RIO SALADO COLLEGE
A MARICOPA COMMUNITY COLLEGE

Nanotechnology Program Review

Review Period: Academic Years 2019-2023

Review Conducted: AY2023-2024

Rio's Academic Program Review Process is an essential component of the College's Strategic Plan. The 2020-2024 work is guided by the following college-wide goals:

Rio Strategic Goal 1: Increase student goal attainment 23% by 2024 with innovative and world-class experiences

Rio Strategic Goal 2: Offer 23 new micro-credentials by 2024

Rio Strategic Goal 3: Foster a culture of diversity, equity, inclusion, and belonging

Data relating to successful course completion, persistence, credentials awarded, and equity in program- and college-level outcomes across all student populations are aligned with the college-wide Key Performance Indicators that measure progress toward achieving the goals of the College's Strategic Plan.

I. Degrees and Certificates in the Nanotechnology Program

CCL, Nanotechnology: The Certificate of Completion (CCL) in Nanotechnology program is designed to provide students with the general principles and foundational skills in the micro/nano-fabrication industry and related manufacturing industries. Students will become familiar with nanotechnology processes, materials, and methods for characterization and fabrication. Product stewardship, occupational safety and health procedures are emphasized throughout the program.

AAS, Nanotechnology: The Associate in Applied Science (AAS) in Nanotechnology program is designed to provide students with the general principles and foundational skills in the nano/micro-fabrication industry and related manufacturing industries. Students will become familiar with nanotechnology processes, materials, and methods for

characterization and fabrication. Product stewardship, occupational safety and health procedures are emphasized throughout the program.

II. Program Purpose and Mission

The nanotechnology pathways have been reorganized and rebranded to reflect the changing nature of industry in the Maricopa region. As a result of the CHIPS Act and local workforce investments, the semiconductor manufacturing business is now the center of activity, and the mission of the program has adapted accordingly. The core purpose continues to be to prepare technicians for a variety of jobs in nanotechnology-related fields through virtual training, in-person labs, and industry partnerships to provide experiential and work-like experiences. Upon completing their chosen program, students will be prepared to immediately enter the workforce with technical knowledge and hands-on experience that employers desire. However, recent changes contextualize those experiences specifically towards chip manufacturing processes.

A hybrid technician training program is truly unique, especially in the area of nanotechnology and semiconductor manufacturing. It is a manifestation of the College's vision to empower learners everywhere. Students can enroll in a technician training program any Monday from almost any location with almost any skill set. Further evidence linking the program to the College's vision is found in the Chair's nomination to the Governor's Innovation Award with the AZ Tech Council in 2024. In starting a nanotechnology program, the College anticipated the needs of learners and now has a program that can adapt to the changing workforce as the semiconductor market explodes. The Chair has strengthened industry partnerships in this space that are reshaping the landscape of education not only locally, but nationally.

III. Student Population of the Nanotechnology Program

a. Student Data Analysis

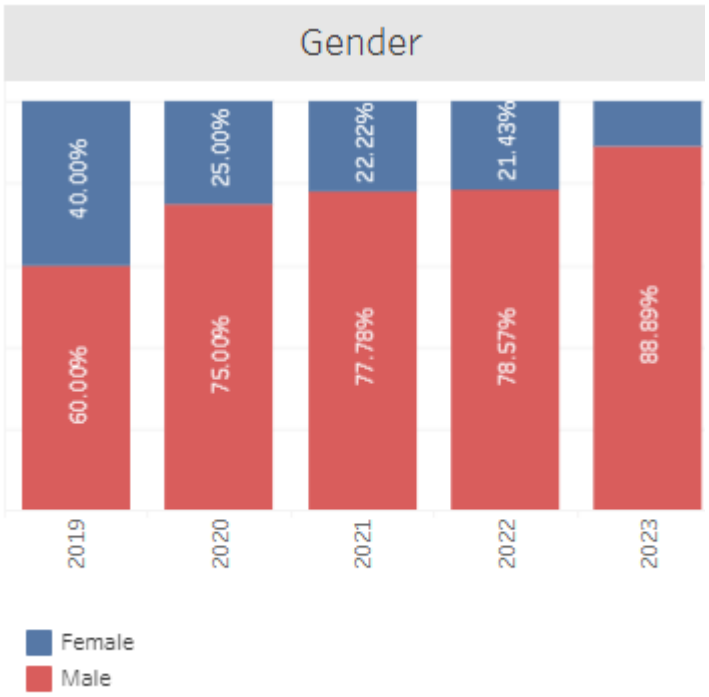
Though there has been historically low enrollment in this program, efforts to recruit specific populations has led to more recent enrollment growth after the timeframe covered in this review. Integrated Education and Training (IET) cohorts are now offered in partnership with Rio's Adult Basic Education team. These students are highly diverse, often predominantly

Hispanic. Their biggest barrier is their confidence in their own language skills, so they are often co-enrolled in English Language Learning courses. Two cohorts began the Level 1 CCL program in the year after this reporting period and a third is planned for the subsequent year. Interestingly, in addition to being ethnically diverse, the second cohort was predominantly female.

Veterans are another student population served by this program. The College is part of a grant that offers a non-credit certificate program, but given that we are able to offer 12 credits for prior learning, students often pursue credit enrollment. Students also may choose to enroll in the credit program when the non-credit program is full or if they apply for the non-credit program, but are not eligible (e.g., dependent of a veteran or not a veteran).

The department chair has received two National Science Foundation (NSF) grants that fund partnerships with Adult Basic Education, Dual partners, industry partners, and military/veteran support organizations to increase access and diversity of students enrolled in technician education programs.

As the program grows, it is anticipated that the student population of technicians will be more diverse than most traditional technician training programs due to its accessibility and affordability.

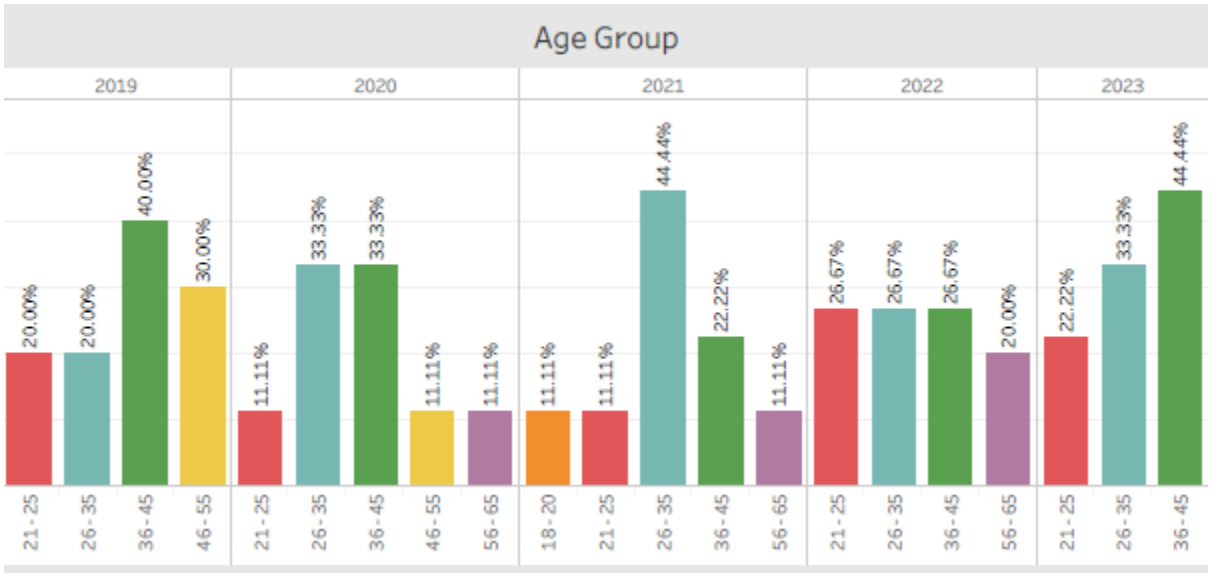


Gender	Metric	2019	2020	2021	2022	2023
Female	Percent	40.0%	25.0%	22.2%	21.4%	11.1%
	Count	4	2	2	3	1
Male	Percent	60.0%	75.0%	77.8%	78.6%	88.9%
	Count	6	6	7	11	8

