

STEM Starter Academy Annual Evaluation Report, Year 6

Jeremiah Johnson, Senior Research Manager

Ivana Zuliani, Research Manager

Catherine Jett, Senior Research Analyst

Donna Spraggon, Senior Research Analyst

Jackie Stein, Senior Research Analyst

Gaby Stevenson, Senior Research Analyst

November 12, 2020





STEM Starter Academy

Annual Evaluation Report—Year 6

The STEM Starter Academy (SSA) is a Massachusetts Department of Higher Education (DHE) initiative to recruit, ready, retain, and ensure completion of credentials by significantly more students through community college STEM pathway programs that result in job placement within STEM professions or transfer to university STEM programs.

STEM Starter Academy

DHE launched SSA system-wide at all 15 Massachusetts community colleges in January 2014. From its inception, the SSA initiative has focused on at-scale implementation while encouraging local site adaptation. Over the years, a collaborative learning community has emerged, bringing together state initiative leaders, college program staff, and administrators to share insights and inform both system-level and institutional guidance, data collection, and program evaluation.

Throughout the initiative, DHE has engaged with data and evaluation to inform decisions about SSA at both the college and the system levels. The UMass Donahue Institute (UMDI) has partnered with DHE as an external evaluator of the initiative since the program began.

This Report

This report summarizes findings related to the SSA initiative’s overall effectiveness in terms of key student outcomes, based on data from SSA Years 1–6 (2014–2019). These findings include descriptive data about SSA participants as well as results from rigorous statistical analyses to assess the impacts of SSA on student success.

To contextualize these findings, the first part of this report provides some background on SSA and the broader landscape of higher education. In previous reports, UMDI provided extensive detail characterizing SSA during each phase of its implementation. This report, however, is intended to be a high-level overview as the SSA initiative closes its seventh year.

Spotlight: Key Findings



SSA has served nearly 31,000 students who reflect the diversity of the community college population.



64% of SSA participants have achieved positive outcomes (degree/certificate, 4-year transfer, STEM workforce entry, retention) and have achieved those outcomes at higher rates than their non-SSA peers.



Black SSA participants are twice as likely* to achieve positive outcomes—and they earn STEM degrees and certificates at higher rates—than their non-SSA peers.



Analyses show that SSA students are achieving positive outcomes. **More work is needed within the program to impact STEM degree and certificate attainment to a statistically significant level.**

*Odds ratios are presented in Appendix C

Contents

Context	
Equity & Diversity.....	3
Core Principles.....	6
Program Development.....	7
Findings	
Participant Characteristics.....	10
Evidence & Outcomes.....	11





Equity & Diversity

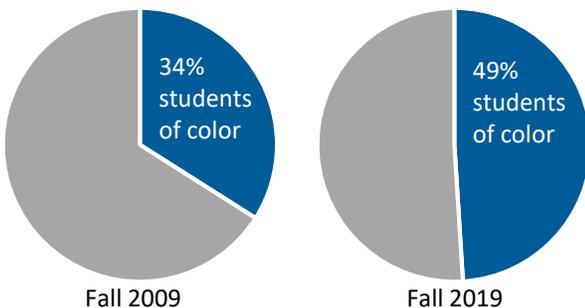
Massachusetts’ increasingly diverse population and need for a diverse STEM-skilled workforce shape the context in which SSA has developed

Community colleges provide a critical on-ramp and connection to STEM education and careers, and are particularly important for serving students who reflect a broader cross-section of societal diversity than is typical of 4-year institutions.¹

Massachusetts’ community colleges have become more diverse; SSA participants broadly reflect this diversity

Of all students in Massachusetts public higher education, 43% are enrolled at community colleges.² Among these students, **racial and ethnic diversity has increased over the past 10 years**, with students of color making up nearly half of all Massachusetts community college students in fall 2019 (compared to 34% in fall 2009). Massachusetts community colleges also serve a higher percentage of low-income students and those above age 25 than the Commonwealth’s public 4-year colleges and universities.³

Racial and Ethnic Diversity at Massachusetts Community Colleges



STEM enrollment has mirrored these broader shifts in racial and ethnic diversity at Massachusetts community colleges. In fall 2009, 34% of STEM students were students of color. By fall 2018—for the first time—a majority (52%) of community college students in the STEM pipeline were students of color.

Information about SSA participant characteristics—including race/ethnicity, gender, and age—is included on page 8.

Community college students differ in key ways from students at 4-year colleges

Community colleges are known for their affordability, open access, and representation of students who have often been considered “nontraditional,” such as older students, those enrolled part time, and those balancing work and family responsibilities.⁴

Massachusetts community colleges serve high proportions of students of color, low-income students, and adult learners. Of community college students nationally, over 60% work full or part time, 29% are first-generation college students, and 20% are students with disabilities.⁵ Also, 40%–60% of Black, Latinx, and Native American undergraduates are enrolled in community colleges.

The goals and academic trajectories of community college students are often more varied than those of their 4-year counterparts.⁶ For example, community college students in STEM programs are more likely to require developmental education and are less likely to have continuous enrollment with no stop-outs.⁷

Community college students may also seek a variety of end points: some work toward an associate degree, some work toward a certificate for a job requirement, and others aim to transfer to a 4-year institution. Finally, non-academic barriers—like needing to work full time—can influence course load and academic engagement.

