Evaluation Report of the Amplifying Montana's Advanced Manufacturing and Innovation Industry (AMAMII) Project

Final Report

Prepared under contract to
Flathead Valley Community College
Kalispell, MT

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RTI INTERNATIONAL

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Executive Summary

Flathead Valley Community College (FVCC) was awarded a Federal Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant in fall 2012. FVCC's project, Amplifying Montana's Advanced Manufacturing and Innovation and Industry (AMAMII), centers on meeting the needs of the nearly 600 local manufacturing businesses operating in northwest Montana while addressing the projected substantial regional job growth in the industry.

AMAMII has responded to student and employer needs in manufacturing through the use of four specific high-leverage strategies: accelerating the pace of learning, providing comprehensive support services, improving the alignment of training and workforce demands, and strengthening the channel for low-skilled workers to enter college. Collectively, these strategies have demonstrated significant positive impacts on learning and employment outcomes for low-skilled workers. AMAMII incorporates these strategies through the following five priority activities:

Advanced Manufacturing Program: Create, augment, and approve the curriculum necessary to implement latticed advanced manufacturing certificate programs; procure equipment and supplies; and address necessary facility renovations.

Workforce Navigators: Use workforce navigators (WFNs) as liaisons between FVCC and public workforce development system partners.

Developmental Math: Contextualize and compress developmental mathematics courses by adopting a technology-enabled, evidence-based "emporium" model and math lab space that will help reduce time-to-completion for students.

Entrepreneurship Training: Create and approve the curriculum necessary to implement stackable entrepreneurship courses aimed at increasing student entrepreneurial capacity and expanding existing business growth capacity to catalyze job growth.

National Career Readiness Certificate: Launch the regional workforce system adoption of the National Career Readiness Certificate (NCRC): WorkKeys® assessments and associated KeyTrain® training program in collaboration with the Spokane Workforce Development Center to create the bottom element in a stackable certificate lattice.

Evaluation Design

This evaluation was designed to address the following questions:

Impact Evaluation Question and Design

- Does student performance provide evidence for the effectiveness of the AMAMII model?

Implementation Questions

- How were programs and program design improved or expanded using grant funds? How do they reflect core elements?
- Have articulation agreements led to greater acquisition of total credits/completion rates?
- How does the work of workforce navigators affect student outcomes?
- What impact does the establishment of a technology-enabled, evidence-based "emporium" model and math lab space have on student outcomes?
- Does the National Career Readiness Credential factor into employers' hiring?

Systemic Evaluation Questions

- How effective are the recruitment procedures in identifying participants who have the potential to complete the program?
- What impact does the Entrepreneurship Center have on the development of jobs and job markets?
- What contributions did each of the partners make? What factors contributed to partners' involvement or lack of involvement in the program? Which contributions from partners were most critical to the success of the grant program? Which contributions from partners had less of an impact?

To address these questions, RTI International developed a mixed-methods evaluation design that included analysis of student outcomes data and survey and interview data. The original study design proposed a quantitative impact analysis of educational (credential attainment) and workforce (employment status and wages) outcomes for students in the other AMAMII program area, advanced manufacturing. However, the number of students who had completed an advanced manufacturing program by spring 2016 was 60[1], which is too small to support an analysis. Moreover, the employment and wage data provided to the evaluation

[1] This includes the total number of students earning certificates of at least one tier.

team did not include a student-level identifier that would allow the data to be matched to programmatic data.

To assess the impact of the AMAMII program's redesign of FVCC's foundational math program (discussed in the implementation findings section above), the evaluation team conducted a cohort comparison of math outcomes between students who enrolled in foundational math before (comparison group students) and after (AMAMII students) the implementation of the new program. The analysis used a propensity-score based weighting strategy to equate the demographic and enrollment characteristics of these two groups of students.

To understand and assess implementation, RTI conducted multiple site visits and administered student surveys to assess student perception of the advanced manufacturing programs and of the foundational math redesign.

Implementation Findings

- AMAMII met its curricular and programmatic implementation goals: FVCC created two Associate of Applied Science (AAS) programs (machining and electronics) and one Certificate of Advanced Study (CAS) program (industrial maintenance), a two-semester firearms technology certificate, and 29 new classes. A new classroom, workshop, and office space were built in spring 2013, as well as the largest machining training facility in Montana.
- AMAMII created the WFN position which has been slightly modified for implementation in two successive TAACCT grants. The WFN acts as a advisor who can help students meet programmatic and college requirements, such as accessing financial aid. The navigator is also proactive and able to identify and focus efforts on those students who need the most support. The position has been well received by students.
- While AMAMII met its implementation goals related to developing entrepreneurship programs and a curriculum, student enrollment was lower than expected. AMAMII is continuing to integrate the entrepreneurship curriculum into its current business courses. A key goal is to develop a capstone course for trade programs that will help students learn how to develop their own businesses. This capstone course was piloted in the culinary arts program in 2015. Given that over half of advanced manufacturing students reported that they have plans to, or already run, their own businesses, this course may meet students' needs.

- AMAMII administered 307 NCRC tests. Students felt that the tests were useful but did not report their results to employers. A few employers were interested in using the test, but most felt that it was not necessary for their needs.

Participant Impact and Outcomes

The data used for the analysis were provided by the FVCC's institutional research department. There is data on 6,332 students who enrolled in FVCC from fall 2009 to spring 2016, and data on foundational math course taking exists for 3,035 of those students. The analysis is restricted to two years following students' program entry to allow sufficient time for each student to complete his or her foundational math sequence and to complete one or more college-level math courses. The analytical sample therefore excludes students who were enrolled after winter 2015 and, to avoid treatment contamination, between winter 2012 and summer 2013 (inclusive) to exclude students who took foundational math courses both before and after the new program was implemented. As a result, the final study sample consists of 1,944 students. While about 69 percent of the students took the foundational math courses prior to the fall 2013 implementation (n = 1,333), 31 percent took foundational math courses after implementation (n = 611).

In terms of outcomes, about 43 percent of all students in the sample completed their foundational math sequence, and 20 percent took and passed a college-level math course (table 2). A higher proportion of AMAMII (46 percent) versus comparison (41 percent) students completed their foundational math sequence, and a small percentage repeated one or more foundational math courses (11 versus 15 percent).

To estimate the causal effects of the redesigned foundational math course and to remove potential differences in demographic and enrollment characteristics between AMAMII and comparison groups, the analysis uses a propensity-score based weighting method, marginal mean weighting through stratification. The analysis starts with a stepwise logistic regression and selects demographic and enrollment variables that predict any of the outcomes.

The results did not reveal significant differences between AMAMII and comparison students for most of the outcomes, with the exception that AMAMII students on average accumulated fewer credits over the two-year time frame ($p<.0001$). Although the remaining observed differences are not statistically significant, the point estimates show that compared to comparison group students, AMAMII students might be more likely to complete their foundational math course sequence ($p=.12$) and may be less likely to repeat one or more foundational math courses ($p=.06$). The average cumulative GPA of AMAMII students was slightly higher than that found for comparison group students ($p=.08$). The results suggest that the two groups had similar likelihoods of taking college-level math courses ($p>.5$),

passing the courses (p>.5), and completing their degree within the first two years of enrollment (p>.5).

As is the case with all studies of this type, the results should be considered in light of a number of limitations, some of which may be addressed once additional data are available should FVCC be interested in expanding this analysis. Chief among these limitations is the program implementation time frame, the limited observation time of program effects and smaller number of AMAMII students, and an oversimplified picture of student degree completion status.

Conclusions

The role of the workforce navigator

The WFN was a key innovation in the AMAMII project that has been built upon in the cohort III and IV TAACCCT grants in Montana. The WFN is a flexible position that has multiple roles—recruitment, student support, and job placement support. Key to the position is its integration with students and faculty from specific programs. The WFN is able to become an expert in the program and, through increased opportunity to build relationships with students, is more likely to be able to help students with program-specific questions, from courses through job placement. Through a physical presence in the trades department, the WFN can build relationships with faculty and offer drop-in services for students.

Sustainability

FVCC opened the Center for Manufacturing Advancement (CMA) in 2015, building off its AMAMII curricular accomplishments and the redesign and expansion of its shop space. Its goal is to help strengthen and support the growth of manufacturers in Northwest Montana by addressing the needs of industry leaders and identifying training and educational needs to bolster workforce preparation and promote manufacturing careers. As designed, the CMA has a dual role: to serve (1) as an access point for local manufacturers to access information and resources and (2) as a resource for students to expand their exploration and awareness of opportunities in manufacturing.

Introduction

Flathead Valley Community College (FVCC) was awarded a Federal Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant in fall 2012. FVCC's project, Amplifying Montana's Advanced Manufacturing and Innovation and Industry (AMAMII), centers on meeting the needs of the nearly 600 local manufacturing businesses operating in northwest Montana while addressing the projected substantial regional job growth in the industry over the next few years. Under this grant, RTI International is conducting an evaluation of AMAMII.

Northwest Montana has a burgeoning advanced manufacturing industry cluster, including large wood-products manufacturers, technology-oriented manufacturers, and a number of newer entrepreneurial start-ups, particularly a growing group of gun manufacturers. All of these advanced manufacturing businesses have expressed difficulty in filling positions locally with qualified workers who have the skills needed to excel in these positions. On the one hand, large employers have identified a lack of sufficient soft-skills development in their entry-level employees, challenged specifically with independent problem solving and effective team-working. On the other hand, local training programs lack sufficient machining and industrial-maintenance emphases to meet employers' specific technical needs. The end result is high turnover in entry-level positions and significant expenditure in recruiting out-of-state talent into upper-level positions. Neither of these trends helps alleviate the unemployment rate in northwest Montana, which has exceeded 10 percent for the last three years, peaking at 18 percent in Lincoln County in 2011.[2]

AMAMII has responded to student and employer needs in manufacturing through the use of four specific high-leverage strategies: accelerating the pace of learning, providing comprehensive support services, improving the alignment of training and workforce demands; and strengthening the channel for low-skilled workers to enter college. Collectively, these strategies have demonstrated significant positive impacts on learning and employment outcomes for low-skilled workers. AMAMII incorporates these strategies through five priority activities: (1) creating latticed and connected short-term certificate programs in advanced manufacturing; (2) adopting the National Career Readiness Certificate (NCRC) assessment; (3) initiating the use of workforce navigators (WFNs) to better strategically align the college and public workforce development system partners; (4) transitioning to a technology-enabled model of developmental mathematics, and (5) strengthening entrepreneurship training to encourage growth of the region's small manufacturing cluster to catalyze job growth.

[2] According to the FVCC TAACCCT proposal.

This report provides details and insights on the efforts and progress made by FVCC from 2012 to 2016. During this period, the evaluation team conducted in-depth site visits and regular telephone interviews with key staff, as well as interviews with local employers and stakeholders engaged in the AMAMII initiative; reviewed various reports and other documents describing the project; surveyed students; and observed classes. Within this report are implementation findings, participant outcomes, and accomplishments and lessons learned.

Implementation Study

Site Visit Methodology

RTI conducted three in-person site visits to FVCC. During these two-day visits, the evaluation team interviewed staff, faculty, and students involved with the AMAMII project and toured the advanced manufacturing facility. Table 1 lists the interviewees' roles and the type of interviews in which they participated during the spring 2013, fall 2014, and spring 2016 visits. The interviews focused on the following themes related to the project's implementation:

- Program design
- Curriculum
- Student support services
- Pedagogy
- Partnerships
- Outcomes
- Sustainability
- Lessons learned to date
- Challenges to date

Table 1: List of interviewees and type of interview during site visits

Role	Type of Interview	Spring 2013	Fall 2014	Spring 2016
Advanced manufacturing outreach and business marketing	Individual	X	X	--
Advanced manufacturing instructors	Focus group	X	X	X
Advanced manufacturing specialist	Individual	X	X	X
Advanced manufacturing students	Focus group	20 students	3 students	--
Career development coordinator	Individual	X	--	--
Dean of student services	Individual	X	X	X
Director of programs in occupational trades	Individual	X	X	X
Director of institutional research	Individual	X	--	--
Employers[1]	Individual	--	X	X
Entrepreneurship specialist	Individual	X	X	X
Faculty, "thinkering" class	Two instructors	X	--	--
Federal grants coordinator	Individual	--	X	--
Foundational center coordinator	Individual	X	X	X
Grant program director	Individual	X	X	X
Math department faculty	Focus group	X	X	X
Math students	Focus group	3 students	3 students	4 students
Online curriculum specialist	Individual	--	X	X
Workforce navigators	Two navigators	X	X	X

[1]Fall 2015 interviews were conducted by phone

Student Surveys

RTI developed two surveys to solicit feedback from students on AMAMII activities. Appendix A provides an in-depth discussion of survey methodologies.

1. The FVCC Certificate Survey, a 50-item questionnaire, was designed to collect information from participating students in the advanced manufacturing programs regarding their beliefs and attitudes toward their coursework, skills, and employability, as well as to better understand their experiences with WFNs and the NCRC. The goal of the survey was to highlight findings and identify areas of strength and areas in need of improvement within the advanced manufacturing program. This survey was piloted in 2014 and administered in 2014 and 2015.

2. The FVCC Foundational Math Survey, an 18-item survey asking students to provide feedback on their experiences with the redesigned foundational math courses and sequence.

Implementation Report

This section of the report provides an update on the progress of implementation of each of the five main project activities as described in the AMAMII proposal.[3] These project areas are as follows:

Advanced Manufacturing Program: Create, augment, and approve the curriculum necessary to implement latticed advanced manufacturing certificate programs; procure equipment and supplies; and address necessary facility renovations.

Workforce Navigators: Use WFNs as liaisons between FVCC and public workforce development system partners.

Developmental Math: Contextualize and compress developmental mathematics courses by adopting a technology-enabled, evidence-based "emporium" model and math lab space that will help reduce time-to-completion for students.

Entrepreneurship Training: Create and approve the curriculum necessary to implement stackable entrepreneurship courses aimed at increasing student entrepreneurial capacity and expanding existing business growth capacity to catalyze job growth.

National Career Readiness Certificate: Launch regional workforce system adoption of the NCRC: WorkKeys® assessments and associated KeyTrain® training program in collaboration with the Spokane Workforce Development Center to create the bottom element in a stackable certificate lattice.

[3] AMAMII grant proposal project work plan, pages 22–24.

Advanced Manufacturing

Create, augment, and approve the curriculum necessary to implement latticed advanced manufacturing certificate programs; procure equipment and supplies; and address necessary facility renovations.

Stacked and Latticed Credentials

The key element of the AMAMII program is the creation of latticed and stackable certificate programs in the advanced manufacturing industry. FVCC looked to a TAACCCT Round I grant recipient (the Center of Excellence for Aerospace and Advanced Materials Manufacturing in Spokane, Washington) for guidance on the development of the structure of its advanced manufacturing credentials. The AMAMII stackable certificate program is a systemic workforce development framework, developed by employers and FVCC to ensure that education and training programs prepare students for skilled jobs in demand by employers. The stackable credentials are designed to allow students to achieve levels of competency within one semester depending on their skill levels and academic direction.

The development of the credentials, specific classes, and learning objectives for each class began with outreach to business partners. The advanced manufacturing stackable credentials were designed with extensive input from community manufacturers to enhance the local workforce market. Over 20 businesses participated in discussions aimed at identifying the key skills and competencies needed in the local workforce. They also provided program design feedback through hands-on design of training programs and curriculum tracks that would effectively address the voids in the local workforce and established goals for individual programs. In addition, FVCC learned that businesses were interested in machining graduates who could work in programming and set-up, not just operation.

One of the challenges FVCC is responding to is that manufacturers are not likely to train their employees or, in cases where there is training, the qualified workers jump from company to company to accept higher positions. Another challenge is that manufacturers want employees who had been trained to use the machines and had significant service time operating them. To that end, FVCC used grant money to buy up-to-date Computer Numerical Control (CNC) mill and lathe machines that meet current industry standards.

