Development (OECD) on micro-credentials identified a set of key challenges to measuring the value of credentials. They are: 1) lack of data,

including lack of an organizing body; 2) lack of standards, including for quality and duration; and 3) variation among credential program participants, who range from learners with no other formal postsecondary education to those with postsecondary degrees, populations likely to have different labor market outcomes.<sup>44</sup>

JFF's extensive experience supporting the design and development of short-term credential programs provides additional insights into their benefits and potential drawbacks compared to degree programs, though credential programs are highly varied, making it difficult to generalize. A key benefit of short-term credentials is that they often take less time and cost less money than degrees to complete (though, in some cases, attaining an associate's degree can be less expensive). Short-term credential programs are less likely to be tied to an academic calendar and may offer more flexibility; often at least part of the program can be done asynchronously, which may work better for people who are currently working, though it also requires self-motivation and self-direction, which can be a challenge for some learners.

One of the greatest benefits of short-term credentials is that they can support lifelong learning and the development of new skills, which is particularly important in the technology sector. Anecdotal evidence suggests that those who already have work experience, especially in tech roles, can especially benefit from the skill development opportunities offered by credentials. However, short-term credential options often offer learners fewer opportunities to develop key employability skills valued

by employers. Opportunities to practice communicating skills and competencies to employers are generally not built into short-term credential programs, a particular challenge given that employers continue to favor candidates with degrees. And, critically, because there are no formal standards for short-term credentials, programs can be offered even if they do not meet employer needs or have value in the labor market. This could mean that students are learning skills that are not highly valued, are outdated, or are not broadly applicable across the tech industry.

Despite the variability in credential programs, there is an emerging consensus in the field about what makes for a high-quality program, and tools such as JFF's [EQOS Quality Assurance Framework](#) can support pathways leaders in identifying high-quality credentials.<sup>45</sup> In the absence of outcomes data, quality indicators related to program design can be helpful in identifying promising credentials. These include:

- *Alignment with labor market demand*, including employment projections, in-demand skills, and occupations that offer family-sustaining wages
- *Industry recognition and portability* to ensure credentials are recognized across multiple employers and enable career mobility and flexibility
- *Connections to employers* via mentoring and paid work-based learning opportunities

- *Credential stackability* that ensures the credential builds toward further education and career advancement
- *Competency mastery and transparency* to support the development of clear, demonstrable competencies that align with employer needs, including the specific skills learned through the credential and the broader competencies required for successful employment in the field
- *Equity and accessibility*, including using *disaggregated data* to measure and promote equitable progress, improving access by improving affordability, ensuring access through financial aid, and offering holistic wraparound and supportive services to remove barriers to completion



Degree attainment data adjusted for completion points to tech employers being more open to nontraditional educational pathways for in-demand jobs. Existing data on ROI shows that even students who do not complete tech degrees are successful in finding employment, suggesting that employers do not necessarily demand degree completion. The percentage of bachelor's degree holders with a negative ROI increases from 2% to 10% when accounting for completion, meaning 90% of students still have a positive ROI. Additionally, 49% of bachelor's students still see an ROI above \$500,000 when adjusting for completion. The percentage of associate's degrees with a negative ROI in computer science and engineering increases from 17% to 25% with adjusting for completion rates, but that still means 75% of students will have a positive ROI.<sup>46</sup> If employers can identify

existing high-performing tech workers who did not complete degrees and determine the skills and abilities that support their success, they make connections to valuable incremental credential opportunities that expand their candidate pool to fill more in-demand roles. Tech employers prefer bachelor's degrees but need to consider other forms of education and training to fill roles, given current levels of educational attainment.<sup>47</sup> Alternative education and training pathways do not require that employers lower their standards, but business, education, and workforce professionals must develop methods of assessing and recognizing alternative pathways in the same way that they do for bachelor's degrees.





# The Need for Tech Pathways With No Dead Ends

High wages and job quality, as well as growing demand, make tech a desirable field and one in which it is critical to develop equitable college and career pathways. But the differences in the value of tech degrees and credentials call for careful design of pathways to ensure that young people do not encounter dead ends on their education-to-career journeys. Approaches like JFF's [No Dead Ends](#) policy agenda multiply options for young people and lead to more equitable access and outcomes, which are badly needed in both education and training programs and the labor market in the tech sector.<sup>48</sup>

Pathways with no dead ends support young people to earn a variety of credentials and degrees—and to do so in any order—rather than asking students to choose a single educational destination. It’s an approach that recognizes the value and potential ROI of multiple educational options and maximizes choice and flexibility. Pathways leaders seeking to develop systems with no dead ends can begin with four key strategies:

- **Incorporate both rigorous core academics and career-focused learning.** Pathways should include the core academic coursework needed to complete the next level of education while simultaneously connecting classroom learning to careers and offering students opportunities to apply learning in real-world settings. For tech pathways, academics should include the rigorous mathematics courses needed to complete degrees in fields such as computer science. Academic preparation in high school, including rigorous course-taking, is closely associated with increased enrollment and completion rates at both two- and four-year institutions. Strengthening academic preparation is a critical equity strategy; research from the Brookings Institution shows that academic preparation can help close existing racial, ethnic, and gender gaps in postsecondary enrollment. In the control group, 63% of Latine students, 62% of Black students, and 72% of white students enrolled in two- and four-year colleges within 18 months of high school graduation. But researchers

found that, after controlling for academic preparation, the pattern reversed, with 79% of Black students and 76% of Latine students enrolling in postsecondary education, while 72% of white students did so.<sup>49</sup>

- **Embed strategic dual enrollment course-taking opportunities.** Strategic dual enrollment courses are aligned to postsecondary programs of study and allow high school students to complete requirements for—and accelerate their progress toward—high-value degrees and credentials aligned with labor market demand. Dual enrollment also sets students up for success in a no dead ends system by improving educational outcomes across a range of domains, including academic achievement in high school; high school completion; college access, enrollment, and degree attainment; and credit accumulation.<sup>50</sup> But access to the benefits of dual enrollment is inequitable. The participation rate of Black students in public high schools is only 6%, and for Latine students, it is 7%—compared to a rate of 12.5% for white students.<sup>51</sup> Addressing this inequity is essential to the design of pathways that disrupt occupational segregation in the tech sector.<sup>52</sup>





- **Ensure stackability of credentials and build on established strategies that support transfer and credit mobility.** Policymakers and practitioners must take steps to ensure the stackability of credentials, including defining quality, eliminating silos between credit-bearing and noncredit options, and embedding short-term credentials into longer-term programs.<sup>53</sup> Despite recent improvements in transfer rates across the board, Black and Latine students and students from low-income households still transfer from two- to four-year institutions at lower rates than their white peers.<sup>54</sup> College and career pathways must support not only seamless transitions from secondary to postsecondary education, but from one postsecondary institution to another, building on the extensive research on best practices in supporting transfer and credit mobility.<sup>55</sup>
- **Adopt incremental credentialing strategies.** Incremental credentials are a series of learning and training opportunities that develop skills through opportunities that are accessible to learners who cannot afford to enroll in a multi-year degree program. Credential As You Go has developed a framework for incremental credentialing that includes strategies to capture learning and formally recognize it as it is acquired.<sup>56</sup> Incremental credentials offer an approach to continually building and recognizing educational opportunities. To implement this approach, we need to support learners in understanding and communicating their skills and how they have applied them, and employers need to see value in alternative approaches to credentialing. The lack of shared value for educational opportunities that aren't degrees is one of the reasons it is hard to determine the ROI of short-term credentials.

Addressing inequitable outcomes will require pathways leaders to pair these strategies with a sharp focus on education and employment practices that center equity and inclusion. Black learners face institutional and structural barriers to tech credential completion that include lack of affordability, lack of access to information about tech careers and support to enter them, lack of Black role models and mentors in the sector, exclusionary entry requirements, and implicit bias.<sup>57</sup> In addition, Black and Latine learners face forms of discrimination such as disrespect, harassment, and lack of physical and psychological safety within postsecondary institutions that many report have caused them to consider dropping out. One in five Black learners and one in four Latine learners report that they “frequently” or “occasionally” experience discrimination, with a greater proportion of those in short-term certificate programs than in associate’s or bachelor’s programs reporting these experiences.<sup>58</sup> Adopting broad-based policies and practices that support equity, including the four strategies

described above, is necessary but not sufficient. There is a clear need to reimagine education and training systems and to explicitly center the needs and perspectives of Black and Latine learners in tech education and training programs.<sup>59</sup> In addition, tech industry leaders must work to make hiring, retention, and advancement more inclusive and equitable. Employers must prioritize recruiting and retaining a more diverse workforce, particularly for high-wage and managerial roles, and put in place changes that limit biases in processes related to hiring, promotion, and pay.<sup>60</sup>

Strategies that create pathways with no dead ends and center equity are key to supporting young people in accessing high wages and meaningful careers in the tech industry. Degrees in tech offer a clear return on investment and an opportunity to work in an innovative and forward-looking sector. But more work needs to be done to increase access and realize the promise of tech credentials for all.



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