*SSA participants generally reflect the racial and ethnic diversity of Massachusetts community college students. That said, **SSA has consistently served a higher proportion of Black students compared to the overall community college population.***



Equity & Diversity

Ongoing inequities in student outcomes indicate a need for higher education to adapt in order to meet the needs of a diverse population

Across the higher education landscape, disparities in completion outcomes have drawn attention to the ways institutions have been underprepared to serve students from traditionally underrepresented populations.

Increased diversity is not reflected in equitable student outcomes

While college populations are becoming more diverse, equitable outcomes are lagging. Nationally, Black and Latinx students in community colleges graduate at lower rates than the overall community college population.⁸ Lower income students are less likely than their higher income peers to transfer to 4-year schools or earn a bachelor’s degree after transfer.⁹ These disparities also exist in Massachusetts, where Black and Latinx students graduate at lower rates than White students.¹⁰

Across the nation, students studying in STEM fields are increasingly likely to be from underrepresented groups—including people of color and single parents—but completion rates are lower for students from these groups compared to their White and Asian counterparts.¹¹ These trends likely contribute to the underrepresentation of women, Black, and Latinx workers in the STEM workforce.¹²

Higher education is adapting in order to support students with diverse needs

Higher education is in a phase of transition and self-reflection in response to these inequities. Students are increasingly diverse, but colleges are not adequately prepared to address the needs of nontraditional populations.¹⁵ Students face barriers beyond the academic sphere, including:

- first-generation status;
- inadequate access to technology and Internet;
- lack of support at home; or,
- responsibilities outside of college.

“[Community colleges] work to educate our most disenfranchised students. I believe it will be the student-ready colleges, not those who are serving only college-ready students, that will survive the next shakeout of higher education.”

Carlos Santiago, Commissioner, DHE

Equity gaps in Massachusetts

Data from the Massachusetts DHE show:

33

Percentage-point gap in college graduation rates



Between White females and Latino males at MA public colleges or universities (2017).¹³

10+

Percentage-point gap in timely completion of gateway courses and on-time credit accumulation



Between White and Black or Latinx students at MA community colleges (2015–2018).¹⁴

Community colleges’ current model—in which students have many options but little direction (sometimes called “cafeteria-style”)—may not be a good fit for students from underrepresented backgrounds.¹⁶

On the other hand, implementing a guided-pathways model—like the one currently used in Massachusetts—offers more direction to students, encouraging them to “start with the end in mind” by establishing a plan early on and revisiting it often. These strategies have been linked to helping students graduate at faster rates.¹⁷

In SSA, the shift to case management incorporates this kind of directed guidance, along with a more sustained and personalized approach to student support.¹⁸



Equity & Diversity

Improving outcomes for today's diverse group of students requires a focus on equity within higher education

As open-access institutions, community colleges are in a unique position to address barriers that students face. SSA is part of a state-wide commitment to addressing issues of equity in higher education.

There is a need for continued growth in higher education around issues of equity, diversity, and access

Historically, and today, structural inequities—including institutional racism—permeate systems of higher education.¹⁹ Acknowledging this fact is a necessary first step toward achieving significant change for all students.

Beyond recognizing that structural inequities exist, research suggests that necessary shifts include changes to institutional culture, program design and development, and allocation of targeted resources.²⁰ For example, while **the community college system may be the “most egalitarian system of higher education in the world,”** increased and continued funding of supports for underrepresented and nontraditional students is key to adequately addressing issues of equity.²¹

“Because of COVID-19, we are truly seeing the barriers that students have ... It really separates out the haves and the have nots.”

NECC Administrator

Efforts to increase equity must consider barriers to access that may be linked to students' diverse circumstances and backgrounds. **The COVID-19 pandemic has brought increased attention to these barriers,** as the inequitable impacts of the disease and the related social and economic ramifications have become evident. For example, SSA administrators reported student struggles with familial financial hardship (as the economy faltered) and access to technology (as college programs shifted toward virtual modalities). The current crisis will likely have long-term implications for educational equity.

Massachusetts has committed to addressing issues related to equity in higher education

The Massachusetts Board of Higher Education (BHE) has “adopted equity as the top performance and policy priority for Massachusetts public higher education.”²² BHE expressed a commitment to maintaining high levels of educational attainment for all students in the Commonwealth—particularly students from underserved and underrepresented populations. Similarly, DHE has made an equity agenda one of its strategic initiatives and is working with state colleges and universities to “develop a system-wide strategic framework to achieve equity.”²³

SSA aligns with and supports the Commonwealth's commitment to equity by:

- recognizing the untapped potential of underrepresented student populations;
- supporting differentiated approaches to meeting student needs; and,
- engaging in an iterative process of learning, evaluation, and application to implement, at scale, best practices that support all students.

“States that are seeing the needle move in terms of college completion have a specific focus on equity and are committed to equitable outcomes for all students.”

*Yolanda Watson Spiva,
President, Complete College America²⁴*



Core Principles

At-scale launch, local adaptation, and collaboration foster innovation

Through a combination of system-level leadership, multi-site collaboration, and local flexibility, the SSA initiative has fostered a unique context in which innovations at the system and institution levels inform one another. This allows for the testing, adaptation, and replication of best practices to support student success.