Initially, FVCC created a Level 1common to all the advanced manufacturing programs but found that the programs needed to be individualized to each track and now offer 3 distinct Tier I Certificates: Electronics Technician, Machinist Technician, and Industrial Maintenance Technology. Students take specific technical prerequisite courses though they also take three common courses: math, communications, and interactions.

FVCC also began with a fourth track in manufacturing management. During the development of the program, the manufacturing management track was not continued. The entrepreneurship program attempted to address the management training. Each track has multiple levels of skill attainment. Level II provides entry-level skills for each industry, while Level III provides advanced skills. Level IV is designed as a capstone semester.

Students earn a one-semester Certificate of Technical Science after completion of Tier I, a two-semester Certificate of Applied Science after Tier II; or a two-year Associate of Applied Science degree after Tier IV.

A unique feature of the newly approved AAS degree for Industrial Maintenance Technology is that a student who has a year of electronics, machining, or welding fabrication may enter the second year of Industrial Maintenance and graduate with an AAS in two semesters, just as if the student had started in industrial maintenance rather than one of the other three programs. FVCC currently has 3 students in the second year of industrial maintenance.

The AMAMII project has met almost all of its implementation milestones related to advanced manufacturing, including

- developing and enhancing 29 classes;
- creating three AAS programs (machining, electronics, and industrial maintenance technology) and one CAS program (industrial maintenance);
- developing Tier I- to Tier IV-level certificates;
- developing a new firearms technology two-semester certificate;
- launching an AAS degree program in welding technology: fabrication option; and
- building, at FVCC, the largest machining training facility in Montana.

Student Perspectives

Students had very positive experiences with the new advanced manufacturing programs. They found the coursework to be challenging and their skills greatly improved (table 2).

Table 2: Students ratings on the level of challenging coursework and their improvement in skills (scale: 1 = not challenging at all; 2 = somewhat challenging; 3 = very challenging)

	2015	2016
How challenging has the coursework been?	2.4	2.3
Experience gaining or improving technical skills in the program classes?	2.9	2.8
Number of respondents	23	53

Source: FVCC Certificate Survey, 2015 and 2016

Students also generally felt prepared, although student graduates in 2015 reported feeling more prepared than did students who earned an AAS degree in 2016 (table 3).

Table 3: How prepared machining students felt they were for a high-skill, high-wage job with their current skills, by current stage (scale: 1 = need a lot more preparation, 2 = need a little bit more preparation, 3 = fairly prepared, 4 = fully prepared)

Current Stage of Program	2015	2016
I earned an AAS	3.7	2.8
Earned 1 or more certificates from Flathead Valley Community College	2.4	2.3
Earned 1 or more industry credentials	3.0	2.8
No degrees, certificates, or credentials	2.0	2.6
Number of respondents	18	27

Source: FVCC Certificate Survey, 2015 and 2016

Firearms Technology Program

The firearms technology program will begin its third year in fall 2016 and is expected to continue as currently structured for at least another year. The faculty lead will develop a second year for the current two-semester program; there is some thought that the program might offer two certificates or become a two-year degree program.

This past year, the program lost students due to personal issues; while the program can hold up to 16 students, it currently has 13. All of the students in the program have had some involvement in the FVCC machining program; the firearms program requires that students be able to run a manual machine. All of the current students want a position in manufacturing after graduation.

Since starting, the program has changed in minor ways to suit students' learning styles and progress. Because students could not demonstrate good working knowledge of the curriculum of the material at the end of the year, the program is now much more hands-on than it was initially. One challenge is that students, even though they met the course prerequisites, may not have retained the information they were taught, such as precision measuring or print reading, which are basic skills for the field. According to the firearms instructor, sometimes students who come through the machining program have not been exposed to everything they should be, such as experience using certain materials (e.g., students learn how to handle aluminum because it is often preferred by instructors, being easier on the machines, but students also need experience working with steel). Such shortcomings may result in students not fully prepared for employment.

The instructor has contact with the firearms trade in the area: employers were involved in the program's initial steering committee and the program was developed based on their comments. FVCC offered a short-term, noncredit National Rifle Association (NRA)

program in the summer in which one or two employers participated. The NRA program was one way to make employers aware of AMAMII, however, it will not be offered in the coming year.

Equipment and Lab Space

AMAMII acquired more equipment, which has allowed faculty to teach current job-required skills and expand the number of students who can participate in the program. FVCC now has two bays for machining and the largest manufacturing training facility in Montana.

Summary

Table 4 shows the milestones as proposed in the AMAMII application and short status descriptions on their implementation.

Table 4: Progress on advanced manufacturing milestones

Year 1 2012–13	Status
Hire faculty to assist in curriculum development and implementation and delivery of the program	Completed: Hired advanced manufacturing specialist; hired adjuncts as necessary (i.e., electronics level 2 class)
Procure necessary new equipment	➢ Completed: Acquired new mills, lathes, and electronic equipment (simulators) in fall 2014. Built the largest machining training facility in Montana, at Flathead Valley Community College. ➢ Companies have begun donating equipment.
Formalize coordination of advanced manufacturing advisory committee	Developed quarterly newsletters and participated in the process of developing courses
In conjunction with the advisory committee, create and gain approval of new and augmented curriculum	Curriculum for 2-year degrees in electronics and machining approved in 2012
Renovate classroom space to accommodate new faculty, equipment, and supplies	Completed: New classroom, workshop, and office space completed in spring 2013
Market to/recruit students into certificate programs; first cohort enters training program in spring 2013	Completed: First cohort, spring 2013, 14 students. Second cohort, fall 2014, 45 students. Third cohort, fall 2015, 45 students. There are 91 unique certificate seekers in total.
Deliverable: Curriculum and course descriptions for roughly 11 new courses and 11 augmented courses (6.30.13)	29 new classes created and implemented.
Deliverable: 11 new stackable certificate programs approved (4.1.13) in the Montana University System	➢ Created two AAS programs (machining and electronics) and one CAS program (industrial maintenance). • Tiers I to III offered in 2013–14 • Tier IV offered in spring 2015 ➢ New firearms technology two-semester certificate developed and offered beginning fall 2014 ➢ Entrepreneurship certificate offered fall 2014

Year 1 2012–13	Status
Formalize three articulation agreements with MUS transfer colleges	The AMAMII stackable certificates do not lend themselves to articulation agreements, as the course requirements differ greatly from that needed to transfer to colleges and the goal of the program is to provide easy entry and exit for students to develop their skills and move in and out of the workforce. The stackable certificates can be used as a career ladder to a transfer program, as happened with one student in the past year.
First student cohorts placed in jobs in industry.	Completed.
Deliverable: in MUS system; assessment report of retention and completion rates for certificate programs versus traditional academic tracks (6.30.15)	RTI working with Flathead Valley Community College to collect and analyze data.

Workforce Navigators

Use workforce navigators as liaisons between FVCC and public workforce development system partners.

Role of the Workforce Navigator

Workforce navigators (WFNs) play a key role in the AMAMII project. They are expected to recruit people (specifically, those eligible for Trade Adjustment Assistance and the un- and underemployed), provide job development and placement assistance, advise students academically, and coach participants. Incoming students with an interest in advanced manufacturing will be assigned a WFN as their advisor. WFNs are academic counselors but also act as career counselors (similar to what Job Services does). According to the job description,

> the Navigator/Advisor is responsible for advising students in [career and technical education] CTE programs and in particular the Occupational Trades Programs, developing internship sites and placing students, conducting industry outreach and job placement, and administering the National Career Readiness Certificate and other assessments. This position will work in collaboration with other AMAMII partners (in particular Job Service and Community Action Partnership), CTE faculty and staff, FVCC Learning Center staff, and other Navigator/Advisor(s), to develop and enhance recruitment and retention activities in advanced manufacturing and other CTE programs, design internship opportunities that meet student and industry needs, and create opportunities for career matching between students and employers.

Because of the similarity of duties between this position and Job Services staff, and because Job Services was not actively involved in the grant proposal process, FVCC worked with Job Services to refine the position, making sure it fit with that department. Two WFNs began the grant co-located in the Job Services office and the occupational trades building, which also houses advanced manufacturing, and a third WFN, who left in spring 2016, was located at a satellite campus. One WFN accepted a job with the FVCC advising department mid-grant; the other WFN remained and ultimately also accepted similar responsibilities for the TAACCCT III and TRIO[4] grants.

[4] Federal outreach and student services programs designed to identify and provide services for individuals from disadvantaged backgrounds.

Recruitment and Student Support Services

WFNs were to assess students' academic and personal needs and barriers to determine appropriate support services to be provided by FVCC and outside agencies, identify resources for students (including tutoring and other services that increase success in education and training), and administer and proctor competency assessments using the NCRC.

Initially, the WFNs worked with Job Services for recruitment, but by the end of the project the remaining WFN had a more limited role with student recruiting, following up with potential students who had reached out to him (typically directed to him by another college office) and who did not end up enrolling right away. The WFN continued to follow up with these potential students: he made six contacts over two years with one person before that person enrolled. Some recruitment activities were curtailed as this position was spread across three grants. When students were asked how they learned about the advanced manufacturing program, over 50 percent reported speaking with an FVCC advisor or WFN (the most common response), while approximately 10 percent learned about it through Job Services (the fourth most common response).[5]

The WFN has multiple responsibilities for providing student support. According to advanced manufacturing faculty, "[The WFN] is instrumental in working with the students one-on-one and very aware of where they are at." According to the WFN, there are "lots of services available on campus and in the community but the challenge is finding out what students need; what they are eligible for, and how the student can best access those services." To that end, the WFN developed a survey of student service needs that students will take when they enroll in the college; this survey will be piloted in fall 2016. Students will be required to complete the survey prior to their first meeting with an advisor, and the information will be entered into the student administrative record system.

The WFN feels that social services are not coordinated and are difficult to figure out. The WFN wants to administer a survey to agencies that offer social services in the area that captures information on the types of services, who is eligible for services, and who to contact for services. This information would be tracked in a database and shared with other individuals working with students on campus. This survey has not yet received approval.

[5] These findings are based upon the FVCC Certificate survey administered by RTI in spring 2015 and 2016.

Student Perspectives

When students were asked how timely WFNs were in responding to students' needs, the majority reported that WFNs always, or almost always, responded in a timely manner. No students reported that WFNs rarely or never responded in a timely manner (table 5).

Table 5: How often the workforce navigators responded to students in a timely manner

	Percent (2015) *N* = 24	Percent (2016) *N* = 51
Almost or almost always	78%	88%
Usually	9%	10%
Sometimes	9%	0%
Rarely or never	0%	2%
I never had questions or needed advice	4%	0%

Source: FVCC Certificate Survey, 2015 and 2016

Students reported that WFNs usually, almost, or almost always addressed their questions sufficiently (93 percent) and that the support they received from WFNs was extremely or somewhat useful (94 percent).

In interviews, students have responded positively about the role of the WFN, noting that the position has helped them negotiate college requirements. As one student wrote,

> the best advice I have would be to try and free up more time to socialize with students in order to get a better understanding of each individuals' needs. Many of the students in these programs simply do not trust the advisers because of the lack of face time with them.

Sustainability

According to FVCC's president, the WFN, through individualized attention to students, has been instrumental in helping students persist and complete the program. She hopes to integrate the WFNs into the college's advising program so that individual advisors will be liaisons to particular areas, such as science, technology, engineering, and mathematics (STEM) and the trades. This would also allow the advisors to connect more deeply with the faculty.

Summary

The AMAMII project has met almost all of its implementation milestones related to the WFN position (table 6).

Table 6: Progress on workforce navigator milestones

Year 1 2012–13	Status
Hire three workforce navigators (two for Flathead County, one for Lincoln County)	Completed: Hired in spring 2013. One left and was hired by the Flathead Valley Community College academic advising department in fall 2014; the satellite navigator left in spring 2016. The remaining navigator is currently also supported by the TAACCCT IV and TRIO grants.
Provide comprehensive systems training	Completed: Done upon hiring.
Provide professional development on implementation of WorkKeys® and KeyTrain® tools	Completed: Trained on National Career Readiness Certificate system and implementing it. Not using WorkKeys®.
Assess at least 166 workers annually	307 assessments were completed.
Initiate scheduling of career counseling and enrollment services with incumbent workers, those who are eligible for Trade Adjustment Assistance, and the unemployed, including development of comprehensive cross-agency intake forms.	Completed: Developed intake forms in spring 2013; developed Access database in summer 2013 to track information; navigators meet with students to do the counseling (all students eligible for and advanced manufacturing certificate are assigned a navigator)
Deliverable: Custom project intake forms that provide sufficient information to fulfill funding and training enrollment needs and assessment of potential prior learning credits (4.1.13)	Completed: Developed and stored in Access database.

According to the WFN, the position differs from current support positions in that the WFN (1) is more accessible to students, being located in the occupational trades building, and is able to offer drop-in services, rather than requiring appointments as other positions do; (2) uses a student success plan to help students figure out what courses to take and when, which helps them plan ahead for the courses they need; (3) and developed a tracking system to identify students that needed extra attention because the WFN does not have time to work with every student intensively. While the students have a faculty advisor, the WFN acts as a secondary advisor who can help with meeting programmatic and college requirements, such as accessing financial aid. The WFN reported that in addition to helping students develop their course plans, he helps them find remedial education classes or supports (such as using free adult basic education classes) and helps them with financial aid. Additionally, the WFN is a key pipeline to sharing student concerns with program faculty and has worked with staff to implement a number of changes. For example, the welding programs used to have two separate tracks, and students would have to choose one to pursue before they understood the difference. They would often switch, miss a prerequisite as a result, and then fall behind. The WFN recommended that the first semester be the same for both tracks, so that students did not have to make the decision upon enrollment.

Foundational Mathematics Curriculum

Contextualize and compress developmental mathematics courses by adopting a technology-enabled, evidence-based "emporium" model and math lab space that will help reduce time-to-completion for students.

The third key component of the AMAMII project was to redevelop the FVCC foundational math curriculum. In the grant proposal, FVCC proposed moving toward an emporium model of foundational math and using the I-Best contextualized mathematics model. According to faculty, about 85 percent of incoming students place into foundational mathematics (FVCC currently uses the COMPASS test as a placement test). Changes in the foundational math curriculum would therefore have a major impact on almost all FVCC students.

Math faculty realized that the previous model of teaching math was not working—students were not succeeding at high enough levels. A boot camp instituted by math faculty had no effect on student outcomes. Many of the foundational math courses are taught by adjunct faculty, so instructional styles and content varied across instructors, as did student outcomes. FVCC math faculty had wanted to transition from the traditional didactic foundational math model but had never had the time or resources to do so. The department wanted to move towards a more interactive environment in the classroom, move away from lectures and tests, and standardize instruction across all faculty.

Foundational Math Sequence

FVCC developed and implemented a foundational math model, similar to an emporium model but, according to FVCC, its model differs from a traditional emporium model in three distinct ways: In an emporium model, the actual structure can vary depending on the needs and preferences of the school, but the vast majority of class time is spent in a math computer lab doing math problems using specialized software. Students receive immediate feedback from the software on whether or not they understand the math. In the FVCC foundational math model, students still receive traditional lectures in class, with the remaining days spent in the lab working on homework. The number of lectures varies depending on the level of foundational math and individual instructor preferences. Second, FVCC does not use any online lectures, although FVCC faculty members are working on creating some as supplements to the course material. Regardless, FVCC will not be "flipping the classroom." Finally, no points were initially tied to classroom attendance, although the faculty is considering changing this.

The faculty has revamped curriculum for the foundational math sequence (Math courses 61, 65, 90, and 95) and piloted the courses in fall 2012 (Math 61), spring 2013 (Math 61, 65, and 90, and fall 2013 (Math 95). The math sequence itself did not initially change. Instead, the

change has been in pedagogy, with some slight changes in content. This piloting has allowed faculty to continue to revise the content and pedagogy.

After the initial revamping and piloting, the sequence has undergone other changes. Math 61 was eliminated in spring 2016 because the class no longer an eligible class for financial aid. Math 65 will still use guided lecture and online homework but will be more independent than before. It will include some elements of Math 61 but will be more accelerated. Students are also encouraged to take adult basic education math, which is free.