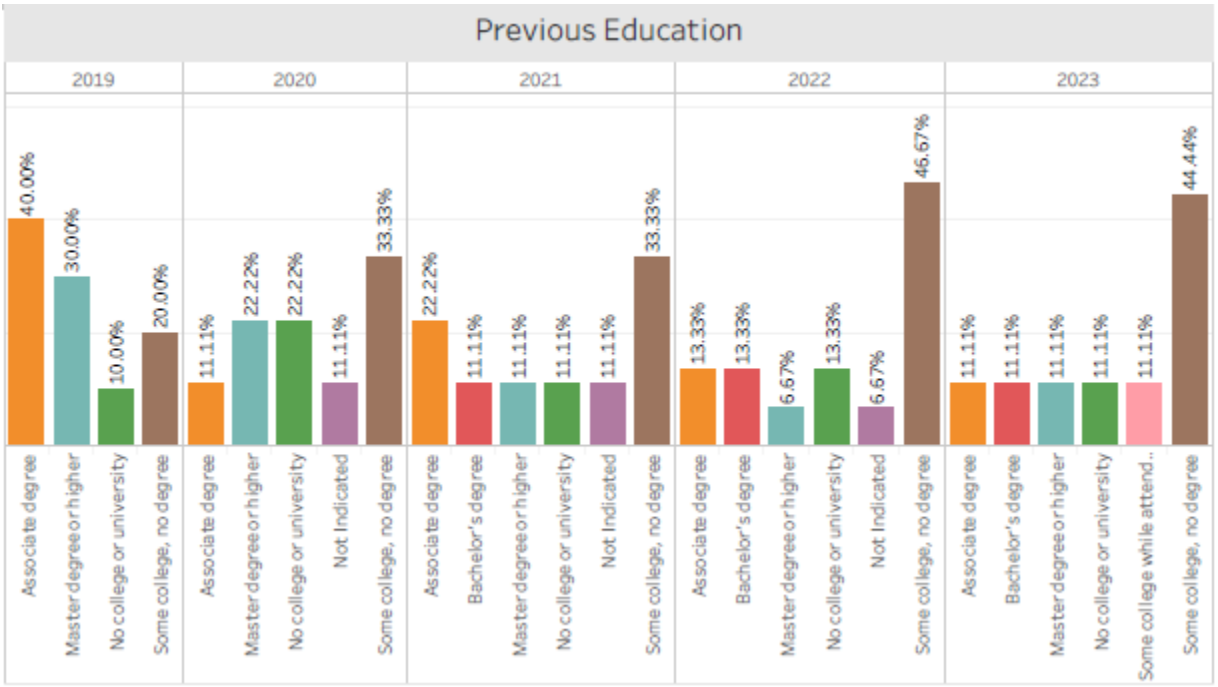
Race/Ethnicity	Metric	2019	2020	2021	2022	2023
Asian	Percent				7.1%	11.1%
	Count				1	1
Black	Percent	10.0%			7.1%	11.1%
	Count	1			1	1
Hispanic/Latino	Percent	20.0%	25.0%	22.2%	21.4%	33.3%
	Count	2	2	2	3	3
White	Percent	70.0%	75.0%	77.8%	64.3%	44.4%
	Count	7	6	7	9	4

The following charts illuminate a couple of interesting trends. In the first, we see that the greatest percentage of students in AY2022-23 (44%) were in the 36-45 age group, and that is the highest proportion of students in that age range during the review period. Additionally, since AY2019-20, we see that the students in the program predominantly enter with some college but no degree. Combining these, we get a

profile of an older student with some college, perhaps still searching for a viable career path that interests them.



Age Groups	Metric	2019	2020	2021	2022	2023
18 - 20	Percent			11.1%		
	Count			1		
21 - 25	Percent	20.0%	12.5%	11.1%	28.6%	22.2%
	Count	2	1	1	4	2
26 - 35	Percent	20.0%	37.5%	44.4%	28.6%	33.3%
	Count	2	3	4	4	3
36 - 45	Percent	40.0%	37.5%	22.2%	28.6%	44.4%
	Count	4	3	2	4	4
46 - 55	Percent	20.0%	12.5%			
	Count	2	1			
56 - 65	Percent			11.1%	14.3%	
	Count			1	2	



Previous Education	Metric	2019	2020	2021	2022	2023
No college or university	Percent	10.0%	25.0%	11.1%	14.3%	11.1%
	Count	1	2	1	2	1
Some college, no degree	Percent	20.0%	37.5%	33.3%	50.0%	55.6%
	Count	2	3	3	7	5
Associate degree	Percent	40.0%		22.2%	14.3%	11.1%
	Count	4		2	2	1
Bachelor's degree	Percent			11.1%	7.1%	11.1%
	Count			1	1	1
Master degree or higher	Percent	30.0%	25.0%	11.1%	7.1%	11.1%
	Count	3	2	1	1	1
Not Indicated	Percent		12.5%	11.1%	7.1%	
	Count		1	1	1	