Launched at-scale with local flexibility

DHE launched SSA simultaneously across all 15 Massachusetts public community colleges in 2014. The initiative’s design included both system-wide guiding principles and flexibility for local site-level adaptation, elements supported by research on best practices for scaling educational reforms.²⁵

Cycles of innovation

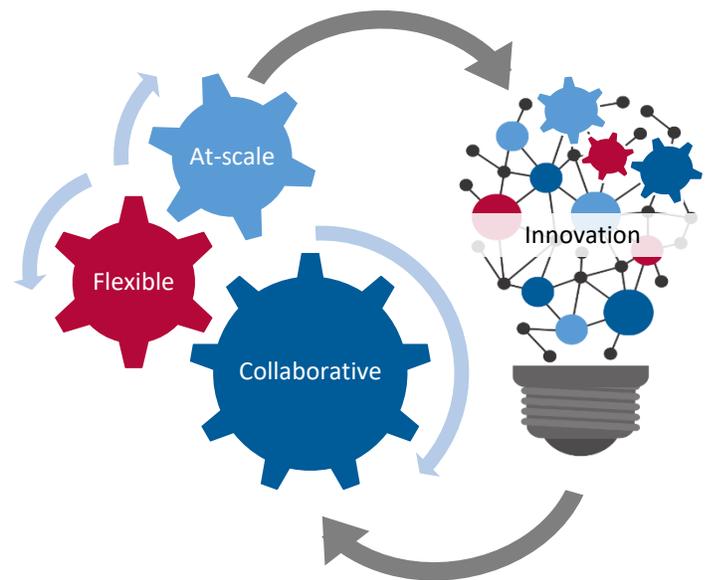
Iterative innovation has been an important part of SSA from its inception. In the original RFP, DHE encouraged SSA sites to test innovative strategies in order to “refine the definition and implementation of the STEM Starter Academy as a model of student success across the Massachusetts community college system.”²⁶

Attending to equity

The SSA community has come to recognize that engaging with equity is key to supporting community college student success. This is especially true in STEM fields, which pose particular access challenges for students who have been in underserved educational settings. As SSA has evolved, the initiative’s design and implementation have been increasingly attentive to issues of equity and diversity.

“We need a robust workforce that reflects our core strengths as a Commonwealth—diverse, well educated, innovative and collaborative. SSA provides all students, statewide, the opportunity to access, grow, and thrive through STEM.”

David Cedrone, Associate Commissioner of Workforce Development, DHE



Collaborative learning community

From the beginning, SSA has been a collaborative endeavor. Representatives from the 15 institutions regularly convene to share information about practices, resources, and insights into implementation.

This learning community has persisted for 6 years, providing continuity to the initiative and sustaining connections between institutions. SSA institutions, through participation in working groups, have also advised DHE on initiative design, implementation, and evaluation.

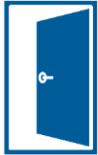
When combined with flexibility for local adaptation, this kind of collaboration supports a positive feedback loop between design and implementation that is key to successful reform—with benefits that accrue both to the participants and their serving institutions.²⁷



Program Development

Over time, SSA has evolved through an iterative process of learning, evaluation, and application

From the outset, DHE envisioned that a collaborative SSA community would continue to refine the STEM Starter Academy as a model for promoting student success.



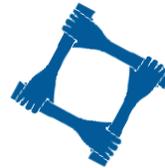
Phase 1 (Years 1–3): Recruitment and readiness

In the early years, SSA implementation focused broadly on recruitment into and readiness for STEM pathways. This was key, as students considering and attending community college are less likely than their 4-year counterparts to have been exposed to a wide array of occupational choices within STEM fields.²⁸

SSA sites worked to **build interest in and awareness of STEM fields**—and specifically to raise awareness of community colleges as entry points to STEM careers. Practices included high school outreach, hands-on challenge events, and visits to college laboratory spaces.

Building readiness for college and for STEM involved programming such as STEM-focused summer bridge-to-college programs and math readiness activities—practices that the literature suggests can help smooth students’ transition from high school to college.²⁹

In an effort to bolster recruitment, **SSA developed relationships, reputations, and name recognition** within their institutions and in their surrounding communities.



Phase 2 (Years 3–5): Retention and relationships

In Years 3–5, SSA programs turned their focus to **increasing retention and readying students for completion**. This focus included attention to both academic and non-academic factors.

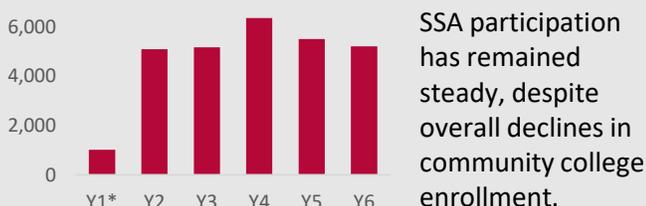
To support student persistence, SSA sites emphasized **building relationships to connect students to each other and to faculty, program administrators, and support resources**.³⁰ Practices included, for example, cohort activities, leadership opportunities, and chances for casual interaction with peers, faculty, and staff.

Cultivating a sense of belonging—specifically conveying a sense of being known and cared about by institutional actors—can be particularly important for retaining underrepresented students in STEM fields.³¹

Acknowledging that money is often a factor in college student attrition, some SSA programs offered financial support to participants, through scholarships, paid internships, stipends, tuition waivers, or in-kind help.³²

To **prepare students for career and transfer**, sites created or connected students to internships, research opportunities, and professional mentorships.³³ They also offered resume review sessions, networking events, field trips, and 2- to 4-year transfer academies.

