

Math Pathways in Washington State Community and Technical Colleges: Results from Analysis of Math Flow Charts

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As part of an Edmonds Community College Professional Leave project and the recommendations developed by the Math Pathways to Completion (MPC) Task Force, Pat Averbeck, with the assistance of Helen Burn, investigated the current status of math pathways in community and technical colleges (CTCs) in Washington State. The results of this research will inform Recommendation 1 and 2 of the MPC project:

Recommendation 1: Provide students, faculty and advisors greater clarity and consistency about the math pathways (based on major and career goals) currently available at Washington higher education institutions.

Recommendation 2: Develop a rationale for math pathways in Washington, including evidence for promising models and approaches that accelerate student progress into and through college-level gateway math courses.

Methods

The full research project will be conducted in three stages: (1) development and analysis of flowchart of mathematics course offerings at the 34 CTCs in Washington state; (2) interviews with a mathematics faculty member in each department to confirm flowcharts and gather information about motivations of program development and future plans of program, the department's assessment of mathematics programs, typical mode of instruction of pre-college mathematics courses, and placement; (3) analysis of effectiveness of pre-college programs from state data. This preliminary report focuses on the first stage.

The first stage of this project was to gather information about the mathematics course offerings at the CTCs in Washington. During Fall Term 2016, Pat visited the 34 colleges' websites to obtain information about their mathematics course offerings. A number of CTCs presented a mathematics course flowchart on the college's website. Other colleges' course offerings were obtained from the college's catalog. To increase the ease of comparing the 34 CTCs, the flowcharts and catalog information were translated into a common flowchart format developed for this project (see Chart 1). In total, 33 flowcharts were developed as both campuses of Pierce College had the same course offerings and as a result were combined into a single flowchart.

In December 2016, Helen and Pat met in person to examine the 33 flowcharts, looking for patterns in the following areas: (1) college level math pathways with specific focus on Elementary Education and Business pathways, and (2) pre-college pathways. To analyze the flowcharts, printouts of the flowcharts were made and then grouped with agreement of both researchers. Then during the 2017 Winter Term, Pat interviewed faculty and staff at the colleges to confirm the flowcharts and re-examined groups with the same criteria used earlier.

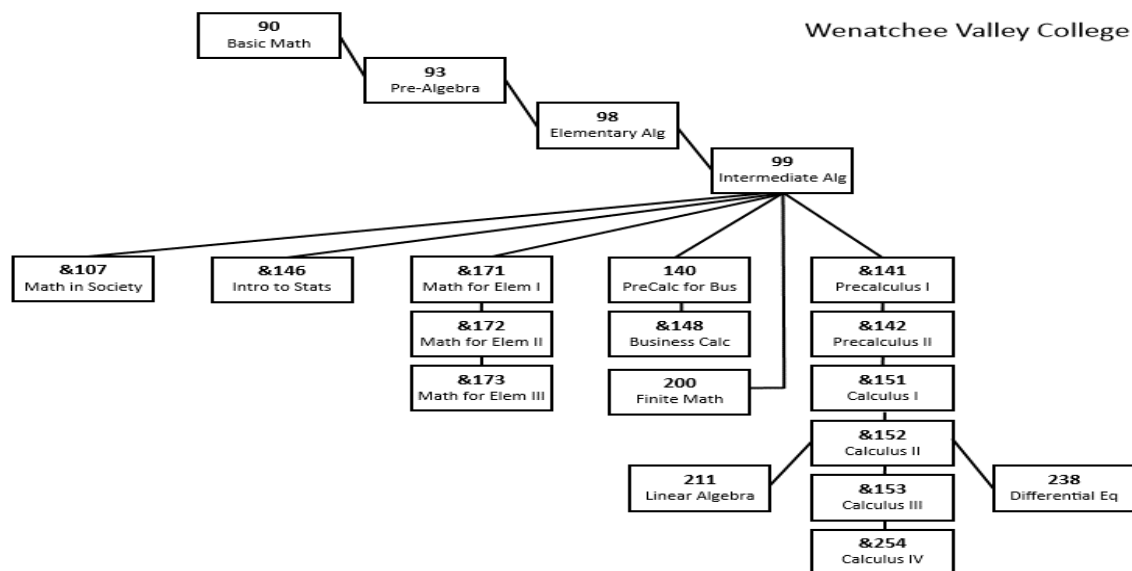


Chart 1: Common flowchart format developed to aid analysis

College-Level Math Pathways

Washington has a Direct Transfer Agreement (DTA) that articulates transfer between the state community and technical colleges (CTCs) and baccalaureate institutions across the state.¹ In 2013, the DTA was renegotiated and adjusted so that the Quantitative/Symbolic Reasoning (QSR) requirement outlines five major college-level math pathway options that satisfy transfer requirements: Precalculus or higher, Mathematics for Elementary Education, Business Precalculus/Finite Mathematics, Statistics, and Math in Society. For ease of reading and to avoid confusion with pre-college math pathways, we refer to these pathways as the “DTA math pathways” and to Math in Society as the “Liberal Arts” DTA math pathway.

Currently, 19 CTCs (58%) have all five DTA math pathways. When a CTC does not offer all five, the missing pathway tends to be the Business pathway and/or the Elementary Education. Concerning the Business DTA math pathway, 27 CTCs (82%) offer a 2-course sequence for business transfer students: Business Pre-calculus/Finite Math/Applied followed by Business Calculus (Math& 148). Five CTCs offer Business Calculus (Math&148) but require or highly recommend the STEM Precalculus (Math&141) as the prerequisite (see Chart 2). Due to low demand for the Business DTA math pathway, two technical colleges do not offer the Business DTA math pathway and instead require business transfer students to take the Precalculus DTA math pathway. Regarding the Elementary Education DTA math pathway, currently 19 CTCs (58%) offer the Elementary Education DTA math pathway (five offer a 3-course sequence and

¹ The QSR requirements can be found on page 15 of the Intercollege Relations Committee (ICRC) Handbook <http://www.washingtoncouncil.org/ICRC%20Documents/2016%20ICRC%20HANDBOOK.pdf>. The SBCTC has a common course numbering system but no common course descriptions. Some but not all of the DTA math pathway courses have common course numbers designated by “Math& XXX”: Precalculus (Math& 141), Math in Society (Math& 107), Math for Elementary Education (Math& 131/132 or Math& 171,172,173), and Introduction to Statistics (Math& 146). However, some colleges have developed their own statistics courses that satisfy the DTA , and there is variation in using the common course numbers for Mathematics for Elementary Education. Further, Business Precalculus/Finite Mathematics does not have a common course number. The QSR requirement can also be satisfied by completing a course in Symbolic Logic.

14 offer a 2-course sequence). Math faculty at colleges that did not offer the Elementary Education DTA pathway indicated two main reasons for not offering the courses: (1) low enrollment numbers, and (2) coordination with the program at the nearby 4-year university.

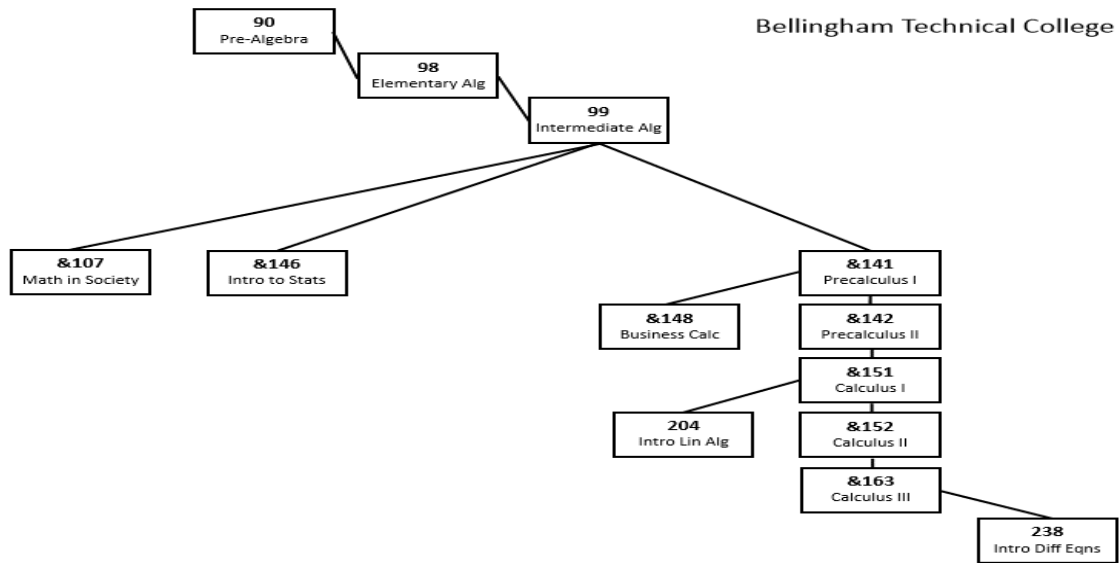


Chart 2: CTC with a non-standard Business DTA math pathway

Pre-college Math Pathways

Examination of the pre-college programs revealed three models: (1) single pathway model, (2) single pathway with "off ramps" model, and (3) tailored pathway model. Appendix A lists the colleges that use each. First, the single pathway model consists of three or more algebra courses that lead to all DTA math pathways offered (see Chart 2). Seven CTCs (21%) use a single pathway model including three of the five technical colleges. Several CTCs offer parallel pathways in which the pre-college course objectives are met through a single course or spread out over two courses (see Chart 3). These were designated as a single pathway model.

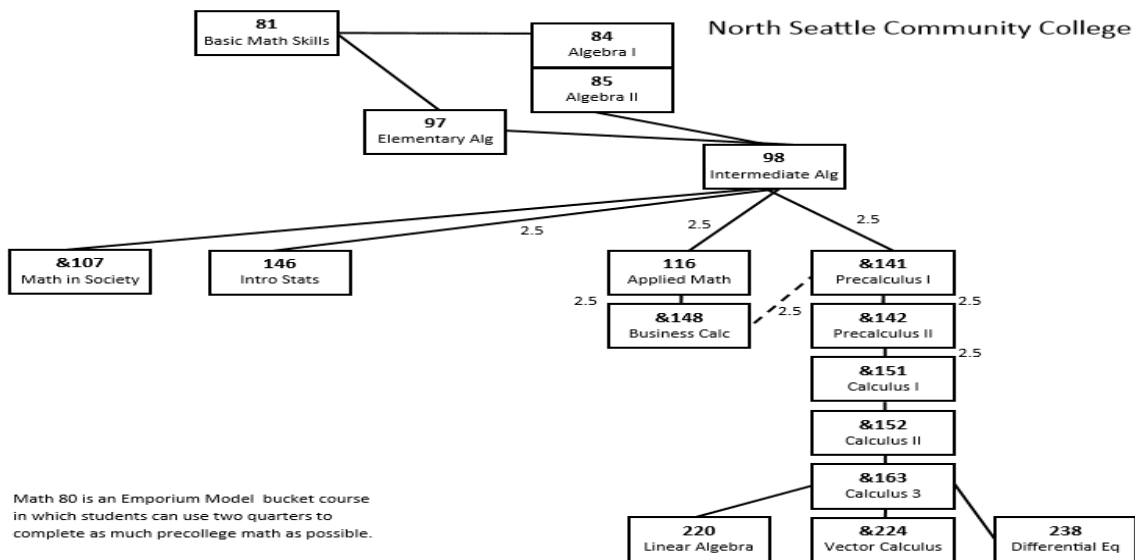


Chart 3: CTC that uses a single pathway with a slower paced option

The second model—the off ramps model—is used by 11 CTCs (33%) and closely resembles the single pathway model. However, in the off-ramps model, students can exit the pre-college sequence one course earlier and enroll in a limited number of DTA math pathways (see Chart 4). All 11 CTCs allow off ramps for the Liberal Arts and Statistics DTA math pathways. Six CTCs allow off ramps for the Elementary Education DTA math pathway and four allow off ramps for the Business DTA math pathway. And, four CTCs allow off ramps to all nonSTEM DTA pathways that each college offers (see Appendix A).

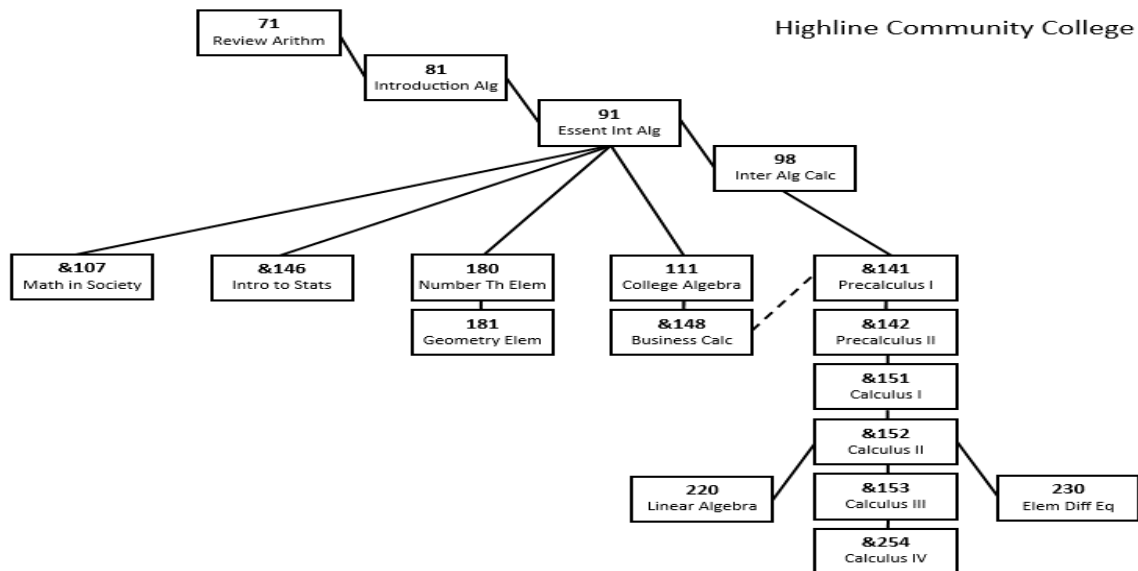


Chart 4: Single pathway with off ramps to four DTA math pathways

The third pre-college pathways model—the tailored pathways model—is defined by the existence of one or more uniquely designed pre-college math courses, separate from the single pathway, which lead to a limited number of DTA math pathways, typically the Liberal Arts and Statistics DTA math pathways. We note that historically, in the late 1990s and early 2000s, three CTCs (Tacoma, Highline and Edmonds College) separately developed such a unique course that allowed students to leave the single pre-college math pathway in order to reach the Liberal Arts or Statistics DTA math pathways. This work was done by individual faculty at Tacoma and Highline Colleges; Edmonds College created its course as part of their work with the Transition Mathematics Project. However, concerns of 4-year institutions placed a temporary hold on the use of this pathway. In 2013, the QSR requirement in the DTA was renegotiated and adjusted to allow CTCs to modify their pre-college programs to meet the needs of their students based on major or career goals.²

² One exception to this policy is that the University of Washington continues to require two years of high school algebra (Algebra II or Integrated Math III) or traditional intermediate algebra course (typically Math 98 or 99 in the SBCTC system) for admission. Further, ICRC Handbook that states that “to qualify for QSR, college level math and logic courses must require intermediate algebra course work (high school or college) with a grade of 2.0 or higher as a prerequisite”(p. 15).

Fifteen CTCs (45%) have a tailored pathway model, and these fall into two types: a redesigned Intermediate Algebra pathway (Chart 5) or a non-algebraically intensive pathway (Chart 6). Currently, seven colleges offer redesigned Intermediate Algebra only, five colleges offer a non-algebraically intensive pathway only, and three colleges offer both types of tailored pathways (see Appendix A).

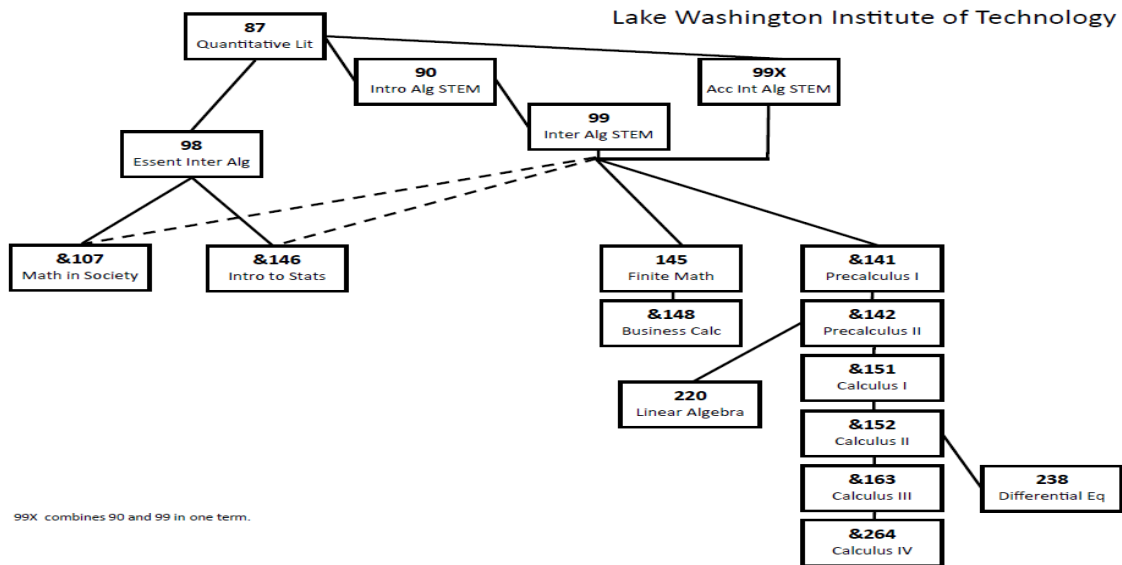


Chart 5: Tailored pathway with redesigned intermediate algebra

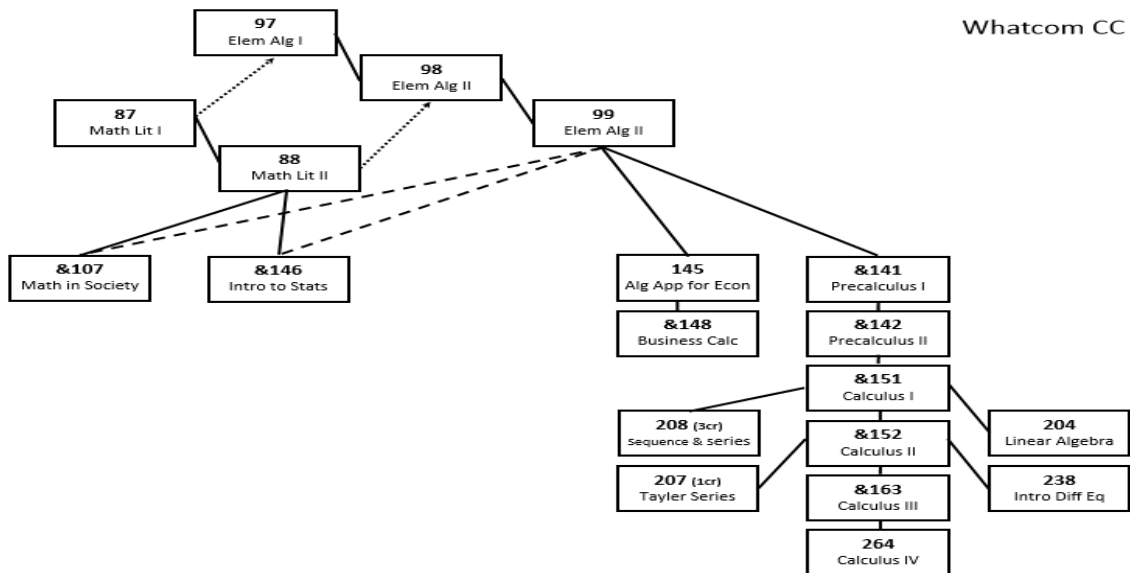


Chart 6: Tailored pathway with non-algebraically intensive pathway (Math Lit I and II)

In the redesigned Intermediate Algebra pathway, students can leave the single pathway to take one or two uniquely designed pre-college courses (e.g., Essentials of Intermediate Algebra) that lead to some DTA math pathways (see Chart 5). Ten CTCs (30%), including the three CTCs which offer both forms of the tailored model, have created a redesigned Intermediate Algebra

pathway. Of these, three CTCs provide a tailored path to Liberal Arts DTA pathway only and the other seven provide a tailored path to Liberal Arts and Statistics DTA pathway. Four provide a path to the Elementary Education DTA math pathway and three provide a path to the Business DTA math pathway. And, two of these CTCs provide a path to all nonSTEM DTA pathways that each college offers (see Appendix A).

The second type of tailored pathway consists of non-algebraically intensive pre-college mathematics courses that exist outside of the single pathway and are tailored to specific DTA math pathways (see Math Lit I and II in Chart 6). These courses included Statway® developed by the Carnegie Foundation and math literacy promoted by AMATYC. Eight CTCs (24%) offer at least one of these tailored pathways, including the three CTCs which offer both forms of the tailored model (see Appendix A). Five offer a tailored pathway only to the Statistics DTA math pathway, with four of these offering Statway® to Math 136. Three CTCs offer a tailored pathway leading to both the Liberal Arts and Statistics DTA math pathway.

Conclusion

Two-year mathematics faculty in Washington have been innovators in responding to student needs by expanding and modifying their course offerings. This was partly enabled by changes made in 2013 to the QSR requirements in the DTA that provided CTCs flexibility in designing responsive courses at the pre-college level. Analysis of the mathematics course offerings gleaned of the flowcharts confirmed in interviews with staff and faculty at the colleges revealed that 19 CTCs (58%) offer all five DTA math pathways courses, and the remaining 14 are missing only the Math for Elementary Education pathway or portions of the Business DTA pathway.³ Analysis of math pathways at the pre-college level revealed that 26 CTCs (79%) have modified their pre-college math programs to assist students in reaching their DTA goals. Eleven CTCs (33%) implemented the off-ramp model where students can leave the single pathway early to take a specific DTA math pathway courses, typically the Liberal Arts or Statistics DTA math pathway. Colleges vary in allowing Elementary Education and Business majors the off-ramp option. Fifteen CTCs (45%) have implemented a tailored pathway that includes a unique pre-college math course designed to serve as a prerequisite for specific DTA math pathways, typically Liberal Arts and/or Statistics. Of the CTCs with a tailored pathway, seven have a redesigned intermediate algebra, five have a non-algebraically intensive course, and three have a combination of both models. Only seven CTCs (21%) retain the traditional single pathway model for their pre-college math program.

³ Recall, the two Pierce College campuses were combined for this analysis leading to a final sample size of 33 CTCs.

Appendix A

Pre-college Math Pathway Models at the CTCs

Model	Colleges
Single ($n=7$)	Bates TC, Bellingham TC ^b , Clover Park TC, Green River CC, Grays Harbor C, North Seattle CC, and Wenatchee CC
Off ramps ($n=11$)	
To LA ^a and Stats	Bellevue C ^c , Big Bend CC, Shoreline CC, Skagit Valley C, and South Puget Sound CC
To LA, Stats, and EE	Cascadia C and Pierce C
To LA, Stats, and Bus	Edmonds CC
To LA, Stats, EE, and Bus	Highline C, Peninsula C, and Walla Walla CC ^b
Tailored ($n=15$)	
Redesigned Intermediate Algebra ($n=7$)	
To LA only	Clark C ^b , Everett CC ^d , and Olympic C ^e ,
To LA and Stats	Columbia Basin C ^f , and Lake Washington IT
To LA, Stats, & EE	Lower Columbia C and Yakima Valley CC
Non-Algebra Intensive ($n=5$)	
To Stats only	Centralia C, Renton TC, and South Seattle CC
To LA and Stats	Spokane Falls CC and Whatcom CC
Both types of tailored ($n=3$)	Seattle Central CC ^g , Spokane CC ^h , and Tacoma CC ⁱ

Note. ^aLA = Liberal Arts DTA math Pathway, Stats = Statistics DTA math Pathway, EE = Elementary Education DTA math Pathway, Bus = Business DTA math Pathway.

^bBellingham, Clark, and Walla Walla colleges are in the initial stages of modifying their precollege programs.

^cBellevue College will be offering a tailored math course providing paths to LA and Stat in 2017-18.

^dEverett CC will be transitioning to the off ramps model in 2017-18.

^eOlympic College is developing a prerequisite to Stats.

^fColumbia Basin has been piloting a 10 credit course as a prerequisite to Stats.

^gFor Seattle Central CC the redesigned Intermediate Algebra pathway provides a path to LA, Stats, and Bus and the non-algebraic intensive pathway provides a path only to Stats.

^hFor Spokane CC the redesigned Intermediate Algebra pathway provides a path to LA, Stats, and Bus and the non-algebraic intensive pathway provides a path to LA and Stats.

ⁱFor Tacoma CC the redesigned Intermediate Algebra pathway provides a path to LA, Stats, EE, and Bus and the non-algebraic intensive pathway provides a path only to Stats.