Abstract: This year-four evaluation report examines final grant student outcomes, as well as strategy implementation including industry partner engagement, curriculum blending, use of work-based learning & simulated work environments, and career coaching & student support services. Additional inquiry is directed toward exploring lessons learned and promising practices with the potential for further scaling.

Integrating Bio-Technology & Applied Engineering: Bio Blend

Third Party Year-Four Evaluation Report,

NSF/ATE Grant # 1901960
Submitted to: Brian Worley, PI
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Cosgrove & Associates
John Cosgrove
john@cosgroveandassociates.com
Maggie Cosgrove
maggie@cosgroveandassociates.com

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EXECUTIVE SUMMARY

This year-four final evaluation report examines Bio Blend progress related to strategy implementation including industry engagement, curriculum blending, use of work-based learning and simulated work environments, and the role of career coaching and student support services. The report also directs attention to grant outcomes connected to student recruitment, enrollment, program completion, and satisfaction, while also exploring the extent to which grant strategies are impacting grant outcomes. Additional inquiries are directed to Bio Blend's use of data for continuous improvement and scaling.

> "Bio Blend students are significantly more prepared than others; even considering candidates with previous industry experience."
> Employer Survey Comment

Cosgrove & Associates' analysis of available data reveals the Bio Blend grant team successfully implemented the full range of grant strategies with fidelity. The team engaged with employer partners and faculty to blend bioprocess technology and applied engineering curriculum. Bio Blend delivered innovative instructional modalities connected to a simulated workplace environment and work-based learning opportunities. Bio Blend exceeded targets associated with recruitment, program completion and related certifications, and program completer employment. Furthermore, the BBGT created internal and external processes to leverage grant lessons learned for continuous improvement and wider scaling across the College.

Cosgrove & Associates observations of components integral to Bio Blend success:

- Creation of a structure to improve and sustain promising practices and to reflect upon their work resulting in an impressive ability to close the loop among challenges, lessons-learned, and actions.
- Active faculty participation and inclusion of the Bio Blend Career Coach. Student comments reflect the importance of work-based instructional modalities and the benefit of the Career Coach in helping them succeed in rigorous course work. Students stress the value of the Career Coach in helping them complete coursework, remain confident in their skills, stay connected and committed to their career goals, and find employment.
- Strategically connecting grant strategies, especially partnership efforts, blended curriculum, student recruitment, and student support. By establishing an internal network to support the grant, the BBGT helped increase grant outcomes in each area while creating a grant impact that was greater than a simple sum of the individual parts.

The ability to continue exploring impactful strategies through the Bio Blend 2.0 grant provides JCC with a unique opportunity to support wider scaling of promising practices. The College is committed to further developing career pathways to support regional economic development. Cosgrove & Associates recommends grant leadership consider the best strategies to more widely share lessons learned to take advantage of the potential synergy between Bio Blend efforts and JCC's vision for career pathways and technical education. The use of a faculty/staff Thought Partner Group[1] connected to enhanced employer engagement and intentional student support and coaching may be beneficial in this regard.

[1] Siang, C. et. al, *Coaching Your Team as a Collective Makes It Stronger,* Harvard Business Review, Feb. 2023. https://hbr.org/2023/02/coaching-your-team-as-a-collective-makes-it-stronger

Introduction

In 2019, the Advanced Technological Education (ATE) program of the National Science Foundation (NSF) awarded $283,880 to Johnston Community College (JCC) to address rapidly expanding biopharmaceutical and biomanufacturing workforce needs in eastern North Carolina by blending and integrating biotechnology and applied engineering curricula and programs. The grant, known as Bio Blend, was due to expire in 2022, but JCC requested a one-year extension from NSF to support additional (beyond targeted grant outcomes) Bio Blend students and program completers, as well as to connect more fully Bio Blend's blended curriculum to employer needs and talent demand.

Previous Cosgrove & Associates (C&A) evaluation reports for years one, two, and three[2], note the successful creation and implementation of grant processes and structures needed to support employer engagement, grant management, curriculum development, career coaching and student support, and the use of lessons learned continuous improvement.

Bio Blend Goals

1) Create & implement a unique curriculum certificate integrating biomanufacturing with applied engineering.

2) Create a multi-skilled talent pipeline from college to industry.

3) Provide hands-on education in a simulated drug manufacturing environment.

In this year-four evaluation report C&A examines final grant strategy implementation, including industry partner engagement, curriculum blending, use of work-based learning, and career coaching and student support services. Furthermore, C&A explores the extent to which Bio Blend met their stated student outcomes, as well as the impact of grant strategies on student academic and employment outcomes. Additional inquiries are directed at examining the extent to which evaluation data are being used for continuous improvement and identification of instructional and student support strategies which hold promise for future scaling and a broader impact.

This evaluation report is inclusive of grant activity from May 1, 2022, to April 30, 2023. This eleven-month period coincides with the College's 2022-2023 academic year and allows the grant to meet NSF's suggested timeframe for submission of the final evaluation report.

[2]Integrating Biotechnology & Applied Engineering: Bio Blend, Third Party Year-One Evaluation Report, May 2020, Integrating Biotechnology & Applied Engineering: Bio Blend, Third Party Year-Two Evaluation Report, May 2021, Integrating Biotechnology & Applied Engineering: Bio Blend, Third Party Year-Three Evaluation Report, May 2022.

EVALUATION: Year-Four Questions, Data Sources, Methods, & Limitations

Bio Blend leadership worked with Cosgrove and Associates (C&A) to develop a set of process, implementation, outcome, and sustainability questions to address throughout the life of the grant. Evaluation of years 1-3 points to successful implementation of grant strategies and achievement of stated grant performance outcomes related to Bio Blend student enrollment, program completion, and subsequent employment. The BBGT sought and secured a one-year NSF extension to help JCC meet increased employer demand for Bio Blend completers and provide instruction and student support to additional (beyond grant target) Bio Blend students. To further support Bio Blend evaluation efforts, the BBGT partnered with C&A to address year-four evaluation questions presented in Table 1.

Year-Four Evaluation Focus & Questions

Specific evaluation strategies for Year 4:

- Partner with JCC to examine immediate and longer-term employment outcomes for Bio Blend cohort 1 (employment retention and upgrades).
- Evaluate program and course success and completion for 2nd cohort of Bio Blend students.
- Interview and survey employer partners to examine employer satisfaction with KSAs of Bio Blend completers.
- Continue to explore the extent to which JCC is using lessons learned from Bio Blend instructional, student support and employment engagement strategies. C&A will partner with JCC to take a deeper dive into which strategies appear to hold promise for scaling and sustainability to other CTE programs and/or CTE program partnerships.
- More fully examine the impact of intentional student support services on program retention and completion.

Throughout the grant and in a manner consistent with Developmental Evaluation, C&A explored BBGT efforts related to Process, Implementation, Outcomes, and Sustainability. To assist BBGT in exploring final grant outcomes, as well as documenting and sharing lessons learned to support the scaling of promising practices, C&A continued to examine such areas. Figure 1 identifies key year-four evaluation questions for each area.

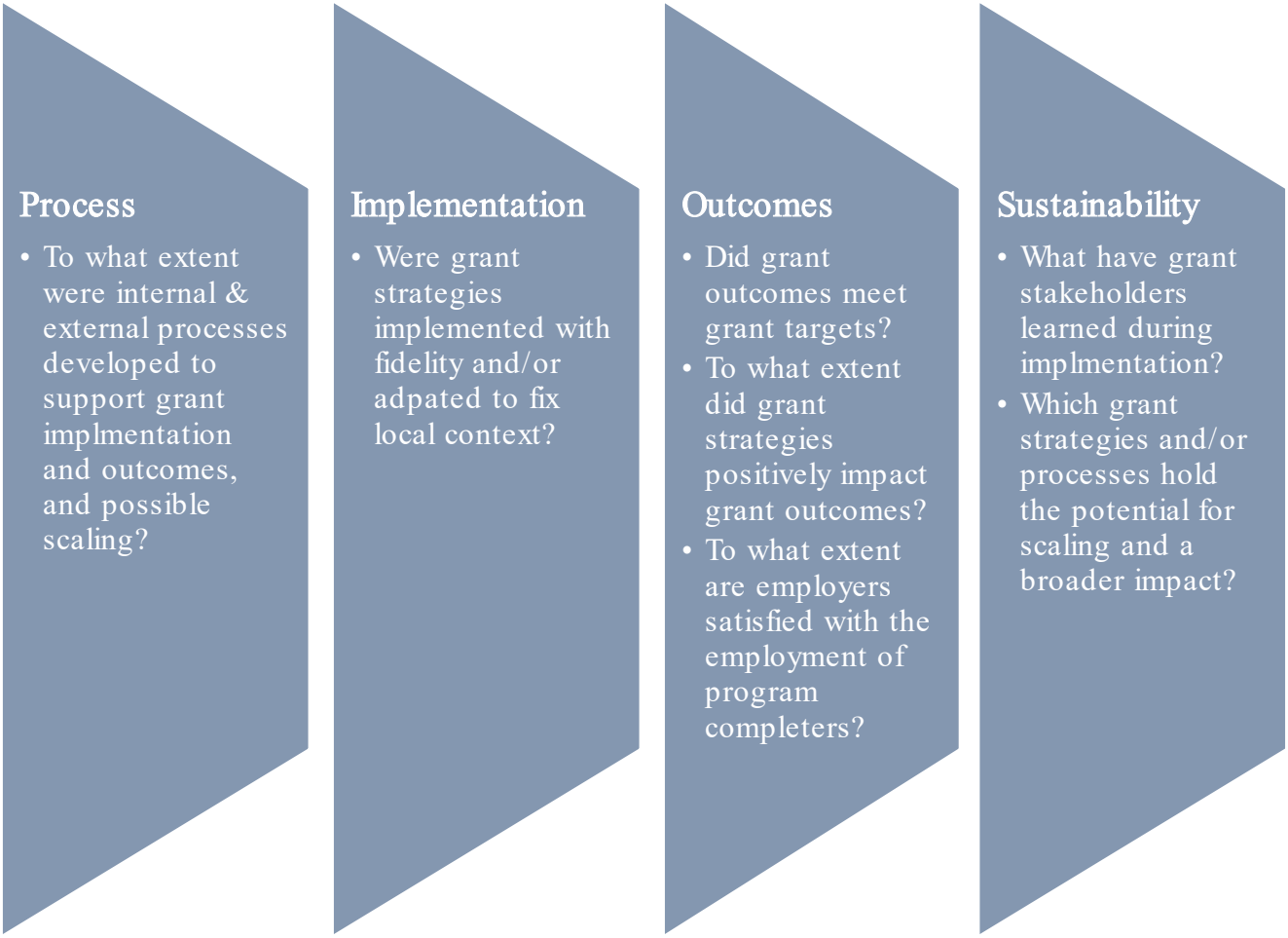

Figure 1: Bio Blend year-four evaluation topics and questions.

Cosgrove & Associates worked with Bio Blend grant leadership to add year-four evaluation data collection activities to align with year-four grant goals and evaluation questions. These activities are presented in Table 1. In November 2022, C&A conducted an in-person campus site where we were able to meet in-person with the BBGT, students, and representatives from two employer partners as well as tour two employer sites. The site visit was in addition to the monthly virtual meetings.