As of Fall 2019, SSA has directly served 30,964 students





Program Development

The SSA learning community is developing its latest innovation: a focus on supporting students along a through-line from entry to completion



Phase 3 (Year 6+): Case management and through-line

Beginning in Year 6, DHE began developing a case management model that would transition SSA programs from discrete interventions focused on particular elements of a student’s academic trajectory (recruitment, readiness, retention, completion) to a model with a **core focus on supporting a set of students along a through-line from entry to completion.**

The introduction of this model marked a **data-driven change in emphasis and practice for SSA.** At launch, SSA focused on filling gaps in services for students at individual points along their paths from entry to completion. By the end of Year 5, SSA data showed that the majority of participants (over 75%) had been actively engaged with SSA for only a single term. Based on such findings and on STEM completion data, DHE and the SSA community broadened that original focus, embracing a model that **ensures supportive connections at every point along a student’s trajectory** (see page 11).

In depth connections and relationships inherent in this model help students feel integrated in the college community. This may be particularly helpful for nontraditional students—and especially for those who are floundering in the current circumstances being shaped by the COVID-19 pandemic.

The SSA Case Management model is sustained, strategic, and personalized—features that the literature suggests helps students have better long-term outcomes.³⁴

Spotlight: SSA case management

At the heart of the SSA case management model is an intensive approach to supporting community college STEM students—or those thinking about STEM—and connecting them to appropriate academic and non-academic services. **The goal of the model is to identify and resolve barriers and challenges that inhibit student success in STEM and to support students from entry through to completion.** Both the model and its implementation are in their early stages.

In fall 2019, DHE began collaborating with SSA colleges to identify core elements of its case management model. In its prototypical form, this model includes:

- ✓ the identification of an academic pathway (with clearly established career or transfer goals);
- ✓ the development and monitoring of an academic plan;
- ✓ monitoring math and gateway course completion;
- ✓ participation in STEM professional or STEM leadership opportunities;
- ✓ community-building activities with peers; and,
- ✓ post-community-college support.

As the SSA case management model continues to evolve, it holds promise as a strategy for addressing equity gaps in STEM outcomes. Some research-based strategies included in the SSA case management model are considered particularly effective with traditionally underserved populations. For instance, research has shown that providing transparency and structure to students has led to positive results.³⁵





Participant Characteristics

SSA participants reflect the diversity of community college students

Demographic characteristics

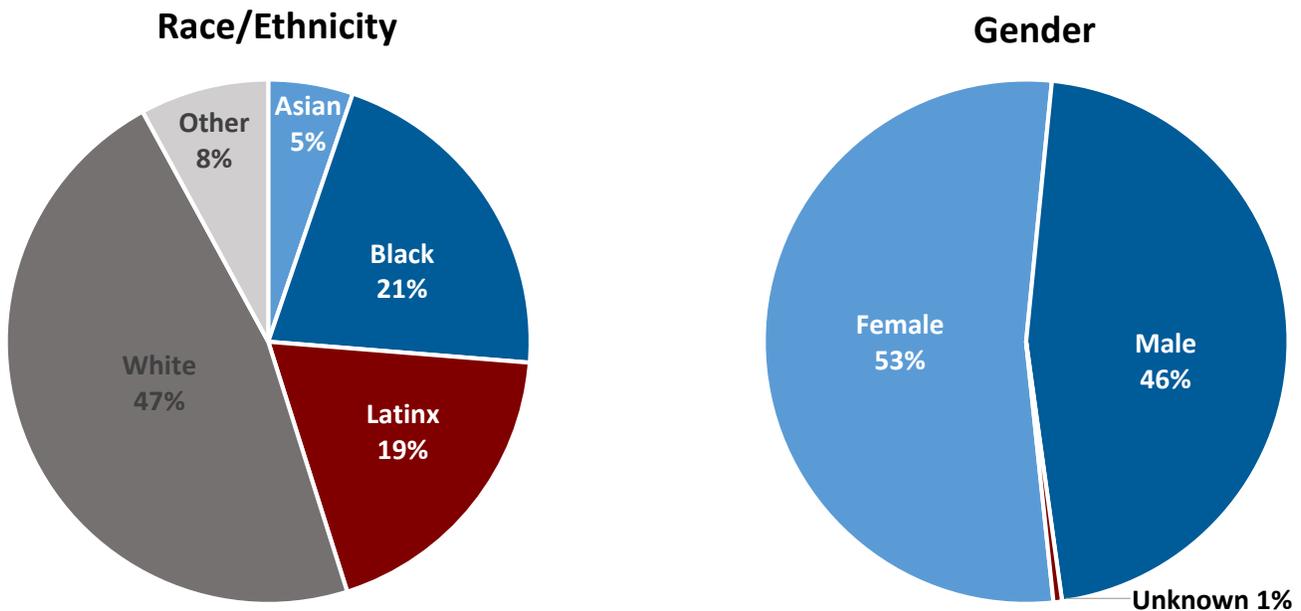
SSA participants come from a broad range of personal backgrounds, into which quantitative data offer a small window. Overall, just over half of SSA participants are female (Figure 1). While representation varies, this is important because women continue to be under-represented in many STEM fields.³⁶

One third of SSA participants overall are considered to be non-traditional aged students (not shown). These students are age 25 and older when they first participate. Overall, over half of SSA participants (54%) attend school part time (not shown).