b. Enrollment Trends

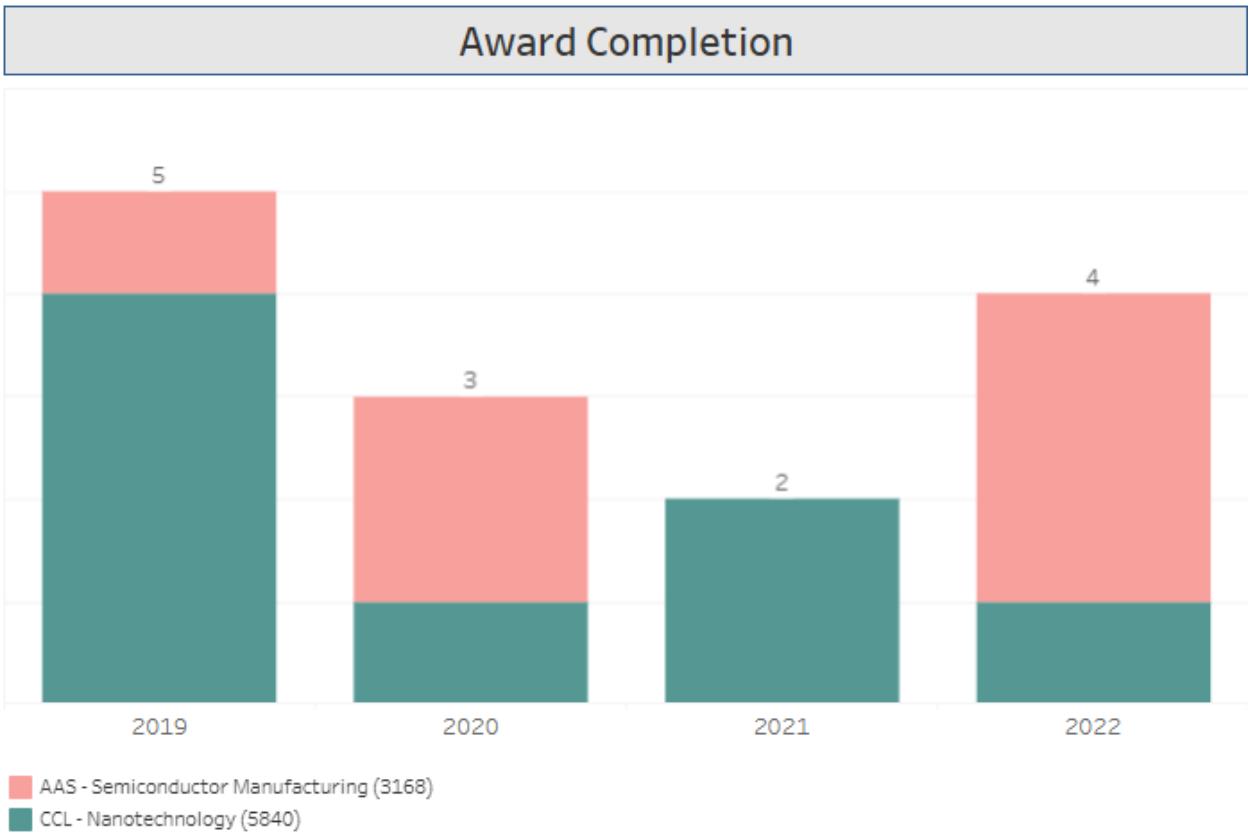
It is difficult to conduct a trend analysis with such low enrollment numbers during the review period. A complicating factor is that the data for this review is drawn from declared program enrollments. However, most students taking the relevant courses did not formally declare the program up-front. This observation is supported by NSF Advanced Technological Education (ATE) grant reporting, which shows overall increases in course enrollments each year. Below is the relevant section from the 2024 ATE report:

> *The MNT prefix (courses in this program) saw duplicated enrollment of 90 to date for the 23-24 academic year. This represents a 20% increase over the academic year 22-23. These 90 duplicated enrollments represent a headcount of 42 unique students. The headcount increased by 31.2%. Of these students, 76% identified as Male and 21% identified as Female, with the remaining 2% unknown, other, or undeclared. 5 (11.9%) identified as Asian, 0 identified as Native American/Alaskan Native, 4 (9.52%) as Black/African American, 17 (40.5%) as Hispanic/Latino, 13 (31%) as White, 1 (2.4%) unknown and 2 (5%) unspecified. The following table summarizes these data and show the percent change from AY22:*

	Asian	**Native American**	**African American**	**Hispanic/ Latino**	**White**	**Unknown**	**Unspecified**
Count	5	0	4	13	13	1	2
Percent	11.8%	0%	9.6%	40.5%	31%	2.5%	5%
Change	5.7%	-3.1%	3.27%	-18.9%	6%	2.5%	5%

> *All appear to be taking courses towards one or both of the CCLs, although some have declared for the AAS degree.*

c. Student Graduation Data



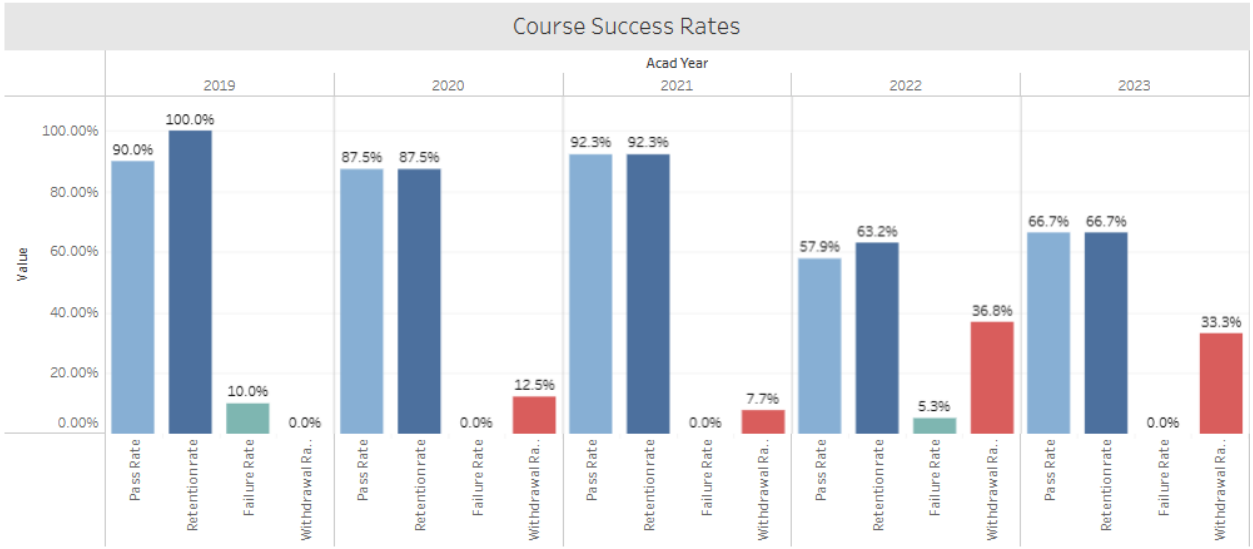
Program	2019	2020	2021	2022
AAS Nanotechnology (3168)	1	2		3
CCL Nanotechnology (5840)	4	1	2	1
Grand Total	5	3	2	4

Even though the number of CCL and AAS completers is low during this review period, many of the students enrolled in the program courses are successfully employed in industry and have been featured in Rio marketing materials, including veterans and IET cohort students:

- Nano Knows No Limits
- Veterans: Sign Up Today
- Rio's Semiconductor Training Program Featured on PBS NewsHour

IV. Retention and Persistence

The data in the following graph and table include anyone enrolled in specified classes, regardless of whether they have declared the program. A relatively small *n* caused large fluctuations in success rates. In general, they hover in the high 80% range or above. In 2022, there was one particular student who enrolled in two classes, failed both of them, re-enrolled, and then dropped or failed again. That one student counted as multiple enrollments, leading to a general decrease in the overall success rate.