Faculty members are now working on another sequence change in foundational math: They are developing two tracks—STEM and non-STEM—that have a similar format but new courses. The STEM track will include Math 90 and 95, and Math 95 is enhanced. Non-STEM students will complete Math 90 and the new Math 94. Math 94 emphasizes quantitative reasoning, has a lighter algebra focus, and prepares students better for probability and statistics. This revision is based on the idea that students need statistics, and Math 95 overprepares them for math they do not need, making them take another class and increasing the cost and potential for dropping out. After Math 94, students will likely advance to Math 115 (math and probability). This change aligns with the TAACCCT IV nursing and allied health grant, as nursing students, for example, would be best suited to enroll in the non-STEM track.

Pedagogical Changes

The new pedagogical approach combined a move away from predominantly lectures to the use of a new computer-based program that allows students to move at their own pace and that monitors their learning outcomes. Now, courses combine brief (20-minute) lectures with students working independently on hands-on exercises under the guidance of the professor and on the computer-based exercises during the remaining class time. Content is now in a book format developed by FVCC faculty and is already outlined so students do not have to take notes. Instead, the focus is on students working on the examples and problems. The activities are tied more tightly to objectives—students must demonstrate that they have accomplished certain objectives as part of their homework each week. Students found the level of interaction with the instructor to be the right amount,[6] as seen in table 7.

[6] See Appendix C: Math survey results, for a complete reporting of this survey.

Table 7: Percent of respondents who reported appropriate levels of interaction with their instructor, by current math class

	There is too much interaction with the instructor	There is just the right amount of interaction with the instructor	There should be more interaction with the instructor
M090	0	91	9
M095	3	95	3
Total	1	93	5

Source: FVCC Foundational Math Survey, 2016

The computer program chosen by faculty differs for each math class: Math 61 used ALEKS while Math 65 used Connectmath in fall 2012 and MathXL by Pearson in spring 2013. Each software package allows students to proceed at their own pace and provides faculty with a way to track student progress and achievement through the curriculum. The use of instruction software has standardized the curriculum and allowed motivated students to complete more than one level of foundational math in a single semester.

Faculty shifted to the use of MyMathLab in Math 90, 94, and 95. MyMathLab is similar to MathXL, which they used previously, but faculty members find the student performance archiving to be better, and the math book they use for Math 94 is not available for MathXL. MyMathLab is more expensive than MathXL, which was initially chosen to save on costs. However, with this latest change, they can offer students a more streamlined experience and can recover some costs because Math 90 and 95 use the same textbook. Students generally reported that the online program was easy to use (table 8).

Table 8: Percent of respondents who reported the ease or difficulty of online program, by current math class

	The online program is easy to use	The online program is mostly easy, but there are some things I have difficulty with
M090	58	42
M095	68	33
Total	63	37

Source: FVCC Foundational Math Survey, 2016

Students reported being comfortable working in different modalities, particularly with the instructor, although very few students reported that working with other students was how they best worked (table 9).

Table 9: Percent of respondents who reported how they work best, by current math class

	Working on the online program	Attending class and/or working with the instructor	Working with other students	Working in the foundational math lab
M090	39	30	3	27
M095	20	50	5	25
Total	29	41	4	26

Source: FVCC Foundational Math Survey, 2016

Foundational Math Lab

In addition to the changes in pedagogical approach, FVCC created a foundational math lab dedicated for use by these courses (there is a different math lab for college-level math courses). The math lab has 26 computers. Students are required to spend at least one hour each week in the lab, in addition to class time. In fall 2013, the foundational math lab moved to a room devoted to it, and with grant money, FVCC hired a foundation center coordinator, which allowed the lab to be open longer (currently math faculty staff the lab). With the new curriculum, testing has increased to every week. In this new instructional model, students do a lot more hands-on work, see more examples of each problem, and collaborate more with other students. Students find the foundational math lab to be very useful in supporting their learning, as seen in table 10, with 78 percent reporting the lab was either essential or useful, and an additional 14 percent reporting the lab was somewhat useful. In interviews with students, most found the lab and the tutoring very useful. One student reported not needing the lab to pass the courses and difficulty in attending the lab, so having lab hours as a requirement of the course was challenging.

Table 10: Percent of respondents who reported on the usefulness of the foundational math lab tutoring

Essential - I would not pass the class without it	29
Useful - It helps me learn some of the things I didn't quite get in class	49
Somewhat useful - I rarely spend more than the required amount of time in the foundational math lab	14
Not useful - I don't feel that I need tutoring	7
Not useful - it is difficult to get help because it's too busy	1
Total	100

Source: FVCC Foundational Math Survey, 2016

Since opening the lab, the math faculty has continued to make small changes to enhance this resource. In addition to the lab coordinator, instructors staff the lab during high-demand times. Some instructors spend some office hours in the foundational math lab, as well. The faculty hired another part-time tutor to work in the lab 5–10 hours a week (initially for 10 hours but reduced to 5 because instructor office hours were added into the lab). The lab is now open longer on Tuesdays and Thursdays because the large number of students in the

lab during test times often caused crowding. However, the faculty noticed dead times in the lab, as well, so began offering Monday, Wednesday, and Friday classes in addition to Tuesday and Thursday classes, which helped spread out lab use more evenly. Table 11 shows student perspectives on math lab hours.

Table 11: Percent of respondents who reported on the accessibility of the foundational math lab

It is open the right amount of hours	71
It is open too few hours	7
It should be open earlier	7
It should be open later	15
Total	100

Source: FVCC Foundational Math Survey, 2016

Math Placement

Foundational math faculty members have examined best practices for math placement. They were previously supported by FVCC's institutional researcher and are now supported by an ad hoc Task Force for placement (which includes math faculty, the vice president [who was the institutional researcher but has recently left the college], and representatives for other departments, including academic advising, nursing, and chemistry). Faculty originally used the COMPASS test for placement, but the institutional researcher found that the use of high school grades was more effective for recent graduates. Currently, placement is made using an alternative math placement matrix for recent high school graduates. In fall 2016, faculty will transition to MyMath test (a Pearson product). The committee also explored EdReady, ALEX, and Mathsuite. It chose MyMath Test because (1) faculty members are able to set up the questions, (2) the product builds in a study plan if students get a placement they do not want, and (3) it resembles the Pearson products that they are used to. The alternative placement matrix is based upon whether students have had certain classes and grades in high school math, ACT scores, and GPA overall, though it only applies to students out of high school for up to two years. Faculty members recommend students use EdReady or the study plan in Mymath test to prepare for the test (or retest).

Of note, 82 percent of the students surveyed in spring 2016 thought that they were correctly placed, 8 percent had an override and did not enroll in the course they placed into, 7 percent thought the class was too easy, and only 3 percent thought the course they placed into was too difficult.

Faculty will test all students, at the end of the semester, in MyMath and COMPASS for six sections of college-level classes and all foundational students (approximately 350) in order to have correlations to COMPASS and to help set cut scores to pilot in the next year.

Technical Math

A final change to the math curriculum was the development of a technical math course that is required of advanced manufacturing students. Previous to AMAMII, there was a course that covered business and communications and math for the trades. There was a strong feeling among faculty that more emphasis on math skills was needed. The new course, Math 111, has a much stronger geometry element and more applied activities for manufacturing students. There is also a newly developed technical math course for electronics (Math 114), as those students need to have more math to succeed. For advanced electronics, students need to learn algebraic equations, matrices, and a little bit of calculus.

Video Capture

Math faculty members planned to produce a number of online videos, for their students, which were being edited during fall 2015. The faculty found the videos to be time consuming, though fun to make. The math lab coordinator has also compiled videos currently available online, such as those from Khan Academy, and created a reference of online videos that is shared with students, cross-referenced to subject.

Impact

Instructors reported that the TAACCCT grant gave them the opportunity to revise their foundational math courses, which they had wanted to do but did not previously have the time or resources to do. Through revising the curriculum, instructors reported a number of impacts on their work. For example, the intense collaboration necessary to revise the curriculum has helped build community among instructors. Full-time instructors report that they see adjuncts more and they now have offices near one another.

Instructors believe that students have been positively impacted. They report more student success in Math 90 and 95. They feel that students are happier, more engaged, and feel they have a support system, not just the support of an individual instructor. Because students can see different instructors (not just their own) in the math lab, as well as the math lab director and tutor, they can learn from multiple instructors and alleviate their math fears. Further, instructors believe there is more uniformity in course content, which is especially helpful with multiple adjuncts teaching courses. Students reported being very or somewhat prepared for the next math class (90 percent of Math 90 students and 96 percent of Math 95 students), as reported in table 12.

Table 12: Percent of respondents who feel prepared for the next math class, by current math class

	Very prepared	Somewhat prepared	Not very prepared	Not at all prepared
M090	48	42	6	3
M095	48	48	5	0
Total	48	45	5	1

Source: FVCC Foundational Math Survey, 2016

Summary

The AMAMII project has met almost all of its implementation milestones, including

- adopting software and curriculum design for two foundational math courses;
- creating a contextualized curriculum for Technical Math II for manufacturing students and a Technical Math II class for electronics students; and
- renovating, opening, and staffing a math lab.

Table 13 provides an overview of progress for the foundational mathematics program as compared to the stated project goals in the original proposal.

Table 13: Progress on foundational math milestones

Year 1 2012–13	Status
Adopt specific software and curriculum design for two developmental math courses	Completed: ALEKS and MathXL for Math 61 and 65. Math 61 has since been dropped from the courses offered. Currently using MyMathLab.
Create and approve contextualized curriculum for Technical Math II	Developed Math 111 and Technical Math 1, piloted before receiving this grant. Math 114 developed for electronics students.
Renovate and set up math lab	Completed: Opened in shared space in spring 2013 and in designated space in fall 2013.
Hire math lab coordinator and tutors	Completed: Hired in June 2013. Faculty act as tutors. Hired part-time tutor (5–10hours per week).
Implement first student cohort in two developmental math courses in spring semester	Completed.
Procure Lecture Capture	Currently developing and posting videos using Lightboard system.
Implement faculty professional development activities surrounding use of Lecture Capture	Faculty worked with curriculum developers to implement the best compatible video with the math software in use (ALEK, EdReady, MyMathLab). Faculty compiled cross-referenced list of videos from other sources that is currently online.
Schedule math lab facility staffing and hours of operation	Completed: Beginning fall 2013, the coordinator and faculty have shared staffing responsibilities.
Deliverable: Contextualized curriculum for Technical Math II (6.30.13)	Completed for Technical Math I (for manufacturing students) and II (for electronics students).
Deliverable: Supplemental curricular materials associated with delivery of emporium curriculum (6.30.13)	Completed: Developed textbook and homework assignments.

Year 1 2012–13	Status
Implement first student cohort in two other developmental math courses during fall semester	Completed.
Assess and revise strategy focusing on obtainment of educational outcomes	Completed: Yearly revisions done with implementing EdReady in 2015 to follow along with TAACCCT Round IV award (HealthCARE Montana).
Deliverable: Study of success/persistence/completion of emporium versus nonemporium students (1.15.14)	Completed.

Entrepreneurship Initiatives

Create and approve the curriculum necessary to implement stackable entrepreneurship courses aimed at increasing student entrepreneurial capacity and expanding existing business growth capacity to catalyze job growth.

FVCC has a two-pronged approach to developing students' entrepreneurship skills: the development of a for-credit certificate that is part of the stackable certificate program and the expansion of not-for-credit opportunities within the Center for Manufacturing Advancement.

Throughout the project, FVCC offered a range of entrepreneurship activities, beginning with the idea of offering a short-term certificate of entrepreneurship and a small business AA degree, in conjunction primarily with the business department, as well as noncredit entrepreneurship activities, such as an arts entrepreneurship program, supported by the Montana Arts Council (the Montana Artrepreneur Program), and another program in agriculture. FVCC used the Ice House Entrepreneurship Program, an online learning program that enables participants to learn from the experiences of successful real-world entrepreneurs. Ultimately, FVCC did not continue with Ice House because of costs, but also because it believed it could create an effective curriculum internally.

FVCC also offered a variety of other entrepreneurship opportunities, including

- a noncredit class, Innovation to Business, enrolling three students, which may not continue (to be decided by the continuing education program);
- Reality Check, a two-hour course offered by the Small Business Center to those with a business idea;
- a 16-hour class on profit mastery, focused on the financial aspects of business; and
- activities which engaged the community, such as start-up business weekend and the Maker Faire.

As FVCC already had a year-long certificate, its hope was to have a one-semester program. However, enrollment was low, and FVCC did not get the 8–10 people they needed to run the course well. FVCC, in consultation with the business program, removed the short-term certificate from the curriculum. (It also eliminated other low enrollment certificates.)

The entrepreneurship activities associated with the TAACCCT grant were proposed to be housed in the Continuing Education Center and supported by a grant-funded entrepreneurship coordinator who was hired in spring 2013 and who left the program near the end of the grant.

FVCC has also catalyzed the community by organizing exciting events, such as the start-up business weekend and the Maker Faire (approximately 600 people attended the most recent fair, including FVCC advanced manufacturing students). Jill Seigmund, the entrepreneurship coordinator, wrote about FVCC's involvement with the Maker Faire and its strong connection to entrepreneurship in the *Journal on Community College Entrepreneurship*.

The AMAMII project has met almost all of its implementation milestones for entrepreneurship, including

- developing and implementing an entrepreneurship curriculum and entrepreneurship activities and events; and
- developing a Center for Manufacturing Advancement—the only of its kind in Montana—that will support the sustainability of program changes. The center will work with employers, as there is a need for employers to have a central resource to be able to work together, which will help the economy of the valley.

Sustainability

Connie Hitchcock, the business department chair, wants to see more integration between the noncredit and academic sides. She believes that the AMAMII pilots have informed the business department's direction and have given them strong guidance in what does and does not work. Entrepreneurship will be integrated into other programs on campus. FVCC is redesigning the capstone course to be available to any program on campus. For example, in fall 2015 culinary arts offered an entrepreneurship capstone course that will continue next year. FVCC may use it as a model for trade programs since more than half of students who responded to the survey in each year believe they might start their own businesses (table 14).

Table 14: Percent of students who plan to start a business

	2015	2016
Already have my own business	13	2
Definitely plan to start my own business	17	16
Possibly will start my own business	30	35
Probably will not start my own business	22	20
Definitely will not start my own business	9	10
I have not thought about it	9	16
Number of respondents	23	49

Source: FVCC Certificate Survey, 2015 and 2016

Finally, FVCC is exploring whether to continue with its community events, such as the start-up business weekend and the Maker Faire. Staff members think the community will expect the college's support in these areas, and the Maker Faire will likely not occur without it.

Summary

Table 15 shows the milestones as proposed in the AMAMII application and short status descriptions on their implementation.

Table 15: Progress on entrepreneurship activity milestones

Year 1 2012–13	Status
Hire AMAMII entrepreneurship coordinator	Completed: spring 2013.
Augment three-course entrepreneurship core to avoid duplication and gain approval for Level I concentration	Completed: entrepreneurship certificate implemented in fall 2014. Will be a Business Innovation and Development certificate which includes six classes (17 credits). Four students completed the program.
Create noncredit Level II entrepreneurship curriculum	Conducting noncredit trainings: Ted festival, Ice House class, Reality Check workshop, Maker Faire. Decided not to create Level II due to low enrollment.
Perform small renovation surrounding collocate Montana Manufacturing Extension Center and Small Business Development Center into Flathead Valley Community College's continuing education department	Completed: spring 2013.
Conduct outreach to small manufacturing businesses	Completed: Multiple ways (navigators, advanced manufacturing outreach and business marketing, employer roundtables, skill panels), including development of new Center for Manufacturing Advancement. Hired staff to conduct outreach.
Offered professional development for faculty and entrepreneurship coordinator	Completed: Coordinator participated in National Career Readiness Certificate training and Ice House facilitation training in spring 2013.
Procure necessary curricular supports	Completed: Hired local experts to examine curriculum, received rights to use Ice House curriculum, worked with faculty development and assessment specialist who guided the process and helped align curriculum with accreditation needs. Five committees reviewed the program before receiving final approval from trustees. Moved from Ice House curriculum to new format developed by business faculty, local entrepreneurs, and the entrepreneur coordinator.
Deliverable: For-credit entrepreneurship curriculum Level I that can be added onto advanced manufacturing certificates and other academic degree programs (4.1.13)	Completed: marketed to advanced manufacturing students.
Deliverable: Noncredit entrepreneurship curriculum Level II that builds upon Level I curriculum for business operators (6.30.13)	Entrepreneurship certificate developed fall 2014.
Engage existing businesses in market research strategies to expand markets	Completed.
Assess the impacts of the above efforts (business growth and new jobs created)	Completed.
Deliverable: Study impact of entrepreneurship activities on individual business growth, development of new markets, and number of employees (1.15.14)	Conducted 20 market research reviews.

National Career Readiness Certificate

Launch regional workforce system adoption of the National Career Readiness Certificate: WorkKeys® assessments and associated KeyTrain® training program in collaboration with the Spokane Workforce Development Center to create the bottom element in a stackable certificate lattice.

The NCRC is an industry-recognized, portable, evidence-based credential that certifies essential skills needed for workplace success. Individuals can earn the NCRC by taking three WorkKeys® assessments: Applied Mathematics, Locating Information, and Reading for Information. WorkKeys assessments measure "real world" skills that employers believe are critical to job success. FVCC has become an auxiliary testing site to Spokane Community College and has the ability to administer the NCRC tests.

FVCC wanted to use the NCRC across systems in order to

1. help students meet employer requirements and be more marketable and hirable;
2. let students know what level they need to attain in order to get the jobs they want (i.e., if a manufacturer wants employees to score at the gold level, students would know to aim for that); and
3. encourage employers to send workers to FVCC for training.

Employers, in conversation with RTI, noted that they had had varied experiences with the NCRC, but all were interested and excited about its potential uses. One employer is now exploring the credential's potential for use as a preferred qualification in hiring. Another multi-state business had used it in at a different site where it did not work well. However, the business believes it was not marketed effectively and want to try it at a new location. A third employer noted that Boeing uses the NCRC exclusively. One employer wanted an entry-level skill assessment and noted that the NCRC was something that the U.S. Department of Labor would accept and that this assessment had the strongest national reputation.

FVCC originally proposed creating an NCRC coordinator position but has since split the responsibilities between the advanced manufacturing outreach and business marketing coordinator and the WFNs. Three hundred and seven people took at least one test.

- 171 individuals completed all three WorkKeys tests that make up the NCRC test.
- 161 individuals (94 percent of all test takers) were awarded an NCRC.
    - 10 people's scores were too low to qualify for a certificate (6 percent)
    - 24 people were awarded a Bronze certificate (15 percent)
    - 90 people were awarded a Silver certificate (56 percent)
    - 47 people were awarded a Gold certificate (29 percent)

  - 0 people were awarded a Platinum certificate
- 25 individuals took the Talent assessment to get the NCRC Plus Certificate.

On average, FVCC students scored

- an average score of 80.78, which is a Gold level score on 221 Reading Tests;
- an average score of 81.14, which is a Gold level score on 227 Math Tests; and
- an average score of 78.00, which is a silver score on 202 Locating Information Tests.

Student Perspectives

Only 7 of the 23 students surveyed in 2015 and 10 of the 48 students surveyed in 2016 reported that they had taken a part of the NCRC. Across the two years, 36 percent of students thought that the NCRC helped them to identify challenges, and the same percentage thought it helped them to identify strengths. Eighty-eight percent met with the WFN to discuss their results. Only one student reported that an employer asked about the results, but no students reported sharing their results with an employer.

Summary

Table 16 shows the milestones as proposed in the AMAMII application and short status descriptions on their implementation.

Table 16: Progress on year 1 and 2 National Career Readiness Certificate (NCRC) milestones

Year 1 2012–13	Status
Hire NCRC coordinator	Approach revised and completed: Hired coordinator to market and meet with employers. Created employer database. Workforce navigators took the responsibility of administering the test while the business marketing specialist conducted outreach to businesses.
Procure licensure of NCRC products from ACT as satellite site of Spokane Workforce Development Center (SWDC)	Completed: fall 2012.
SWDC provided professional development consultation	Completed: spring 2013.
Initiate assessment and training component of NCRC	Completed: trained workforce navigators, entrepreneurship coordinator, entrepreneurship specialist, and advanced manufacturing position.
Coordinate Public Workforce System Training Advisory Committee	Approach revised and completed: Workforce navigator doing this through Job Services.
Market/recruit students to take the NCRC and businesses to use the NCRC when hiring	Completed for Year 1 workforce navigators, advanced manufacturing outreach and business marketing, ongoing, and college brochures and continuing education.
Create career map(s)	Created pathway maps for navigating the program.
Explore possible integration of NCRC with existing assessment tools (e.g., COMPASS, TABE, and Prove It!, existing occupational/academic skills assessment developed in Montana)	NCRC focus is best when used for work readiness rather than academic placement. Implementing EdReady in revision of foundational math.
Deliverable: Career maps describing progression of stackable certificate	Completed: brochure and advising tools.
Deliverable: Assessment report of how NCRC is compatible or redundant when used in conjunction with commonly used workforce assessments like TABE and COMPASS (1.15.15)	NCRC focus is best when used for work readiness rather than academic placement.

Other Implementation Highlights and Challenges

Alignment with State-Wide Initiatives

The AMAMII project is aligned with the other two TAACCCT grants awarded to Montana colleges: the cohort III consortium grant Strengthening Workforce Alignment in Montana's Manufacturing and Energy Industries (SWAMMEI) and the cohort IV Consortium award to HealthCARE Montana. This alignment has allowed the state to (1) leverage existing work and (2) tweak current work to understand the most effective, most sustainable practices.

Advanced manufacturing curriculum: Through the AMAMII grant, FVCC developed a two-year advanced manufacturing curriculum. SWAMMEI has built off of this work by having FVCC adapt the curriculum for online use. However, the SWAMMEI grant required faculty to develop year 1 classes for online delivery concurrent to developing the year 2 face-to-face curriculum, placing a heavy burden on the manufacturing faculty.

Workforce navigators: The WFN role was first introduced in AMAMII, which hired three WFNs. AMAMII piloted the recruitment, retention/case management, and job placement aspects of the WFN role. SWAMMEI leveraged this work by asking each of its participating colleges to hire for this position as well. HealthCARE Montana has also tweaked the WFN model. In thinking about the challenges of sustaining the position, instead of having one position at each college focused on all three key aspects of the role, HealthCARE Montana created three regional positions—a career coach (CC) focused on student recruitment and program placement, a workforce coordinator (WC) focused on employer relationships and job placement, and a transformation specialist at each college who assumed the student retention/case management role as well as grant management[7]. Both the CC and the WC are based outside of the college at regional health education centers and have a regional focus, working across three to five campuses depending on location. The assumption is that by having these roles located outside of the college, both organizations would see the benefit of the position and could work together to fund the position when the grant concludes.

Partnerships

This project was developed with intensive communication with and involvement by community businesses. Employers reported that FVCC was very responsive to the needs of

[7] In SWAMMEI, each college also has a grant coordinator responsible for grant management.

the community and that the community has become invested in the success of the school. Employers spent time with the college before they knew that FVCC would receive the grant, which is evidence of their commitment and the college's responsiveness to the community. As discussed earlier, businesses contributed to the content and structure of courses in certificate levels, working collaboratively with one another and FVCC faculty and staff.

Although most of the largest local manufacturers were involved in the development of the grant and the stackable certificates, FVCC is continuing outreach to other manufacturers. This allows FVCC to make connections with these businesses to continue to learn about local needs, tweak its programs to meet those needs, and establish links to businesses that would look to hire FVCC graduates. Developing a collaborative relationship with business creates a feedback loop that helps FVCC know its skill set deficiencies, how the industry is changing, and what technological changes are coming.

A secondary benefit of the AMAMII project is that it is supporting increased partnerships, connections, and interdepartmental collaborations at FVCC. Students and staff noted that the advanced manufacturing building felt separated from campus and that advanced manufacturing students did not have much interaction with other students on campus. Recently, though, connections have been made, such as advanced manufacturing students making parts for physics students to use in lab experiments, or chemistry students using the advanced manufacturing lab to create materials they have designed but have not previously been able to make. On a departmental level, AMAMII is developing potential internships for its advanced manufacturing students based on the process used by the college's internship coordinator. AMAMII will then integrate its contacts and database with the college's internship coordinator at the end of the grant.

Open Educational Resource

AMAMII staff members uploaded their developed curriculum in fall 2015 and noted two main challenges to Open Educational Resource (OER) development and uploading. First, they had difficulty finding a curriculum developer who could review the online aspects of the AMAMII courses. Second, they felt that Full Tilt, an organization that helps with the development of OER resources for TAACCCT grants, was not helpful and had given them the wrong information. Further, they reported that they did not use the 17-page rubric developed by Full Tilt and instead developed their own 3-page rubric.

Student Outcomes Study

Impact Analysis Overview

To assess the impact of the AMAMII program's redesign of FVCC's foundational math program (discussed in the implementation findings section above), the evaluation team conducted a cohort comparison of math outcomes between students who enrolled in foundational math before (comparison group students) and after (AMAMII students) the implementation of the new program. The analysis used a propensity-score based weighting strategy to equate the demographic and enrollment characteristics of these two groups of students. The original study design also proposed a quantitative impact analysis of educational (credential attainment) and workforce (employment status and wages) outcomes for students in the other AMAMII program area, advanced manufacturing. However, the number of students who had completed an advanced manufacturing program by spring 2016 was 60[8], which is too small to support an analysis. Moreover, the employment and wage data provided to the evaluation team did not include a student-level identifier that would allow the data to be matched to programmatic data.

The foundational math impact analysis considers the following student outcomes: (1) remedial math course taking, (2) college-level math course taking, (3) cumulative credit and average GPA, and (4) degree completion. The analysis addresses the following research questions to compare the outcomes of students who took foundational math before (comparison groups students) and after (AMAMII students) fall 2013.

- Were AMAMII students more likely than the comparison group students to complete their foundational math sequence?
- Were AMAMII students less likely than the comparison group students to repeat foundational math courses?
- Were AMAMII students more likely than the comparison group students to enroll in and pass one or more college-level math courses?
- Did AMAMII students accumulate more credits and/or have higher GPAs than the comparison group students for the two years after first enrolling in foundational math?
- Were AMAMII students more likely than the comparison group students to earn a certificate or degree within two years of first enrolling in foundational math?

[8] This includes the total number of students earning certificates of at least one tier.

For the analysis, FVCC's institutional research office provided individual student records for all students who enrolled in foundational math courses from fall term 2009 to spring term 2016. The grant award was made in October 2012. The evaluation team selected fall 2013 as the implementation date in accordance with the U.S. Department of Labor's time frame for TAACCCT grant program development and implementation.[9]

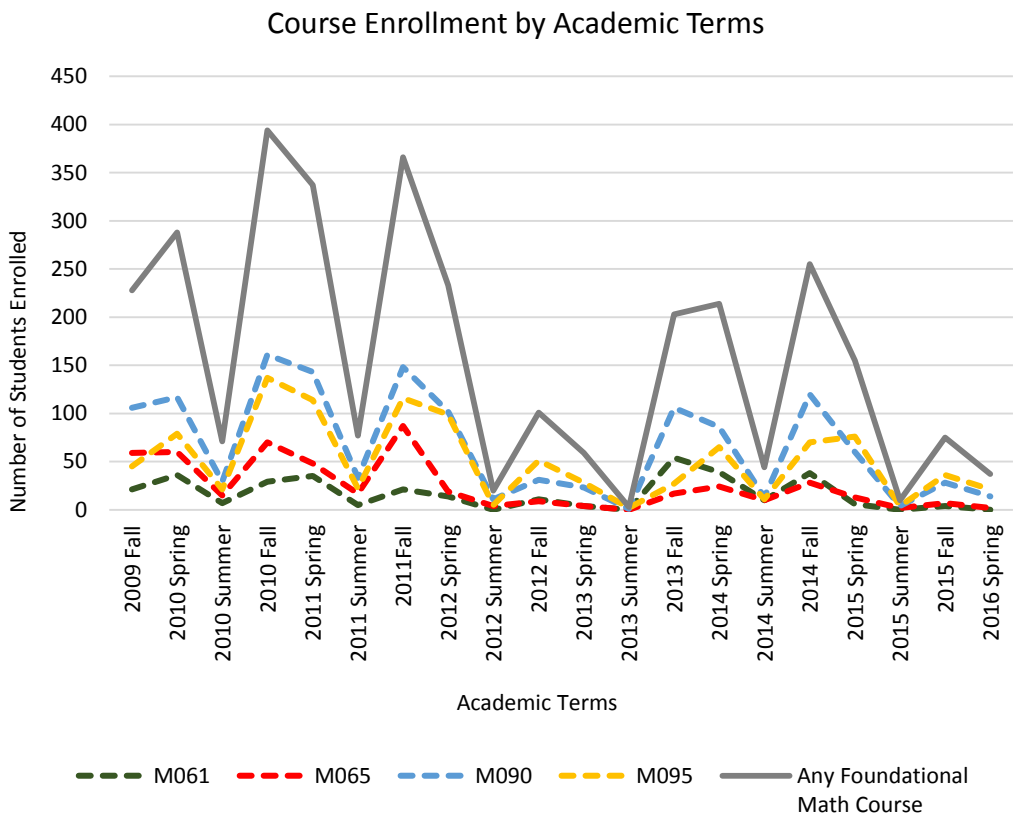
Data

The data used for the analysis were provided by the FVCC's institutional research department. There is data on 6,332 students who enrolled in FVCC from fall 2009 to spring 2016, and data on foundational math course taking exists for 3,035 of those students. The analysis is restricted to two years following students' program entry to allow sufficient time for each student to complete his or her foundational math sequence and to complete one or more college-level math courses. The analytical sample therefore excludes students who were enrolled after winter 2015 and, to avoid treatment contamination, between winter 2012 and summer 2013 (inclusive) to exclude students who took foundational math courses both before and after the new program was implemented. As a result, the final study sample consists of 1,944 students.

As noted, the intervention is participation in one or more of the foundational math courses that were redesigned as part of the AMAMII project. Among the study sample, 282 students took Math 61, 459 took Math 65, 1,193 took Math 90, and 941 took Math 95. While about 69 percent of the students took the foundational math courses prior to the fall 2013 implementation (n = 1,333), 31 percent took foundational math courses after implementation (n = 611). Enrollments in foundational math declined over the study period, reflecting an overall decline in enrollments at the college and statewide (figure 1).

[9] The implementation time frame, however, varied by course, and some of the courses were conducted gradually and included pilot terms, in which the new curricula were tested in some but not all course sections.

Figure 1: Foundational math course enrollment by term, fall 2009 to spring 2016



Source: FVCC administrative data, received 2016

The majority of the students in the analytical sample are white (85 percent) and female (57 percent). About 64 percent of the students are Pell Grant recipients (table 1). The average number of years between high school completion and college enrollment is about 4.3 and the average age is 25. More than 40 percent of the students attended full time for every term that they were enrolled, and about a third attended mostly full time (i.e., attended full time for the majority of the terms that they were enrolled over the two-year course). Pairwise comparisons suggest that AMAMII students share some similar demographic and enrollment characteristics with their prior cohorts, but they were significantly younger (coefficient= -1.65, SE=.48, t= 3.56, $p < .001$) and were less likely to receive a Pell Grant (coefficient=.30, SE=.10, $\chi^2=9.11$, $p<.05$).

Table 1: Enrollment and demographic characteristics of students included in the analytical sample

Characteristic	All students *N* = 1,944	AMAMII students *n* = 611	Comparison students *n* = 1,333
Race/ethnicity			
White	85%	86%	84%
Black	0%	1%	0%
Hispanic	2%	1%	2%
Asian	1%	1%	1%
Other	4%	3%	5%
Missing	8%	8%	8%
Female	57%	54%	58%
Disability	9%	8%	10%
Pell Grant recipient	64%	59%	66%
Average number of years between high school graduation and college enrollment[1]	4.3 (8.6)	4.3 (8.6)	4.4 (8.6)
Average age at college enrollment[1]	24.9 (9.9)	23.8 (9.2)	25.5 (10.2)
Two-year enrollment intensity			
Always full time	41%	41%	41%
Always part time	17%	19%	16%
Mostly full time	33%	32%	34%
Mostly part time	9%	8%	9%

Source: FVCC administrative data, received 2016
[1] Mean (standard deviation) is presented.

In terms of outcomes, about 43 percent of all students in the sample completed their foundational math sequence, and 20 percent took and passed a college-level math course (table 2). A higher proportion of AMAMII (46 percent) versus comparison (41 percent) students completed their foundational math sequence, and a small percentage repeated one or more foundational math courses (11 versus 15 percent).

Table 2: Outcomes among all, AMAMII, and comparison group foundational math students

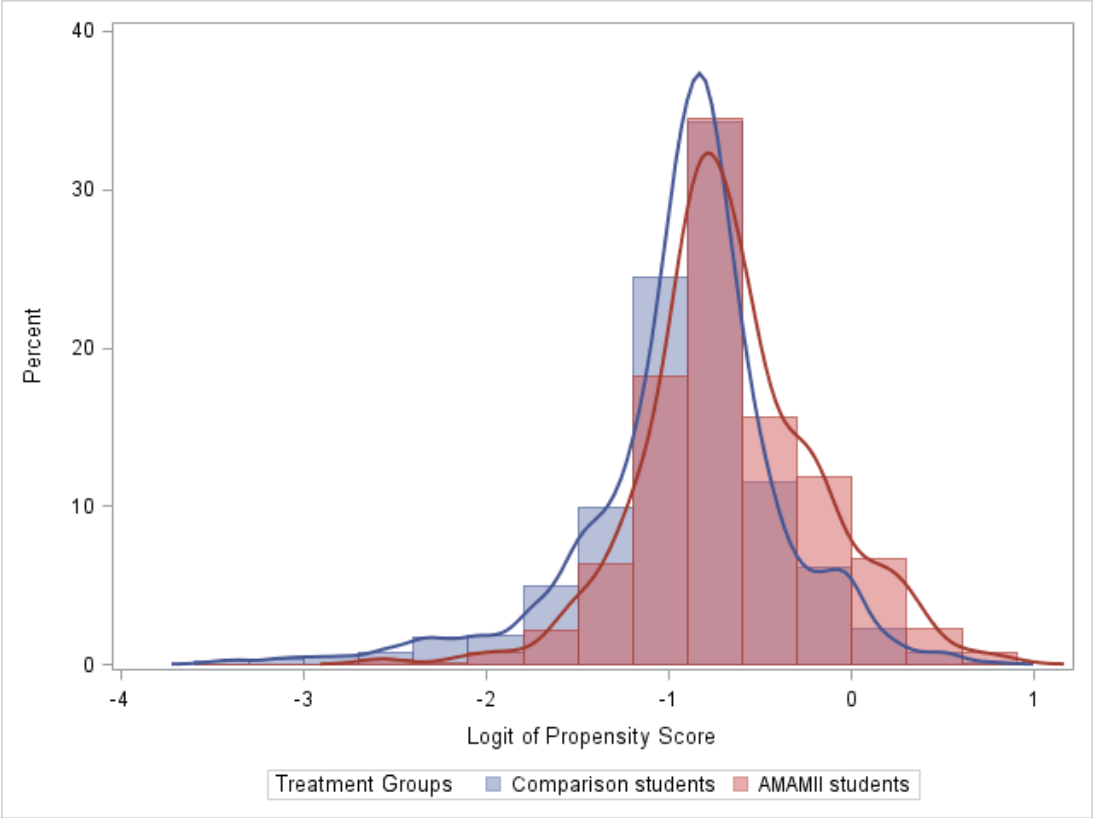
Outcomes	All students *N* = 1,944	AMAMII students *n* = 611	Comparison students *n* = 1,333
Completed foundational math course sequence	42.6%	45.5%	41.3%
Repeated one or more foundational math courses	13.6%	11%	15.0%
College-level math taking			
None	73.1%	74.1%	72.5%
Taken, not passed	6.2%	5.1%	6.8%
Taken, passed	20.7%	20.8%	20.7%
Two-year credit accumulation[1]	22.6 (19.0)	19.4 (17.4)	24.2(19.5)
Two-year average GPA [1]	2.2 (1.3)	2.3 (1.3)	2.2(1.3)
Completed degree (earned credential) at the end of two years of enrollment[2]	5.5%	5.1%	5.6%

Source: FVCC administrative data, received 2016
[1] Mean (standard deviation) is presented.
[2] Includes AA, AS, AA/AS, AAA, AAC, AAS, ASN, CAS, and CT credentials only.

To estimate the causal effects of the redesigned foundational math course and to remove potential differences in demographic and enrollment characteristics between AMAMII and comparison groups, the analysis uses a propensity-score based weighting method, marginal mean weighting through stratification. The marginal mean weighting through stratification method is a viable solution for evaluating various types of treatments including binary, multivalued, or multiple treatments (Hong and Hong 2009). It opts for a nonparametric procedure and hence is robust to potential misspecifications of the functional form of a propensity model (Hong 2010).

The analysis starts with a stepwise logistic regression and selects demographic and enrollment variables that predict any of the four sets of outcomes. In total, 18 significant outcome predictors are identified, including female, disability status, Pell Grant recipient, Trade Adjustment Assistance or Workforce Investment Act recipient, age at college enrollment, number of years between high school graduation and college enrollment, two-year enrollment intensity, high school GPA and missing indicator, availability of GED score, and the first prealgebra, algebra, calculus, and trigonometry placement test scores and availability of the scores. The information of these variables is summarized into one unidimensional propensity score and the sample is stratified into eight strata based on the distribution of the logit of the propensity score (see figure 2). A marginal mean weight is computed as the ratio of the number of students in a stratum to the number of treated students in that stratum. After being adjusted by the marginal mean weight, the AMAMII and comparison groups have a similar pretreatment composition, with a weighted group difference of .01 (SE=.03, t=.38, p>.5) in the logit of the propensity score.

Figure 2: Distribution and stratification of the logit of propensity score



Source: FVCC administrative data, received 2016
Note: The stratification further excludes three students that have either a zero probability of assigning to one or the other treatment condition or had no match in the other condition.

The marginal mean weight is combined with each of the final outcome models. To examine each of the binary outcomes, including remedial course sequence, remedial course repetition, and degree completion, a weighted binary logistic regression model is run with group membership (AMAMII vs. comparison) as a predictor and the weight is assigned to students in the analytic sample. To examine multicategory outcomes and college-level math taking, a weighted multinomial logistic regression is conducted and the AMAMII and comparison groups are compared at one level of coursetaking relative to another. A weighted regression analysis is used to examine continuous outcomes, that is, two-year credit accumulation and average GPA.

Results

Table 3 summarizes the results from the weighted outcome analysis. The results did not reveal significant differences between AMAMII and comparison students for most of the

outcomes, with the exception that AMAMII students on average accumulated fewer credits over the two-year time frame (p<.0001).

Although the remaining observed differences are not statistically significant, the point estimates show that compared to comparison group students, AMAMII students might be more likely to complete their foundational math course sequence (p=.12) and may be less likely to repeat one or more foundational math courses (p=.06). The average cumulative GPA of AMAMII students was slightly higher than that found for comparison group students (p=.08). The results suggest that the two groups had similar likelihoods of taking college-level math courses (p>.5), passing the courses (p>.5), and completing their degree within the first two years of enrollment (p>.5).

Table 3. Weighted outcome analysis results

	Intercept	Estimated Program Effect	
	Coefficient	Coefficient (SE0)	*t* or χ^2
Completed foundational math course sequence	-.34 (.06)	.15 (.10)	2.40
Repeated one or more foundational math courses	-1.76 (.08)	-.28 (.15)	3.49
Took a college-level math course	-.97 (.06)	-.03 (.11)	.09
Passed a college-level math course	-1.35 (.07)	.07 (.12)	.30
Two-year credit accumulation[1]	23.78 (.52)	-4.01 (.92)	-4.35 ***
Two-year average GPA [1]	2.19 (.04)	.11 (.06)	1.73
Completed degree (earned credential) at the end of two years of enrollment[2]	-2.83 (.12)	-.01 (.21)	.00

Source: FVCC administrative data, received 2016
[1] Mean (standard deviation) is presented.
[2] Includes AA, AS, AA/AS, AAA, AAC, AAS, ASN, CAS, and CT credentials only.
*** *p*<.0001

Limitations

As is the case with all studies of this type, the results should be considered in light of a number of limitations, some of which may be addressed once additional data are available should FVCC be interested in expanding this analysis.

1. Program implementation time frame: The evaluation team selected fall 2013 as the implementation date in accordance with the U.S. Department of Labor's time frame for TAACCCT grant program development and implementation. The implementation timing of the AMAMII math program, however, varied by course. In addition, implementation for some courses included pilot terms, in which the new curricula were tested in a subset of course sections. Since implementation is a process that is refined over time, an ideal approach is to test the robustness of the results using different implementation cutoff dates (such as fall and spring 2014). The National Center for Academic Transformation, for example, recommends a development and

implementation time frame of about 18 months (The National Center for Academic Transformation 2013). The reporting time frame did not permit this analysis at this time, but RTI recommends this approach for future analyses.

2. Limited observation time of program effects and smaller number of AMAMII students. Since the last wave of data included in this analysis was from spring 2016, to ensure comparability of the outcomes between AMAMII and comparison groups, this study limited the observation time to the first two years of program enrollment, which may not be long enough for the program to take effect. The limited data collection points after program implementation also resulted in a smaller AMAMII sample relative to that for the comparison group. The unequal sample size may reduce the statistical power to detect significant program effects.

3. History threat associated with the pre-post program comparison. The analysis is limited by the data available, which allows for a comparison between students who took the foundational math courses before and after the program redesign. The estimated effects may be confounded by other school events that occurred over the study years that are not reflected in the data, such as changes in admission policies.

4. Potentially insufficient control for group differences. Past research (Steiner 2010) suggests that pretest scores (preprogram academic ability) can account for 90 percent of the treatment-control pre-intervention differences. The propensity score analysis adjusts for the preprogram differences based on the scores from students' first math placement test. However, the topic (prealgebra, algebra, trigonometry, and/or calculus) of the first test varied by student. As a consequence, the test results may not be comparable, which poses challenges for the propensity score analysis in fully capturing the differences in preprogram academic ability.

5. Oversimplified picture of student degree completion status. Due to limitations on the reporting time period, the analysis limits the degree completion time frame to two years and cannot distinguish between students who stop out or entirely drop out of the program if a student's two-year period ends with one or more terms in which he or she was not enrolled. The data also do not allow the analysis to distinguish between those who dropped out and those who transferred during the time frame.[10]

[10] The data used for this analysis included information from the National Student Clearinghouse on whether a student transferred to another institution. However, the data did not indicate whether the transfer occurred during the two-year time frame included in the analysis.

Summary

The results of the quantitative outcomes analysis indicate that AMAMII students have a lower credit accumulation rate than their comparison group peers during their first two years of enrollment. The remaining differences observed are not statistically significant but suggest that further studies might reveal that the program has positive benefits for students, such as improving foundational math course sequence completion rates and reducing course repetition. Since this study was conducted less than three years after the program was implemented (fall 2013 to spring 2015), these results should be regarded as preliminary. The implementation of FVCC's modified emporium math program implied changes not only in course content but also in how content is delivered and the role of the instructor. Each element of the program, such as online delivery and the creation of short, targeted lectures, takes time and practice to offer effectively.

Future research that includes more students and allows a longer time frame for degree completion would provide a more complete overview of how the FVCC's new foundational math program has impacted students. In addition, RTI recommends (in accordance with the study limitation described above) that the analysis test different implementation dates, perhaps determined in consultation with foundational math faculty. Faculty members may be able to provide feedback regarding when they considered the new courses to be fully implemented, and whether the implementation date should be allowed to vary by course, an option that was not feasible in the current analysis. Finally, as more data become available, analysts may also be able to determine whether particular courses are driving program effects, and the extent to which the new foundational math program reduces the time needed to complete remedial math courses and time to degree.

Conclusion

The Workforce Navigator

The WFN was a key innovation in the AMAMII project that has been built upon in the cohort III and IV TAACCCT grants in Montana. The WFN is a flexible position that has multiple roles—recruitment, student support, and job placement support. Key to the position is its integration with students and faculty from specific programs. The WFN is able to become an expert in the program and, through increased opportunity to build relationships with students, is more likely to be able to help students with program-specific questions, from courses through job placement. Through a physical presence in the trades department, the WFN can build relationships with faculty and offer drop-in services for students.

Foundational Mathematics

The foundational mathematics sequence has undergone an initial revision and multiple changes, including pedagogical and placement changes, since the AMAMII grant began, including the elimination of courses. Because the program has been continually changed, it is important that faculty continue to monitor and review data to ensure that each new change has improved students' abilities to learn math, progress quickly through the foundational math sequence, and prepare for higher-level math. The faculty reported increased collaboration with adjuncts, which must continue to allow staff to review and keep changing the program as needed.

Entrepreneurship

The entrepreneurship initiative has undergone many changes during the AMAMII project. Similar to the continual changes made to the foundational math program, AMAMII staff piloted multiple programs to support those interested in entrepreneurship, including intensive noncredit courses, community events, and introductory workshops. Partnerships were broached with the Small Business Center and FVCC's business department. While the business department will now be responsible for entrepreneurship activities, it is unclear if it will continue—or is the best choice to continue—leading community events, such as the Maker Faire, which have been successful but likely need the college's support to be sustainable. The development of a capstone entrepreneurship course that can be modified to support students from multiple programs is an effective, low-cost method to continue to support students' entrepreneurial goals. Given that many advanced manufacturing students, for example, reported that they had or planned to have their own business, there is a need to provide them with this education.

The Center for Manufacturing Advancement

FVCC opened the Center for Manufacturing Advancement (CMA) in 2015, building off its AMAMII curricular accomplishments and the redesign and expansion of its shop space. Its goal is to help strengthen and support the growth of manufacturers in Northwest Montana by addressing the needs of industry leaders and identifying training and educational needs to bolster workforce preparation and promote manufacturing careers. As designed, the CMA has a dual role: to serve (1) as an access point for local manufacturers to access information and resources and (2) as a resource for students to expand their exploration and awareness of opportunities in manufacturing.

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Appendix A: Advanced Manufacturing Certificate Program Requirements

For information about the advanced manufacturing certificate, see http://www.fvcc.edu/wp-content/uploads/2013/05/Advanced-Manufacturing-Brochure.pdf?61d1e1.