Regarding race/ethnicity, participants are generally similar to the community college population, though the SSA program serves a slightly larger proportion of students of color. Just under half of participants are White (Figure 1), fewer than community college students overall.

SSA consistently serves a higher proportion of Black students compared to the community college population overall.

Figure 1: Demographic Characteristics of SSA Participants Overall, 2014–2019



STEM status

SSA was designed to serve undeclared students and STEM-interested students. STEM students make up a consistently higher proportion of SSA participants than they do of the entire community college population.

In fall 2019, 57% of SSA participants were STEM students, compared to 31% of community college students overall.



Evidence & Outcomes

SSA students continue to advance toward higher-level outcomes years after initial participation

SSA participants were assessed for the highest outcome achieved as of Fall 2019 (Table 1). Overall, **almost two thirds of participants to date (64%) have earned a degree or certificate, have transferred to a 4-year institution, have joined the STEM workforce, or are continuing their education at the community college** (see “Overall” row).

In general, students continued to achieve higher-level outcomes with each additional year since starting with SSA. **The proportion of students earning degrees and certificates rose each year**, from 5% among those who started in Year 6, to 15% among the Year 5 cohort, and eventually to 42% among those who started in Year 1.

Overall, 64% of SSA participants have achieved positive outcomes.

Transfer to a 4-year institution (without earning a degree or certificate at the community college) reached 10%–11% and remained in that range for the Year 1 to Year 5 cohorts.

Table 1: Highest Outcome Achieved as of Fall 2019, by Year of First SSA Participation†

SSA Year First Participated	Earned degree or certificate	Transferred to 4-year institution	Retained at original CC in Fall 2019	Transferred to 2-year institution	Indeterminate status
Year 1	42%	10%	4%	4%	40%
Year 2	37%	11%	5%	4%	44%
Year 3	35%	11%	9%	3%	41%
Year 4	27%	11%	17%	3%	41%
Year 5	15%	10%	33%	2%	39%
Year 6	5%	5%	58%	2%	30%
Year 7	0%	0%	99%	0%	1%
Overall	23%	9%	30%	3%	36%

†Mutually exclusive outcomes are listed from left to right in order of priority (e.g. “earned a degree or certificate” is considered a higher outcome than “transferred to 4-year institution”). Some Group 1–3 (Primary) Participants were not trackable (i.e., were not found in HEIRS). This includes those who did not have a SSN, and those who had been assigned a student ID number (for tracking within an institution) but had not registered for a course (e.g., high school participants that returned to high school).³⁷

Quasi-experimental modeling procedures

In addition to completing descriptive analyses, UMDI evaluated the effectiveness of the SSA intervention using rigorous, quasi-experimental, matched-comparison-group designs. These statistical analyses compared the outcomes of SSA participants with those of similar students who did not participate in the intervention. A full description of quantitative methods is included in Appendix B. Results from these analyses are discussed on the following two pages.

Two outcomes were assessed using this design:

1. Positive educational outcomes—a broad measure of student progress and retention that includes those who were retained, completed, transferred to a 4-year institution, or joined the STEM workforce.
2. STEM degree and certificate earning—an important measure of success that is part of the SSA program goals.



Evidence & Outcomes

SSA participants have achieved positive outcomes at higher rates than their peers, at all time points and across nearly all subgroups

Overall and subgroup results



SSA participants were **more likely than their peers to achieve a positive outcome at every time point assessed** (1, 2, 3, 4, and 5 years after entry).

Various subgroups of students were also assessed, as shown in Table 2. Subgroups were based on **STEM at entry status, college math ready status, specific types of SSA supports received, race/ethnicity, and gender.**

Across nearly all subgroups, SSA participants out-achieved their peers to a statistically significant degree.

Spotlight: Positive outcomes and equity

Supporting students of color as they progress and complete their educations is an important goal of the SSA initiative in its efforts to advance racial equity. Analyses suggest that some students are served better than others:



Black SSA participants achieved positive outcomes at higher rates than their peers at each time point that could be assessed (1, 2, and 3 years after entry).

However, Latinx SSA participants at longer follow-up periods (3, 4, and 5 years after entry) were not statistically significantly more likely to achieve a positive outcome. Nor were Asian SSA participants after 1 year, the only time period that could currently be assessed. These findings warrant further investigation.

Table 2: Students Achieving Positive Outcomes 1 to 5 Years After Entry SSA vs. Non-SSA, by Subgroup, with Model Results [∇]