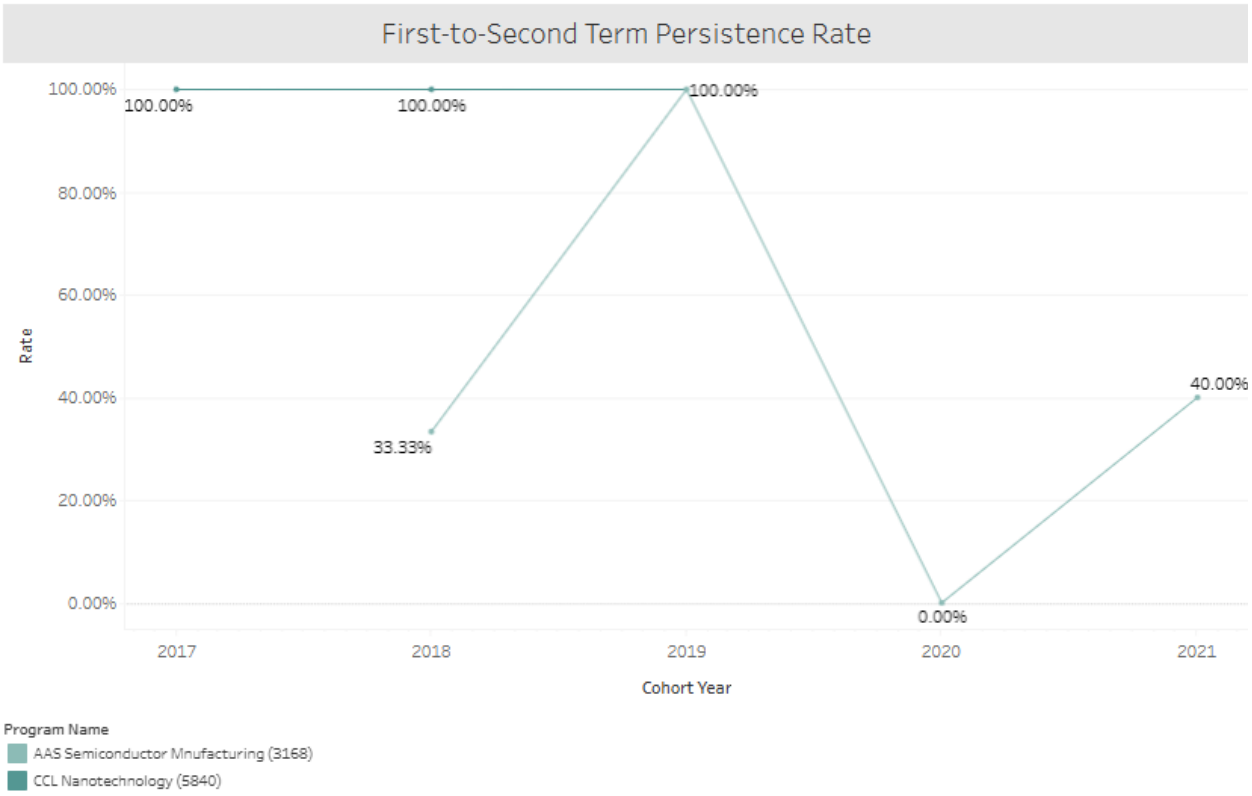


Year	Metric	Classes					
		MNT201	**MNT210**	**MNT220**	**MNT230**	**MNT240**	**MNT250**
2019	Pass Rate	75.0%	75.0%	100.0%	100.0%	100.0%	100.0%
	Retention rate	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	Failure Rate	25.0%	25.0%	0.0%	0.0%	0.0%	0.0%

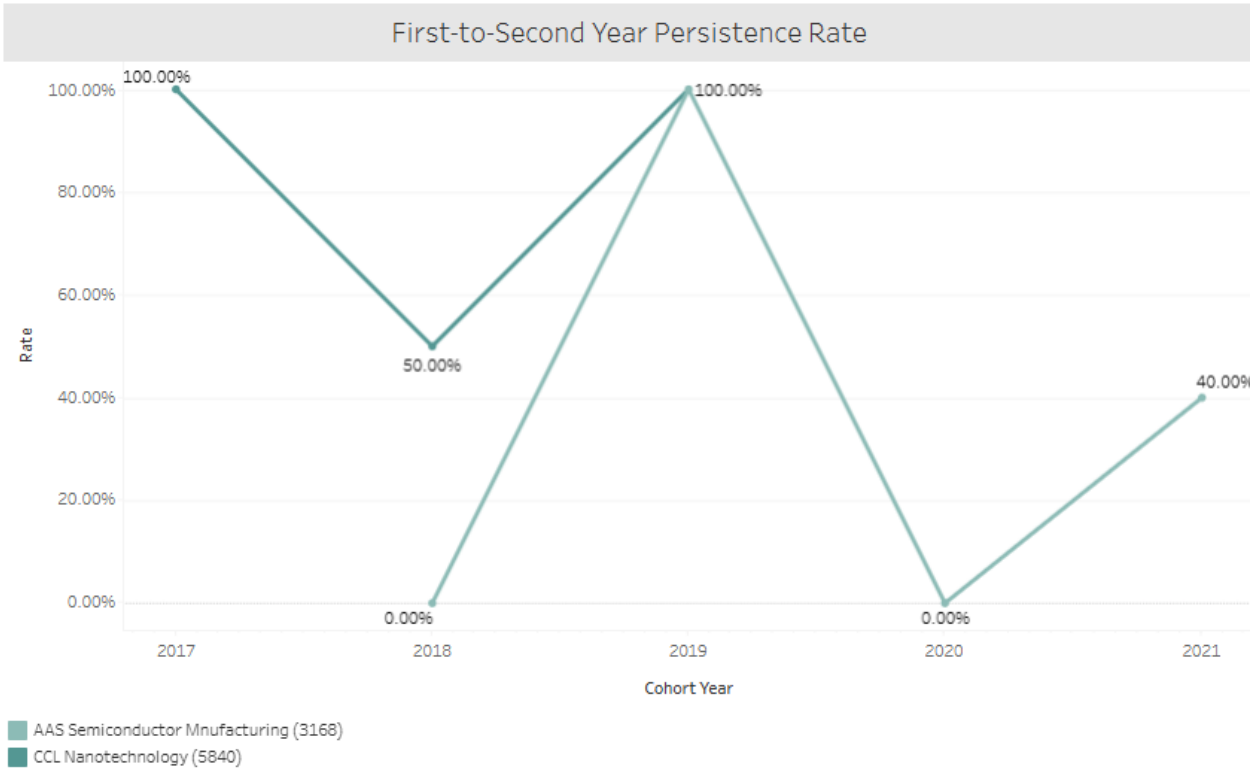
2020	Pass Rate	100.0%	100.0%	100.0%		0.0%	
	Retention rate	100.0%	100.0%	100.0%		0.0%	
	Failure Rate	0.0%	0.0%	0.0%		0.0%	
2021	Pass Rate	75.0%	100.0%	100.0%	100.0%	100.0%	
	Retention rate	75.0%	100.0%	100.0%	100.0%	100.0%	
	Failure Rate	0.0%	0.0%	0.0%	0.0%	0.0%	
2022	Pass Rate	40.0%	33.3%	25.0%	100.0%	100.0%	100.0%
	Retention rate	40.0%	33.3%	50.0%	100.0%	100.0%	100.0%
	Failure Rate	0.0%	0.0%	25.0%	0.0%	0.0%	0.0%
2023	Pass Rate	50.0%	100.0%	100.0%	50.0%		
	Retention rate	50.0%	100.0%	100.0%	50.0%		
	Failure Rate	0.0%	0.0%	0.0%	0.0%		

Again, the small *n* led to wide fluctuations in the persistence data displayed in the graphs below.