Table 1. Year-four Evaluation Methods & Data Sources

- Quarterly calls with project Principal Investigator (PI), & Bio Blend faculty, Bio Blend Career Coach, and grant team members.
- November 2022 campus site visit, including the opportunity to meet in-person with the BBGT team and students and to interview two primary employer partners and tour their biopharmaceutical manufacturing plants.
- Observation of grant program advisory meetings with PI, Bio Blend Team, and external grant partners.
- Periodic review of employer and high school partner input/feedback.
- Program and strategy implementation self-assessment completed by grant team near the end of year four (April 2023). Data are first provided by the Bio Blend team, then C&A conducts follow-up interviews (PI, grant team, students, employers), to confirm reported progress.
- Additional data analyzed to explore self-assessment include grant team meeting observations, document & artifact review, JCC leadership interviews, and institutional data related to course enrollment, course performance, and certificate/program completion.
- Review of grant related documentation/artifacts associated with program outreach, student recruitment, and employer engagement.
- College institutional data related to course enrollment and in-course student outcomes.
- Program completer follow-up surveys.
- Employer engagement follow-up surveys.

The Self-Assessment Implementation Tool (SAIT) was designed at the beginning of the grant to align with the Bio Blend scope of work and to play a key role in the evaluation process. Cosgrove & Associates worked with grant leadership to develop the SAIT to enable the BBGT to self-assess grant progress across each grant goal and its respective activities, outputs, and outcomes (AOOs) as well as track grant partner engagement and record grant challenges and accomplishments. In this spirit, the SAIT is meant to serve as both a data collection instrument, as well as a planning tool to help focus attention on promises outlined in the grant statement of work. The PI and BBGT completed this self-assessment at Baseline and again in January 2021[3], April 2020, April 2021, April 2022, and finally in April 2023.

[3] The January 2021 SAIT was added due to Covid restrictions on site visits.

Evaluation Limitations

Throughout the grant, the PI and entire BBGT have been supportive of grant evaluation efforts and willing to share information, collaborate on data collection activities, and partner to interpret and reflect upon evaluation data. As Bio Blend entered year-four, JCC began to experience executive level administrative change and re-organization. Such changes continued through the fall, 2022 term and into winter/spring 2023. As a result of this context, C&A was not able to interview JCC executive leadership during our November 2022 campus site visit and thus was unable to explore the extent to which the new JCC leadership is aware and supportive of Bio Blend's partnership engagement, blended curriculum, and enhanced student support strategies.

Bio Blend grant leadership continues to suggest JCC leadership is supportive of Bio Blend efforts and lessons-learned and believes executive leadership values activities to leverage Bio Blend efforts to enhance Bio Blend 2.0 implementation, strategies, and student outcomes.

YEAR-FOUR EVALUATION RESULTS

This section of the report explores evaluation results and key findings related to each of the following grant components: Process, Strategy Implementation, Outcomes, and Sustainability.

Bio Blend Grant Processes: To what extent were internal and external processes developed to support grant implementation, outcomes, and possible scaling?

Cosgrove & Associates salutes the BBGT for formalizing internal and external processes to support grant efforts. C&A continuously partnered with the team to explore the extent to which such processes helped support grant progress and outcomes. We commend the PI, Career Coach, and entire BBGT's willingness to share grant progress, challenges, and lessons learned on a regular basis and for allowing C&A access to grant meetings/activities.

As Bio Blend entered year two, the original PI stepped down and a Co-PI undertook the PI role. The new PI was an experienced faculty member committed to the blending of process technology and applied engineering curriculum. Despite this change, the BBGT continued to function effectively with the active engagement of Co-PIs, including faculty and the Career Coach, in helping ensure grant processes and strategies connected to student outcomes.

Cosgrove & Associates has observed and been a part of BBGT meetings and discussions over the life of the grant and has been consistently impressed with both the formal and informal communication among the BBGT. This strategic and intentional communication allowed the team to see potential problems early, secure workable solutions, and act promptly. Moreover, C&A observed the PI and Co-PIs were in frequent informal communication regarding students and employers with the result of quick adaptations to improve student performance.

From onset, the BBGT took steps to include key internal stakeholders (budget/finance, institutional research, faculty/academic leaders, and student services staff) to support grant management, strategy implementation, information sharing, and sustainability of promising practices. Furthermore, C&A sees evidence the BBGT created and used employer and secondary partner engagement to secure ongoing external feedback needed to create and enhance blended curriculum and instructional and student support strategies; develop bioprocess technology career pathways; recruit students; advance talent pipelines; and improve student academic and employment outcomes.

Bio Blend faculty & employer partners are continuing to integrate Skills, Knowledge, Abilities (SKAs) required by the biopharmaceutical industry into curriculum and to modify/adapt instructional content and pace to support student success. Cosgrove & Associates notes evidence of internships and simulated work environments being used to support student learning and meet employer expectations. Industry partners are hiring Bio Blend program completers and, in some cases, hiring students before program completion. Appropriate processes are in place to continue this college-to-industry talent pipeline, and Bio Blend faculty and Career Coach are working to recruit additional students while continuing to strengthen the pipeline.

The Bio Blend Career Coach served as the main conduit of this communication channel, and supported faculty and students, as well as eased the interactions amongst students, faculty, employers, high schools, and JCC administration.

As Bio Blend progressed from years 1 through 4, C&A repeatedly noted the strong faculty engagement in curriculum development. Bio Blend faculty created, adapted, and updated curriculum to best serve the needs of students and industry. Upon learning of student learning challenges, the BBGT worked with students and/or employers to identify and address any gaps. The team brought in new faculty to meet student and employer needs more fully and industry representatives continue to partner with faculty to review curriculum, content, and learning outcomes.

The ongoing interaction of BBGT and sharing of faculty and student feedback associated with the impact of curriculum blending and intrusive and intentional student support efforts on student academic and employment outcomes is especially noteworthy[4]. Such efforts appear to have created a foundation of internal awareness and knowledge for JCC to continue to examine sustainability and scaling of similar efforts across a broader set of career and technical education programs. Cosgrove & Associates notes the continuation of such efforts in JCC's Bio Blend 2.0 NSF grant.

Employer partner involvement has been a central theme of the Bio Blend grant with the BBGT expecting employers to assist in the design and delivery of curriculum, the simulated work environment. internships and work-based learning opportunities, professional development for faculty. and recruiting and connecting students to the career pathway and employment.

Throughout the course of Bio Blend, the BBGT has rated the degree to which external partners are meeting Bio Blend expectations using the scale at the right.

The BBGT also rated all partners across a variety of stakeholder roles using a three-point scale with 1 indicating low engagement, two indicating medium engagement, and three indicating high engagement.

Scale for the Degree to which Partnership is Meeting Expectations:

1-Well Below Our Expectations
2-Below Our Expectations
3-About What We Expected
4-Exceeded Our Expectation
5-Greatly Exceeded Our Expectations

EMPLOYER PARTNERS

Table 2 presents the results of the BBGT's assessment of employer partners through year four. The team continues to report employer partners are meeting and/or exceeding expectations. By the end of year-four the BBGT reported four employer partners, with all meeting or exceeding expectations.

[4] OCCRL Transformative Change, https://occrl.illinois.edu/docs/librariesprovider2/tci/strategies-for-transformative-change/intrusive-support.pdf
Lumina Foundation, https://www.luminafoundation.org/wp-content/uploads/2021/03/focus-spring-2021.pdf

Table 2. Bio Blend Grant Team's Self-Assessment of Employer Partners

	2020		2021		2022		2023	
Stakeholder Ratings	Count	%	Count	%	Count	%	Count	%
1-Well Below Our Expectations	0	0%	0	0%	0	0%	0	0%
2-Below Our Expectations	0	0%	0	0%	0	0%	0	0%
3-About What We Expected	0	50%	1	50%	2	67%	3	75%
4-Exceeded Our Expectation	2	50%	1	50%	1	33%	1	25%
5-Greatly Exceeded Our Expectation	0	0%	0	0%	0	0%	0	0%

The BBGT also used a three-point scale (1=low, 2=medium, 3= high) to rate grant partners on their level of engagement across a series of key activities. The mean score is calculated by summing the employer scores and dividing by the number of employers (2023 had four employers). Table 3 shows BBGT rating employer engagement as the highest in recruitment/outreach and connecting students to pathway roles (Mean Scores of 2.5).

Table 3. Bio Blend Grant Team's Ranking of Employer Engagement Roles

ROLE	2023 Mean Score
Identify workforce needs	2.0
Recruit or outreach to students	**2.5**
Develop or review curriculum	1.8
Collaborate on program design or delivery	2.0
Provide resources for program sustainability or improvement	1.8
Provide support or resources for instruction	2.0
Provide opportunity for work-based or experiential learning	2.0
Provide opportunity for faculty professional development	1.8
Help connect students to career pathways	**2.5**
Hire students or completers	1.8

In our Fall 2022 site visit, C&A interviewed the two main Bio Blend employer partners, and each expressed a strong need for the development of a talent pipeline of qualified workers. An employer, who recently opened a new $1.8 billion pharmaceutical production facility in the JCC service region requiring a large workforce, expressed a continued desire to partner with JCC to help meet their talent needs. Moreover, in Industry Council meetings and employer engagement surveys, employers expressed continued interest in partnering with JCC across the full spectrum of employer engagement[5].

[5] Shayne Spaulding and Ananda Martin-Caughey, 2015 *The Goals and Dimensions of Employer Engagement in Workforce Development Programs,* The Urban Institute

Bio Blend Employer Engagement Examples

- Internships created and college/employer processes for future internships formalized. Twenty students successfully completed internships.
- Strategies to encourage current industry employees to participate in Bio Blend, including DeltaV training.
- Partner participation in employer networking and high school outreach events. Plus, employer partners are visiting Bio Blend courses to clarify employer expectations and help connect classroom instruction to the workplace.

To further explore employer impressions of Bio Blend efforts, members of the Bio Blend Industry Council were surveyed in April 2023. Using a five-point scale, employers rated their participation in various grant roles. Table 4 provides the average employer engagement score and reveals Industry Council members' continued interest in partnering with JCC. Table 4 reveals employers are especially interested in supporting Bio Blend efforts related to: Serving in employer program advisory groups; Helping JCC recruit students; Helping improve the connection between program curriculum and employer needs; Providing internships and other work-based learning opportunities for students; and Hiring students and/or program completers from JCC.

Table 4. Employer Survey Results: Average Employer Engagement Score by Partner Role (n=9)

Partner Role - Engagement Area	Average Employer Engagement Score*
Serving on an employer program advisory group	3.89
Helping improve the connection between curriculum and employer needs	3.56
Hiring students and/or graduates from JCC	3.33
Providing internships and other work-based learning opportunities	3.22
Helping JCC recruit students	2.78
Helping develop program competencies & learning objectives	2.33
Providing scholarships/funding for students	1.89

*Employer Engagement Scale: 1 = "not at all"; 2 = "a little"; 3 = "some, but not very much"; 4 = "pretty much"; and 5 = "quite a bit".

When asked to indicate the extent to which they are satisfied with BBGT engagement efforts, respondents reported a high degree of satisfaction (33% "satisfied", 22% "more than satisfied", and 45% "very satisfied") with such efforts. These data align with C&A's observations of Industry Council meetings and employer feedback collected during one-on-one interviews.