(Sub)group	1 Year After		2 Years After		3 Years After		4 Years After		5 Years After	
	SSA	non-SSA	SSA	non-SSA	SSA	non-SSA	SSA	non-SSA	SSA	non-SSA
1. All	67%***	57%	58%***	45%	52%**	41%	52%**	41%	54%***	41%
2. STEM at Entry	68%***	56%	59%***	45%	53%**	41%	54%**	40%	60%***	41%
3. Not STEM at Entry	67%***	57%	56%***	46%	51%**	42%	49%*	41%	47%	41%
4. College Math Ready	77%***	67%	70%***	56%	63%**	54%	65%**	54%	68%***	54%
5. Not College Math Ready	63%***	54%	52%***	42%	47%**	38%	46%**	37%	48%***	38%
6. SSA Aid	70%***	57%	62%***	46%	59%***	41%	58%***	41%	60%**	41%
7. SSA Extra Support	69%***	57%	60%***	45%	55%***	41%	53%***	41%	53%**	41%
8. SSA Counseling	71%***	57%	63%***	45%	57%***	41%	55%**	41%	57%*	41%
9. Black	64%***	54%	60%***	43%	57%**	38%	Insufficient Sample		Insufficient Sample	
10. Asian	69%	63%	Insufficient Sample		Insufficient Sample		Insufficient Sample		Insufficient Sample	
11. Latinx	61%***	51%	51%***	38%	44%	34%	39%	34%	41%	34%
12. White	71%***	60%	61%***	49%	54%**	45%	57%*	45%	60%**	46%
13. Men	66%***	54%	57%***	42%	50%**	38%	50%*	37%	53%***	37%
14. Women	69%***	59%	59%***	48%	54%***	44%	54%**	44%	54%	45%

[∇] First-time students, registered at their institutions in a fall term, and enrolled either full or part time. SSA participants include those who first participated in SSA in summer or fall. Positive outcome includes retained, completed, transferred to 4-year, or joined the STEM workforce. Statistically significant results from quasi-experimental modeling are indicated with asterisks (*p < .05, **p < .01, ***p < .001).



Evidence & Outcomes

Analyses show that SSA students are achieving positive outcomes, but more work is needed to address STEM degrees and certificates

SSA participants appear to earn STEM degrees and certificates at higher rates than their peers, but not to a statistically significant level. Additional data are needed to clarify this ambiguous result.

Overall and subgroup results



SSA participants were **not statistically significantly more likely to earn a STEM degree or certificate** at every time point assessed (2, 3, 4, and 5 years after entry), as shown in Table 3.

Analyzing the statistical significance of modeling results allows for more certainty that the data represents impacts that are not due to chance alone. It also ensures that baseline differences between SSA participants and non-participants are taken into account.

Across all groups, the percentage of students earning STEM degrees and certificates appears to be higher for SSA participants than for non-participants. Statistically significant differences are noted (*).

Spotlight:

Successes in STEM completion

For nearly all groups, effects of participation were positive but not statistically significant. There were positive and significant results for two groups:



Black SSA participants earned STEM degrees and certificates at higher rates than their peers 3 years after entry, the furthest time point that could be assessed.



Among **college math ready students**, SSA participants earned STEM degrees and certificates at significantly higher rates than their peers at all time points.

Table 3: Students Earning STEM Degrees and Certificates 2 to 5 Years After Entry SSA vs. Non-SSA, by Subgroup, with Model Results^Y

(Sub)group	2 Years After		3 Years After		4 Years After		5 Years After	
	SSA	non-SSA	SSA	non-SSA	SSA	non-SSA	SSA	non-SSA
1. All	4%	2%	10%	5%	14%	7%	17%	9%
2. STEM at Entry	7%	7%	17%	14%	23%	20%	26%	23%
3. Not STEM at Entry	1%	0%	1%	1%	3%	3%	5%	4%
4. College Math Ready	7%**	3%	14%*	6%	19%**	10%	29%*	14%
5. Not College Math Ready	3%	2%	8%	4%	12%	6%	11%	7%
6. SSA Aid	6%	2%	16%*	5%	20%	7%	22%	9%
7. SSA Extra Support	4%	2%	12%	5%	14%	7%	15%	9%
8. SSA Counseling	6%	2%	14%*	5%	18%	7%	21%	9%
9. Black	4%	2%	11%*	3%	Insufficient Sample		Insufficient Sample	
10. Asian	Insufficient Sample		Insufficient Sample		Insufficient Sample		Insufficient Sample	
11. Latinx	3%	1%	8%	4%	9%	5%	Insufficient Sample	
12. White	4%	3%	11%	5%	14%	8%	15%	10%
13. Men	5%	3%	11%	5%	16%	7%	18%	8%
14. Women	3%	2%	9%	4%	12%	7%	14%	9%

^Y First-time students, registered at their institutions in a fall term, and enrolled full time. SSA participants include those who first participated in SSA in summer or fall. Statistically significant results from quasi-experimental modeling are indicated with asterisks (*p < .05, **p < .01, ***p < .001).



End Notes

1. Malcom, S., & Feder, M. (Ed.) (2016). *Barriers and opportunities for 2-year and 4-year STEM degrees: Systemic changes to support students' diverse pathways*. <http://www.nap.edu/21739>; Dimino, M. (2019). *How outcomes metrics can better reflect community college performance*. <http://www.thirdway.org/report/how-outcomes-metrics-can-better-reflect-community-college-performance>
2. Massachusetts Association of Community Colleges. (n.d.). *Fast facts*. <https://www.masscc.org/about-mcceo/fast-facts>. Data from this source is from FY2018.
3. Ibid.; Massachusetts DHE Data Center (n.d.). *Report: Adult learners at Massachusetts public colleges & universities—realities & opportunities*. <https://www.mass.edu/datacenter/2017adultlearners.asp>
4. Dimino (2019).
5. Ibid.
6. Zinshteyn, M. (2019). *An Inside Higher Ed special report. Success at scale: Strategies to improve outcomes for underserved students*. Inside Higher Ed. <https://www.insidehighered.com/content/success-scale-strategies-improve-outcomes-underserved-students>
7. Malcom & Feder (2016).
8. Smith, A. (2019, February 24). Next on college completion agenda: Equity. *Inside Higher Ed*. <https://www.insidehighered.com/news/2019/02/25/community-colleges-focus-equity-next-piece-completion-agenda>; Malcom & Feder (2016).
9. Libassi, C. J. (2018, May 23). *The neglected college race gap: Racial disparities among college completers*. <https://cdn.americanprogress.org/content/uploads/2018/05/22135501/CollegeCompletions-Brief1.pdf>
10. Retrieved from the Massachusetts Department of Higher Education website: <https://www.mass.edu/datacenter/equityspotlight-latinomales.asp>
11. Malcom & Feder (2016).
12. This excludes health fields, where women are 75% of the workforce. Adapted from Funk & Parker (2018). Women and men in STEM often at odds over workplace equity. Pew Research Center: <https://www.pewsocialtrends.org/2018/01/09/diversity-in-the-stem-workforce-varies-widely-across-jobs/>
13. Retrieved from the Massachusetts Department of Higher Education website: <https://www.mass.edu/datacenter/equityspotlight-latinomales.asp>
14. Retrieved from the Massachusetts Department of Higher Education website: <https://www.mass.edu/datacenter/PMRS/reports/2019/Success-Completion.asp>
15. Dimino (2019); Dowd, A., & Bensimon, E. A. (2015). *Engaging the “race question”, accountability and equity in U.S. higher education*. In J. Banks (Ed.), *Multicultural Education Series*. Teachers College, Columbia University.
16. Bailey, T., Smith Jaggars S., & Jenkins, D. (2015). *Redesigning America’s community colleges: A clearer path to student success*. Harvard University Press; Lee, J. (2015, September 17). Rethinking community college to boost enrollment and completion [Blog post]. <https://www.brookings.edu/blog/the-avenue/2015/09/17/rethinking-community-college-to-boost-enrollment-and-completion>
17. Bailey (2015); Schwartz, N. (2019, April 15). Community colleges embracing “guided pathways” see pay-off. *EducationDive*. <https://www.educationdive.com/news/community-colleges-embracing-guided-pathways-see-payoff/552684>.



End Notes

18. See more about the SSA case management approach on page 8.
19. Rodriguez, F. C. (2015). Why diversity and equity matter: Reflections from a community college president. *New Directions for Community Colleges* 2015(172), 15–24.; Dowd & Bensimon (2015); Malcom-Piqueux, L., & Bensimon, E. M. (2017). Taking equity-minded action to close equity gaps. *Peer Review*, 19(2), 5.
20. For example, see Rodriguez (2015).
21. Rodriguez (2015, p.15)
22. Retrieved from the Massachusetts of Higher Education website:
<https://www.mass.edu/datacenter/PMRS/reports/2019/Success-Completion.asp>
23. Ibid.
24. Ibid.
25. Datnow, A., Hubbard, L., & Mehan, H. (2002). *Extending educational reform*. Taylor & Francis; Kezar, A. (2011). What is the best way to achieve broader reach of improved practices in higher education? *Innovative Higher Education*, 36(4), 235–247.
26. STEM Starter Academy RFP (2013).
27. Snyder, J., Bolin, F., & Zumwalt, K. (1992). Curriculum implementation. *Handbook of research on curriculum*, 40(4), 402–435; McLaughlin, M. W., & Mitra, D. (2001). Theory-based change and change-based theory: Going deeper, going broader. *Journal of Educational Change*, 2(4), 301–323; Coburn, C. E. (2003). Rethinking scale: Moving beyond numbers to deep and lasting change. *Educational researcher*, 32(6), 3–12; Datnow, A., Hubbard, L., & Mehan, H. (2002); Gehrke, S., & Kezar, A. (2017). The roles of STEM faculty communities of practice in institutional and departmental reform in higher education. *American Educational Research Journal*, 54(5), 803–833.
- Kezar, A., & Gehrke, S. (2017). Sustaining communities of practice focused on STEM reform. *The Journal of Higher Education*, 88(3), 323–349;
- Daly, A. J. (2010). Mapping the terrain: Social network theory and educational change. In A. J. Daly (Ed.), *Social network theory and educational change* (pp. 1–17). Harvard Education Press.
28. Boroch, D., & Hope, L. (2009). *Effective practices for promoting the transition of high school students to college: A review of literature with implications for California community college practitioners*. Academic Senate for California Community Colleges; Hagedorn, L. S., & Purnamasari, A. V. (2012). A realistic look at STEM and the role of community colleges. *Community College Review*, 40(2), 145–164.
29. Boroch, D., & Hope, L. (2009). Math readiness, in particular, continues to be a barrier for community college students interested in STEM, and SSA practices such as co-requisite remediation are considered best practices by the research community:
 - a. Bragg, D. D. (2012). two-year college mathematics and student progression in STEM programs of study. In *National Research Council and National Society for Engineering report: Community colleges in the evolving STEM education landscape: Summary of a summit*. http://www.nap.edu/catalog.php?record_id=13399;
 - b. Chaplot, P., Rassen, E., Davis Jenkins, P., & Johnston, R. (2013). *Principles of redesign: Promising approaches to transforming student outcomes*. Community College Research Center, Columbia University.



End Notes

- c. Many sites have worked to contextualize their college navigation courses for STEM, and this is supported by the literature, which suggests that creating engaging opportunities to learn college navigation skills that feel relevant to students' plans and goals can help with retention.
Karp, M.M. (2011). *Toward a new understanding of non-academic student support: Four mechanisms encouraging positive student outcomes in the community college* (Working Paper No. 28). Community College Research Center.
 - d. Nodine, T., Jaeger, L., Venezia, A., & Bracco, K. R. (2012). *Connection by design: Students' perceptions of their community college experiences*. WestEd.
 - e. Chaplot, P., Rassen, E., Davis Jenkins, P., & Johnston, R. (2013).
 - f. Dadgar, M., Venezia, A., Nodine, T., & Bracco, K.R. (2013). *Providing structured pathways to guide students toward completion*. WestEd.
 - g. Scrivener, S., & Coghlan, E. (2012). Opening doors to student success: A synthesis of findings from an evaluation at six community colleges (MDRC paper). <http://www.mdrc.org/publication/opening-doors-student-success>
30. Practices that are supported by research. For example:
- a. Karp, M. M., Hughes, K. L., & O'Gara, L. (2010). An exploration of Tinto's integration framework for community college students. *Journal of College Student Retention: Research, Theory & Practice*, 12(1), 69–86.
 - b. Karp (2011).
 - c. Hodara, M. (2013). Improving students' college math readiness: A review of the evidence on postsecondary interventions and reforms (Working Papers Series). Community College Research Center. <http://dx.doi.org/10.7916/D8M32SS7>
 - d. Packard, B. W. L. (2012). Effective outreach, recruitment, and mentoring into STEM pathways: Strengthening partnerships with community colleges. In *Community colleges in the evolving STEM education landscape: Summary of a summit*. National Research Council and National Society for Engineering.
 - e. Scrivener & Coghlan (2012).
 - f. Deil-Amen, R. (2011). Socio-academic integrative moments: Rethinking academic and social integration among two-year college students in career-related programs. *The Journal of Higher Education*, 82(1), 54–91.
 - g. Strayhorn, T. L. (2019). *College students' sense of belonging: A key to educational success for all students* (2nd ed.). Routledge.
 - h. Packard, B. W. L. (2004). Mentoring and retention in college science: Reflections on the sophomore year. *Journal of College Student Retention: Research, Theory & Practice*, 6(3), 289–300.
 - i. Starobin, S. S. (2004). Gender differences in college choice, aspirations, and self-concept among community college students in science, mathematics, and engineering [Unpublished doctoral dissertation]. University of North Texas.
31. Strayhorn (2019).



End Notes

32. Dowd, A. C., & Coury, T. (2006). The effect of loans on the persistence and attainment of community college students. *Research in Higher Education*, 47(1), 33–62; Hagedorn, L. S., Maxwell, W., & Hampton, P. (2001). Correlates of retention for African-American males in community colleges. *Journal of College Student Retention: Research, Theory & Practice*, 3(3), 243–263; Paulsen, M. B., & John, E. P. S. (2002). Social class and college costs: Examining the financial nexus between college choice and persistence. *The Journal of Higher Education*, 73(2), 189–236.
33. Literature suggests that undergraduate research improves academic outcomes and encourages students to pursue science careers.
- a. Gregerman, S. R. (2008). The role of undergraduate research in student retention, academic engagement, and the pursuit of graduate education. *National Academy of Science: Promising Practices in STEM Education*.
 - b. Hathaway, R. S., Nagda, B. A., & Gregerman, S. R. (2002). The relationship of undergraduate research participation to graduate and professional education pursuit: An empirical study. *Journal of College Student Development*, 43(5), 614–631.
 - c. Jones, M. T., Barlow, A. E., & Villarejo, M. (2010). Importance of undergraduate research for minority persistence and achievement in biology. *The Journal of Higher Education*, 81(1), 82–115.
 - d. Lopatto, D. (2004). Survey of undergraduate research experiences (SURE): First findings. *Cell Biology Education*, 3(4), 270–277.
 - e. Russell, S. H., Hancock, M. P., & McCullough, J. (2007). Benefits of undergraduate research experiences. *Science*, 316(5824), 548–549.
 - f. Seymour, E., Hunter, A. B., Laursen, S. L., & DeAntoni, T. (2004). Establishing the benefits of research experiences for undergraduates in the sciences: First findings from a three-year study. *Science Education*, 88(4), 493–534.
34. Karp, M., Mechur, J., Stacey, G. W. (2013). *What we know about nonacademic student supports: Research overview*. Community College Research Center, Columbia University. <http://dx.doi.org/10.7916/D88G8HPJ>
35. Rassen, E., Chaplot, P., Jenkins, P. D., & Johnstone, R. (2013). *Understanding the student experience through the loss/momentum framework: Clearing the path to completion*. Community College Research Center, Columbia University. <https://doi.org/10.7916/D8N58JC7>
36. For example, see Chen, G. (2019). Fewer women pursuing STEM programs at community college today. *Community College Review*. <https://www.communitycollegereview.com/blog/fewer-women-pursuing-stem-programs-at-community-college-today>; and Funk & Parker (2018).
37. See glossary in Appendix A for definition of terms used in this report (e.g., Indeterminate Status). STEM workforce numbers are not shown in Table 1. This outcome was measured using an exit survey—administered to current and former SSA participants—that received very low response rates. Students who reported joining the STEM workforce made up less than 1% of SSA participants. DHE will continue to explore alternative measures for assessing this outcome.