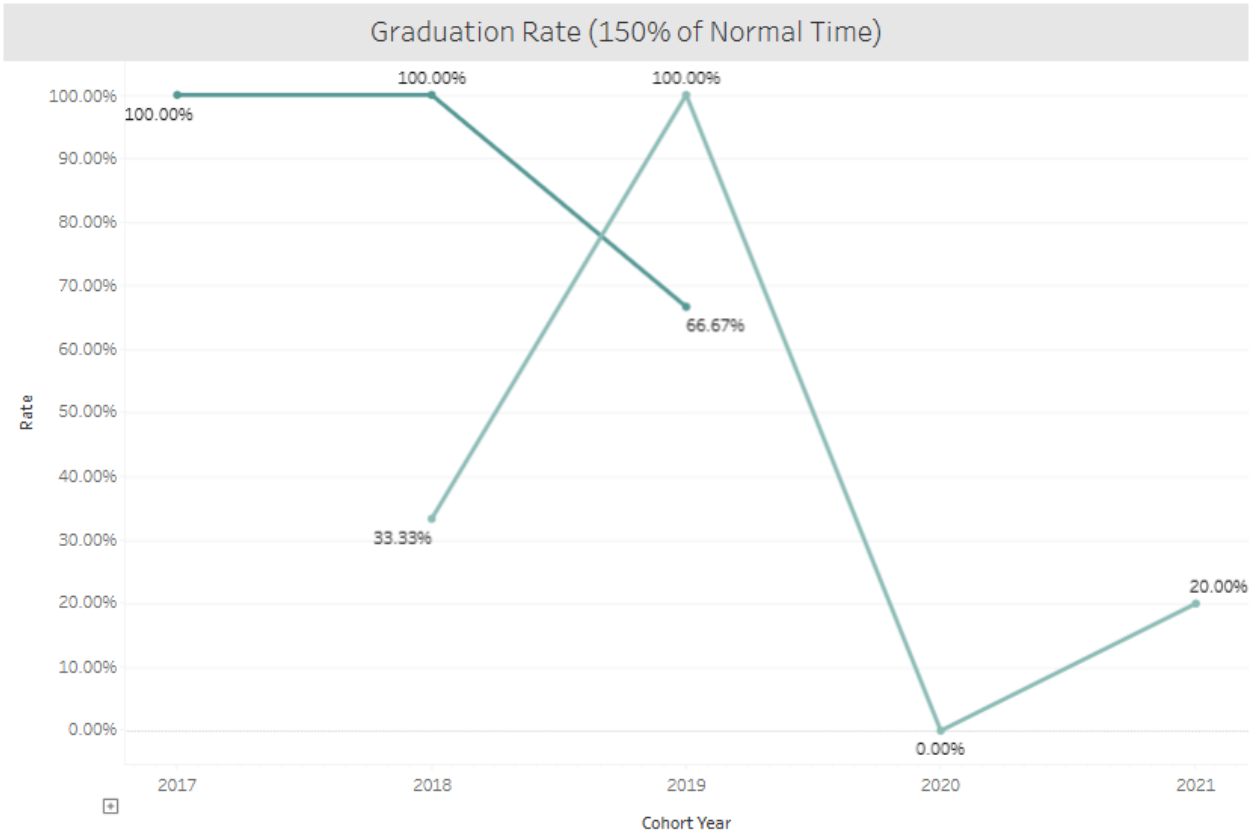
Note: The following graphs represent student cohorts based on when students first declared their academic program. For example, students who declared their program in Fall 2016, Spring 2017, and Summer 2017 are grouped into cohort year 2017.



Program	2017	2018	2019	2020	2021
AAS Nanotechnology (3168)		33.3%	100.0%	0.0%	40.0%
CCL Nanotechnology (5840)	100.0%	100.0%	100.0%		



Program	2017	2018	2019	2020	2021
AAS Nanotechnology (3168)		0.0%	100.0%	0.0%	40.0%
CCL Nanotechnology (5840)	100.0%	50.0%	100.0%		



Program	2017	2018	2019	2020	2021
AAS Nanotechnology (3168)		33.3#	100.0%	0.0%	20.0%
CCL Nanotechnology (5840)	100.0%	50.0%	67.7%		

In contrast to the 2017-21 cohorts covered during this review period, more recent data specific to the IET cohort indicate high persistence rates for students who completed their first class. After completing MNT140, 56% of the Cohort 1 and 86% of the Cohort 2 students persisted and successfully completed the program, suggesting that a cohort

approach may be warranted in other nanotechnology program offerings (see bulleted action plans in Section IX.c.).

Semiconductor IET, Student Persistence, Cohort 1							
# of Students Who Started MNT140	# of Students Who Completed MNT140	# of Students Who Started MNT110	# of Students Who Completed MNT100	# of Students Who Started MNT120	# of Students Who Completed MNT120	# of Students Who Started MNT130	# of Students Who Completed MNT130
12	9	9	8	7	5	5	5

Semiconductor IET, Student Persistence, Cohort 2							
# of Students Who Started MNT140	# of Students Who Completed MNT140	# of Students Who Started MNT110	# of Students Who Completed MNT100	# of Students Who Started MNT120	# of Students Who Completed MNT120	# of Students Who Started MNT130	# of Students Who Completed MNT130
10	7	7	6	6	6	6	6

V. Program Learning Outcomes

AAS Nanotechnology (Learning Outcomes)

1. Apply ethical and professional standards within the field of micro-and nanotechnology. (FYE101, FYE103, MNT110, MNT120, MNT130, MNT140, MNT201, MNT215, MNT225, MNT235, MNT245)

2. Compare and contrast various types of patterning processes. (MNT110, MNT120, MNT130, MNT201, MNT215, MNT225)

3. Compare and contrast nanotechnology manufacturing processes. (MNT110, MNT120, MNT130, MNT215, MNT235)

4. Compare and contrast product and research trends in nanoscience and nanotechnology. (MNT110, MNT140, MNT215, MNT225, MNT235, MNT245)

5. Describe manufacturing concerns in the nanotechnology industry. (MNT110, MNT140, MNT225)

6. Examine safety procedures and equipment used in the nanotechnology industry. (MNT130, MNT201, MNT215, MNT225, MNT235, MNT245)

7. Compare and contrast classification procedures for materials in the nanotechnology industry. (MNT201, MNT225)

8. Explain properties of colloids and self-assembly materials. (MNT225)

9. Explain photoresist applications. (MNT225, MNT235)

10. Describe photolithography techniques, technology, and tools. (MNT235)

11. Review characterization tools and techniques for nanotechnology structure and materials

12. Compare and contrast types of electron beam characterization tools and procedures. (MNT235, MNT245)

13. Examine applications for nanotechnology in the health science, energy, manufacturing, electronics, food, and environmental industries. (MNT245)

14. Examine tools and processes for advanced Scanning Probe Microscopy (SPM). (MNT245)

15. Apply relevant knowledge, skills, and habits of mind to seek career opportunities in the field. (FYE101, FYE103)

CCL Nanotechnology (Learning Outcomes)

1. Examine safety procedures and equipment used in the nanotechnology industry. (MNT201)

2. Compare and contrast classification procedures for materials in the nanotechnology industry.(MNT201, MNT220)

3. Describe manufacturing concerns in the nanotechnology industry. (MNT210, MNT220)

4. Compare and contrast nanotechnology manufacturing processes. (MNT210, MNT220, MNT230, MNT240)

5. Compare and contrast various types of patterning processes. (MNT210, MNT230)

6. Explain properties of colloids and self-assembly materials. (MNT220)

7. Describe photolithography techniques, technology and tools. (MNT230)

8. Explain photoresist applications. (MNT230)

9. Compare and contrast product and research trends in nanoscience and nanotechnology. (MNT240)

10. Examine applications for nanotechnology in the health science, energy, manufacturing, electronics, food, and environmental industries. (MNT240)