Industry Council Member Comments & Feedback

- "Keep up the good work; enjoy partnering with you to support the talent pipeline."
- "The Career Coach is an amazing advocate for both her students and the program. I have enjoyed our partnership immensely and can't wait to partner for years to come to find these students life changing careers.Δ
- "Acquisition of technical skills, knowledge, and abilities is important, but focusing on interpersonal skills is vital for a successful employee."
- "I don't directly hire students, but I am fully comfortable with the quality of your graduates."
- "Working with the Career Coach to provide the best internship experience."
- "The Bio Blend team is a pleasure to work with."
- "The Bio Blend program is great and helps us find the talent we need."

SECONDARY EDUCATION PARTNERS

Cosgrove & Associates also continued to see evidence of JCC creating and leveraging partnerships with Johnston County Public Secondary Schools to support bio-manufacturing career pathway awareness and recruitment (dual-enrolled and high school graduates) of students to the Bio Blend curriculum. By the end of year-four, the BBGT reported secondary partners are exceeding grant team expectations as high school partner interest in Bio Blend partnership opportunities continues to grow. Using the scale Low, Medium, or High, the BBGT rated the involvement of their high school partner as of Spring 2023. Table 5 reveals the high school partner is primarily involved in activities related to student recruitment and outreach, collaboration on program design & delivery, and helping students connect to career pathways.

Table 5. Bio Blend Grant Team's Rating of High School Partner Involvement in Key Roles

Partnership Role	Rating
Collaborate on program design or delivery	High
Help connect students to career pathway	High
Recruit or outreach to students	High
Provide resources for program sustainability or improvement	Medium
Provide support or resources for instruction	Medium
Provide opportunity for faculty professional development	Medium
Identify workforce needs	Low
Develop or review curriculum	Low
Provide opportunity for work-based or experiential learning	NA
Hire students or completers	NA

Evaluation of Implementation

Throughout Bio Blend, the grant team collaborated with C&A to systematically explore and reflect upon the implementation of grant strategies, as well as document lessons learned. Specific questions associated with this section include: were grant strategies implemented with fidelity and/or adapted to fix local context; and what have grant stakeholders learned during implementation?

Bio Blend Implementation: Were grant strategies implemented with fidelity and/or adapted to fix local context?

To fully explore Bio Blend implementation levels and progress for each of the grant goals and associated activities, outputs, and outcomes (AOOs), as well as to assist Bio Blend grant leadership in tracking grant progress and lessons learned, C&A partnered with the BBGT to complete the Bio Blend Self-Assessment Implementation Tool (SAIT) at the end of year four (Spring 2023). Results from the 2023 SAIT update are provided in this section. Levels of Implementation are outlined in Table 6.

The BBGT has continued to implement grant strategies with fidelity, and we see evidence that grant activities, outputs, and outcomes have indeed moved to mature and/or sustainable levels of implementation. In addition, the BBGT has demonstrated the willingness & capacity to use evaluation results & lessons learned to modify instructional content and strategies as needed. Evaluation data reveal students are experiencing and benefiting from grant strategies, including participation in revised/blended curriculum, career coaching, internship opportunities, and work-based instructional modalities. Furthermore, C&A notes BBGT efforts to sustain Bio Blend 1.0 promising practices in JCC's NSF Bio Blend 2.0 grant.

It is important to note the "self-assessment" nature of this data collection. After the BBGT submitted their data, C&A conducted extensive follow-up interviews with the PI, BBCC, and grant leadership to explore progress, as well as to review and clarify self-assessment data. Cosgrove & Associates then analyzed these self-reported data within the context of C&A observations; grant team, partner, and student interviews; and institutional course and student performance data. Cosgrove & Associates used these multiple sources to triangulate various data points to gain a deeper and more comprehensive understanding of the final Bio Blend implementation.

Table 6. Self-Assessment of Implementation Level Scale

Ranking	Definition
1-Planning	item is being planned as part of the grant, but implementation has not begun.
2-Initial implementation	implementation has begun but experience is limited. Little is known about how this item is working because implementation is new.
3-Advancing implementation	implementation is occurring on an on-going basis; however, the item is not considered mature.
4-Mature implementation	implementation has reached the highest level and no changes or modifications are expected during the grant.
5-Sustaining Implementation	the college has made a formal, tangible commitment of resources (budget, people, facilities) to continue this item beyond the grant.

Considering all three Bio Blend goals, and the eight activities, nine outputs, and fifteen outcomes connected (AOOs) to these goals, PIs report high levels of implementation, with 38% of all items recorded as in the Mature Implementation stage, and 62% as having moved to the Sustaining Implementation stage (see Table 7).

Table 7. Bio Blend Grant Team's Self-Assessment of Implementation of Grant Activities, Outputs, and Outcomes of All Goals Baseline through Spring 2023

	2020		2021		2022		2023	
Implementation Status	Count	%	Count	%	Count	%	Count	%
Planning	18	56%	7	22%	0	-	0	-
Initial Implementation	4	13%	4	13%	0	-	0	-
Advancing Implementation	3	9%	6	19%	13	41%	0	-
Mature Implementation	7	22%	7	22%	9	28%	12	37.5%
Sustaining Implementation	0	-	8	25%	10	31%	20	62.5%
	32	100%	32	100%	32	100%	32	100%

Using the five-point scale outlined in Table 6, C&A calculated an Average Implementation Score (AIS)[6] for each of the three Bio Blend goals. The year-four AIS for each of the Bio Blend goals is presented in Figure 2. These data show the BBGT believes the majority of grant AOOs have attained the highest level of implementation and the college has committed resources to continue several AOOs beyond the end of the grant.

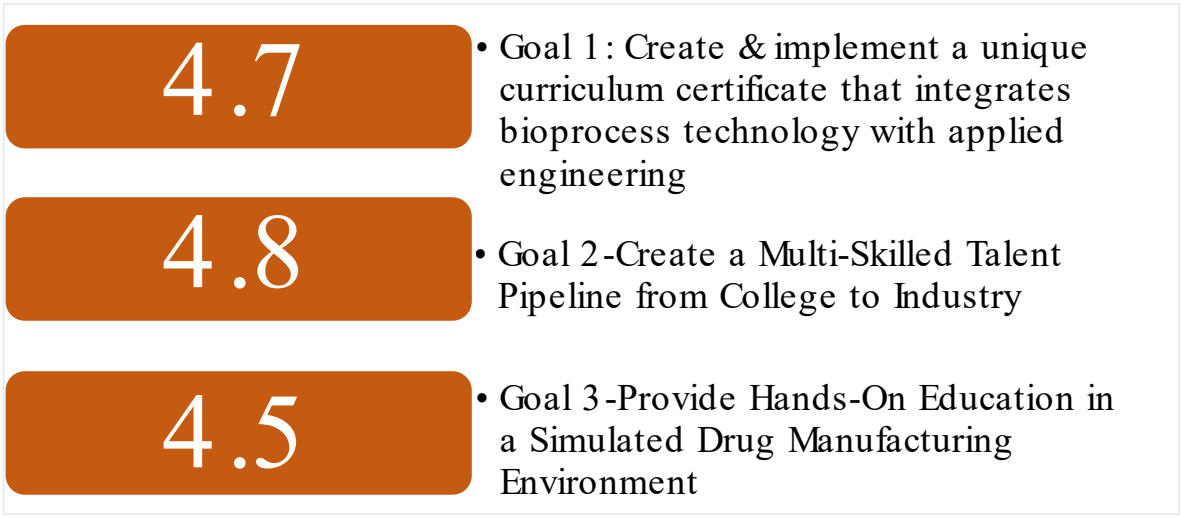

Figure 2 The year-four average implementation score for each Bio Blend goal.

To explore grant progress more fully, the Bio Blend team used the SAIT to review implementation of each grant activity, output, and outcome for each goal. The following section presents the grant team's self-assessment followed by C&A's evaluation of grant implementation based upon the data and methods previously outlined.

[6] AIS = Sum of self-assessment implementation ratings divided by the number of activities, outputs, & goals.

- **Goal 1: Create & implement a unique curriculum certificate that integrates bioprocess technology with applied engineering.**

The Bio Blend curriculum goal is comprised of two activities, three outputs, and six outcomes. Consistent with our developmental evaluation approach, C&A partnered with BBGT to explore three over-arching questions for each goal: What did you do; What was challenging; and What did you learn.

The BBGT feedback related to these questions is highlighted in Figure 3, while Figure 4 presents the overall progression of implementation of the curriculum goal from the baseline through year four.

PI Comments Related to Goal One – Curriculum

WHAT DID YOU DO?

Bio Blend certificate courses were changed to include ATR 112 (Intro to Automation) and remove ELC 117 (Motors and Controls). Also, the Bio Blend certificate is now a College and Career Promise Pathway (CCP) thus allowing high school students to enroll in Bio Blend courses in high school. BPM 110 and PTC 110 (BioWork certificate) courses continue as required curriculum for Applied Engineering providing biopharmaceutical manufacturing exposure to students interested in maintenance/instrumentation/automation careers.

WHAT WAS CHALLENGING?

Most of the Bioprocess Technology program is online with the exception of flexible labs. Students interested in the Bioprocess Technology Associate Degree program can enroll and work alternating schedules while completing the degree but have difficulty with the Applied Engineering courses as their labs are offered in person on the same days every week. This makes it difficult for someone working in a typical rotating biopharmaceutical manufacturing position to complete all degree-required courses. Also, during the course of the grant we had multiple discussions with industry partners re: the need for instrumentation SKA's and that at least one of our industry partners is hiring students from a college several hours away to fill their instrumentation roles.

WHAT DID YOU LEARN?

We learned that listening to our stakeholders is critical to student success.

Additional Comments on Implementing this goal:

We have initiated discussions on how to create flexible labs for the Applied Engineering courses. The two challenges with this are limited personnel and limited lab space. Special funding to support flexible labs in Applied Engineering is currently under consideration. Also-re: instrumentation, the Applied Engineering program is adding an instrumentation course.

Figure 3: Principal Investigator comments related to implementing the curriculum goal.

To explore overall progression of implementation of the curriculum goal more fully from the baseline to the end of year four, C&A examined the Average Implementation Progress Score for the curriculum goal. Figure 4 reveals continued progress related to the Bio Blend grant goal of creating and implementing integrated bioprocess technology and applied engineering curriculum, as the Average Implementation Progress Score reached 4.7 on a range from 1.0 to 5.0. Eight of the AOOs have reached the sustaining level, and three have progressed to the Mature implementation stage.

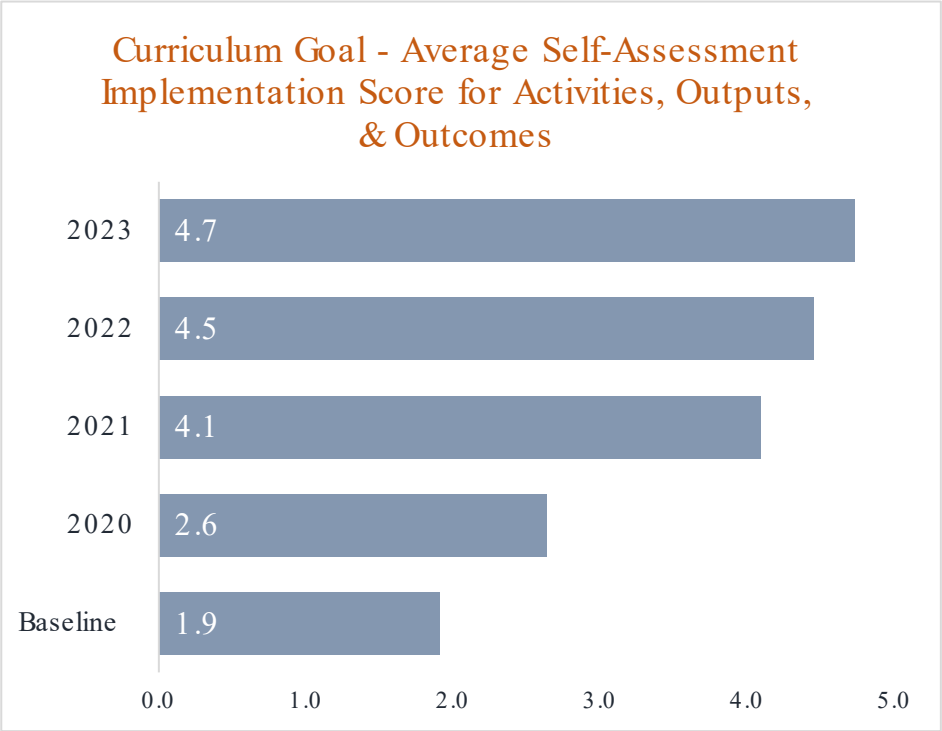

Figure 4: Progression of self-assessment of implementation average score for the curriculum-related goal 1.

Table 8 compares the BBGT's self-assessment of implementation ratings from baseline to the end of year-four for all 11 AOOs. The BBGT rated eight of the AOOs as having reached the sustaining level, (defined as "the college has made a formal, tangible commitment of resources (budget, people, facilities) to continue this item beyond the grant). Three AOOs are rated as having progressed to the Mature implementation stage (defined as implementation has reached the highest level and no further changes or modifications are expected. Curriculum related outcomes continue to show progress.

Table 8. Progression of Self-Assessment of Implementation of Goal 1: Create & Implement a Unique Curriculum Certificate Integrating Bioprocess Technology with Applied Engineering

Goal 1 - 11 Activities, Outputs, & Outcomes	2020	2021	2022	2023
Total score	29	45	49	52
Average Implementation score (AIS)	2.6	4.1	4.5	4.7

Self-Assessment of Implementation		Level of Implementation				
TYPE	DESCRIPTION	PLANNING	INITIAL	ADVANCING	MATURE	SUSTAINING
ACTIVITY	Redesign curriculum for both program areas			Baseline	2020	2023 2022 2021
ACTIVITY	Identify content to blend			Baseline	2022	2023 2021
OUTPUT	NCCCS approved course addition to degree programs by June 2018			Baseline	2020	2023 2022 2021
OUTPUT	NCCCS Program Coordinator approved curriculum redesign		2020		2020	2023 2022 2021
OUTPUT	Biotech and Applied Engineering integrated curriculum (Bio Blend)		Baseline	2020		2023 2022 2021
OUTCOME	Create Bio Blend curriculum certificate			Baseline	2020	2023 2022 2021
OUTCOME	Recruit & enroll 15 students for Bio Blend	Baseline	2020			2023 2022 2021
OUTCOME	15 graduates with Bio Blend certification from JCC	Baseline 2020		2021 2022	2023	
OUTCOME	Bio Blend offered continually with another cohort enrolled.	Baseline 2020	2021			2023 2022
OUTCOME	Graduates with integrated skills meet industry need	Baseline 2020	2021	2022	2023	
OUTCOME	Bio Blend curriculum shared with other colleges	Baseline 2020		2021	2023 2022	

Cosgrove & Associates Observations Related to Curriculum Goal Implementation

Cosgrove & Associates notes evidence of continuous growth related to Goal 1 and confirms the Bio Blend grant team's implementation assessment. Progress connected to Goal 1 activities, outputs, and outcomes (including student enrollment and program completion) advanced to Mature and Sustaining implementation levels. Furthermore, C&A notes evidence of the continuation of Goal 1 instructional and student support strategies as the College moves forward with its Bio Blend 2.0 NSF grant.

Cosgrove & Associates also acknowledges BBGT's ongoing commitment to curriculum improvement to meet employer and student needs more fully. The BBGT believes the addition ATR:112, Introduction to Automation more fully supports the skills, knowledge, and abilities students need to meet employer expectations, as the ATR:112) course is designed to introduce basic principles of automated systems and describes the tasks technicians perform on the job and provides additional third-party certification. Employer feedback to-date views the inclusion of ATR:112 as a positive step.

- ## Goal 2: Create a multi-skilled talent pipeline from college to industry.

The Bio Blend talent pipeline goal is comprised of four activities, four outputs, and five outcomes. The BBGT reported year-four efforts, challenges, and lessons learned are highlighted in Figure 5. Figure 6 reveals the overall progression of implementation of the talent pipeline goal from the baseline to the end of year four and Table 9 compares the BBGT's self-assessment of implementation ratings for the end of year four with ratings from the baseline, Spring 2020, and Spring 2021 for each item related to the talent pipeline goal.

PI Comments Related to Goal 2 – Talent Pipeline

WHAT DID YOU DO?

Reviewed resumes & interview questions, and elevator pitches with students. Scheduled industry interviews for graduating students. Scheduled/facilitated two speed networking events (11/22, 3/23). Facilitated internships for 10 students. Invited ECU to Bio Blend to share the Bachelor of Industrial Technology Degree. Corresponded with ECU on residency requirement barriers for early college graduates. Hosted meeting of Bio Blend students and Grifols engineering managers. Networked with PSC Biotech resulting in career fair/pharma conference opportunities and interviews. Student opportunities: offered tours of Novo Nordisk (IFP & API); API tour; provided additional support to student with autism; facilitated TEACCH Autism supports for students employed; and presented Bio Blend 1.0 to InnovATE BIO.

WHAT WAS CHALLENGING?

The onboarding process at one of our industry partners was challenging for the student with autism. To further complicate this, the partner's Human Resource Department did not want the job coach to discuss performance directly with the student's supervisor even though it is a legal accommodation.

WHAT DID YOU LEARN?

Further education for our industry partners on reasonable accommodations and autism is necessary, even though both support our efforts to increase the number of individuals with autism in the talent pipeline.

ADDITIONAL COMMENT: A Pathway Navigator has been hired to support Biotechnology students and those taking BPM 110. Applied Engineering students will have access to the Pathway Navigator via BPM 110. JCC needs to address increasing access to the Pathway Navigator for Applied Engineering students. NSF awarded Bio Blend 2.0. Via BB 2.0, industry partners have received Autism 101 training through the TEACCH Autism Program.

Figure 5: Principal Investigator comments related to implementing the talent pipeline goal.

Using the Average Implementation Progress Score, Figure 6 shows implementation of activities, outcomes, and outputs related to Goal 2, Creating a Talent Pipeline from College to Industry continued to progress, as the AIS reached 4.6 in 2023. Further review of these self-reported data (see Table 9) shows eight of the 13 activities, outputs and outcomes have moved to the Sustaining level, and five are reported as achieving the Mature implementation stage. By the end of the Spring 2023 term, a total of 20 Bio Blend participants completed their program of study and 18 have secured employment in biopharmaceutical manufacturing. Two additional completers are transferring to a four-year university, and one joined the military.

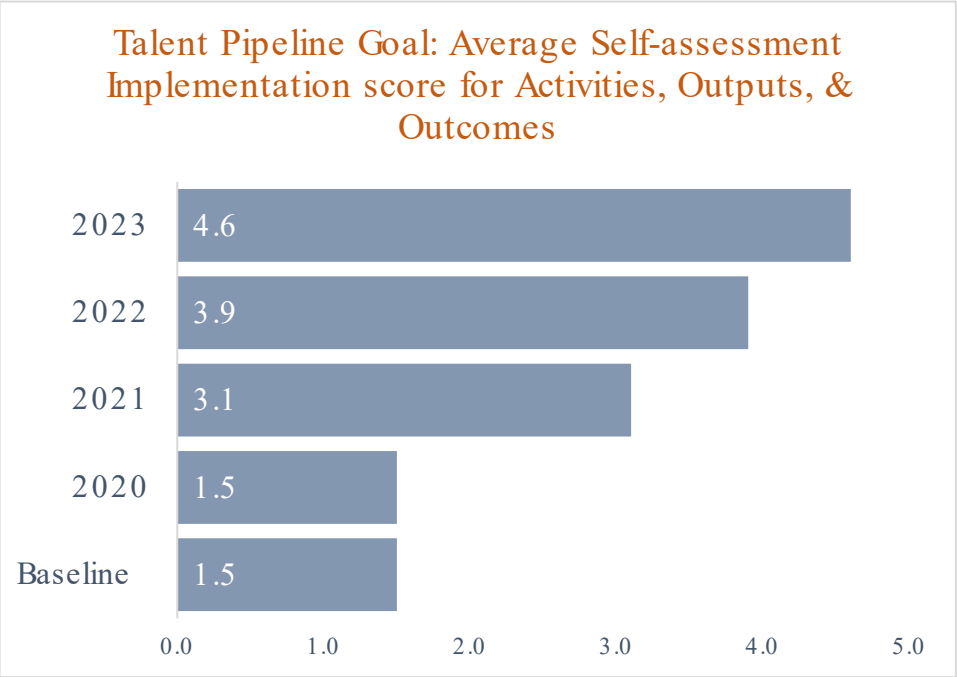

Figure 6: Progression of average self-assessment of implementation score for talent pipeline goal 2.

Table 9. Progression of Self-Assessment of Implementation of Goal 2: Create a Multi-Skilled Talent Pipeline from College to Industry

	2020	2021	2022	2023
Goal 2 - 13 Activities, Outputs, & Outcomes				
Total score	20	40	51	60
Average Implementation score (AIS)	1.5	3.1	3.9	4.6

Self-Assessment of Implementation		Level of Implementation				
TYPE	DESCRIPTION	PLANNING	INITIAL	ADVANCING	MATURE	SUSTAINING
ACTIVITY	Hire Bio Blend Career Coach (BBCC)			2020 Baseline	2023 2022 2021	
ACTIVITY	Design recruitment materials				2020 Baseline	2023 2022 2021
ACTIVITY	BBCC promotes Bio Blend to CCP students.	Baseline	2020		2023 2022 2021	
ACTIVITY	BBCC coordinates student internships, performs work-based assessments, and hosts career fair	2020 Baseline			2021	2023 2022
OUTPUT	BBCC supports student retention and success through advising	2020 Baseline			2023 2022 2021	
OUTPUT	CCP student engagement	2020 Baseline		2022 2021	2023	
OUTPUT	Internship opportunities	2020 Baseline		2021		2023 2022
OUTPUT	Students interviewed by Grifols and Novo Nordisk or other company.	2020 Baseline		2021	2022	2023
OUTCOME	Industry support of Bio Blend		2020 Baseline		2022 2021	2023
OUTCOME	Students intern 48 hours at Grifols or Novo Nordisk or other company[7]	2021 2020 Baseline			2022	2023
OUTCOME	80% (12) of cohort students complete Bio Blend are available for employment.[8]	2021 2020 Baseline		2022		2023
OUTCOME	Create a talent pipeline from college to industry	2020 Baseline	2021	2022	2023	
OUTCOME	Relevant industry workforce needs are met	2020 Baseline	2021	2022		2023

[7] Bio Blend student outcome data reveal the grant secured 20 internships for Bio Blend students, thus exceeding the grant targeted outcome.

[8] Bio Blend student outcome data reveal 20 students completed the Bio Blend program, with 17 securing employment: thus, exceeding the grant targeted outcomes.

Cosgrove & Associates Observations Related to Goal 2 Implementation

Cosgrove & Associates concurs with the Bio Blend team's self-assessment of Goal 2 implementation progress and acknowledges the creation of a solid foundation for further development of Bio Blend promising practices related to industry partnerships, increased program awareness and student recruitment, talent and career pathway development, the use of a Career Coach/Navigator to support and connect strategies related to student retention, program completion, and employment outcomes.

Cosgrove & Associates notes the value of the Bio Blend Career Coach in efforts related to all activities, outputs, and outcomes connected to Goal 2. The ability of the BBCC to support such efforts and connect students, faculty, and employers to recruitment materials, internships, and use of work-based learning opportunities is noteworthy. This "connecting role" as well as the BBCC's support for student success, are promising practices which JCC is implementing in its Bio Blend 2.0 NSF grant and is considering for additional scaling and sustainability.

• Goal 3: Provide hands-on education in a simulated drug manufacturing environment.

The Bio Blend hands-on goal is comprised of two activities, two outputs, and four outcomes. The BBGT reported year-three efforts, challenges, and lessons learned are highlighted in Figure 7. Figure 8 explores the overall progression of implementation of the hands-on goal from baseline through year four and Table 10 compares the BBGT's self-assessment of implementation ratings for the end of year four with ratings from the baseline report for each item related to the hands-on goal.

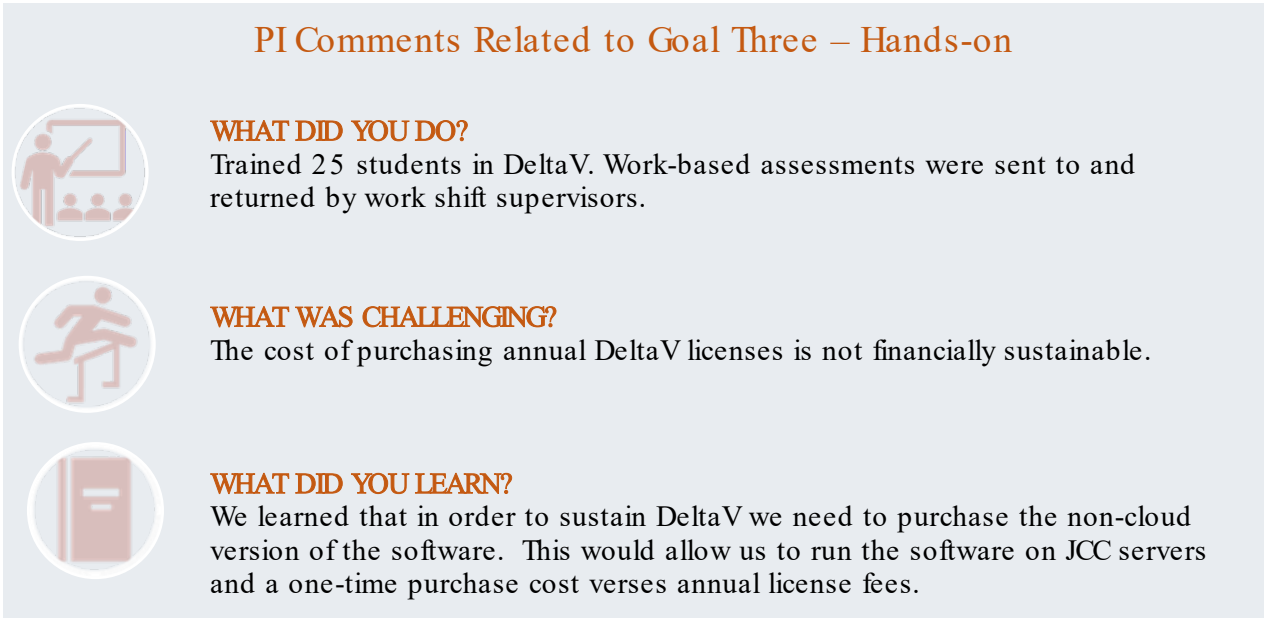

Figure 7: Principal Investigator comments related to implementing the hands-on goal.

The Bio Blend team reported continued development in their efforts to provide hands-on education in a simulated drug manufacturing environment, as evidenced by their self-assessment scores and the related AIPs displayed in Figure 8. The BBGT rates implementation of activities, outputs, and outcomes related to the use of a simulated work environment have moved from the Advancing stage in 2022 to Mature and Sustaining Implementation levels in 2023 (AIS from 3.1 to 4.5).

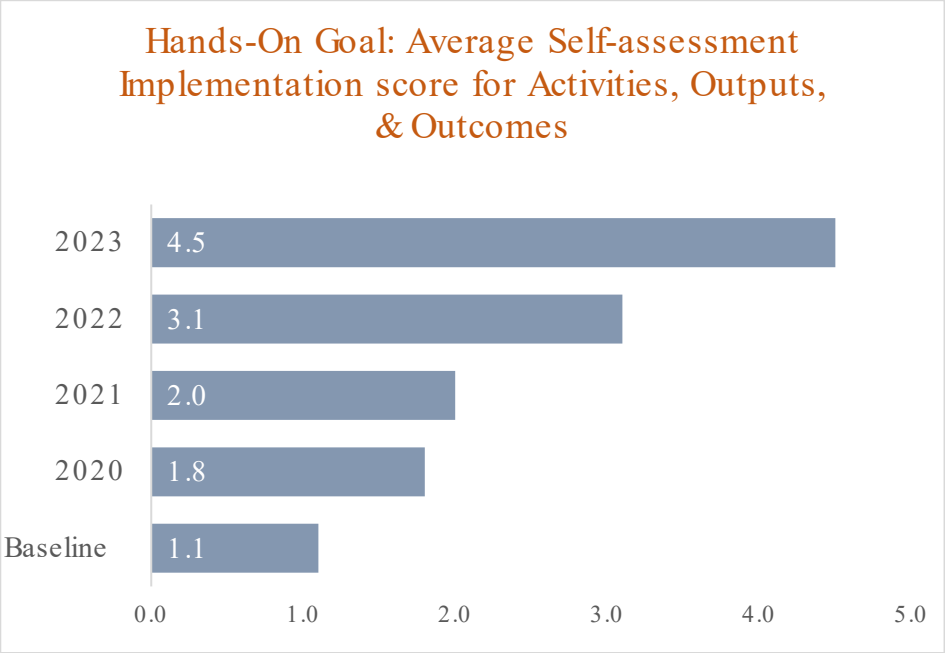

Table 10 reveals implementation ratings for all eight activities, outputs and outcomes connected to Goal 3 and demonstrates all items have progressed to the Mature (four items) or Sustaining (4 items) Implementation stage.

Table 10. Progression of Self-Assessment of Implementation of Goal 3-Provide Hands-On Education in a Simulated Drug Manufacturing Environment

Goal 3 - 8 Activities, Outputs, & Outcomes	2020	2021	2022	2023
Total score	14	16	25	36
Average Implementation score (AIS)	1.8	2.0	3.1	4.5

Self-Assessment of Implementation		Level of Implementation				
TYPE	DESCRIPTION	PLANNING	INITIAL	ADVANCING	MATURE	SUSTAINING
ACTIVITY	DeltaV purchased & train-the-trainer performed.		Baseline	2022 2020	2021 2023	
ACTIVITY	Hands-on education in BioSWE	Baseline	2020	2022 2021	2023	
OUTPUT	12 DeltaV certified trainers	Baseline			2022 2021 2020	2023
OUTPUT	15 students DeltaV certified	2021 2020 Baseline		2022		2023
OUTCOME	Bio Blend cohort receives relative biomanufacturing software certification	2021 2020 Baseline		2022		2023
OUTCOME	During internships students use skills learned through DeltaV certification on the job.	2021 2020 Baseline		2022	2023	
OUTCOME	Work-based assessments (employer & student surveys) show significant knowledge attainment by Bio Blend cohort.	2021 2020 Baseline		2022	2023	
OUTCOME	Grifols and Novo Nordisk support purchase of DeltaV educational license for JCC students.	2021 2020 Baseline		2022		2023

Cosgrove & Associates Observations Related to Goal 3 Implementation:

Cosgrove & Associates notes continued progress and attention to continuous improvement regarding the implementation of Goal 3 and concurs with Bio-Blend's self-reported assessment. C&A recognizes Bio Blend efforts to enhance DeltaV training sessions and to expand DeltaV training to include industry partner employees. Cosgrove & Associates see evidence the BBGT is continuing to provide hands-on education in a simulated drug manufacturing environment and notes DeltaV training as a central feature in this effort. Furthermore, C&A acknowledges BBGT efforts to purchase additional technology and IT-infrastructure to support JCC efforts to provide Delta V training directly and avoid the cost for a third-party vendor.

In summary, C&A notes evidence across multiple data sources of year-four grant implementation progress moving to Mature and Sustaining Implementation levels and concurs with BBGT assessment that promising grant practices have been incorporated into JCC's Bio Blend 2.0 NSF grant and are being considered for scaling across the College.

Industry and secondary school partners continue to work with the BBGT to support program development, instructional content, and student recruitment and success efforts. Such data provide further evidence that Bio Blend students experienced the full spectrum of grant strategies, including participation in revised and blended curriculum developed through employer input; student support & career coaching, work-based instructional modalities, including internships with biopharmaceutical companies; and hands-on/workplace education in a simulated drug manufacturing environment, including Delta V training and certification.

Evaluation of Grant Outcomes

Bio Blend provided instructional and student support services to two cohorts of students. Cohort One (14 students) began in the Spring 2021 term and Cohort Two (11 students) started in the Spring 2022 term. Figure 9 provides data related to the progression of grant outcomes, from recruitment, student experience, program completion, and employment.

Recruitment efforts have produced two cohorts of Bio Blend students. Data reveal students are successfully completing coursework and moving on to Bio Blend program completion and subsequent employment. Recruitment, program completion, and subsequent employment outcomes all exceeded grant targets.

Did Grant Outcomes Meet Grant Targets?

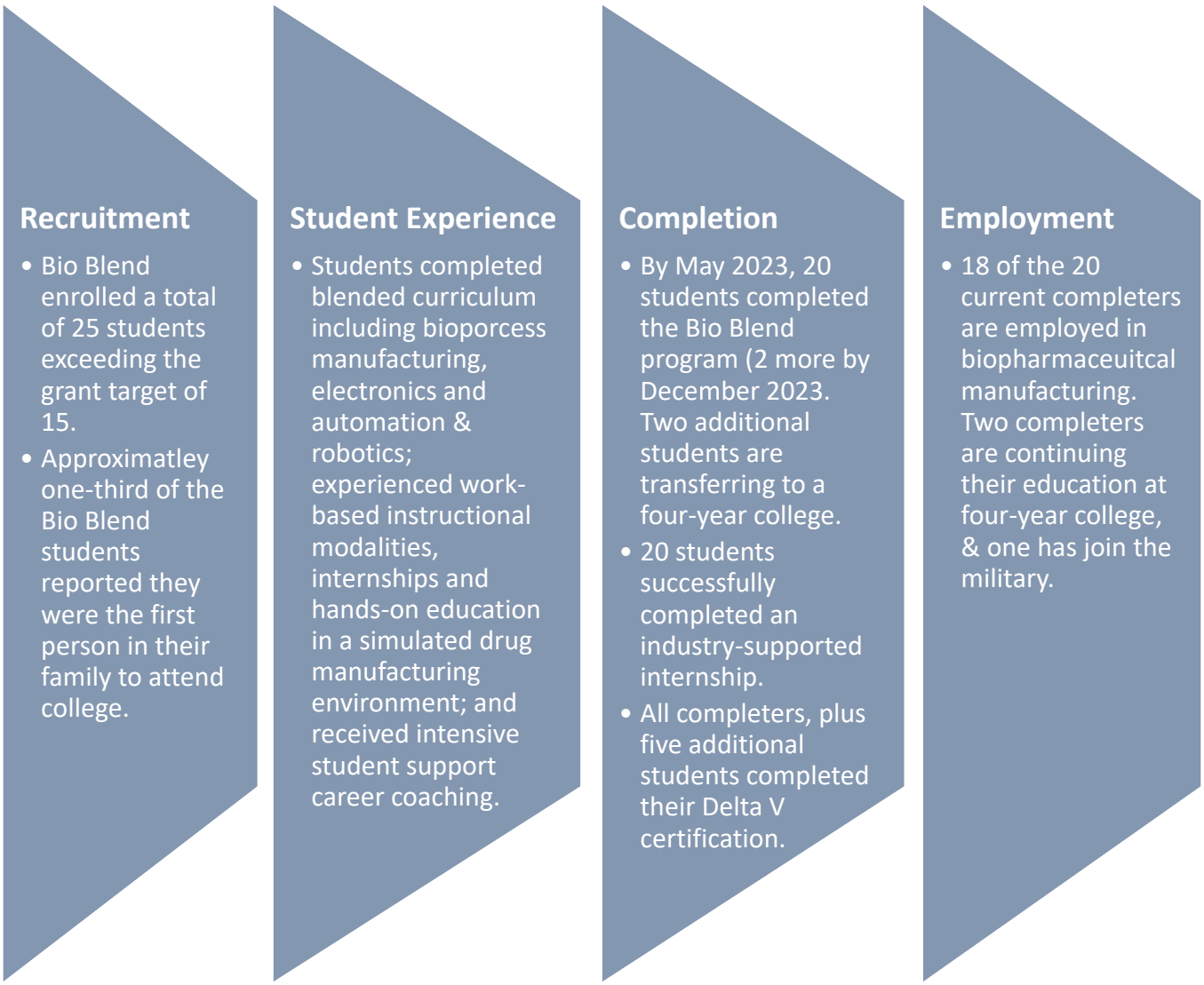

Figure 9: Progression of Bio Blend student outcomes.

To what extent did grant strategies positively impact grant outcomes?

• Student Success in Essential Bio Blend Coursework

To help explore the extent to which grant strategies positively impacted program completion and subsequent employment, C&A collected course completion for four essential Bio Blend courses. Data for the Spring and Fall 2022 terms are presented in Table 11 and reveal a high student success rate for these courses.

Table 11. Course Enrollment and Student Success Rate for Essential Bio Blend Courses, Spring and Fall 2022 Terms

Course	Total Course Enrollment	Student Success Percent of A, B, & C Grades
ATR:112 Introduction to Automation	15	73%
BPM:110 Bioprocess Practices	27	91%
MNT:110 Introduction to Maintenance Procedures	22	85%
PTC:110 Industrial Environment	22	82%

It should be noted that Introduction to Automation, ATR:112, was introduced into the Bio Blend curriculum in the 2022-2023 academic year. As part of BBGT's continuous improvement efforts, as well as employer feedback, this course replaced Motors and Controls, ELC:117. The ATR:112 course is designed to more fully address learning outcomes needed by both bioprocess technology and applied engineering students and connects to the goal of blending curriculum. This course introduces the basic principles of automated systems and describes the tasks technicians perform on the job. Topics include the history, development, and current applications of robots and automated systems including their configuration, operation, components, and controls.

• Program Completer Student Feedback

To help gauge student satisfaction with Bio Blend coursework, instructional modalities, and student support/coaching, Cosgrove & Associates conducted a follow-up survey with the 10 program completers from December 2022 and May 2023. Nine of the 10 completers responded to this survey.

When asked to indicate their overall satisfaction with the instruction they received through the Bio Blend program, 78% said they were “very satisfied”, and 22% reported they were “more than satisfied”. Student comments associated with this question reveal that students were especially pleased with instructional and student support efforts to connect them to employers and actual industry experience (i.e., internships, simulated work environment, and career networking events). All nine completers reported they had participated in an industry-sponsored internship. Fifty-six percent said they were "very satisfied" with their internship and 44% indicated they were “more than satisfied”.

100%
Instruction
Satisfaction

COMPLETER SURVEY FEEDBACK

Students reported a high degree of satisfaction (100% "very satisfied" or "more than satisfied") with the overall instruction they received. In addition, all students participated in an internship and 100% reported they were "more than satisfied" or "very satisfied" with their internship. Student comments related to their internship:

- *My internship allowed me to visit four different labs and now I have a better sense of my career goal.*
- *My internship helped me gain a sense of organizational culture and actual working environment.*
- *I was able to actually try things in an industry setting.*
- *The hands-on work was great.*
- *The internship helped me network and meet people I will be working with.*

100%
Internship
Satisfaction

Program completers revealed a high degree of confidence when asked if the Bio Blend program helped them acquire the skills, knowledge, and abilities (SKAs) to be a successful employee. Fifty-six percent said they were "very confident" they had acquired the necessary SKAs, and 33% indicated they were "fairly confident". Eleven percent said they were "somewhat confident".

COMPLETER SURVEY FEEDBACK

Program completers mentioned the following as important in their overall employment preparation.

- *Learning about safety and how a pharmaceutical plant works.*
- *Delta V gives me an edge that most people don't' have.*
- *Exposure to policies, processes, and practices in the classroom before I am on the job site.*
- *My internship was great.*

As discussed throughout our evaluation efforts, the BBCC is a central feature of the Bio Blend instructional and student success strategies. Students reported a fairly high level of engagement with the BBCC, as eight of the respondents indicated they met with the BBCC more than ten times during their Bio Blend experience. One student reported meeting with the BBCC 5-7 over the course of the Bio Blend program. When asked to indicate their level of satisfaction with the support and assistance they received from the BBCC, completers reported a high degree of satisfaction—7 indicated "very satisfied", 1 "more than satisfied" and 1 said "satisfied".

BBGT recognizes the value of connecting instructional and student support strategies more fully and has embedded this strategy in their Bio Blend 2.0 NSF expansion grant. Students also value and recognize this connection as evidenced by their comments and feedback related to the Career Coach. Figure 10 provides a sampling of such comments.[9] It is worth noting that the comments reflect assistance and support across the full spectrum of student needs: course enrollment/registration; encourage & emotional support; academic/student outcomes; and career and employment opportunities.[10]

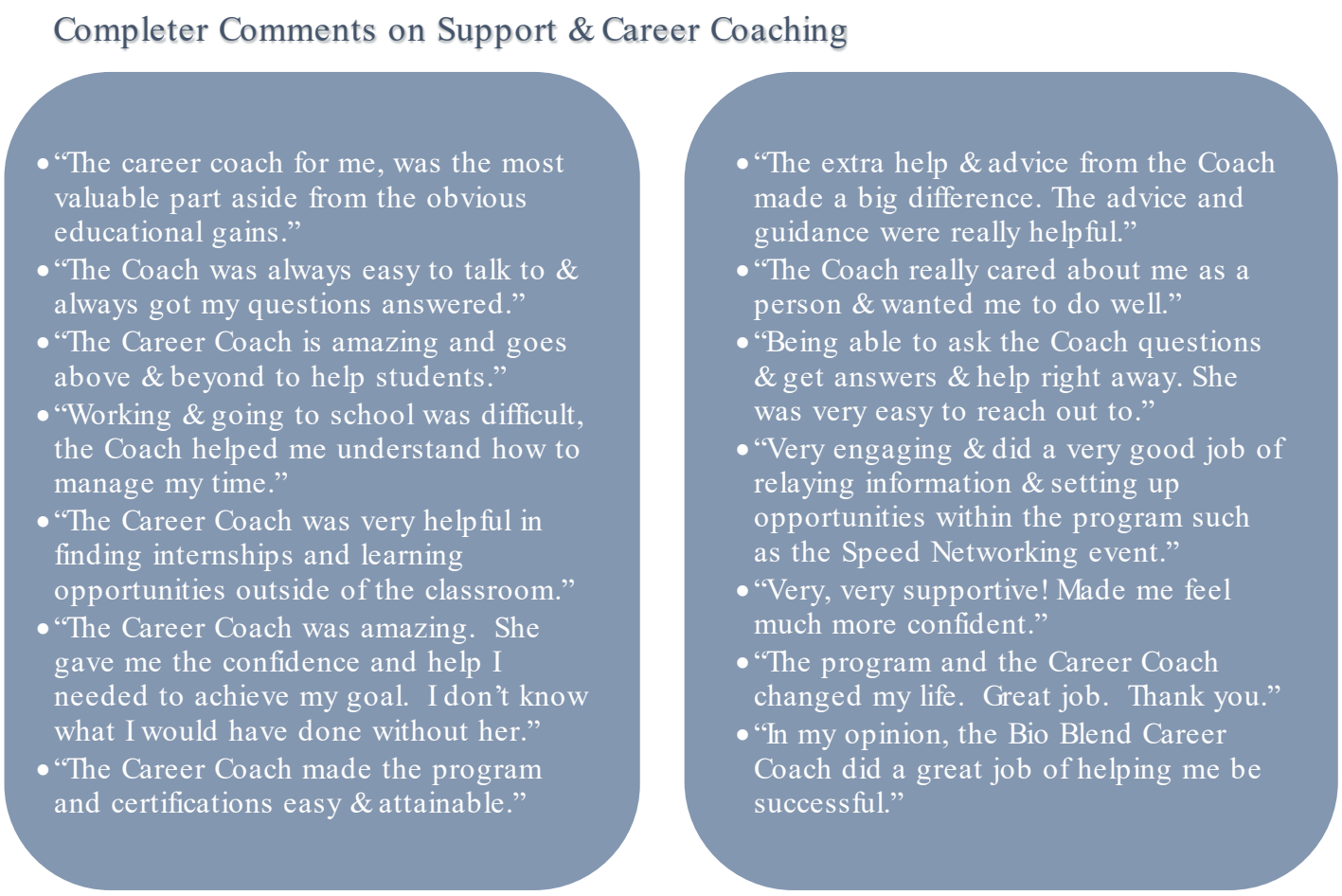

Figure 10: Program completer comments on career coach.

[9] *Across all four-years, students consistently provided positive feedback related to the Bio Blend Career Coach. The full set of such comments can be found in C&A's previous year 1, year 2, and year 3 evaluation progress reports*

[10] National Evaluation of Student Support Service: U.S. Department of Higher Education, https://www2.ed.gov/rschstat/eval/highered/student-support/final-report.pdf

To what extent are employers satisfied with the employment of program completers?

Employer survey feedback revealed a high degree of employer satisfaction with the overall employment preparation of Bio Blend program completers. In addition, employers reported they are confident Bio Blend program completers have the skills, knowledge, and abilities to be successful employees in the biopharmaceutical industry. Tables 12 and 13 reveal employer feedback associated with each of these areas.

Employer feedback data and employers' willingness to actively engage with the BBGT suggest satisfaction with the Bio Blend program. Moreover, in survey responses, in-person interviews, and industry council meetings, employers who have hired Bio Blend students and/or program completers expressed a high degree of confidence in the skills, knowledge, and abilities those hires bring to the workplace.

Table 12. Employer Satisfaction with Bio Blend Program Completers (n=9 responses)

Topic	Very Satisfied	More than Satisfied	Satisfied	Less than Satisfied	Not Satisfied at All
Overall satisfaction with Bio Blend completers you have hired	56%	44%	0%	0%	0%

Table 13. Employer Confidence in Skills, Knowledge & Abilities of Bio Blend Program Completers (n=9 responses)

Topic	Very Confident	Fairly Confident	Confident	Somewhat Confident	Not Confident at All
Confident Bio Blend program completers you have hired have the skills, knowledge, & abilities to be successful employees in your organization.	56%	33%	11%	0%	0%
Confident Bio Blend program completers you have hired have the necessary understanding of Delta V processes & technology	67%	11%	22%	0%	0%

When asked to compare the overall employment preparation of Bio Blend program completers to the employment preparation for other new hires, 67% of the employers said Bio Blend completers were more prepared and 33% reported the employment preparation was about the same. One employer commented, "Bio Blend students are significantly more prepared than others; even considering candidates with previous industry experience".

Sustainability & Scaling

What have grant stakeholders learned during implementation?

From the onset of the grant, C&A has observed BBGT's willingness to use challenges as opportunities for improvement.[11] As outlined in the previous section, BBGT consistently tracked and recorded implementation challenges and lessons learned and described steps taken to address such challenges.

Using employer input to blend/modify curriculum from different academic areas required continuous intra-department conversations, as well as ongoing employer engagement. Such processes can be time consuming, and the creation of an internal network to connect and support this collaboration and use of lessons learned has proven valuable.

By closing the loop between challenges, lessons-learned and actions, the BBGT created a structure to help improve and sustain promising practices, as well as the opportunity for the team to reflect upon their work. The use of student and faculty feedback data to adjust instructional pace and related course content, modify curriculum to include additional attention to automation/robotics and internship efforts, and clarify student roles and responsibilities are especially noteworthy as they represent Bio Blend real-time responses to challenges related to student success.

Cosgrove & Associates suggests such efforts represent a sophisticated and strategic level of thinking by the BBGT, (see Figure 11) as it sought to improve the overall student experience[12], and strengthen the Bio Blend career pathway and connections among JCC, high school partners, students, and employers.

Figure 11: Bio Blend improvement process.

[11] See C&A Evaluation Progress Reports Years 1-3 for examples related to course content modification, revised recruitment strategies, adaptations to student support efforts, and enhanced partnership/outreach approaches.

[12] Building Momentum: Using Guided Pathways to Redesign the Student Experience, https://cccse.org/sites/default/files/BuildingMomentum.pdf

Cosgrove & Associates analysis of Bio Blend challenges and lessons learned through year-three suggested four primary areas of learning: Engaging Employers, Blending Curriculum, Recruiting & Retaining Students, and Coaching/Student Support. To support continued attention to these areas, C&A worked with the BBGT during year-four to take a deeper dive into what BBGT discovered as they worked to strengthen and further establish connections among these areas during year four.

• Blending Curriculum

Blending and modifying different instructional content (Bioprocess Technology and Applied Engineering) required continuous efforts to keep faculty from different areas connected and to link employer and secondary partners to new curriculum. The BBGT, in particular the PI and Career Coach, recognized this need and deployed the Career Coach as an internal and external hub to support organizational and partner connections.

Specific curriculum modifications included the following:

- Modifications to the original instructional pace of Motors & Controls (ELC:117). The BBGT also recognized the need to adapt the curriculum to eventually replace ELC:117 with Introduction to Automation (ATR:112). Although ELC:117 is still available as a course offering, employers are supportive of the ATR:112 course content and stressed the value of knowledge, skills, and abilities connected to automation, robotics, and AI.
- Curriculum blending along with faculty and external partner efforts continue to help grow and support the bioprocessing and applied engineering career pathway. When the Bio Blend pilot launched, there was only a single point of entry for career pathway opportunities. Due to increased external partner engagement, faculty-based curriculum modifications, collaboration between JCC standard credit and workforce development operations, and additional student support/advising, the pathway now includes multiple points of entry.
- Internships are a central component of Bio Blend's work-based instructional mode and, as such, the BBGT worked to more fully align internships with course work, especially DeltaV and BioWork certification. The BBGT also worked to improve the connections between interns and employer supervisors, so the student has more direct contact with a potential hiring supervisor. To further support student and employer needs, the BBGT recognized the need for a more flexible hourly internship structure and took steps to embed the Bio Blend internship opportunity into a specific course offering.
- Given faculty schedules, course times and lab space, creating flexible lab settings/structures in Applied Engineering is a challenge. These challenges make it difficult for full-time manufacturing industry employees to secure and complete the lab time necessary to complete both bioprocessing technology and applied engineering courses.
- Employers (and faculty) continue to stress the importance and value of instruction taking place in a simulated manufacturing environment. DeltaV is a key feature of this SME, thus the BBGT moved to embed DeltaV into Bio Blend coursework. Furthermore, to help ensure the continued use of DeltaV beyond the grant, the BBGT recognized the need for a non-cloud-based license option and is working to purchase servers to host DeltaV internally to avoid high-cost annual license fees.

• Recruiting & Retaining Students

The Bio Blend team continued to recruit students from high school and employer partners, as well as from existing JCC students. This approach resulted in a total of 25 Bio Blend students for cohort 1 and cohort 2, as well as additional students for the College's Bio Blend 2.0 NSF expansion grant. Employer demand for Bio Blend program completers appears to remain strong, and BBGT recognizes student recruitment and secondary partner development is a continuous process. Recent BBGT efforts to connect with high school partners have resulted in BBGT hosting more than 100 high school students for a Bio Tech/Bio Blend information session on campus.

Notwithstanding the importance of student recruitment, the BBGT also has recognized the Bio Blend curriculum can be demanding and students must be prepared for rigorous coursework. The Bio Blend Career Coach (and faculty) continue to provide extensive student support aimed at program retention and completion, academic success, and employment.

To stress the importance and value of the BBCC and help students understand their role and responsibilities in their program success, the BBGT modified the new student orientation process to require Cohort Two students to sign a memorandum of understating (MOU) outlining a student's responsibility to work with the BBCC, and clearly describing engagement with the BBCC is mandatory. The Career Coach and faculty reported that, although not a "perfect solution" this process helped Cohort Two students more fully understand the level of commitment needed to successfully complete the Bio Blend coursework and related curriculum. As a part of this effort, the BBGT has learned that "students don't do optional".[13]

• Engaging Employers

The BBGT team continued to recognize that employer engagement must be a continuous, formalized process connected to ongoing curriculum development and built upon personal and organizational relationships. As noted throughout our evaluation efforts, the Bio Blend Career Coach plays a key role in working to strengthen connections among employers, faculty, and students. The BBGT held four Bio Blend program advisory meetings during year four (June 2022, September 2022, December 2022, March 2023). Cosgrove & Associates participated in both meetings and observed active employer partners contributing to curriculum development, internships structures/strategies, and hiring of program completers.

Cosgrove & Associates continues to see Bio Blend progress associated with employer engagement and notes all grant activities, outputs, and outcomes related to goal 3 (provide hands-on education in a simulated drug manufacturing environment) have progressed to the Mature or Sustaining implementation stage. We also see evidence that the BBGT continues to adapt/modify experiential learning strategies to connect to ever-evolving industry needs. To meet employer demand, additional offerings of DeltaV training were conducted during the 2022-2023 academic year, resulting in a total of 25 students having received Delta V certification. As noted above, the Career Coach is working with employer partners to align internships more closely with specific Bio Blend course completion and connect interns to potential hiring managers.

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[13] *Students Don't Do Optional: A Resource Guide. Center for Community College Student Engagement chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://cccse.org/sites/default/files/Resource_Guide_Optional.pdf*

Spring 2023 feedback from employers on the Bio Blend Program Advisory Council reveals a high degree of satisfaction with Bio Blend efforts and notes the value of Bio Blend instruction and the overall course content. As noted in C&A's previous evaluation progress reports, employer immediate need for qualified talent is resulting in employers hiring some students before they complete the final Bio Blend program award. The BBGT is aware of this phenomenon and is continuing to create strategies (i.e., employer tuition reimbursement and more flexible course times) to allow such students to benefit from employment while working to complete their program certificate/degree.

- ## Coaching/Student Support

The Bio Blend curriculum is rigorous and can be especially challenging for students who are working and attending JCC. The original designers of the grant recognized the curriculum would at times challenge students and included a Bio Blend Career Coach to help support student retention and program completion. As the grant progressed, the BBCC role expanded beyond direct student support and included efforts to improve communication and connections among students, faculty, and external partners (employers and secondary schools). The services provided by the BBCC, and related connection efforts helped produce the Bio Blend arc of achievement displayed in Figure 12.

As Bio Blend 1.0 concludes, C&A see evidence JCC is leveraging impactful grant strategies to support its Bio Blend 2.0 expansion grant. Students, faculty, and external partners increasingly note coaching/student support as a vital ingredient in efforts to support program recruitment, faculty engagement, student experience and success, and external partner engagement. As noted above, the Career Coach is an impactful force of the BBGT and the Coach's work to connect the various components of Bio Blend cannot be overstated. Student, faculty, and external partner feedback related to BBCC's work suggest a high degree of satisfaction with such efforts. Student feedback relative to coaching is especially encouraging as students consistently reported BBCC's support, assistance, and coaching as a crucial factor in their success.

Furthermore, as students progressed through their coursework, the BBCC continued to work with employers to develop work-based learning opportunities for students as well as to support employer needs for work-ready talent. Beyond the formalization of internships, the BBCC and Bio Blend team have worked to link students to employers by offering a series of Virtual Speed Employer Networking events. Such events are scheduled for each academic term to align with upcoming program completion to intentionally connect program completers with employers seeking talent.

It is our opinion that the services provided by the BBCC, and related connection efforts helped produce the Bio Blend Arc of Achievement displayed in Figure 12.

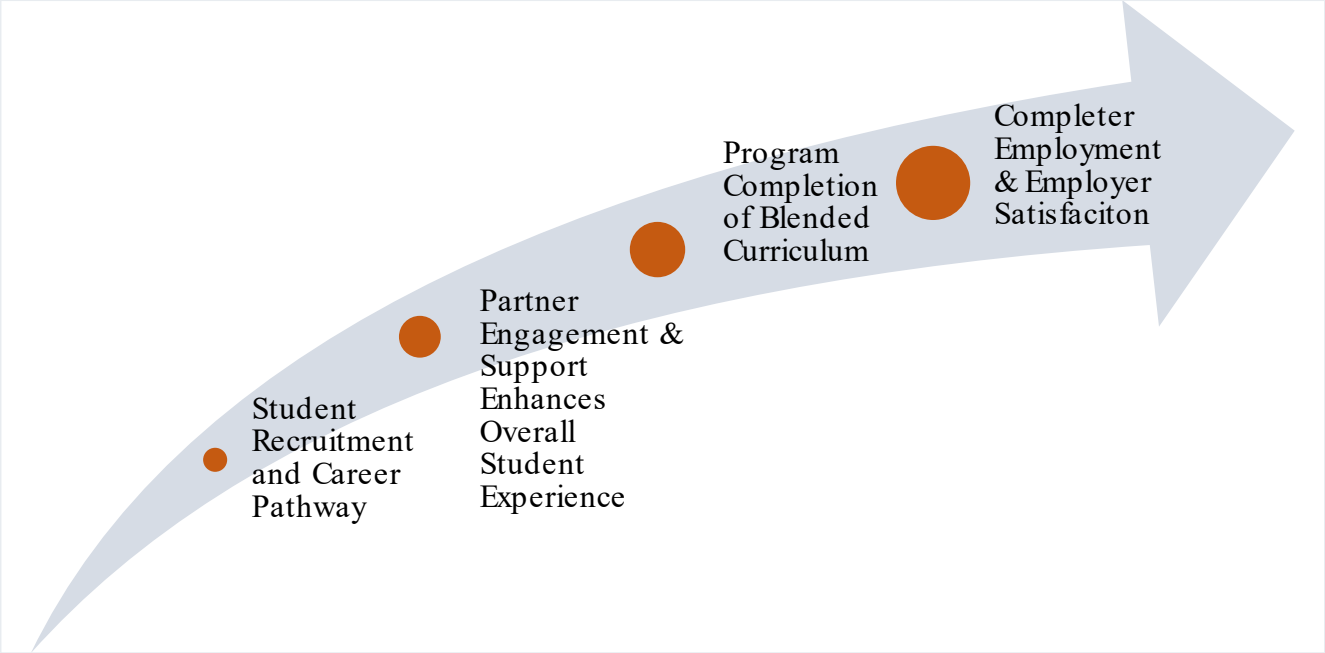

Figure 12: Career coach role and Bio Blend arc of achievement.

- Connecting Strategies for a Network of Student Support & Success

Grant team comments, student outcomes and feedback, and C&A observations of grant and program advisory meetings continue to support the importance of connecting grant activities and strategies related to blended curriculum, student recruitment, student success and support, and external partner engagement. Moreover, by intentionally connecting these areas, the BBGT has created a network (see Figure 13) in which the ***CONNECTION*** role helped improve grant outcomes in each area while creating a grant impact that is greater than a simple sum of the individual parts. Evaluation data point to the following as evidence of this success: employer-to-faculty engagement is being used to adapt and improve blended curriculum and support work-based and active learning instructional modalities; students enrolled in successfully completed Bio Blend coursework and program awards; and students note and value career coaching and student support as a driving force in their academic success, program completion, and employment.

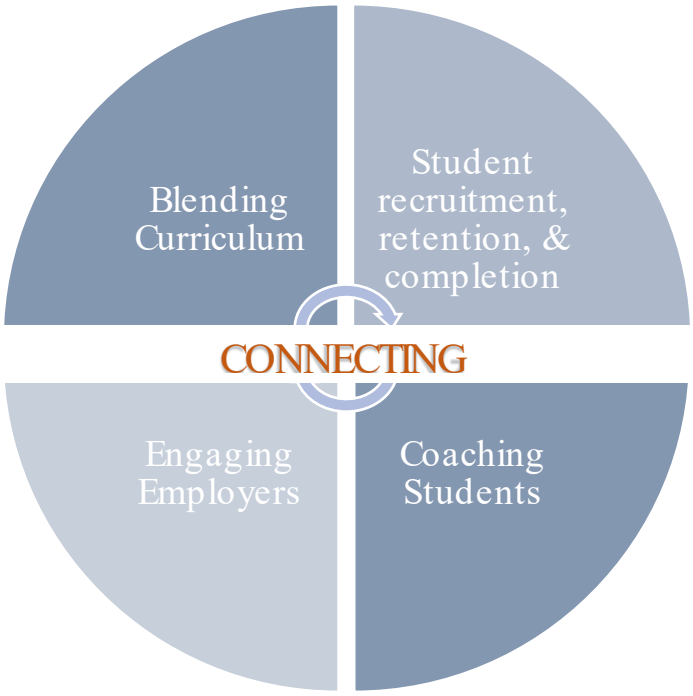

Figure 13: Bio Blend connection network.

The synergy created by connecting these areas to one another is significant and student, faculty, and employer feedback suggests the connection strategy helped produce and support a student experience that enhances academic and employment outcomes. Furthermore, C&A suggests efforts to intentionally connect impactful individual strategies has the potential to enhance college-wide culture, and communication related to student success.

Which grant strategies and/or processes hold the potential for scaling and a broader impact?

Sustaining and scaling successful innovations requires intentional efforts within an organization to support transformative change.[14] Such efforts demand an organizational commitment to the use of data to support improved student outcomes and continuous improvement processes. As noted throughout our evaluation Cosgrove & Associates sees evidence the BBGT has established processes to support the use of lessons learned and evaluation feedback to adapt and improve grant strategies implementation on an ongoing basis. Furthermore, our evaluation suggests the BBGT is using such processes to expand the use of promising strategies to its Bio Blend 2.0 expansion grant.

Cosgrove & Associates notes the BBGT used evaluation data and feedback to continuously explore grant implementation and progress. The team combined such data with faculty and staff expertise to successfully implement strategies and processes to enhance student recruitment, expand employer engagement, blend and improve curriculum, and undertake intensive student support and coaching aimed at improving student outcomes. We see evidence the BBGT worked to intentionally connect these processes and inject them into JCC's Bio Blend 2.0 expansion grant.

BBGT's willingness to close the loop between grant actions, challenges, lessons learned, and improvement efforts is a key ingredient in their scaling efforts related to recruitment, employer engagement, blended curriculum and intensive student coaching and support. The use of student and faculty feedback data to adjust instructional pace and related course content, modify curriculum to include additional attention to automation/robotics and internship efforts, and clarify student roles and responsibilities are especially noteworthy as they represent Bio Blend real-time responses to challenges related to student success. Moving forward, the College has committed to the use of lessons learned from the Bio Blend 1.0 pilot to support Bio Blend 2.0 and JCC efforts related to the following areas:

- Increased attention to employer engagement and recognition of the time and energy required by JCC faculty and staff to engage with employers.
- Continue to connect student recruitment, curriculum blending, instructional and student support/coaching processes, work-based learning strategies/opportunities, and employer partnerships. The emergence of value in the connecting role suggests an opportunity for further scaling across the College.
- Expanded commitment to improving issues/outcomes related to diversity, equity, and inclusion.
- Expanded efforts to provide instructional and student support services to enhance retention, course/program completion, and employment opportunities.
- Expand commitment to strategically support institutional learning and scaling of promising practices related to career pathway development and innovative instructional and student support efforts.

[14] Guiding Principles for Transformative Change https://files.eric.ed.gov/fulltext/ED558790.pdf

Conclusion

Cosgrove & Associates' analysis of available data reveals the Bio Blend grant team implemented the full range of grant strategies with fidelity. The team engaged with employer partners and faculty to create and launch blended curriculum from bioprocess technology and applied engineering. In addition, the BBGT implemented innovative instructional modalities connected to a simulated workplace environment, as well as work-based learning opportunities. Students who participated in internships reported it was valuable to learn from workers and supervisors and the experience helped them connect what they were learning in class to what employers would expect in the workplace. Furthermore, students consistently stressed the value of Bio Blend's "learn to earn" career pathway and saw a good job at the end of their program as motivation to successfully complete their coursework.

The BBGT exceeded grant targets associated with student recruitment, program completion and related certifications, and program completer employment. Furthermore, the BBGT created internal and external processes to leverage grant lessons learned for continuous improvement and wider implementation in the College's Bio Blend 2.0 NSF expansion grant.

Cosgrove & Associates applauds the BBGT for their ongoing efforts and commitment to student success and sees three over-arching components which were especially important to Bio Blend's success. The first is he BBGT's ability to effectively close the loop between challenges, lessons-learned and actions. The team created a structure to help improve and sustain promising practices, as well as the opportunity for the team to reflect upon their work. The second is the active participation of faculty and the inclusion of the Bio Blend Career Coach. Student comments reflect the importance of work-based instructional modalities, as well as the value of the Career Coach in helping them succeed in Bio Blend's rigorous course work. Throughout the grant, students continued to stress the value of the Career Coach in helping them complete coursework, remain confident in their skills, stay connected and committed to their career goals, and find employment. The third is strategically connecting grant strategies, especially partnership efforts, blended curriculum, student recruitment, and student support. By establishing an internal network to support the grant, the BBGT helped increase grant outcomes in each area while creating a grant impact that was greater than a simple sum of the individual parts.

The ability to continue to pilot and explore impact strategies through the extension grant provides JCC with a unique opportunity to support wider scaling of promising practices across the College. The College is committed to further developing career pathways and career education to support regional economic and social development. Cosgrove & Associates recommends grant leadership may wish to consider the best strategies to more widely share grant lesson learned to take advantage of the potential synergy between Bio Blend efforts and JCC's vision for career pathways and technical education. The use of a faculty/staff Thought Partner Groups[15] connected to enhanced employer engagement and intensive student support and coaching may be beneficial in this regard.

[15] Siang, C. et. al, *Coaching Your Team as a Collective Makes It Stronger,* Harvard Business Review, Feb. 2023. https://hbr.org/2023/02/coaching-your-team-as-a-collective-makes-it-stronger

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Acronyms

Abbreviation	Definition
AI	Artificial Intelligence
AIS	Average Implementation Score
AOO	Activities, Outputs, Outcomes
AS	Associate of Science
ATE	National Science Foundation's Advanced Technological Education
ATR	Automation & Robotics
BBCC	Bio Blend Career Coach
BBGT	Bio Blend Grant Team
BIO	Biology
BPM	Bioprocess Measurements
C&A	Cosgrove and Associates
CCP	College & Career Promise
CE	Continuing Education
Co-PI	Co-Principal Investigator
CTE	Career & Technical Education
ECU	East Carolina University
ELC	Electrical
JCC	Johnston Community College
MNT	Maintenance
MOU	Memorandum of Understanding
NCCCS	North Carolina Community College System
NSF	National Science Foundation
PI	Principal Investigator
PTC	Pharmaceutical Technology
SAIT	Self-Assessment of Implementation Tool
SKA	Skills, Knowledge, and Abilities
SME	Simulated Manufacturing Environment
SWE	Simulated Work Environment
TEACCH	Treatment and Education of Autistic and Related Communication Handicapped Children

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