Electronics Technician Program

Table A-1: Electronics Technician Tier I program requirements

Course Number	Title	Credits
CAPP 106	Short Courses: Computer Applications	1
	or	
CAPP 114	Short Courses: MS Word	1
	or	
CAPP 116	Short Courses: MS Excel	1
ECP 104	Workplace Safety	1
ELCT 100	Introduction to Electricity	3
ELCT 110	Basic Electricity I	5
ELCT 137	Electrical Drafting	2
M 114	Extended Technical Mathematics	3
MCH 101	Intro to Manufacturing Processes	1
TOTAL CREDITS		**16**

Table A-2: Electronics Technician Tier II program requirements

Course Number	Title	Credits
BMGT 205C	Professional Business Communication	3
	or	
COMX 115C	Intro to Interpersonal Communications	3
ELCT 102	Electrical Fundamentals II	4
ELCT 111	Electric Meters and Motors	3
ETEC 130	Panel Wiring and Soldering	2
PHSX 110	Applied Physics	4
TOTAL CREDITS		**16**

Table A-3: Electronics Technician Tier III program requirements

Course Number	Title	Credits
ELCT 210	Advanced Current Theory	5
ELCT 250	Programmable Logic Controllers	4
ETEC 245	Digital Electronics	4
ETEC 250	Solid State Electronics	4
TOTAL CREDITS		**17**

Table A-4: Electronics Technician Tier IV program requirements

Course Number	Title	Credits
BMGT 205C	Professional Business Communication	3
	or	
COMX 115C	Intro to Interpersonal Communications	3
ELCT 211	AC Measurements	3
ETEC 280	Advanced Electronics	4
ETEC 285	Advanced Programmable Controllers	4
ETEC 299	Capstone: Electronics	3
TOTAL CREDITS		**17**

Machinist Technician Program

Table A-5: Machinist Technician Track Tier I program requirements

Course Number	Title	Credits
ECP 104	Workplace Safety	1
M 111	Technical Mathematics	3
MCH 101	Introduction to Man. Processes	1
MCH 120	Blueprint Reading and Int. Mach.	3
MCH 129	Machine Quality Control and Precision Measurement	3
MCH 132	Introduction to Engine Lathes	4
MCH 134	Introduction to Mills	4
TOTAL CREDITS		**19**

Table A-6: Machinist Technician Track Level II program requirements

Course Number	Title	Credits
BMGT 205C	Professional Business Communication	3
	or	
COMX 115C	Intro to Interpersonal Communications	3
DDSN 135	Solidworks	2
MCH 102	Intro to Manufacturing Materials	2
MCH 122	Introduction to CAM	3
MCH 125	Intro to Computer Numerical Control (CNC) Lathe Operations	3
MCH 127	Intro to CNC Mill Operations	3
MFGT 115	Machine Shop Fundamentals	2
TOTAL CREDITS		**18**

Table A-7: Machinist Technician Track Level III program requirements

Course Number	Title	Credits
MCH 220	Geometric Dimensions and Tolerancing	3
MCH 221	Advanced Manual Mill	3
MCH 222	Advanced CNC Mill Operations	3
MCH 225	Machinery's Handbook	3
MFGT 226	Advanced CAD/CAM	4
TOTAL CREDITS		**16**

Table A-8: Machinist Technician Track Level IV program requirements

Course Number	Title	Credits
BMGT 205C	Professional Business Communication	3
	or	
COMX 115C	Intro to Interpersonal Communications	3
MCH 227	Swiss CNC and Mill-Turn Systems	4
MCH 223	Advanced Manual Lathe	3
MCH 224	Advanced CNC Lathe Operations	3
MFGT 299	Capstone: Machinist	3
TOTAL CREDITS		**16**

Industrial Maintenance Technician Program

Table A-9: Industrial Maintenance Technician Track Level I program requirements

Course Number	Title	Credits
ECP 104	Workplace Safety	1
ELCT 100	Introduction to Electricity	3
M 111	Technical Mathematics	3
MCH 101	Introduction to Man. Processes	1
MCH 120	Blueprint Reading and Int. Mach.	3
MCH 129	Machine Quality Control and Precision Measurement	3
MCH 132	Introduction to Engine Lathes	4
TOTAL CREDITS		**18**

Table A-10: Industrial Maintenance Technician Track Level II program requirements

Course Number	Title	Credits
BMGT 205C	Professional Business Communication	3
	or	
COMX 115C	Intro to Interpersonal Communications	3
CAPP 106	Short Courses: Computer Applications	1
	or	
CAPP 114	Short Courses: MS Word	1
	or	
CAPP 116	Short Courses: MS Excel	1
CSTN 125	Basic Cabinetry and Furniture making	3
ELCT 111	Electric Meters and Motors	3
MCH 102	Intro to Manufacturing Materials	2
WLDG 111	Welding Theory I Practical	4
TOTAL CREDITS		**16**

Firearms Technology Program

Table A-11: Firearms technology certificate semester I program requirements

Course Number	Title	Credits
FT 100	Introduction to Firearms	1
FT 111	Firearms Theory	3
FT 120	Bench Metal Techniques	3
FT 131	Firearms Repair I	3
MCH 132	Introduction to Engine Lathes	4
TOTAL CREDITS		**14**

Table A-12: Firearms technology certificate semester 2 program requirements

Course Number	Title	Credits
FT 112	Firearms Theory II	3
FT 125	Machine Tools for the Gunsmith	4
FT 132	Firearms Repair II	3
FT 140	Precision Rifle Building	3
TOTAL CREDITS		**13**

Entrepreneurship Program

Table A-13: Entrepreneurship program semester I requirements

Course Number	Title	Credits
ACTG 101	Accounting Procedures	4
BGEN 122	Applied Business and Allied Health Math	4
BMGT 215	Human Resource Management	3
BMKT 225	Marketing	3
TOTAL CREDITS		**14**

Table A-14: Entrepreneurship program semester 2 requirements

Course Number	Title	Credits
BGEN 280	Business Planning	3
BMGT 205C	Professional Business Communication	3
BMGT 210	Small Business Entrepreneurship	3
BMIS 211	Introduction to Business Decision Support	4
ECNS 201B	Principles of Microeconomics	3
or		
ECNS 202GB	Principles of Macroeconomics	3
TOTAL CREDITS		**16**

Appendix B: Flathead Valley Community College Certificate Survey

The Flathead Valley Community College (FVCC) Certificate Survey was designed to collect information from participating students in AMAMII related Advanced Manufacturing programs regarding their beliefs and attitudes toward their coursework, skills, and employability, as well as to better understand their experiences with Workforce Navigators and the National Career Readiness Certificate. This report highlights the trends observed in surveys completed in both 2015 and 2016. This survey was previously piloted in 2014, but the program enrolled a small number of students (14 students completed the survey) that the results from that year are not included in this summary.

The 2016 FVCC Certificate Survey was sent to all Occupational Trade students in spring 2016. In total, 54 of the 70 students (78 percent) participated in the survey. Similarly, the 2015 FVCC Certificate Survey was sent to all Occupational Trade students on May 27th, 2015. For students who initially did not submit a survey, a reminder email was sent in June 2015. For students who received these reminders but still had not filled out a survey, RTI followed up via phone. In total, 23 of the 45 students (51 percent) participated in the survey.

Throughout this report we aggregate responses from students across all four occupational trade programs. The majority of students were enrolled in manufacturing or electronics and we did not see differences in their responses. Few students were enrolled in the other programs and so we could not make a comparison between their perspectives and the perspectives of students in manufacturing or electronics.

Enrollment and Current Status

Enrollment

In both 2015 and 2016, more than half of students reported learning about the Advanced Manufacturing program (Table B-1) by speaking with a Workforce Navigator. The most frequent other responses for both years included seeing information about the program on the FVCC website, reading about it through a brochure, flyer, or poster in the college, hearing about it from a job service or work agency, and/or learning about it from another employer, high school instructor, or counselor. Most of those who reported another reason included learning about the program from a related program or class or hearing about it from a family member.

Table B-1: Percent of respondents who reported how they first found out about the Advanced Manufacturing programs

	2015 *N* = 23	2016 *N* = 54
I spoke with a FVCC advisor or Workforce Navigator	57	52
I saw it on the FVCC college website	22	31
I saw a brochure/flyer/poster in the college	17	15
I heard about it from staff at a Job Service/Workforce agency	13	9
An employer told me about it	4	4
A high school instructor or counselor told me about it	0	4
Other	26	13

Source: FVCC Certificate Survey, 2015 and 2016

In both years, the majority of respondents reported that they initially enrolled in their current programs because they wanted to enter a new profession, they wanted to qualify for a job that offered higher pay, and/or that financial aid was available to them (Table B-2). Other reasons included the benefits of various resources, services, and support offered by the college, as well as the short time it would take to complete all coursework.

Table B-2: Percent of respondents who reported various reasons why they started the program

	2015 *N* = 23	2016 *N* = 54
Enter a different/ new profession	83	67
Wanted to qualify for a job that offered higher pay	43	61
Financial aid was available to me	39	31
Short time to complete coursework	9	7
Services available to me from the college (e.g., tutoring, childcare, academic help, coaching, career advising)	9	11

Source: FVCC Certificate Survey, 2015 and 2016

At the time of enrollment, the highest percentage of students in both years reported not working (approximately 40 percent of students in each year) (Table B-3). Thirty percent of students in 2015 and 35 percent of students in 2016 reported working full time, while 30 percent of students in 2015 and 24 percent of students in 2016 reported working only part-time.

Table B-3: Percent of respondents by employment status when entering the program

	2015 *N* = 24	2016 *N* = 54
I was working full time at the time of my enrollment	30	35
I was working part time at the time of my enrollment	30	24
I was not working at the time of my enrollment	40	41

Source: FVCC Certificate Survey, 2015 and 2016

Of all respondents in both years, the vast majority of students reported that they understood the steps and the courses needed to complete the Advanced Manufacturing certificate when they started the program "very well" (Table B-4). Overall, in 2016, more students reported understanding somewhat or slightly, as opposed to not at all, than in 2015. Nine percent of students reported that they did not understand the process in 2015.

Table B-4: Percent of respondents who reported various levels of understanding the steps and courses needed to complete an Advanced Manufacturing certificate when starting the program (scale: 1 = did not understand; 2 = understood slightly; 3 = understood somewhat; 4 = understood very well)

	2015 *N* = 23	2016 *N* = 54
Understood very well	87	63
Understood somewhat	4	28
Understood slightly	0	7
Did not understand	9	2

Source: FVCC Certificate Survey, 2015 and 2016

Current Status

The majority of students who completed the survey reported being enrolled in the machining program in both 2015 (74 percent) and 2016 (51 percent). The 2016 survey results showed a higher number of students enrolled in the electronics program (40 percent) than the year before (13 percent). The number of students in the Firearms Technology and Industrial Maintenance programs remained relatively low in both years (Table B-5).

Table B-5: **Percent of respondents by currently program**

	2015 *N* = 23	2016 *N* = 53
Machining	74	51
Electronics	13	40
Firearms Technology	9	4
Industrial Maintenance	4	6

Source: FVCC Certificate Survey, 2015 and 2016

When asked about progress toward their degree or certificate, most students reported either earning one or more certificate(s) from FVCC, or not having earned any degrees, credentials, or certificates, followed by reports of earning an AAS, or industry credentials (Table B-6).

Table B-6: **Percent of respondents by stage of current program**

	2015 *N* = 23	2016 *N* = 54
I earned 1 or more certificates awarded by FVCC (Tier 1, etc)	35	26
I will not have received any degrees, certificates, or credentials at this time	35	44
I earned an AAS degree	26	13
I received 1 or more industry credentials (NIMS, AWS, NCCER)	4	17

Source: FVCC Certificate Survey, 2015 and 2016

Table B-7 displays the number of student respondents by the highest level of their program completed and by their current stage of certificate/credential/degree completion in both 2015 and 2016. Twenty-three students responded in 2015 and 54 students responded in 2016.

Table B-7: Percent of respondents by stage of completion

Current stage	I will not have received any degrees, certificates, or credentials at this time		I earned 1 or more certificates awarded by FVCC (Tier 1, etc.)		I earned AAS		I received 1 or more industry credentials (NIMS, AWS, NCCER)	
	2015 N=8	2016 N=24	2015 N=8	2016 N=14	2015 N=6	2016 N=7	2015 N=1	2016 N=9
Technician Track Level I	12.5	8	0	14	0	14	0	0
Machinist Level 2	0	16	75	29	17	43	100	0
Machinist Level 3	12.5	4	0	14	0	43	0	0
Machinist Level 4	0	4	0	0	83	57	0	22
Electronics Technician Level 2	12.5	12.5	12.5	29	0	14	0	22
Electronics Technician Level 3*	N/A	0	N/A	0	N/A	14	N/A	11
Electronics Technician Level 4*	N/A	0	N/A	0	N/A	43	N/A	11
Industrial Maintenance Level 2	12.5	4	0	0	0	0	0	0
2-year AAS degree *	N/A	8	N/A	0	N/A	86	N/A	22

Source: FVCC Certificate Survey, 2015 and 2016
Note: Categories with * were only offered as options in the 2016 survey as no student would have been enrolled at that level in 2015.

Coursework and Skills

Level of Challenge and Improving Skills

The FVCC certificate survey asked students a number of questions about their experiences with and perceptions of their coursework and skills. In both years, most students reported their coursework being somewhat to very challenging (Table B-8).

Table B-8: Average rating of respondents who reported different levels of engagement with coursework (scale: 1 = not challenging at all; 2 = somewhat challenging; 3 = very challenging)

	2015 *N* = 23	2016 *N* = 53
How challenging has the coursework been?	2.4	2.3
Experience gaining or improving technical skills in the program classes?	2.9	2.8

(N=49)

Source: FVCC Certificate Survey, 2015 and 2016

All but one of the 23 participants in 2015, and all but two of the 49 participants in 2016, reported feeling that their program used modern instrumentation and industry-standard technologies (Table B-9).

Table B-9: Percent of respondents who believed the program was relevant to the demands in the field (scale: 1 = did not gain or improve skills at all; 2 = gained slightly; 3 = gained or improved a lot)

	2015 *N* = 23	2016 *N* = 49
Do you feel that your program is using modern instrumentation and industry-standard technologies to address the knowledge, skills, and competencies needed in your field?	96	96

Source: FVCC Certificate Survey, 2015 and 2016

Participants were also asked to rank how much they felt their program emphasized specific skills as well as how applicable they thought these skills would be to employment. Table B-10 provides an overview of the degree to which students felt their program emphasized the provided list of skills, and Table B-11 shows how applicable respondents felt these skills will be for a job or career.

Table B-10: Average rating of the respondents who reported the program emphasized the listed skills (scale: 1 = not at all; 2 = somewhat/a lot; 3 = a great deal)

	2015 *N* = 23	2016 *N* = 48
Attention to Detail	2.6	2.4
Discipline	2.5	2.3
Creativity	2.5	2.3
Cooperation	2.4	2.4
Communication	n/a	2.7

Note: Communication was only listed as a skill in the 2016 survey
Source: FVCC Certificate Survey, 2015 and 2016

Table B-11: Average rating of the respondents who believed these skills were applicable to an employer (scale: 1 = not at all; 2 = somewhat/a lot; 3 = a great deal)

	2015 *N* = 23	2016 *N* = 48
Attention to Detail	2.6	2.5
Discipline	2.6	2.6
Creativity	2.4	2.5
Cooperation	2.4	2.4
Communication*	n/a	2.5

Note: Communication was only listed as a skill in the 2016 survey
Source: FVCC Certificate Survey, 2015 and 2016

Participants also rated how much their programs emphasized skills *customized to their program*. Because industrial maintenance, electronic, and firearms programs only had a few students respond to the survey, the presented results focus on machining students. Below are the highest and lowest rated emphasized skills (for a full list of skills rated and for other program rankings, see Appendix A). Machining students reported that the following three skills were most emphasized by their program in both 2015 and 2016 (Table B-12). Machining skills that were lowest rated are shown in Table B-13 (2015) and Table B-14 (2016).

Table B-12 Highest rated skills student reported as being emphasized by the machining program in 2015 and 2016 (scale: 1 = not at all; 2 = somewhat; 3=a lot; 4 = a great deal)

Ranking	Machining Skill	2015	2016
1	Use tools and equipment to machine various materials	3.4	3.3
2	Safely operate basic machinery and equipment	3.3	3.3
2	Accurately measure and record dimensions with micrometers and calipers	3.3	3.2

Source: FVCC Certificate Survey, 2015 and 2016

Table B-13: Lowest rated skills student reported as being emphasized by the machining program in 2015 (scale: 1 = not at all; 2 = somewhat; 3=a lot; 4 = a great deal)

Ranking	Machining Skill	Average Score
3	Identify features contained on a blueprint in relation to actual work piece and identify features of the design part in relation to machining production methods	2.9
2	Locate materials list and identify the material call-outs on lists of materials	2.8
1	Discuss processes necessary to cast and mold materials in a manufacturing laboratory environment	2.4

Source: FVCC Certificate Survey, 2015 and 2016

Table B-14: Lowest rated skills student reported as being emphasized by the machining program in 2016 (scale: 1 = not at all; 2 = somewhat; 3=a lot; 4 = a great deal)

Ranking	Machining Skill	Average Score
3	Demonstrate quality assurance and quality management techniques (2.6)	2.6
2	Discuss processes necessary to cast and mold materials in a manufacturing laboratory environment	2.4
1	Organize and develop a logical written representation of one's thoughts; craft and execute a variety of professional quality correspondence, including a resume	2.1

Source: FVCC Certificate Survey, 2015 and 2016

Student Learning

Students were also asked about aspects of the program that affected their ability to learn. Table B-15 displays the distribution of rankings for each factor in both 2015 and 2016. The most highly rated factor in 2015 was the ability of the instructors to explain things clearly and was the quality of course materials in 2016. The lowest rated factor in both years, quality

of the projects and assignments, was still rated highly when it comes to positively affecting students' ability to learn. Of all ratings across the five factors, only 11 percent in 2015 and 17 percent in 2016 were negative ratings, indicating that students generally felt that that their learning by positively influenced by the factors.

Table B-15: Average rating of the respondents who listed the following factors that affected their learning (scale: 1 = negatively affected; 2 = somewhat negatively affected; 3 = somewhat positively affected; 4 = positively affected)

	2015 *N* = 23	2016 *N* = 49
The ability of the instructors to explain things clearly	3.7	3.5
Amount of time given to complete assignments and study for tests	3.5	3.4
The quality of course materials	3.4	3.6
Enough time given to student collaboration	3.4	3.4
Quality of projects and assignments	3.3	3.3

Source: FVCC Certificate Survey, 2015 and 2016

Student Suggestions to Improve Learning

Some respondents provided suggestions for how to improve student learning. In 2015, one student mentioned that providing M114 Technical Math as an in-person class would be beneficial, while another student mentioned that the movement of separating manual mill and manual lathe was a "great idea". The notion of bringing in previous students to provide examples of how to succeed in the program was brought up by another participant, who thought that they could learn from the prior student's experiences. In 2016, more suggestions were made about types of resources that should be available to students, including "study skill resources," "check-lists" and "check-ins."

Workforce Navigators

Role of Workforce Navigators

The role of the Workforce Navigator is to provide academic counseling, collect and distribute resources for job employment in the industry, answer student questions about the programs, and generally guide students through the Advanced Manufacturing program. All student respondents in 2015, and 96 percent (n=53) student respondents in 2016, reported meeting with a workforce navigator at least once during their time at FVCC.

Student Experiences with Workforce Navigators

When asked how timely Workforce Navigators were in responding to students' needs, the majority of students reported that Workforce Navigators always or almost always, responded

in a timely manner (Table B-16). No students in 2015, and only 2 percent of students in 2016, reported not that the Workforce Navigators rarely or never responded in a timely manner.

Table B-16: Percent of respondents who reported how often the Workforce Navigators respond in a timely manner

	2015 *N* = 24	2016 *N* = 51
Almost or almost always	78	88
Usually	9	10
Sometimes	9	0
Rarely or never	0	2
I never had questions or needed advice	4	0

Source: FVCC Certificate Survey, 2015 and 2016

When asked how sufficiently workforce navigators answered student questions and inquires, the overall results were positive. All but one student reported that the Workforce Navigator usually, almost, or always addressed their questions sufficiently, and no student reported that they rarely or never addressed their questions sufficiently in 2015 (Table B-17). In 2016, 2 students reported that their questions were rarely or never answered sufficiently.

Table B-17: Percent of respondents who reported that the Workforce Navigators answered questions sufficiently

	2015 *N* = 23	2016 *N* = 51
Always or almost always	70	67
Usually	26	25
Sometimes	4	2
Rarely or never	0	4
I never had questions or needed advice	0	2

Source: FVCC Certificate Survey, 2015 and 2016

When students were asked how useful the support they received was from the Workforce Navigator, the majority of students reported that it was extremely useful (Table B-18). No students in 2015, and only 1 student in 2016, reported that it was not useful at all.

Table B-18: Percent of respondents who reported receiving useful advice from the Workforce Navigators

	2015 *N* = 23	2016 *N* = 51
Extremely useful	83	75
Somewhat useful	9	22
Slightly useful	9	2
Not useful at all	0	2

Source: FVCC Certificate Survey, 2015 and 2016

Student Suggestions to Improve Workforce Navigator Support

Some respondents offered suggestions on how to improve the support that Workforce Navigators provide to students. In 2015, one participant mentioned that they felt the Workforce Navigators could better recognize that students often come with experience and bring their own backgrounds to the classroom, so they do not need to be approached as "an 18 year old kid off the street." Two students mentioned that simply keeping consistent communication, being available, and checking in on the students would continue to be helpful. Additionally, another respondent suggested that Workforce Navigators could better communicate how a "decent GPA" could grant them the opportunity for "free schooling before our first semester." In 2016, several students mentioned that advisers should be more accessible, transparent and available to get to truly know, encourage and guide students, particularly during their first semester. Regular check-ins were a strong suggestion from a couple of the students. One student complained about the way advisers would play favorites and another student complained about misinformation being communicated that were specific and important to supporting Running Start students (The Running Start program provides eligible high school juniors and seniors with the opportunity to enroll in college classes).

National Career Readiness Certificate

The National Career Readiness Certificate (NCRC) is an external and optional examination that assess skills often required for employability. The exam is based on situations that can be found in many work environments, and students are measured on skills such as critical thinking and their ability to apply information learned in order to solve problems. Table B-19 shows the percentage of respondents who took the NCRC, have not taken the NCRC, or who had not heard of the NCRC in both 2015 and 2016. Thirty percent of students in 2015 and 21 percent in 2016 had taken the NCRC. Table B-20 shows the percentage of respondents, of those who took the NCRC, who took each assessment.

Table B-19: Percent of respondents who took NCRC

	2015 *N* = 23	2016 *N* = 48
Yes, I have taken some of the NCRC	30	21
No, I have not taken the NCRC	57	46
No, I have not heard of the NCRC	13	33

Source: FVCC Certificate Survey, 2015 and 2016

Table B-20: Percent of respondents who took NCRC by specific types of assessment

	2015 *N* = 7	2016 *N* = 10
Applied Mathematics	86	80

Talent Assessment	71	60
Reading for Information	57	70
Locating Information	57	70

Source: FVCC Certificate Survey, 2015 and 2016

Student Perceptions of the NCRC

In 2015, all students who took the NCRC felt that the NCRC was "important" in helping them identify challenge areas in both 2015. Five of the seven students also felt that the NCRC was "important" in helping them identify areas of strength, while the other two students felt it was "very important" or "not very important." Three students had reportedly retaken at least one exam, and no students reported taking a class to help improve their score.

In 2016, five students felt the NCRC was "important," and three other students, "very important," in identifying challenge areas. The two other students reported feeling that it was "not very important" or "unimportant" in doing so. Similarly, most students reported that the NCRC was "important" (4 students) or "very important" (3 students) in identifying areas of strength. Two reported it being "not very important" and one reported it being "unimportant" in doing so (Table B-21).

Table B-21: Average rating of the respondents who reported the NCRC was important in identifying challenge areas and areas of strength (scale: 1 = unimportant; 2 = not very important; 3 = important; 4 = very important)

	2015 *N* = 7	2016 *N* = 10
Identify challenge areas	3	3
Identify areas of strength	3	2.9

Source: FVCC Certificate Survey, 2015 and 2016

In 2015, six of the seven students who took the NCRC reported that they met with a Workforce Navigator to discuss their results. Of these six students, five reported that the Workforce Navigator helped them identify opportunities to enhance their scores. Similarly, in 2016, only one student did not meet and discuss the results of the NCRC with their advisor and of the 9 who did meet with the advisor, 8 reported that the Workforce Navigator and Advisor helped them to identify opportunities to enhance scores (Table B-22).

No students reported sharing their NCRC results with an employer in either year, although one student in both 2015 and 2016 reported speaking about the NCRC with an employer, and another reported that an employer asked them about their results in 2015 (Table B-23).

Table B-22: Percent of respondents who reported discussing the NCRC with FVCC advisors/Workforce Navigators

	2015 *N* = 7	2016 *N* = 10
Discussed the results of my NCRC with my FVCC advisor or Workforce Navigator?	86	90
FVCC advisor or Workforce Navigator helped identify opportunities or courses to enhance scores	83 (n=6)	88 (n=9)

Source: FVCC Certificate Survey, 2015 and 2016

Table B-23: Percent of respondents who reported discussing the NCRC with employers

	2015 *N* = 6	2016 *N* = 9
A potential employer asked me about my results	17	0
I shared my results with an employer and they seemed interested	0	0
I shared my results with an employer and they did not seem interested	0	0
I have spoken with potential employers but have not shared the results of my NCRC assessment	17	22
I have not yet discussed my NCRC with an employer	83	78

Source: FVCC Certificate Survey, 2015 and 2016

Employability and Future Plans

What is a High-Skill, High-Wage Job?

A number of questions focused on students' perceptions of their ability to gain employment with their current skills. Students were asked to define what they considered a high-skill, high-wage job. Responses in both years resembled one another and included definitions and remarks about:

- Hourly rates that students felt adequately defined a high-skill, high-wage job
- High-skill, high-wage job as one that requires specialized knowledge and skills attained through experience
- Skillsets compensated well and typically acquired through training/on the job requirements
- "Living wages" that can help support families and is beyond a "paycheck to paycheck situation"
- "Professional, "disciplined," "independent"
- One student listed "deep knowledge of multiple processes….machining operations, cad/cam programming, and material selection as opposed to manning a machine and pushing the start button."

Perceptions of Employability and Job Preparedness

When asked how likely a student's current skills would help them obtain a high-skill, high-wage job, most students rated that it would be likely in both years (Table B-24). Machining student responses are presented below by the students' current stage in the program.

Table B-24: Average rating of the respondents who reporting *how likely* students felt they could get a high-skill, high-wage job with their current skills, by current stage in the Machining program (scale: 1 = not at all likely; 2 = somewhat likely; 3 = likely; 4 = very likely)

Current stage of Machining program	2015 *N* = 18	2016 *N* = 23
I earned AAS	3.0	3.5
I will not have received any degrees, certificates, or credentials at this time	3.4	3.8
I earned 1 or more certificates awarded by FVCC (Tier 1, etc.)	3.5	3.7
I received 1 or more industry credentials (NIMS, AWS, NCCER)	3.0	4.0

Source: FVCC Certificate Survey, 2015 and 2016

Students were asked *how prepared* they currently felt for high-skill, high-wage employment. Students may have reported different levels of preparation because of their specific field of their current stage within their program. To investigate this further, Table B-25 presents these results by stage of completion within the Machining program in both 2015 and 2016.

Table B-25: Average rating of the respondents who reporting *how prepared* Machining students felt they were for a high-skill, high-wage job with their current skills, by current stage (scale: 1 = need a lot more preparation; 2 = need a little bit more preparation; 3 = fairly prepared; 4= fully prepared)

Current Stage of Program	2015 *N* = 18	2016 *N* = 27
I earned AAS	3.7	2.8
Earned 1 or more certificates from FVCC	2.4	2.3
Earned 1 or more industry credentials	3.0	2.8
No degrees, certificates, or credentials	2.0	2.6

Source: FVCC Certificate Survey, 2015 and 2016

Non-Machining students reported the following results:

- The three respondents who were Electronic students reported different feelings of preparedness, with the two students who had no degrees/certificates/credentials reporting that they needed "a lot more preparation" and the other reporting that they were "fairly well prepared" for a job.
- For the one Electronics student who earned 1 or more certificate awarded by FVCC, they reported feeling like they needed "a little bit more preparation."
- For the firearms program, one student who had earned one or more certificates at FVCC, reported that they felt fairly well prepared for a high-skill, high-wage job.

- The other Firearms student who does not have any degrees/certificates/credentials reported needing "a lot more preparation."
- For the one Industrial Maintenance student respondent, they had no degrees/ certificates/ credentials but felt they were "fairly well prepared."

Feedback to Improve Student Preparation

Students were asked to describe what they felt might help them better prepare to enter a high-skill, high-wage job. The responses for each year is presented in Table B-26.

Table B-26: Respondents reports for how to become more prepared for high-wage high-skill positions

2015	2016
More time or making additional progress in the program would help	Being able to attend class in person and with hours that work with schedule
More experience would better prepare them	Better class organization
A degree beyond an AAS	Job training/ Resume/ Interview Help
More emphasis on AutoCAD was needed.	Hands on experience
Internships	NX design
"Add complex multi setup and difficult setup jobs to the second year of the program. Have very hard machining prints available to the students for capstone machinist. Extend the capstone to a 10 credit course done in two sections to capture Swiss machining, 5 axis mill, and complex mill setups."	Better program of instruction with more emphasis on large areas of manufacturing- "If it wasn't for having 6 months of mandatory work assessment in a machine shop and being taught what to do I would be totally lost on what I should be doing and not feel confident to even apply for most machinist jobs in the valley."
	Finishing up degrees/ advanced degrees/ completing higher level certificates
	Focus on "effective precision and self-quality control skills"

Source: FVCC Certificate Survey, 2015 and 2016

Value of a Credential

Students were asked how valuable they felt a credential would be to a potential local employer, and responses were mixed. Respondent results are reported in Table B-27.

Table B-27: Percent of respondents who reported how valuable the credential was to someone seeking employment in the industry among local employers (respondents could choose all that apply)

	2015 *N* = 23	2016 *N* = 49
It very valuable and would be uncommon to get a good job without it.	52	33
It depends a lot on the employer	43	67
It is valuable, but other factors are important as well, such as basic knowledge, reliability, and ability to learn on the job	52	35
It is not valuable	9	0

Source: FVCC Certificate Survey, 2015 and 2016

Job Availability and Assistance

When asked about perceptions of the availability of high-skill, high-wage jobs in their local communities, 61 percent of students felt that there were in 2015 and 73 percent of students felt there were in 2016 (Table B-28). In 2015, 39 percent of students expected to move for employment, while 39 percent did not expect to move and 22 percent were not sure. In 2016, only 18 percent expected to move, while 39 percent did not expect to move and 43 percent were not sure (Table B-29).

Table B-28: Percent of respondents who believed there are high-wage, high-skill jobs available in the local community

	2015 *N* = 23	2016 *N* = 49
Yes	61	73

Source: FVCC Certificate Survey, 2015 and 2016

Table B-29: Percent of respondents who reported expecting to move to another location for employment

	2015 *N* = 23	2016 *N* = 49
Expect to Move	39	18
Not sure	22	43
Not expect to move	39	39

Source: FVCC Certificate Survey, 2015 and 2016

When asked if students took advantage of any resources and opportunities at FVCC to support their job search, most students reported that they did not need any help or resources in both 2015 and 2016 (Table B-30). In 2015, 39 percent of students reported receiving all the help and resources they needed, as compared to 23 percent of respondents in 2016. The rest of the respondents in 2015 reported getting most or some of the help and resources they needed. Thirty-two percent of respondents reported the same, but 2 percent also reported getting none of the help and resources needed.

Table B-30: Percent of respondents who reported taking advantage of resources and opportunities available at FVCC to support a job search

	2015 *N* = 23	2016 *N* = 53
Yes, I received ALL the help and resources that I needed	39	23
Yes, I received most/some of the help and resources that I needed	17	32
Yes, I received none of the help and resources that I needed	0	2
No, I did not need any help or resources	43	43

Source: FVCC Certificate Survey, 2015 and 2016

Student's plans to continue or leave their program

Students were asked whether they were going to continue onto the next semester in their program. The majority of students reported returning in 2016 for all program areas (Table B-31). In 2015, all industrial maintenance and electronics students reported returning, while machining and firearms technology students' reports showed more variability.

Table B-31: Percent of respondents who reported plans in the Advanced Manufacturing program for next semester

	Not sure		Leaving and not returning		Leaving and hope to return		Returning	
	2015	2016	2015	2016	2015	2016	2015	2016
Machining	6	4	41	18	12	4	41	75
Firearms technology	0	0	50	0	0	0	50	100
Industrial maintenance	0	0	0	0	0	33	100	67
Electronics	0	24	0	5	0	0	100	71

Source: FVCC Certificate Survey, 2015 and 2016

In 2015, there were 17 machining respondents, 2 firearms technology respondents, 1 industrial maintenance respondent, and 3 electronics respondents. In 2016, there were 28 machining students, 3 firearms technology respondents, 2 industrial maintenance respondents, and 21 electronics respondents. Overall there were 23 student responses in 2015 and 54 student responses in 2016.

Student's Plans to Start Their Own Business

Plans for starting a new business were also explored in this survey. Most students felt that they would possibly start their own business in both years, however the second largest proportion of students felt that they probably would not (Table B-32). A notably greater percentage of students already had their own business in 2015 than in 2016.

Table B-32: Percent of respondents who reported planning to start a business

	2015 *N* = 23	2016 *N* = 49
Already have my own business	13	2
Definitely plan to start my own business	17	16
Possibly will start my own business	30	35
Probably will not start my own business	22	20
Definitely will not start my own business	9	10
I have not thought about it	9	16

Source: FVCC Certificate Survey, 2015 and 2016

Conclusions and Recommendations

Overall Satisfaction

The majority of students in both 2015 (80 percent) and 2016 (77 percent) reported being "very satisfied" with their overall experiences in the advanced manufacturing program, while 13 percent of 2015 respondents and 18 percent of 2016 respondents reported feeling "somewhat satisfied." 13 percent of respondents in 2015 and 2 percent of respondents in 2016 reported feeling "partially satisfied." No student in 2015, and only one student (2 percent) in 2016, reported that they were "not satisfied at all." When asked how likely the student would be to recommend the program to someone with similar interests, the majority of respondents (70 percent in 2015 and 81 percent in 2016) reported that they would be "very likely" to recommend the program. 17 percent of students in 2015 and 13 percent of students in 2016 reported feeling it would only be "somewhat likely" that they would recommend the program, while 12 percent of students in 2015 and 6 percent of students in 2016 felt that they would "not very likely" recommend it.

Areas of Strength

In general, the trends observed in 2015 were not markedly different than those observed in 2016. Items on the FVCC Certificate survey that asked about the quality of the advanced manufacturing programs were generally met with positive responses. Coursework was rated as challenging and students felt that their programs were helping them to refine skills they thought was relevant and important for an employer. Those skills that seemed to be important to students and emphasized in the program were generally consistent over the two years.

Workforce Navigators seemed to play an integral role to most students in the Advanced Manufacturing program. The majority of student respondents over the two years reported learning about the advanced manufacturing program from a workforce navigator. Students also mostly reported Workforce Navigators as being responsive, sufficient in their answers to questions, and were found to provide useful information. In 2016 particularly, the Workforce Navigators seemed to provide a lot of additional support to students who chose to take the NCRC exam.

Areas of Improvement and Recommendations

In 2016, there was an increase in the percentage of students who reported working full time, with over half of the students reporting working full or part-time in both years. One student reported that they were unsure if they were going to continue the program because of job obligations in 2015 (Check 2016).**One way to help students stay and succeed in the program is to offer more flexibility of courses to accommodate the schedules of working-students.** Students could be surveyed about their work hours, and try to create classes that work around those hours (e.g. night classes, or early morning classes), or build in flexibility.

When student respondents were asked about what they thought a high-skill, high-wage job was, the answers varied but covered a similar range of definitions in both years. Some students thought that over $20 an hour, others thought over $50 an hour, and some only reported that they required technical skills. We believe that there may be such a wide variety of student answers because it is not clear to students how much a high-skill, high-wage worker in their area makes, or exactly what skills are most required of those workers. **Providing students with information on current position listings, or bringing in graduated students to talk about their experiences in the job market may help students to understand what they can expect to make as a high-wage, high-skill worker.**

Avenues of support to exchange feedback between students and workforce navigators might also help with this issue. For example, one student recommended that Autocad be more emphasized to help students prepare to enter the workforce. By **creating an open forum online or hosting job preparation meetings after hours,** Workforce Navigators and Instructors can hear these suggestions and start to help implement them, guide the student to resources, or have a conversation about why employers don't need their workers to know Autocad.

Additionally, many students seemed concerned that workforce navigators were not as accessible as they would have liked and found it difficult to develop familiar and amicable relationships with them. In general, ratings about workforce navigator quality of support were slightly less in 2016. **Building a scheduling structure that will allow workforce navigators to regularly check-in with students** may help students feel more readily supported. Additionally, many students in 2016 communicated their desire to have more professional and academic resources to leverage, like study skills workshops and training in quality professional correspondence, which can certainly be an area of growth.

An interesting finding in this survey has been that half of the students who reported earning one or more industry credentials claimed that they felt they needed a little bit more, or a lot

more preparation in order to get a high-skill, high-wage job. The other half reported that they were fairly well prepared, and no student felt they were fully prepared. Similarly, three of the four students who reported earning one or more certificates from FVCC felt that they needed a little bit more or a lot more preparation to get a high-skill, high-wage job. When students provided suggestions on how to better prepare, two reported feeling more experience would help, and one reported internships**. Providing students with an opportunity to gain more direct experience beyond the classroom, such as in the case of internships or assistantships, might help students prepare, and feel prepared to enter the job market**.

Student ratings on how much emphasis was given to program-specific skills by their program were often mixed— a sign that skills might be taught inconsistently. Some skills in Machining, such as "discuss processes necessary to cast and mold materials in a manufacturing laboratory environment," had an average score rating of 2.4, with students reporting that it was both emphasized "a great deal" and "not at all." With such differing opinions, **faculty could arrange to connect with one another and decide 1) if they feel these student ratings are accurate, and 2) if they are, where can they make improvements to emphasize the specific skills. Faculty can also work to prioritize which skills would best translate to a high-skill, high-wage career and focus instruction on them.**

Appendix A

Machining skills emphasized by program

Table B-33: Average rating of the machining program respondents who reported that they learned the learning objectives of the machining program (scale: 1 = not at all; 2 = somewhat; 3=a lot; 4 = a great deal)

Machining Outcomes	2015	2016
Use tools and equipment to form and shape various materials in a manufacturing laboratory environment	3.2	3.2
Discuss processes necessary to cast and mold materials in a manufacturing laboratory environment	2.4	2.4
Use tools and equipment to machine various materials	3.4	3.3
Safely operate basic machinery and equipment	3.3	3.3
Read and understand the various symbols and features of a blueprint	3.1	2.9
Distinguish between various views represented on typical manufacturing blueprints	3.2	2.9
Locate materials list and identify the material call-outs on lists of materials	2.8	2.9
Read and interpret information on various manufacturing blueprint drawings	3.0	2.9
Identify features contained on a blueprint in relation to actual work piece and identify features of the design part in relation to machining production methods	2.9	2.9
Identify and apply quality control procedures to ensure product integrity	3.1	2.8
Accurately measure and record dimensions with micrometers and calipers	3.3	3.2
Define quality and the precision measurements associated with a machined part	3.1	3.0
Demonstrate quality assurance and quality management techniques	2.9	2.6
Accurately measure and identify various types of threads	3.3	2.8
Perform job set-up*	-	3.0
Perform manual operation*	-	3.4
Organize and develop a logical written representation of one's thoughts; craft and execute a variety of professional quality correspondence, including a resume*	-	2.5
Utilize and apply mathematical operations, measurement, introductory geometric principles, and applied algebra into technical applications in academic and workplace situations*	-	3.2

Source: FVCC Certificate Survey, 2015 and 2016
Note: Questions marked with * were not included in the 2015 survey

Industrial maintenance skills emphasized by program

Table B-34: Average rating of the industrial maintenance program respondents who reported that they learned the learning objectives of the industrial maintenance program (scale: 1 = not at all; 2 = somewhat; 3=a lot; 4 = a great deal)

Industrial Maintenance Outcomes	2015	2016
Understand and use Ohm's Law in practical situations	2.0	3.3
Demonstrate the use of test equipment to troubleshoot	2.0	2.7
Describe the features associated with static electricity	3.0	2.3
Use tools and equipment to form and shape various materials in a manufacturing laboratory setting	3.0	3.0
Discuss processes necessary to cast and mold materials in a manufacturing laboratory environment	2.0	3.3
Use tools and equipment to machine various materials	3.0	3.0
Safely operate basic machinery and equipment	4.0	3.0
Read and understand the various symbols and features of a blueprint	4.0	3.3
Distinguish between various views represented on typical manufacturing blueprints	4.0	3.3
Locate materials list and identify the material call-outs on lists of materials	3.0	3.3
Read and interpret information on various manufacturing blueprint drawings	3.0	3.3
Identify features contained on a blueprint in relation to actual work piece and identify features of the design part in relation to machining production methods	3.0	3.3
Organize and develop a logical written representation of one's thoughts; craft and execute a variety of professional quality correspondence, including a resume	2.0	2.7

Source: FVCC Certificate Survey, 2015 and 2016

Electronic skills emphasized by program

Table B-35: Average rating of the electronics program respondents who reported that they learned the learning objectives of the electronics program (scale: 1 = not at all; 2 = somewhat; 3=a lot; 4 = a great deal)

Electronics Outcomes	2015	2016
Read and interpret basic circuit diagrams and schematics	2.5	3.3
Identify and use in basic electrical circuits components such as transistors, resistors, capacitors, inductors, and diodes	2.5	3.2
Use ohmmeters, ammeters, voltmeters, multi-meters, signal generators, and oscilloscopes to make measurements of electrical quantities in a laboratory setting	1.5	2.9
Design basic circuits and experiments to test theoretical predictions by experiment	2.0	2.7
Demonstrate a working knowledge of accepted electrical laboratory procedures, methods, and safety practices	2.0	2.9
Understand and use Ohm's Law in practical situations	2.5	3.6
Demonstrate the use of test equipment to troubleshoot	1.5	2.7
Describe the features associated with static electricity	2.0	2.8
Understand alternating and direct current and how they are produced	2.5	3.5
Demonstrate an advanced understanding of Ohm's and Kirchoff's Laws	2.5	3.4
Understand magnetic induction, capacitive and inductive reactance and resistance, and their relevance in series and parallel circuits	2.5	3.2
Use basic trigonometry and vector algebra in the solution of electrical problems	2.5	3.3
Utilize and apply algebraic skills, geometric principles and theorems, and right and oblique trigonometric relationships to solve industrial and technical applications in academic and workplace situations	2.5	3.2
Organize and develop a logical written representation of one's thoughts; craft and execute a variety of professional quality correspondence, including a resume	3.0	2.8

Source: FVCC Certificate Survey, 2015 and 2016

Appendix C: Flathead Valley Community College Foundational Math Student Survey

In fall 2015, FVCC foundational math faculty, in collaboration with RTI evaluators, administered a math survey to all foundational math students.

Seventy-three students completed the survey. Table C-1 provides background information on the survey participants.

Table C-1: Percent of survey respondents, by current math class, in different demographic categories

Current Class	Number of Respondents	Percent of Respondents	Percent Enrolled in Previous FVCC Class	Percent Male	Percent Female
Math 90	33	45	40	24	76
Math 95	40	55	83	30	70

Source: FVCC Foundational Math Survey, 2016

Table C-2: Percent of survey respondents, by age, by current math class

	17 or younger	18 –23	24 –30	31 –37	38 –45	46 –55	Older than 55
Math 90	0	58	24	6	3	6	3
Math 95	3	68	18	8	0	5	0
Total	**1**	**63**	**21**	**7**	**1**	**5**	**1**

Source: FVCC Foundational Math Survey, 2016

Table C-3: Percent of respondents by time since last math class, by current math class

	Within the Past Year	2–3 years ago	4–5 years ago	6–10 years ago	More than 10 years ago
Math 90	39	12	15	15	18
Math 95	53	18	8	10	13
Total	**47**	**15**	**11**	**12**	**15**

Source: FVCC Foundational Math Survey, 2016

Table C-4: Percent of respondents by degree pursued, by current math class

	Career & Technical Degree (Certificate, CAS, AAS)	Transfer Degree (AA, AS)	None; Transferring Before Degree	Other	Unsure
M090	39	58	0	3	0
M095	25	65	3	6	3
Total	**32**	**62**	**1**	**3**	**1**

Source: FVCC Foundational Math Survey, 2016

Table C-5: Percent of respondents who believed the placement test placed them in the appropriate math class

Appropriate for my skill level at that time	82
Not appropriate for my skill level at that time - it was too easy	7
Not appropriate for my skill level at that time - it was too challenging	3
Not applicable - I did not enroll in the course indicated by my placement test (I had a prior course, received an override, etc.)	8
Total	**100**

Source: FVCC Foundational Math Survey, 2016

Table C-6: Percent of respondents who reported appropriate levels of interaction with their instructor, by current math class

	There is too much interaction with the instructor	There is just the right amount of interaction with the instructor	There should be more interaction with the instructor
M090	0	91	9
M095	3	95	3
Total	**1**	**93**	**5**

Source: FVCC Foundational Math Survey, 2016

Table C-7: Percent of respondents who reported appropriate levels of interaction with other students, by current math class

	There is too much interaction with other students	There is just the right amount of interaction with other students	There should be more interaction with other students
M090	6	91	3
M095	0	93	8
Total	**3**	**92**	**5**

Source: FVCC Foundational Math Survey, 2016

Table C-8: Percent of respondents who reported the ease or difficulty of online program, by current math class

	The online program is easy to use	The online program is mostly easy, but there are some things I have difficulty with
M090	58	42
M095	68	33
Total	**63**	**37**

Source: FVCC Foundational Math Survey, 2016

Table C-9: Percent of respondents who reported how they work best, by current math class

	Working on the online program	Attending class and/or working with the instructor	Working with other students	Working in the Foundational Math Center
M090	39	30	3	27
M095	20	50	5	25
Total	**29**	**41**	**4**	**26**

Source: FVCC Foundational Math Survey, 2016

Table C-10: Percent of respondents who were comfortable with different pedagogies

	Working on the online program	Attending class and/or working with the instructor	Working with other students	Working in the Foundational Math Center
Very comfortable	28	47	0	26
Somewhat comfortable	32	36	8	24
Somewhat uncomfortable	25	25	0	50
Very uncomfortable	0	0	100	0
Total	**29**	**41**	**4**	**26**

Source: FVCC Foundational Math Survey, 2016

Table C-11: Percent of respondents who reported on the accessibility of the Foundational Math Center

It is open the right amount of hours	71
It is open too few hours	7
It should be open earlier	7
It should be open later	15
Total	**100**

Source: FVCC Foundational Math Survey, 2016

Table C-12: Percent of respondents who reported on the usefulness of the Foundational Math Center tutoring

Essential - I would not pass the class without it	29
Useful - it helps me learn some of the things I didn't quite get in class	49
Somewhat useful - I rarely spend more than the required amount of time in the Foundational Math Center	14
Not useful - I don't feel that I need tutoring	7
Not useful - it is difficult to get help because it's too busy	1
Total	**100**

Source: FVCC Foundational Math Survey, 2016

Table C-13: Percent of respondents who feel prepared for the next math class, by current math class

	Very prepared	Somewhat prepared	Not very prepared	Not at all prepared
M090	48	42	6	3
M095	48	48	5	0
Total	**48**	**45**	**5**	**1**

Source: FVCC Foundational Math Survey, 2016

Table C-14: Percent of respondents reporting on their next math class, by current math class

	M090	M095	Total
M065 - Prealgebra	0	3	1
M094 - Quantitative Reasoning	18	0	8
M095 - Intermediate Algebra	45	0	21
M114 - Technical Math	0	5	3
M115 - Probability and Linear Math	0	28	15
M120 - Math with Health Care Applications	0	8	4
M132/133 - Math for K–8 Teachers	0	10	5
M145 - Math for the Liberal Arts	0	10	5
M152 - Precalculus Algebra	3	13	8
Other math course	0	5	3
None - I plan to take my next math course at a transfer institute	9	10	10
None - I do not plan on taking any more math courses	24	10	16

Source: FVCC Foundational Math Survey, 2016