11. Review characterization tools and techniques for nanotechnology structure and materials.

(MNT250)

12. Compare and contrast types of electron beam characterization tools and procedures. (MNT250)

13. Examine tools and processes for advanced Scanning Probe Microscopy (SPM). (MNT250)

Program Learning Outcomes - AAS Nanotechnology

Learning Outcome	Assessment Method(s)	Student Count	Students @ CL
Apply ethical and professional standards within the field of micro-and nanotechnology.	MNT 201-Final Exam	22	77%
Compare and contrast various types of patterning processes.	MNT201-Final Exam	22	77%
	MNT220-Final Exam	19	89%
Compare and contrast nanotechnology manufacturing processes.	MNT210 Final Exam	20	90%
	MNT220 Final Exam	19	89%
Compare and contrast product and research trends in nanoscience and	MNT210 Final Exam	20	90%
	MNT220 Final Exam	19	89%

nanotechnology.	MNT230 Final Exam	16	94%
	MNT240 Final Exam	15	80%
Describe manufacturing concerns in the nanotechnology industry.	MNT230-Final Exam	16	94%
Examine safety procedures and equipment used in the nanotechnology industry.	MNT220-Final Exam	19	89%
Compare and contrast classification procedures for materials in the nanotechnology industry.	MNT230-Final Exam	16	94%
Explain properties of colloids and self-assembly materials.	MNT230-Final Exam	16	94%
Explain photoresist applications.	MNT240-Final Exam	15	80%
Describe photolithography techniques, technology, and tools.	MNT240-Final Exam	15	80%
Review characterization tools and techniques for nanotechnology structure and materials.	MNT250-Final Exam	15	100%
Compare and contrast types of electron beam characterization tools and procedures.	MNT250 Final Exam	15	100%
Examine applications for nanotechnology in the health science, energy, manufacturing, electronics, food, and environmental industries.	MNT250 Final Exam	15	100%
Examine tools and processes for advanced Scanning Probe Microscopy (SPM).	MNT250-Final Exam	15	100%

Program Learning Outcomes - CCL Nanotechnology

Learning Outcome	Assessment Method	Student Count	Students @ College Level
Examine safety procedures and equipment used in the nanotechnology industry.	MNT 201-Final Exam	22	77%
Compare and contrast classification procedures for materials in the nanotechnology industry.	MNT220-Final Exam	19	89%
Describe manufacturing concerns in the nanotechnology industry.	MNT210-Final Exam	20	90%
Compare and contrast nanotechnology manufacturing processes.	MNT240-Final Exam	15	80%
Compare and contrast various types of patterning processes.	MNT210-Final Exam	20	90%
Explain properties of colloids and self-assembly materials.	MNT220-Final Exam	19	89%
Describe photolithography techniques, technology and tools.	MNT230-Final Exam	16	94%
Explain photoresist applications.	MNT230-Final Exam	16	94%
Compare and contrast various types of plasma deposition coverage.	MNT240-Final Exam	15	80%
Evaluate characteristics of various types of etch systems	MNT240-Final Exam	15	80%
Review characterization tools and techniques for nanotechnology structure and materials.	MNT250-Final Exam	15	100%
Compare and contrast types of electron beam characterization tools and procedures.	MNT250-Final Exam	15	100%
Examine tools and processes for advanced Scanning Probe Microscopy	MNT250-Final Exam	15	100%

The following three program learning outcomes fell below the 80% target. They are all assessed via the MNT201 Final Exam.

- Apply ethical and professional standards within the field of micro and nanotechnology.
- Compare and contrast various types of patterning processes.
- Examine safety procedures and equipment used in the nanotechnology industry.

See Section IX.c. of this review for a Plan-Do-Check-Act (PDCA) cycle to address the identified achievement gaps.

VI. College-wide Student Learning Outcomes

In addition to the program-level outcomes addressed above, Rio Salado College places a high priority on developing core competence in the following areas:

1. **Critical Thinking:** The student will demonstrate the ability to analyze information, evaluate material, use inference to draw conclusions, and use deductive reasoning and inductive reasoning at a college level
2. **Information Literacy:** The student will demonstrate the ability to determine an information need, access successfully and evaluate critically the needed information, and organize and apply the information appropriately to accomplish a given research task.
3. **Oral Communication:** The student will demonstrate the ability to prepare and present oral communication in a variety of contexts as a college-level speaker.
4. **Reading:** The student will demonstrate the ability to comprehend a variety of materials by determining the central idea and providing textual evidence, drawing inferences or valid conclusions, analyzing the author's purpose and bias, and applying the text to a given task or course content.
5. **Writing:** On a written assignment, the student will demonstrate the ability to generate relevant and sufficient content; organize his or her thoughts coherently; adhere to the conventions of correct mechanics and sentence structure; and use correct terminology and rich vocabulary in the fulfillment, at the college level, of his or her writing assignments.

For more information: http://www.riosalado.edu/about/teaching-learning/assessment/Pages/SLO.aspx

Student Learning Outcomes (SLOs) are being assessed in the following courses:

Course	Critical Thinking	Information Literacy	Reading	Writing	Oral Communication
MNT110	Y	Y	Y	Y	
MNT120	Y		Y	Y	
MNT140	Y	Y	Y	Y	
MNT201		Y		Y	Y

The table below represents student performance on each of the SLOs for the courses and timeframe included in this review.

Learning Outcome	All Student Assessments	Assessments at College Level	Percent of Assessments at College Level
Critical Thinking	427	324	75.9%
Information Literacy	227	206	90.7%
Oral Communication	9	9	100.0%
Reading	615	500	81.3%
Writing	614	573	93.3%

The nanotechnology/semiconductor manufacturing program assesses all of the college-wide student learning outcomes in at least one course. A review of the data shows that over 80% of students performed at a college level in every area except Critical Thinking, which fell just short (75.9%). Critical Thinking is tagged in three of the 100-level courses. With 11 students already enrolled in MNT110 for Fall 2024, the department will carefully monitor the tagged assessments for performance on critical thinking. If the pattern identified in this report continues, then a PDCA cycle will commence.

VII. Impact of Co-curricular Programs

Learning Outcome	All Student Assessments	Assessments at College Level	Percent of Assessments at College Level	Co-Curricular Student Assessments	Co-Curricular Assessments at College Level	Percent of Co-Curricular Assessments at College Level
Critical Thinking	427	324	75.9%	1	1	100.0%
Information Literacy	227	206	90.7%	1	1	100.0%
Oral Communication	9	9	100.0%			
Reading	615	500	81.3%	1	1	100.0%
Writing	614	573	93.3%	2	2	100.0%

