COLLEGE SPARK WASHINGTON

# Post-Achieving the Dream Study Math Reform Issue Brief

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Two cohorts of 16 Washington community and technical colleges participated in Achieving the Dream (AtD) from 2006 through 2015, with the goal of increasing student success and closing equity gaps. Funding for these cohorts was provided by College Spark Washington. As part of the initiative, we conducted an independent, third party evaluation, also funded by College Spark, to document and evaluate the impact of AtD on participating colleges, provide timely feedback to the colleges to help inform their efforts, and document lessons learned and their implications for policy, practice, and systems. This included conducting regular college site visits and structured interviews, analyzing Student Achievement Initiative (SAI) data provided by the State Board for Community and Technical Colleges, participating in statewide meetings of the colleges, and reviewing AtD reports and other documents.

This issue brief is part of a post-AtD study funded by College Spark that takes a deeper look at the impact of AtD on participating colleges and their implications for efforts to increase student success and close equity gaps moving forward.

This issue brief focuses on math reform. It analyzes colleges' AtD precollege math reform interventions, results, lessons learned, and their implications for policy, practice, and systems. It draws on evaluation work done over the years of the initiative, a review of colleges' AtD annual reports, a follow-up survey of colleges, an analysis of State Board data, and a review of research in the field.

The 16 colleges that participated in AtD with College Spark support were not alone in undertaking math reforms during this time period. Other colleges in the state also worked on the issue and the State Board helped support math reform throughout the system by providing a broad model for reform and redefining SAI momentum points to emphasize transition from precollege to college level coursework. However, the 16 colleges provide a microcosm for examining the issue of math reform, the results and lessons learned.

**About this series:**

This is the last in a series of issue briefs analyzing the impact of Achieving the Dream on two cohorts of 16 Washington community and technical colleges that participated in AtD from 2006 through 2015, with funding support from College Spark Washington; and the implications for efforts to increase student success and close equity gaps moving forward.

The first issue brief focused on institutional change and assessed the progress made by colleges in achieving broad institutional change and the factors affecting this, positive and negative. The second focused on efforts to transform advising and reviewed colleges' AtD advising interventions, and profiled two colleges' interventions that took a systems approach and built an enhanced, proactive advising model. The third focused on large scale, strategic professional development and its connection to student success and equity, and profiled three colleges' interventions (active learning and Reading Apprenticeship). Each issue brief also highlighted lessons learned and their implications for policy, practice, and systems.

All of the issue briefs are available at http://collegespark.org/grantee-results/achieving-the-dream/.

## Math reform and its connection to student success and equity

College math plays a key gatekeeper role in degree completion at community and technical colleges, and the precollege math sequences meant to lead students successfully to and through college math themselves present significant barriers to student retention and completion. Thus, precollege math reform has been a key focus of many Achieving the Dream interventions. These reform efforts have sharply increased over the last decade as both practitioners and researchers have come to recognize the critical importance of helping students complete the college math they need to earn their college credentials.

Several key points about precollege math are now well established in the national literature: a majority of entering college students are placed in precollege math; most who are placed do not complete the entire precollege math sequence or college math; and not completing college math is a significant barrier to degree completion for both transfer and workforce students.[1] Achieving the Dream's emphasis on closing equity gaps has also been a driver of precollege math reform work, because low income students and students of color have typically been placed in precollege math at higher rates.[2] These patterns hold true for Washington.

Moreover, completing college math early on is associated with higher rates of degree completion down the road. For example, Washington data indicate that students who complete college math in their first year earn transfer and workforce degrees at a higher rate than those who do not.[3]

1. See Thomas Bailey and Shanna Smith Jaggars, "When College Students Start Behind" (2016), available at https://tcf.org/content/report/college-students-start-behind; and Community College Research Center, What We Know About Developmental Education Outcomes (2014), available at https://ccrc.tc.columbia.edu/media/k2/attachments/what-we-know-about-developmental-education-outcomes.pdf.

2. See Bruce Vandal, "Remedial Education's Role in Perpetuating Achievement Gaps" (2016), available at https://completecollege.org/article/remedial-educations-role-in-perpetuating-achievement-gaps/; and Elizabeth Ganga, Amy Mazzariello, and Nikki Edgecombe, Developmental Education: An Introduction for Policymakers (2018), available at https://ccrc.tc.columbia.edu/publications/developmental-education-introduction-policymakers.html.

3. Washington State Board for Community and Technical Colleges, Guided Pathways database. Dashboard use licensed under https://creativecommons.org/license/by/4.0/

## Washington Community and Technical Colleges' AtD Precollege Math Reform Interventions

Almost all of the 16 Washington community and technical colleges that participated in Achieving the Dream with College Spark support undertook precollege math reform interventions. These fell into several categories:

### Advising/Mentoring

A quarter of colleges provided advising and mentoring to students starting math at the precollege level. Specific interventions included advising students on the importance of taking math early as well as what math course sequences to take and what kinds of support were available; and providing faculty and staff mentoring to address key student attributes (e.g., active engagement, responsibility, and perseverance), connect them to available resources, and help build relationships and connections to the college community.

### Placement/Test Prep

Over a third made changes in their math placement policies and practices. Specific interventions included developing new placement tests, using high school transcripts for placement purposes, and providing math brush-up sessions, refresher courses, and boot camps.

### Instructional Supports

Almost half of colleges offered instructional supports to students starting math at the precollege level. Specific interventions included offering supplemental instruction, math study sessions, support courses, and tutoring.

### Curriculum/Instruction

Almost two-thirds made changes to their math curriculum and instruction, with a focus on the precollege level. Specific interventions included shortening the pre-college sequence; developing a self-paced, modularized curriculum; creating math pathways (e.g., STEM and non-STEM); and incorporating instructional activities and techniques focused on productive persistence, growth mindset, efficacy and resiliency, and active learning.

(A table showing the 16 colleges and their precollege math reform interventions is included at the end of this issue brief.)


Most colleges that were part of the first AtD cohort (2006-10) started out by focusing their precollege math reform interventions on advising and mentoring; placement test prep; and instructional supports such as supplemental instruction, study sessions, support courses, and tutoring. Most were outside of class and optional in nature. Challenges included limited participation and limited impact.

This led a number of colleges in the first AtD cohort, either toward the end of their initial AtD participation or shortly thereafter, to shift their focus to making more fundamental, structural changes to their precollege math curriculum and instruction.

Big Bend, for example, adopted the Emporium model, which features a flipped classroom, with class time used for higher order thinking and activities; required attendance; online homework, with instant feedback; on-demand help available from instructors and tutors; competency-based modules; and a flexible pace. Seattle Central and Tacoma adopted Statway, which is an accelerated math pathway that leads to college level statistics and includes productive persistence and growth mindset activities.

Colleges using these models reported increased success rates in the limited numbers of sections offered.

Colleges that were part of the second AtD cohort (2011-15), for the most part, started where the first cohort of colleges ended up: making more fundamental, structural changes to their pre-college math curriculum and instruction. Much of the focus was on shortening the precollege sequence and modularizing the curriculum. Some also addressed the issue of placement, including developing new placement tests and multiple placement methods such as use of high school transcripts.

Lower Columbia is one example of a college that took a more comprehensive approach to math reform. It developed new diagnostic testing; created a math boot camp; began using high school transcripts for placement purposes; shortened the precollege math sequence; developed a self-paced, modularized curriculum; and developed a non-STEM math pathway. Lower Columbia reported a decrease in enrollment in precollege math, indicating more students starting at college level; and an increase in precollege and college math success rates.

The shifting nature of precollege math reform interventions undertaken by the AtD cohorts in Washington —from a focus on advising and mentoring, placement test prep, and instructional supports to more fundamental, structural changes in curriculum and instruction—closely parallels the evolution of developmental education reforms across the country.

Jaggars and Bickerstaff, in their analysis of the evolution of developmental education, describe three waves of reform.[4] They note the first wave included interventions such as tutoring, supplemental instruction, intensive advising, college success courses, computer-assisted courses, and learning communities. However, as with the two AtD cohorts in Washington, these reforms were small in scale and had limited impact on student outcomes.

Second-wave reforms focused on assessment, acceleration, and curriculum content and pedagogy, according to Jaggars and Bickerstaff. Assessment reforms included developing customized tests, preparing students for placement tests, using multiple placement measures, and lowering cutoff scores. Acceleration strategies included compression and co-requisite models, modularization, and I-BEST. And reforms to curriculum and pedagogy included contextualization, development of students' metacognition skills, and math pathways.

In comparing the math reform efforts of the two AtD cohorts in Washington to the two waves of developmental education reform across the country, there are many similarities but also some differences. For example, two approaches that received less attention here were the lowering of placement test cutoff scores and the co-requisite model.

Research conducted by Scott-Clayton found that about one quarter of students placed in developmental math could have earned a B or better in college math if they had been placed there directly.

Lowering placement test cutoff scores is one way to address the issue of students being misplaced in developmental math. For example, research conducted by Scott-Clayton found that about one quarter of students placed in developmental math could have earned a B or better in college math if they had been placed there directly.[5]

4. Shanna Smith Jaggars and Susan Bickerstaff, "Developmental Education: The Evolution of Research and Reform" in M.B. Paulsen (ed), Higher Education: Handbook of Theory and Research, 33: 469-503 (Springer International Publishing AG, 2018).

5. Judith Scott-Clayton, "Evidence-based reforms in college remediation are gaining steam – and so far living up to the hype" (2018), available at https://www.brookings.edu/research/evidence-based-reforms-in-college-remediation-are-gaining-steam-and-so-far-living-up-to-the-hype/. See also Judith Scott-Clayton, Peter M. Crosta, and Clive Belfield, "Improving the Targeting of Treatment: Evidence from College Remediation," Educational Evaluation and Policy Analysis, 36 (3): 371-393 (2014); and Thomas Bailey and Shanna Smith Jaggars, op. cit.

With respect to the co-requisite model, which makes it possible for students to enroll directly in college math courses with support, there is growing evidence of its effectiveness. In their review of development education reforms, Jaggars and Bickerstaff found that the co-requisite model had the strongest results of all the acceleration strategies they examined.

States that have adopted the co-requisite model have seen significant increases in the proportion of students earning college math. Tennessee initially saw its college math completion rates increase from 12% in one year to over 50% in one semester (however, other reforms were underway at the same time, so additional factors may have also been at work).[6] Complete College America reports that other states adopting the co-requisite model have also seen first year college math completion rates of over 50%.[7]

With respect to the co-requisite model, which makes it possible for students to enroll directly in college math courses with support, there is growing evidence of its effectiveness. Complete College America reports that other states adopting the co-requisite model [in addition to Tennessee] have also seen first year college math completion rates of over 50%.

At the college level, Logue, Watanabe-Rose, and Douglas conducted a randomized controlled trial and found that students assessed as needing remedial elementary algebra, but not requiring college algebra for their majors, and assigned to introductory college level statistics with support (workshops) had higher pass rates than did those assigned to elementary algebra (56% versus 39%). Over time, they also accumulated more college credits and had higher graduation rates. With the co-requisite approach, Logue et al. found that results did not differ according to students' race/ethnicity.[8]

Jaggars and Bickerstaff also identify an emerging third wave of developmental education reform, one tied to broader Guided Pathways reforms (this is explored in more detail in the following section).

6. Clive Belfield, Davis Jenkins, and Hana Lahr, Is Corequisite Remediation Cost-Effective? Early Findings from Tennessee (2016), available at https://ccrc.tc.columbia.edu/publications/corequisite-remediation-cost-effective-Tennessee.html. See also Elizabeth Ganga, Amy Mazzariello, and Nikki Edgecombe, op. cit.

7. Complete College America, Corequisite Remediation: Spanning the Completion Divide, available at http://completecollege.org/spanningthedivide/.

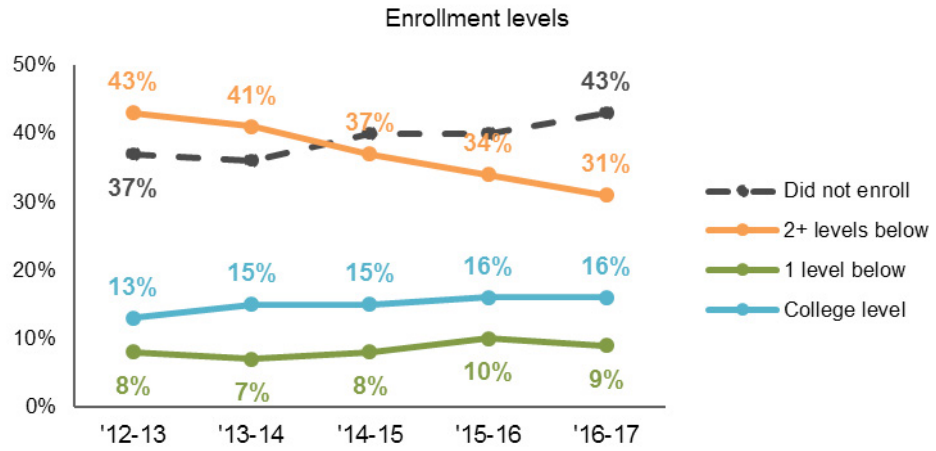
8. Alexandra W. Logue, "The data already tells us how effective co-requisite education is" (2018), available at https://www.insidehighered.com/views/2018/07/17/data-already-tell-us-how-effective-co-requisite-education-opinion/. See also A.W. Logue, Mari Watanabe-Rose, and Daniel Douglas, "Should Students Assessed as Needing Remedial Mathematics Take College-Level Quantitative Courses Instead? A Randomized Control Trial," Educational Evaluation and Policy Analysis, 38(3): 578-598 (2016).

## Progress in math enrollments and completions in Washington

Institutional level data show that almost all of the colleges in the two AtD cohorts in Washington increased the proportion of students earning college math in their second year during 2009-2016, and the median change for AtD colleges was slightly higher than the rest of colleges in the system (nine percent for the first AtD cohort, seven percent for the second AtD cohort, and five percent for non-AtD colleges).[9]

However, more work remains to be done in Washington on math enrollment, completion, and equity gaps.

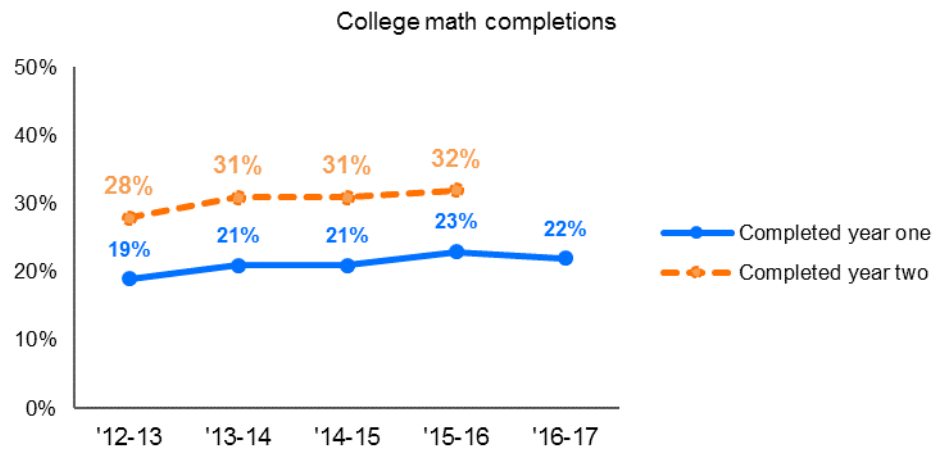
**Enrollment.** Systemwide, the proportion of students not enrolling in math during their first year has increased slightly in recent years, reaching 43% for the 2016-17 cohort year.[10] The share of students starting at college level has shown a very mild increase, and those starting one level below, little change. The proportion of students starting at two or more levels below has steadily decreased—but we do not know how much of this decrease is associated with the overall decline in first year math enrollment versus improvements in placement or other factors.




**Completions.** Looking at the most recent cohort year 2016-17, 22% of all students earned college math in their first year in 2016-17, a figure that has increased a couple of percentage points over the last five cohort years. Thirty-two percent earned college math in their second year in 2015-16, a figure that has also increased slightly in recent years.

9. Deena Heg and Bob Watrus, Post-AtD Study Data Brief on Student Outcomes (2018), unpublished College Spark report.

10. Data in this section are from the Washington State Board for Community and Technical Colleges, Precollege Enrollments and Completions database. Dashboard use licensed under https://creativecommons.org/license/by/4.0/




Of the students who did enroll in math sometime during their first year, the majority started at two or more levels below college math—and the likelihood of completing college math in a year for these students was relatively low. For example, in the entering 2016-17 cohort, about one out of seven students starting two or more levels below completed college math within a year.

**Equity gaps.** Historically underrepresented students of color[11] in this cohort (about 9,000 students) enrolled in math at a slightly higher rate than white/Asian students (61% compared to 55%)—but a higher share started two levels or more below college math (39% versus 28%), and a smaller percentage of that subgroup completed it within a year (11% vs. 15%). There is a consistent six to eight percent gap in completion rates between these two groups in both years one and two.

11. Historically underrepresented students of color: African American, Hispanic, Native American, and Pacific Islander.

## Lessons learned and implications for policy, practice and systems

### Set goals that target college math completion.

When colleges started their math reform work as part of AtD over a decade ago, many focused specifically on increasing completion of precollege math courses. The assumption was that this in turn would contribute to higher completion rates of college math within two years and ultimately to increased degree attainment. These efforts were undertaken with the best will in the world and the belief that they would have significant impact—yet the magnitude and scale of improvements in outcomes have not lived up to these hopes.

As work on this has progressed in the state and across the country, there is increasing evidence that students are more likely to complete degrees if they finish college math within their first year of enrollment. Complete College America calls this the "Momentum Year," during which one of the major goals is completing gateway college courses in math and English. The Community College Research Center (CCRC) recommends this as part of its Guided Pathways model. And Washington's Guided Pathways Initiative has set a target of having a majority of students earn degree math in their first year.

### Take a comprehensive approach to math reform.

Many AtD math interventions focused on a couple of aspects of reform that colleges believed were key to improving outcomes for students—for example, boot camps and other supports for better placement outcomes; instructional supports such as supplemental instruction and tutoring; or modularization of the curriculum. In particular, many interventions were optional and outside the classroom, and often at pilot level rather than at scale.

Working on math reform in a piecemeal approach tends to make for a slow process of change as well as a limited amount of progress in improving student outcomes. Looking at how students experience math in a whole-systems, comprehensive way is likely to make these reforms far more effective. This means fundamental, structural changes at scale, and includes placement, advising, and supports in the mix as well as changes in curriculum and instruction. One of the clearest lessons from the years of Achieving the Dream work, both here and nationally, is that incremental change is not fast enough or "big" enough.

Current research and practice support the idea that math reform is best designed with a specific focus on completing college math, so that all of its components and supports work in the service of that goal. For example, Complete College America's strategy is to treat all students as college students; provide corequisite academic support; have gateway courses completed in the first year; and have multiple math pathways in place to serve all students. CCRC's Guided Pathways essential practices are similar.

## Embed math reform in broader systems change.

Institutional change is a central focus of Achieving the Dream—which, at the time, had as its guiding principles committed leadership, use of evidence, broad engagement, systemic institutional improvement, and equity—but perhaps the divergence between this whole-systems focus and the often pilot-sized interventions made it challenging to gain traction on system change.

Math reform is more likely to be effective at increasing college math completion and degree attainment rates when embedded in broader systems change rather than being approached as a stand-alone change.

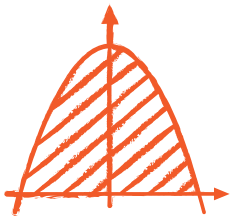
As noted by Bailey and Jaggars, math reforms "have led to some encouraging results, but most have not led to marked increases in graduation rates. In general, reforms that focus on only one segment of a student's experience are insufficient to improve graduation rates, because the positive benefits of any reform will quickly fade when a student returns to the wider college and its traditional un-reformed structures and practices."[12]

This has led to an emerging third wave of development education reform, according to Jaggars and Bickerstaff, one tied to Guided Pathways (or similar systems-level) reforms.[13] CCRC's Guided Pathways model includes essential practices that address math reform along with mapping of programs of study, exploration of career/college options, advising, student progress monitoring and intervention, and student learning.

Twelve colleges are currently participating in Washington's Guided Pathways Initiative, 10 with College Spark support.

12. Bailey and Jaggars, op. cit.,
13. Jaggars and Bickerstaff, op. cit.

## Focus not just on the "what" of change, but the "how".



In the first issue brief done as part of this post-AtD study, we looked at where and how real institutional change occurred among the colleges in the second AtD cohort in Washington.[14] Genuine belief in the need for change and identification of the necessary changes were not by themselves enough. Those colleges that made the most progress on institutional change used specific, effective organizational strategies to do so. Some of these strategies are likely to be useful in moving math reform forward. These include:

- Active, engaged, intensely focused leadership from the top that communicates an ongoing, core commitment to improving math completion to the campus at large.

- Shared, distributed leadership, and broad, deep engagement. These strategies use the college's structure in a strategic, intentional way from top to bottom and across functions and departments. In math reform work, this could include a mix of vice presidents, deans, department chairs, faculty, and staff, including those who are recognized as informal leaders and champions of innovation.

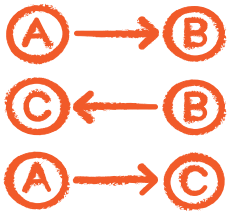
  A key component of shared, distributed leadership and comprehensive engagement is that the efforts go beyond a single department to involve others in the larger system whose work is relevant to math reform and who can provide support and momentum for change. External partners in K-12 and universities are also part of broad, systemic engagement. Involvement in the work itself is a core component of genuine engagement and requires deliberate structures, processes, and supports to be put in place.

- Case making. Making the case for why change needs to occur in math is essential. At the AtD colleges, much of this conversation began with examination of institutional data on precollege and college math completion, with data disaggregated to identify equity gaps.

  Beyond this, case making can include collaborative, structured conversations about findings from recent research on math reform and related Guided Pathways systems reform, and how those findings can inform college beliefs, values and culture. The kinds of cross-discipline conversations that have occurred at Guided Pathways colleges as they have developed their program maps is a good example of this, and have been pointed to by those colleges as helpful in building relationships and a cross-campus understanding of the values and principles of Guided Pathways.

14. Deena Heg and Bob Watrus, Lessons Learned from Achieving the Dream: An Issue Brief on Institutional Change (2017), available at http://collegespark.org/grantee-results/achieving-the-dream/.

## Evaluate math reforms as part of continuous improvement.




One of the hallmarks of Achieving the Dream is its focus on creating a culture of evidence. AtD colleges in Washington still note this as a key gain from their AtD participation—the protocol of data inquiry; structured discussions; openness to innovative responses; thoughtful evaluation of what worked and what didn't; and willingness to change what they are doing based on this information. Yet even with this emphasis, evaluation practices at the colleges tended to be sporadic and at times treated more as an add-on than an essential practice.

The adoption of evaluation as an essential feature of math reform work is important. This includes regularly examining institutional data to see if the reforms are working. For example, is the proportion of students enrolling in math their first year increasing? Is the proportion starting at college level, with supports, increasing? Is the proportion earning college math in their first year increasing? And are equity gaps closing? Likewise, it will be important for math departments to look at disaggregated course level data internally as they work to improve student outcomes. This kind of evaluation supports colleges in capturing what's working and not working as well as lessons learned, making course corrections, and developing, testing, and improving new approaches.

Time and resources need to be built into math reform work so that evaluation is firmly established as a central part of the work.

## Washington Community and Technical Colleges' Achieving the Dream Precollege Math Reform Interventions

| | Advising/ Mentoring | Placement/ Test Prep | Instructional Supports | Curriculum/ Instruction | Summary |
|---|---|---|---|---|---|
| **Cohort 1 (2006-2010)** | | | | | |
| **Big Bend** | ✓ | ✓ | ✓ | ✓ | Advising and mentoring targeted to precollege students; test prep; supplemental instruction and tutoring; modularized curriculum (Emporium) |
| **Highline** | ✓ | | | ✓ | One-on-one faculty mentoring; changes in course content and shortened precollege math sequence |
| **Renton** | | | ✓ | | Math tutoring center |
| **Seattle Central** | | | ✓ | ✓ | Wide range of instructional supports, including yearlong math cohorts, study skills, math study sessions, support courses, and supplemental instruction; start of curriculum/instruction changes (Statway) |
| **Tacoma** | | ✓ | ✓ | ✓ | Computer-based refresher course; supplemental instruction and embedded tutors; start of curriculum/instruction changes (Statway) |
| **Yakima Valley** | ✓ | | ✓ | ✓ | Paired study skills class with pre-algebra; extended three quarter precollege math sequence; advising on precollege options; ABE math course |

| | Advising/ Mentoring | Placement/ Test Prep | Instructional Supports | Curriculum/ Instruction | Summary |
|---|---|---|---|---|---|
| **Cohort II (2011-2015)** | | | | | |
| **Bellingham** | | | | | N/A |
| **Clover Park** | | | | ✓ | Modularized, accelerated precollege math |
| **Edmonds** | | | ✓ | ✓ | Supplemental instruction; incorporation of instructional activities and techniques focused on student efficacy and resiliency; and modularization (modified Emporium) |
| **Everett** | | | ✓ | | Supplemental instruction for selected sections of precollege math |
| **Grays Harbor** | | ✓ | | | Math brush ups |
| **Lower Columbia** | | ✓ | | ✓ | Multiple placement methods; new diagnostic testing; math boot camps; shortened precollege math sequence; modularization and curriculum redesign; non-STEM pathway development |
| **Northwest Indian College** | | | | | N/A |
| **Skagit Valley** | ✓ | ✓ | | ✓ | Advising for students placing into precollege math; shortened precollege math sequence and curriculum redesign; and alternative placement methods |
| **Spokane Falls** | | | | | N/A |
| **Whatcom** | | ✓ | | ✓ | Revised and shortened precollege math curriculum with embedded study skills and growth mindset in precollege math; revised placement methods and testing; and non-STEM pathway development |

## Resources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