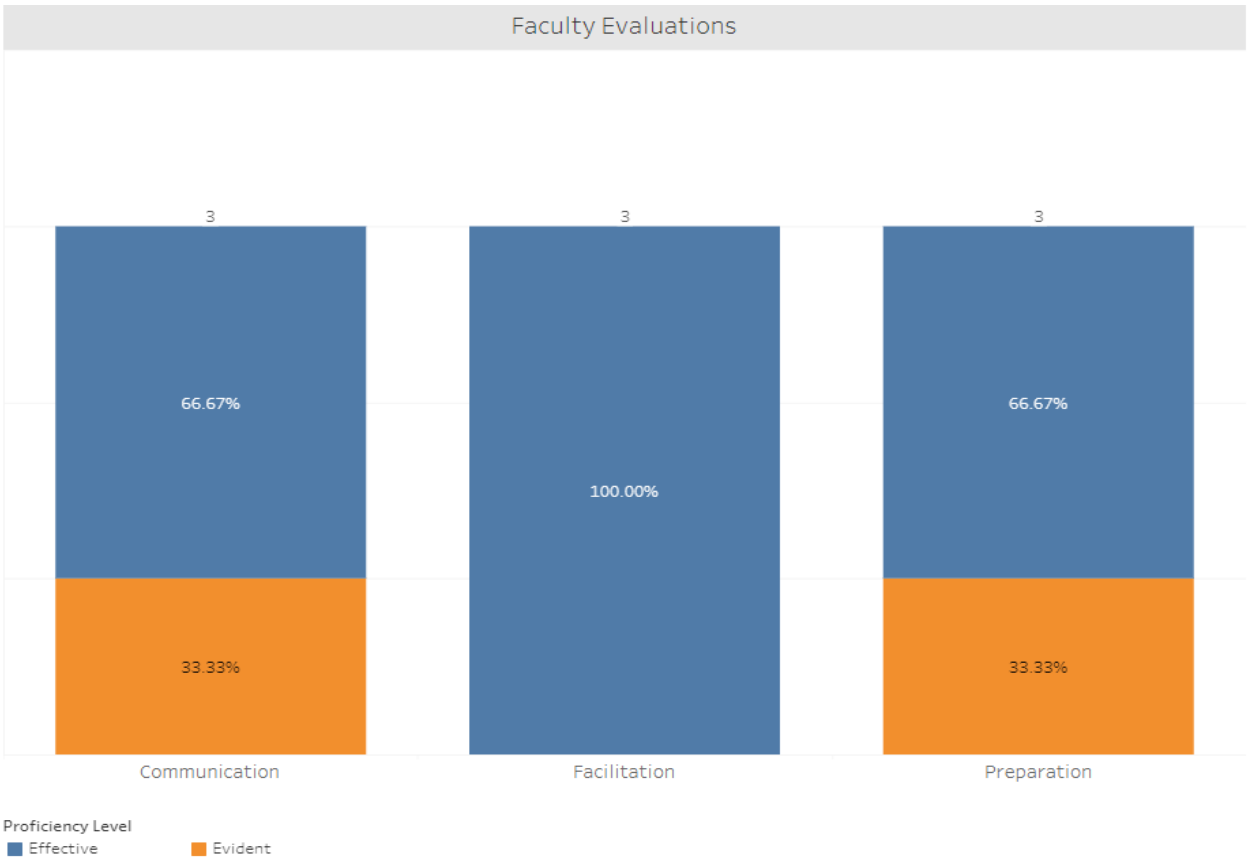
Co-curricular activities include Achieving a College Education (ACE), Honors, National Society of Leadership and Success (NSLS), and Phi Theta Kappa (PTK)

Though there are only 0-2 data points for each SLO, participation in co-curricular activities did correlate with increased performance. In addition to the student groups identified above, the department is actively engaged in community events such as Girls Get IT and Geeks Night Out.

MNT201 is offered for Honors credit. Honors students have research expectations for their lab experiments on safety, vacuum, and metrology with the ellipsometer and profilometer. These research papers are in addition to the hands-on labs that are expected of students in the non-Honors sections.

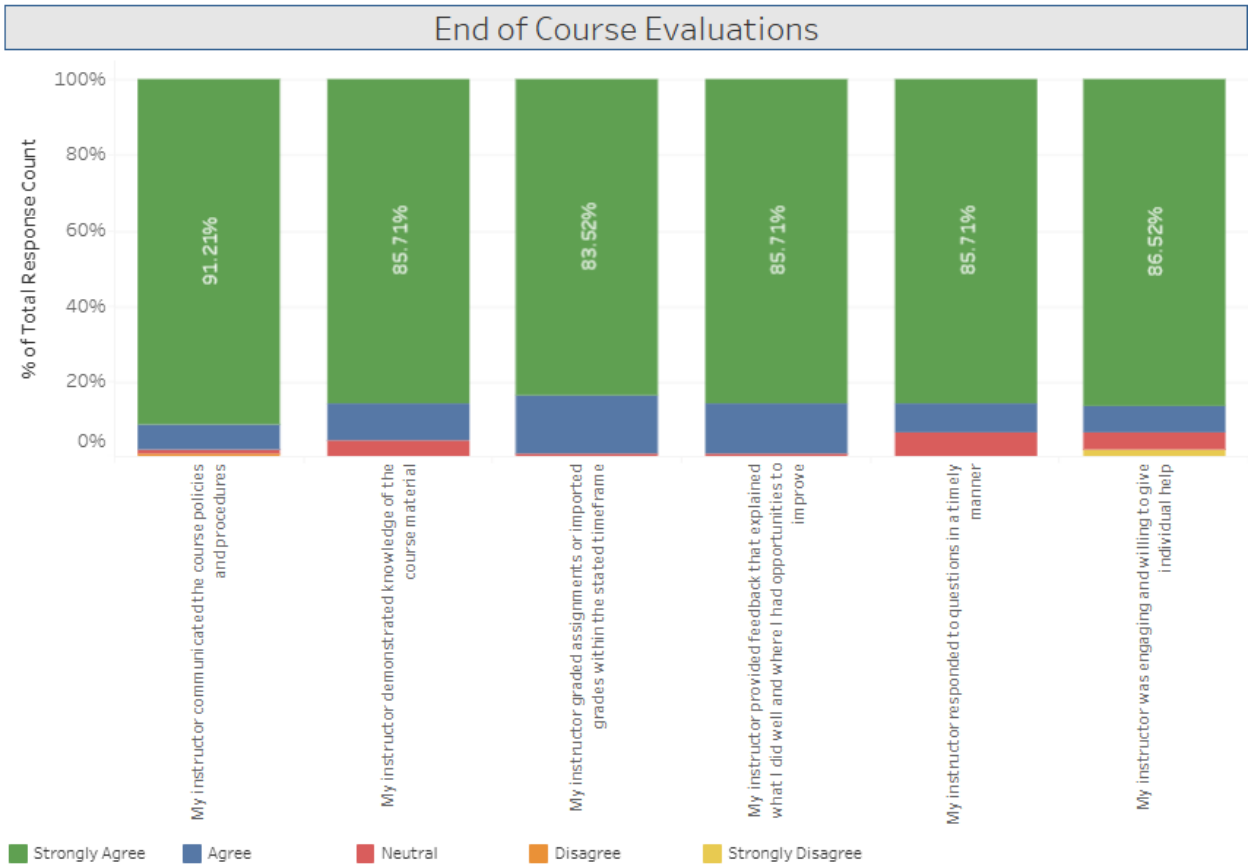
VIII. Effective Teaching

Instructor evaluations are conducted by the lead or chair. As demonstrated in the chart below, all faculty were rated as effective or evident in the areas of focus. Instructors were commended for their high-touch and personalized instruction.



Evaluation Component	Effective	Evident	Needs Improvement
Communication	66.7%	33.3%	0.0%
Facilitation	100.0%	0.0%	0.0%
Preparation	66.7%	33.3%	0.0%

Student evaluations show very strong satisfaction with the quality of instruction in the department. In 2019, the lowest-scoring items assessed timeliness of response and feedback. By 2023, scores for those items had risen to the highest rating possible.



Survey Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
My instructor communicated the course policies and procedures	91.2%	6.6%	1.1%	1.1%	
My instructor demonstrated knowledge of the course material	85.7%	9.9%	4.4%		
My instructor graded assignments or imported grades within the stated timeframe	83.5%	15.4%	1.1%		
My instructor provided feedback that explained what I	85.7%	13.2%	1.1%		

did well and where I had opportunities to improve					
My instructor responded to questions in a timely manner	85.7%	7.7%	6.6%		
My instructor was engaging and willing to give individual help	86.5%	6.7%	4.5%		2.2%

Department faculty regularly engage in professional development opportunities including nanomanufacturing at the Center for Nanomanufacturing Education and Utilization (CNEU), SemiconWest, and the High Impact Technology Exchange Conference (HI-TEC). The department chair was selected as a fellow for the Future of Work as part of the European Union Study Tour, where he visited Germany and Spain and brought back best practices for teaching vocational education in Maricopa and the United States.

IX. Evaluation of Curriculum

Curriculum is evaluated regularly via a local advisory board, a district advisory board, and a national Business and Leadership Team (BILT). The BILT with the Micro and Nano Technician Education Center (MNT-EC) has published a list of knowledge skills and abilities (KSAs). The district team, under the control of the Arizona Advanced Manufacturing Institute (AzAMI), has focused their efforts on advanced manufacturing/mechatronics (industrial) aspects of the industry. Local partners, such as the Center for Semiconductor Manufacturing (CSM), tend to land more on the process side. All of these parties are in active conversation about the constant state of change for the industry and ensuring that the curriculum at Rio and throughout the district is adapting to meet their needs.

Changes occur continuously. For example, in the past year, MNT220 Materials in Nanotechnology was discontinued and replaced with MNT225 Material Properties and Effects of Size. Currently, MNT230 Patterning for Nanotechnology is being discontinued and replaced by MNT235 Nanotechnology Characterization Tools and Techniques. AIT132 Industrial Technology for the Semiconductor Industry is under development. A new apprenticeship program is being proposed. These changes are always prompted by requests from industry. Recently, we received a new list of job descriptions from TSMC. Curriculum will again need to be adapted to ensure students are prepared for job roles within their company as they will be a major employer in the years to come.

A new CCL and microcredential pathway in Precision Optics has already been developed, and the department is engaged in discussions with another institution in the district that offers a microcredential in a related area. In addition, the department is leading district-wide efforts to align curriculum and co-enroll students from multiple institutions in Semiconductor Manufacturing and Cybersecurity.

X. Program Resources

The program has been successful in acquiring grant funding to support its efforts, and work is in progress for additional grant funding. Future needs may include a lab

technician, additional physical facilities and, perhaps, a new funding model for cohort/hybrid offerings for the technician programs with hands-on training. The non-credit program for veterans has benefitted from mentoring and high-touch student navigators, and funding could be used to expand these services to the credit programs. Additional funding would also allow Rio to scale the non-credit program to additional veterans and other cohorts.

Additional discipline-specific academic resources are being incorporated in the curriculum to support student success. The book Chip War is available as an eBook with free access via the Rio Library, and its content is being added to MNT110. See Section XI.c. for an action plan to create a specialized resource guide for students in Semiconductor Manufacturing that includes job descriptions, career exploration, and math and science skill tutorials.

XI. Program Recommendations, Decisions, and Action Plans

a. Program Best Practices

Best Practice #1 The program was built using resources and curriculum with direct input from industry and other college partners with the Advanced Technology Education (ATE) community.

Best Practice #2 The program has carefully analyzed activities with industry for the pieces that must be hands-on and the pieces that can be enhanced through the use of virtual reality, augmented reality, extended reality, and artificial intelligence. It is through hybridization that scaling of technician training will be able to meet our future workforce needs

Best Practice #3 The program is continuously listening and adapting to the needs of industry and students. The program evolves to work with different types of cohorts of students. While this is sometimes at odds with the pace of traditional educational course development, it is necessary for a diverse workforce.

b. Program Viability

Historical enrollment patterns do not accurately reflect the current vibrant status of the nanotechnology program and the semiconductor manufacturing job market. The program has anticipated the growth of the sector, and Rio is strategically positioned in this space. As the Vice President of Academic Affairs recently said, “there is a true ecosystem of semiconductor training here in Tempe” that can be credited to Rio Salado College. Close to $700,000 has been secured in federal grants, with another $1 million in development. Partnerships have been fostered with TSMC, Intel, NXP, TEL, WGNStar, Edwards, UofA, ASU, NAU, and many others. The program has been invited to present to Congressional committees, to the NSF, and has been featured on numerous media outlets. Enrollment in the Fall (2024) is already at 13 veterans (non-credit but eligible for credit for prior learning), 13 in the IET cohort, and 11 additional students in the entry level MNT110 credit class. The program is thriving, viable, a role-model for others, and looking to the future.

In August of 2024, the Taiwan Semiconductor Manufacturing Company (TSMC) provided the following up-to-date information on open positions in the field:

Role	# of Openings	Salary Range
Construction Technician	5	$30.50-$54.11/hr
E-Beam Operation Manufacturing Technician	60	$23.98-$26.60/hr
Equipment Technician	30	$25-$54/hr
Manufacturing Technician	40	$22.17-$24.24/hr
Process Technician	20	$24-$31.50/hr
Facilities Technician	26	$30.50-$50.50

c. Action Plans

The following PDCA cycle is designed to address the achievement gap noted in Section V.

Plan: (Fall 2024) Write new unique questions for a shorter, more focused, final exam. Create an ungraded review exercise for the students. Map the new final exam questions to the program learning outcomes.

Do: (Spring 2025) Deploy changes to MNT201.

Check: (Fall 2026) Pull assessment results for AY2025-26.

Act: (Fall 2026) Disseminate results. Initiate new PDCA if data still does not meet the target of at least 80% of students performing at college level.

Additional action plans include:

- Create an academic resource guide for students in Semiconductor Manufacturing that includes job descriptions, career exploration, and math and science skill tutorials. According to the Library Co-Chair, this will be the "first guide to build" assignment for the new Library Instructional Coordinator. As that position is currently being filled, the anticipated rollout is spring 2025.
- Complete new ATE grant proposal by October 2024 deadline.
- Discuss Microcredential pathway with Mesa by September 5, 2024.
- Visit Tempe Union High School District Engineering CTE Advisory Board for additional Outreach by January 2025.
- The curriculum is currently aligned with ASTM certification standards. New information from industry suggests a different skill set is required from technicians. Revise the curriculum again to adapt to these new skill sets and align to the MNT-EC BILT standards by May 2025.
- Disseminate findings from Future of Work vocational training models during November 2024 International Education month.
- Pilot alternative delivery models such as in-person or hybrid cohorts or limited starts to effectively attract target populations, retain students, and scale lab experiences.
- Market Honors section of MNT201 to increase enrollment. Activities include: Outreach to High schools, flyers, class visits, and academic advisors. Specialized recruitment for Presidents' Scholars. We are also working with Chandler Unified School District who is starting a CTE program.

d. Assessment Team Recommendation

X Continue program and implement stated action plan. Next review due 2028-29.

□ Continue program, implement stated action plan, and address comments listed below. Spotlight follow-up report due {1-2 years}.

□ Refer to college administration to determine program viability.

□ Discontinue program.

Comments: