

Washington Community and Technical Colleges Mathematics Landscape



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Submitted by Laura Schueller

PhD Mathematics

Policy Associate, State Board of Community and Technical Colleges

Based on interviews conducted during campus visits:

| | |
|---|-----------|
| Bates Technical College | 19-Nov-19 |
| Bellevue College | 8-Jan-20 |
| Bellingham Technical College | 10-Dec-19 |
| Big Bend Community College | 31-Jan-20 |
| Cascadia College | 3-Dec-19 |
| Centralia College | 1-Nov-19 |
| Clark College | 7-Nov-19 |
| Clover Park Technical College | 10-Jan-20 |
| Columbia Basin College | 28-Jan-20 |
| Edmonds Community College | 23-Jan-20 |
| Everett Community College | 21-Jan-20 |
| Grays Harbor College | 20-Nov-19 |
| Green River College | 12-Nov-19 |
| Highline College | 21-Oct-19 |
| Lake Washington Institute of Technology | 7-Oct-19 |
| Lower Columbia College | 16-Dec-19 |
| North Seattle College | 30-Oct-19 |
| Olympic College | 25-Oct-19 |
| Peninsula College | 9-Dec-19 |
| Pierce College Fort Steilacoom | 15-Nov-19 |
| Pierce College Puyallup | 18-Nov-19 |
| Renton Technical College | 11-Oct-19 |
| Seattle Central College | 27-Jan-20 |
| Shoreline Community College | 8-Nov-19 |
| Skagit Valley College | 6-Dec-19 |
| South Puget Sound Community College | 31-Oct-19 |
| South Seattle College | 16-Oct-19 |
| Spokane Community College | 9-Jan-20 |
| Spokane Falls Community College | 7-Jan-20 |
| Tacoma Community College | 14-Nov-19 |
| Walla Walla Community College | 13-Nov-19 |
| Wenatchee Valley College | 6-Jan-20 |
| Whatcom Community College | 5-Dec-19 |
| Yakima Valley College | 13-Jan-20 |



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Prologue

A Note from the Author

I cannot begin to thank everyone who has supported this work. There were an army of people that helped with parking passes, meeting rooms, maps, and travel plans in addition to the countless student services staff, faculty and administrators who gave generously of their time and expertise. I have done my best to faithfully capture the incredible work on your campuses.

My tone in this document is often more conversational than formal; please don't mistake this familiarity for a lack of seriousness on my part but instead a recognition that the work of reconceiving student success in mathematics is difficult, personal work,

Report Structure

In the following pages, I have tried to stitch together snapshots of the ways in which Washington Community and Technical Colleges serve our students to elucidate the statewide mathematics landscape. I recognize that this one report cannot include every detail of the landscape and that the scene continues to evolve, but I hope that this document is useful as you both look in the mirror at your own work and out the window to see what is possible.

When referencing colleges outside of our Washington Community and Technical College system, I have been overt in my description. Thus, any reference to “colleges” in general refers to colleges within our system.

The Executive Summary is an attempt to give a relatively short encapsulation of the project including the purpose, protocol, and a general description of my discoveries. The sections that follow elaborate on some of the more complex issues and considers how they are dealt with on our campuses.

Executive Summary

Purpose of the Project and Fundamental Premises

For many years, math departments in Washington Community and Technical Colleges have grappled with issues around increasing the mathematics success of our students. Each college has adopted its own policies, procedures and practices based sometimes on the deeply held beliefs of college staff and other times on serendipity or the availability of resources. Whatever the provenance, we now have, across the state, an incredible wealth of ideas and solutions. The primary goal of this report is to share the observations collected from thirty-four campus visits that occurred between October 2019 and January 2020 in order to support continuing positive change.

This is not a document to call out colleges who have or have not implemented particular initiatives or adopted particular philosophies, and for that reason college names are not included within the following sections. It is meant to be a document that inspires colleges to continue the difficult work of increasing mathematics success for our students by seeing what is possible.

As any mathematician would agree, it is important to identify the “givens”, and four important ones are outlined here.

The first cannot be overstated. There is overwhelming agreement that “student success” is central to our work. This is sometimes lost because we have such different ideas about the meaning of “student success.”



Are we trying to maximize the number of students who complete a credential or who are prepared for a life in today's complicated world? How do questions of "which students" stack up against questions of "how many students?" While we may never fully agree on how to measure student success, it is productive to acknowledge that decisions that we may not agree with or understand should not be easily dismissed as thoughtless or as disregarding students but instead may offer an opportunity for further discussions regarding our definition of student success.

The second is that lots of work has already been done. Each one of the 34 colleges has done work on improving student success in mathematics in the last decade. New courses have been developed, new pedagogical methods have been tried, new placement methods have been implemented, and on and on. This is important, not just because it gives evidence of the investment of mathematics faculty but because it is important to recognize that many of these changes have caused ripples of extra work out to advisors, placement offices, registrars, tutoring centers, bookstores, financial aid offices, institutional researchers and information technology offices. This is not to say that we should not persist in our efforts, it is just to say that we need to recognize the work that has been done in the past as we continue to innovate.

The third is admitting that although our work must be student centered, students will not be the only ones affected by change. While it might seem to someone from the outside that a system that is not giving us the results that we are hoping for will need to change and that those changes might require a different balance of staff and faculty, it is also a reality that eliminating a position or substantially changing a job description could significantly affect the livelihood of someone who has dedicated their life to the service of our students. Thus, as we consider changes to improve student success, we must be vigilant about acknowledging the value that individuals have brought to our students and finding ways to capture that expertise and experience as we redesign processes.

The fourth is that resources are not infinite and so priorities must be set based on the vision of success for students at each college. In the short term, for example, investment of time and energy on significant pedagogical change may come at the expense of the energy required to rethink placement. We are called to work with urgency, but this does not mean we can do everything at once, and regardless of how hard we work, we will never be done.

Protocol

Between October 2019 and January 2020, I visited each of the thirty-four community and technical colleges in Washington. The goal of my visit was to better understand the variety of ways in which our colleges serve students with respect to mathematics in order to

- Provide baseline data for the Guided Pathways work plans,
- Inform the future learning agenda,
- Inform project leaders as they work to support co-requisite projects,
- Provide clarity around initiatives that are currently active in the state, and
- Identify expertise within the state.

By engaging with a series of questions related to math offerings, placement policies, pedagogical initiatives, relationships with adult basic education, equity strategies, related instruction for career and technical



education offerings, and the use of data, groups of faculty and administrators generously offered insights into mathematics instruction and the unique policies and procedures at each of our colleges.

Summary of Discoveries

When considered as the complex ecosystems that they are, each of the thirty-four colleges is unique. Their sizes, locations, student demographics, faculty contracts, regional high schools, common transfer partners, program offerings, budgets, histories, and cultures for example all affect their service models. However, with apologies to Maya Angelou for taking her quote out of context, “I note the obvious differences between each sort and type, but we are more alike, my friends, than we are unlike.”

I have chosen a few big themes that I believe offer a glimpse into spaces that we can learn from each other. To be absolutely clear, even as I separate the narrative into sections, the issues that I have chosen to expand on are not issues that can be siloed. As you consider changes at your own college, I encourage you to consider how each change affects the spiderweb of policies and practices that form the student experience.

Placement

Placement has emerged as a concrete and yet very complicated issue facing our colleges. Although the focus on placement often centers primarily on procedures, it is a change in philosophy that has propelled colleges who are spearheading efforts to improve placement. In the 1960’s and 1970’s, the “right to fail” philosophy of placement resulted in students enrolling in courses that were not prepared for them.



In the 1980’s placement philosophies shifted with the intention of protecting at-risk students from failure by restricting their enrollment into gateway courses unless they could provide evidence that they were prepared for these courses. For most colleges and universities, this meant a score on a placement exam.

Within the last decade, colleges have adopted the slightly more nuanced philosophy that students should be placed in the highest course for which they have a reasonable chance of success, and most of our colleges have begun to allow students to use a broad set of artifacts to establish this evidence of preparation; including things like high school GPA, previous course grades, and a variety of standardized and home-grown tests.

But, a few of our colleges have gone further and started to view placement through a very different lens and have begun to rethink the role of placement and its intersection with advising and instruction. Three interesting themes (paraphrased) that have come up from faculty on my visits appear below.

Students with a high school credential should almost always be enrolled into a college level course; placement should help us determine which supports we will need to provide in order for them to be successful in these courses.

A large part of placement is helping students determine which math pathway is appropriate for them given their goals and helping them to determine which course along the pathway is best for them given their background, current situation, and available supports.



We need to use placement as an indicator of what we need to do in our classes to be prepared for our students instead of using it to determine which students are prepared for the classes that we currently offer.

Most of our colleges, regardless of philosophy, have struggled to establish evidence of the efficacy of their placement measures or to identify equity issues of their policies and practices. Unlike some data, like enrollment data, the collection and sharing of college data about placement is strictly a local process. So, while some colleges have robust protocols around placement data collection and analysis, the majority of our colleges do not.

Transfer Math Pathways and Shortening the Path

Our colleges have created math pathways for numerous different programs. In accordance with the [Direct Transfer Agreement](#) (DTA), colleges have chosen to offer STEM, Business, Elementary Education, Statistics, and Math for Liberal Arts pathways designed for students planning to transfer either to other universities or to Applied Baccalaureate Programs. While not all colleges offer all five pathways, all colleges offer the two most popular STEM and Statistics pathways. There has been significant shortening of the non-STEM pathways across the state, but most colleges have kept, or even lengthened, the STEM pathways.

Most of the change in the non-STEM pathways has come from acknowledging that the traditional Intermediate Algebra courses offered as pre-requisite for pre-Calculus were not the best preparation for students working toward college level math courses in Statistics or Math for Liberal Arts. The traditional “one size fits all” Intermediate Algebra courses have been replaced at most colleges with alternatives which may include courses whose content has been carefully curated for the pathways, just in time co-requisite support courses, or courses with a new emphasis on problem solving.

While the reforms that most colleges have made to their STEM (or Algebra intensive) pathways to date are smaller, there is considerable activity right now with colleges working on these pathways including a large group of faculty helping to define a state level set of common expectations for pre-Calculus and many colleges looking to introduce co-requisite supports for students intending to complete the STEM pathway.

It should be noted that we do not currently have sufficient data to measure how the loss in enrollment brought on by shorter pre-college pathways, in the short term, will be mitigated by increased college level enrollments. So although we should agree that enrollment pressure is not a reason to keep students in pathways that are not working, we must also acknowledge up front that there could be a cost for this position.

Math for Career and Technical Education Pathways

For programs which do not require a transferable college level mathematics course as their degree math, colleges have identified appropriate math courses in very different ways. Some colleges allow standard pre-college mathematics courses to satisfy degree requirements and some have developed non-transferable college level courses within the mathematics department. However, the most common model involves courses taught by faculty from other departments; these include classes like Business Math and Math for Welders. Although there are colleges where mathematics faculty work closely with the faculty who teach these courses, it is more common for



these applied and technical courses to be developed independent of the mathematics department. These courses vary from having no pre-requisites or placement requirements to having significant Algebra requirements. In many cases, these courses have been designed to meet very specific content objectives like modeling with triangle trigonometry, computing dosages, or doing interest calculations.

One tension in determining the appropriate degree course for terminal Associate in Science degrees is balancing the desire to have students take a transferable course in case they decide to transfer into a baccalaureate program at some point in the future with the desire to have students enroll in a non-transferable course which would likely have fewer pre-requisites or have content more closely aligned with program objectives. By integrating some specialized content into transferable college pathways and significantly decreasing the number of pre-requisite courses needed to enroll in the transferable courses, a few colleges have managed to significantly mitigate this tension.

Basic Education for Adults (BEaA)

For some colleges, streamlined protocols are in place to determine which students are best served starting in BEaA courses and which are best served starting in tuition bearing pre-college courses. Similarly, some colleges have well-defined and transparent protocols for transitioning students from BEaA courses into tuition bearing courses with pre-requisite agreements or even co-enrollment courses.

However, it is more common that placement procedures are completely separated and students may be placed into one sequence or the other based simply on which door they enter or who they talk to first. In some cases, when students place sufficiently low on a standard placement exam, they are referred to BEaA for a new round of testing and placement. In other cases, students who speak first to a BEaA advisor skip the original placement exam and instead CASAS test and enroll directly into BEaA coursework.

Once students are enrolled in BEaA mathematics courses, it is not uncommon for the path back to require students to go back through the original placement process as if they were a brand-new student.

While individual faculty relationships appear to be overwhelmingly positive, there are often systems including different faculty contracts, competition for FTE's, misalignment of course objectives, different faculty credentials, and regulations around placement and progress that silo BEaA departments and math departments.

Pedagogy

There is evidence of increased emphasis on improved pedagogy in every corner of the state. With full or modified flipped classrooms, collaborative learning with an emphasis on "group worthy tasks", use of a variety of assessments, using real life data and problem sets based on student interests, using formative assessment strategies to inform classroom practice and adopting a multitude of strategies to encourage students to engage with their courses, some of our faculty have made significant progress in creating mathematics courses that are truly centered on students and taught with high expectations of student learning.

In addition, we have faculty who through the adoption of Open Educational Resources (OER) materials, implementation of 4 Connections, employment of Universal Design for Learning (UDL), and use of Transparency in Teaching and Learning (TILT) are working hard to reach students who we have failed to fully serve in the past. These faculty have recognized the mathematics equity gaps that exist, have made the



choice to recognize our part in perpetuating those gaps, and have committed to doing their part in closing those gaps.

For most faculty, the time to develop new materials and completely rethink their course design has seemed overwhelming. Faculty must balance their investment in the students that are sitting in front of them right now, who need their regular time, energy, and feedback, and choosing to spend time and energy rethinking what courses could be and how best to design for the students who will be coming to them in the future. This was never more apparent than during the recent move to remote instruction where faculty, already feeling at their limit, were asked to completely rethink and redesign their courses in a very short amount of time. The ways in which faculty committed to spending extra hours and supporting each other during this time has been nothing short of heroic. But heroics are not sustainable, and as faculty are being asked not just to move to emergency remote instruction but to develop the highest quality, equitable, accessible remote instruction, they will need more support.



In the past faculty have shared ideas about content and teaching strategies at the annual Washington College Mathematics Conference as well as through regional convenings and personal contacts. They have also shared WAMAP shells, Canvas shells, and coursework on publisher software. This has been particularly important as faculty prepared to teach new courses and as a means to support adjunct faculty. The support for professional development as well as faculty interest in participating in such development varies wildly across the system.

As faculty experiment within their classes, there are very few colleges who have identified methods for collecting data to correlate course structures and pedagogical initiatives with student success. Although most faculty regularly reflect on the success of a given course or exam, very few have found ways to collect and analyze these reflections to improve student success and identify gaps in consequential ways that can be shared and scaled.



In the sections that follow, I have tried to take a closer look and to examine the themes outlined above in more detail.

A Closer Look

Placement

Every college has a mathematics placement policy, and at some colleges, placement is carefully integrated into the onboarding process; policies are in place to ensure that students have access to guidance in choosing the appropriate mathematics class based on their goals and to completing the placement process based on their previous academic experiences. However, at others, students are left to learn about their options on their own.



Multiple Measures

The idea of using Multiple Measures for placement has gained popularity nationally as colleges acknowledge that a single one size fits all standardized test cannot give sufficient data to identify the right course for every student. Early adopters realized that if you were to collect multiple data points for a student (High School GPA, test scores, course taking history, program intent....) together these would give a more complete picture of an individual student and would allow the college to better match a student with an appropriate class. More recently, Multiple Measures has come to mean giving students multiple ways with which to give evidence of their ability to be successful in a course; leading to a “highest placement wins” implementation. That is, if a high school transcript indicates that a student is ready for a college level statistics course but ACCUPLACER indicates that the student should enroll in Elementary Algebra, the student would be “placed” in the college level statistics. Most of our colleges have chosen this newer interpretation, sometimes combined with information about a student’s program, to identify appropriate course placement for a student.

There are two statewide agreements being used by all colleges.

The first is the [Smarter Balance/Bridge to College](#) agreement. Although there has been a temporary modification to the agreement due to COVID-19, the agreement states that a student with a sufficiently high Smarter Balance math score and completion of selected high school courses or a grade of B or better in a Bridge to College Math class will be given placement into a college level math course in the fall quarter immediately following high school graduation. Although some colleges have adopted a broader policy, most have adopted the agreement as written.

The second statewide agreement is [Placement Reciprocity](#) which allows students who attain a placement from one CTC in Washington to have that placement honored at all of the other Washington CTC’s. Although all of our colleges honor the agreement, some colleges publish this widely and others not at all. Maybe more significantly is how the existence of the agreement has prompted some colleges to consider the placements available from other colleges in determining their own. For example, if a certain course grade in high school or certain ACCUPLACER cutoff score gives college level placement at one college, some colleges have determined that those same grades and cutoffs should allow for college placement at their college as well. The thinking for these colleges is that placement reciprocity should not be available only to those with the capital to invest in it, but should instead be used to encourage the alignment of policies so





that all students benefit. This is not universal. Some college faculty are concerned that differences in courses between colleges make common placements detrimental for their students.

In addition to these two statewide agreements, a number of colleges consider high school transcripts, a variety of tests, and a few different forms of self-placement.

High School Transcripts

Not all colleges consider high school transcripts when placing students. However, more than half of our colleges do and the number is growing. There is, however, very little agreement on which high school transcripts to consider and what they should mean in terms of placement.

The most common practice right now is for colleges to consider transcripts from local districts using specific memorandums of understanding. In these cases, college faculty have worked directly with high school partners to determine the content for each high school course being considered and thereby gained confidence that particular courses with particular grades give sufficient evidence of student readiness for courses being offered at the college. The results of these decisions often come in the form of complex sets of grids sometimes differing significantly from high school to high school. College faculty have acknowledged that this is a labor-intensive project and that every year high school courses and faculty change, thus requiring ongoing, frequent updates.

Other colleges have more general high school transcripts policies which apply not just to specific high schools but to any high school. Although some sharing has taken place amongst these colleges, there is no universal or even prevailing high school placement policy. For example, a transcript showing a grade of B in Algebra 2 within the last two years would place a student into a college level math course at some colleges, up to two levels below college level at others, and not qualify for transcript placement at all at others.

Most colleges only consider recent high school courses when making a transcript placement where recent may be defined as anywhere from one to three years. A small number of colleges have started to accept older transcripts as part of a policy to use a student's overall GPA in addition to specific math course grades to determine placement. The policies are predicated on the idea that a student who has demonstrated their ability to be a successful student by attaining an overall GPA at a certain level will not lose these skills and habits within a few years.

Amongst colleges who accept transcripts for placement there is also significant variability in how they collect transcript information. COVID-19 restrictions have made some of these collection methods impossible in the short term. Some colleges require official high school transcripts, however, most are collecting unofficial transcripts, screen shots of student records (like those a student might find on Skyward), or even student self-reported grades and GPA's. A few colleges have special relationships with local high schools which gives the college access to students' records directly from the high school.

Interestingly, a number of our colleges have chosen not to include their own BEdA students' high school transcripts (through HS 21+) when establishing these policies.



Tests

The role of on campus testing has changed dramatically with the restrictions resulting from COVID-19. While some colleges are using this as an opportunity to completely rethink placement and the role of testing in the placement process, others are making emergency plans that are focused on temporary changes with the hope of “returning to normal” as quickly as possible.

At the time of my visit, every college had some type of placement test. While very few appeared confident in the efficacy of their tests, only two colleges at the time were actively developing plans to eliminate their use; this number has since increased.

Some offer tests to almost everyone (by design) whereas some try to offer tests only to students who are unable to be placed by other methods. It appears that the number of students who could, in theory, be placed by other methods might be quite large, but because of difficulties in implementation many of these students end up testing as well.

The most popular test is the Accuplacer Next Generation. This is a relatively new exam and colleges are still collecting their first student data regarding cut scores. Colleges not using Accuplacer are using ALEKS, home grown exams on WAMAP, EdReady, MyMathTest and Wonderlic.

Many colleges offer resources that range from study guides to boot camps that students are encouraged to take advantage of before testing, but many faculty expressed concern that only a small percentage of students are actually making use of these opportunities. Approximately one third of the colleges employ a multi-step testing process whereby students pre-test, target weak skills, and then test again. Little data was available to suggest how many students were actually taking advantage of this skill development stage. There are still a small number of colleges who do not encourage students to study for placement with the idea that this could artificially inflate students’ scores.

There is a great deal of variability amongst colleges in retest policies with differences in length of time required between tries, total number of tries, and costs for retests. For most colleges, scores remain valid for placement for somewhere between one and three years.

In addition to the tests given on campus, many colleges allow other standardized college admissions tests like the SAT or ACT or course exams like the AP or IB to be used for placement. The determination of cut scores for these exams appears to be ad hoc and the general consensus is that very few students use these exams for placement. However, from the available data, it was not clear exactly how many.

A small number of colleges allow CASAS or GED scores to be used for placement.

Self-Placement

A growing number of colleges include student self-assessment as part of their placement processes. For some colleges, this means implementing a form of directed self-placement where students, with the aid of a college tool, usually WAMAP, provide information about their background, confidence with certain mathematical material, and interests and then are guided to an appropriate placement. For others, students begin with a more traditional placement method but then receive a placement that is more suggestion than requirement, that is, students are given a recommendation and then given information about how they can elect to apply that recommendation. For example, they may be able to choose from courses from one level above to one



level below their recommended placement or the placement may be a non-binding recommendation allowing students to enroll in whatever course they choose.

A number of questions have come up about the appropriateness of using directed self-placement with Running Start students. Are high school students, sometimes influenced by parents who would rather that their child be at the college and take courses without having to pay tuition, able to honestly determine if they are ready for a college level course? Luckily, since these students are still in high school, their high school transcripts can be used to determine if they would be better served by enrolling in their high school math sequence or if they would benefit from college offerings. These students are also almost always served by special advisors who work with them to guarantee that they are meeting their high school graduation requirements.

Process and Data Collection

Math departments have spent a great deal of time and energy trying to align measures with placements. The student experience, however, is not only affected by the decisions of the math department.

Most schools require that students find information about which measures can be used for placement and which documents will be needed on the college web page while others share the information with students in advising appointments or orientations. It is not uncommon at some colleges for students to first schedule a placement exam and then get information about other measures from testing center staff members.

The collection of artifacts from students takes place in a variety of ways. Some colleges have students scan or type information into an online tool, others have all students submit documents to some central location like the testing center or the registrar's office, and others have students share documents with individual advisors.

The translation of these documents to placements may involve staff entering specific data about the type of document (transcript, SBAC score sheet, etc.) and the score into their student management system, others enter the resulting placement into the system without capturing the specific method of placement, and others give overrides or entry codes for courses without ever entering placements into the student management system.

Although every college has a policy about the length of time that a placement is valid, the enforcement of these policies varies. Consider, for example, a student who submits a placement reciprocity form showing that almost one year ago the student placed into college level math at another college. For some colleges, the student would only be given placement for the college level math course for the coming quarter. If the student chose to wait or didn't pass the course, they would then need another placement method to take the college level course. For other colleges, the students' score would be placed into the system and then stay valid for another year or more. For other colleges, the data would be entered into the system and be valid forever.

For students taking placement exams, it appears that almost all colleges are capturing these scores in their student management system. It also appears that the timing out of placements for students with old scores is often automatic unlike the purging of placements from other methods.



Ideally every college would be collecting data for each student including placement method, placement level, date of placement, and date of expiration in a form that was easy to access so that investigations linking student placement data with enrollment and course success data could be used to regularly analyze student use of different measures, efficacy of measures, and issues of equity in placement. While a few colleges are both collecting complete data sets and doing regular analysis, most colleges have not found efficient methods to capture and report out on the full breadth of placement measures.

Almost every college gives math faculty the ability to override a placement to allow a student into a more advanced class. For some colleges, faculty override is the primary method of placement for students hoping to enter the STEM sequence beyond Math& 141. Many colleges allow students to enroll in courses below their placement level without special permission; although students may not have the same options depending on their funding stream.



The lowest scoring students at some colleges are placed into courses in Basic Education for Adults (BEEdA), at other colleges these same students are placed into tuition bearing courses, and at some colleges the students are advised about their options to either enroll in a BEEdA course or a tuition bearing course. In a small number of colleges, students may choose not to engage in the placement process at all if they want to enroll in the first course in the pre-college sequence. It is not clear how many students choose this option or why. There is some concern that students may be avoiding placement for reasons of convenience or anxiety and may not be correctly placed with this policy.

A few colleges offer non-transferable college level courses that serve as the degree math for professional technical degrees which have no placement requirements. However, students destined for these classes may or may not participate in the placement process depending on how placement is integrated into the onboarding process.

As a side note, faculty at a number of colleges expressed frustration with technicalities of pre-requisite checking. Some faculty noted that automatic pre-requisite checks are not available meaning faculty have to manually verify placement for every student in their courses. Others noted that the available system had significant problems. The most common example involved students being able to enroll in a course for the subsequent quarter while they are enrolled in a prerequisite course with no follow-up process to drop students who are unsuccessful in the pre-requisite course. It was not clear how often, however, students attempting to enroll in their first course after placement are enrolling in an inappropriate course.

Effects of Covid-19 on Placement

It is not surprising that Washington's "Stay Home, Stay Healthy" order significantly impacted college placement procedures. As mentioned above, colleges were no longer able to have students come to campus for proctored placement exams or to drop by a campus office to share other artifacts. With this new reality, colleges have done an enormous amount of work to move to remote placement. For some colleges, the change is intended as a stop-gap measure until students can return to campus. Others have seen this as a chance to completely rethink their placement processes going forward.

A small number of colleges have implemented a third-party proctoring service like Examity with Accuplacer which has allowed them to keep most of their placement policies unchanged. Others have changed to exams

that are offered online as unproctored tests. Still others have chosen to continue to do their own proctoring through ZOOM or other video share products. For many colleges, the concern about technology requirements and other online testing issues led them to eliminate exams as part of their current placement process.



Even as many colleges have expanded their use of transcripts during this time, not all students are able to establish a placement with their transcripts. It should also be noted that many colleges have expressed concern about Spring 2020 high school grades as indicators of student learning due to significant changes in high school instruction and grading. With on campus placement testing unavailable, some colleges have required students who cannot be placed by a transcript or other measure to talk to an advisor or math faculty member who then uses information about the student's background and academic plans to give a placement. Other colleges have embraced directed self-placement. It should be noted that colleges who were already implementing and working toward scaling directed self-placement have been extraordinary resources for colleges looking to use directed self-placement for the first time.

Transfer Pathways

Colleges in Washington have been working to define and streamline their math pathways to transfer for more than a decade. In 2005, the Transition Math Project published a set of college readiness definitions linked to state academic standards. This work laid the foundation for the efforts of the Rethinking Pre-College Math group in 2013, the "Strategic Plan for Improving Student Math Success in Washington Community and Technical Colleges" which was published in 2015, and eventually for the Math Pathways to Completion final recommendations which were published in 2017. Most of this work was under the guidance of Bill Moore with support from a variety of sources including College Spark Washington and the Dana Center at UT Austin.

In 2013, new language in the DTA was adopted which clarified pathways to our Baccalaureate partners. In this same year, a common course description was adopted for Math& 107, "Math in Society", the math for liberal arts course.

In 2017, Pat Averbek created a set of Math Pathways Flowcharts for each of the 34 colleges and an analysis of these flowcharts was published by Averbek and Helen Burn which noted that at the time, pre-college math pathways fell into one of three categories; single pathways, single pathways with off-ramps, and tailored pathways.

Burn also spearheaded an effort to make recommendations about the Statistics pathway. These recommendations were included as part of the Transfer and Applicability Work Group's recommendations to the Joint Transfer Council (JTC). In Spring of 2019, a JTC-sponsored Math Advisory Group met to begin the work of clarifying and providing faculty input on the recommendations from the Transfer and Applicability Work Group.

In the Spring of 2020, a group of faculty began meeting to work on creating common course descriptions for the pre-Calculus (Math& 141 and Math& 142) courses. As of this writing, this work is ongoing.

While college faculty have collaborated in a number of statewide and regional initiatives to improve their math pathways, since each college has the autonomy to construct their own pathways, it is not surprising that sometimes significant differences exist among college offerings.

Math for Liberal Arts

Almost everyone is offering Math& 107, and each of the colleges that are offering the course is using the common course description. While some colleges continue to have a robust enrollment in Math& 107 and point to its presence on the Washington 45 list as a possible factor, many other colleges have seen enrollments significantly decline in Math& 107 as students are directed to courses that are seen as a better match for their particular programs and educational goals.

One interesting observation is that although colleges have adopted the common course description, this does not imply that common pre-requisites have been set. A few colleges have adopted a conservative approach with Math& 107 and pre-Calculus having the same pre-requisites, namely a traditional Intermediate Algebra course. The most common pathway into Math& 107 requires students to have some Algebra and often some explicit problem solving but less of the traditional Intermediate Algebra content than would be required for entry into pre-Calculus before enrolling in Math in Society. A small, but growing, number of colleges allow almost any student who needs Math& 107 for their path to enroll without any pre-requisite coursework and instead offer co-requisite support to students who need it.

Statistics

Everyone is offering a statistics pathway, and almost everyone is offering it in the form of Math& 146. A handful of schools are offering a more advanced statistics course as well, usually as a course to prepare students planning to transfer to a baccalaureate program in business.

No common course description exists for Math& 146. The recommendations offered as part of the Transfer and Applicability Work Group highlight both common ground and significant differences between courses being taught with this common course number. Like with Math& 107, there is no commonly agreed upon pre-requisite for Math& 146. This is made more complicated by the fact that many health pathways require Statistics as the degree math course but also include science courses with mathematics pre-requisites as part of their program requirements. So, although some schools agree that Math& 146 could be successfully taught with little algebraic background, there are questions about how to simultaneously streamline the math pathway and assure students are prepared for science classes which have algebraic pre-requisites.

Three colleges are also offering Carnegie's Statway as an alternative statistics pathway for students in select programs. It was originally designed to be offered as a two semester course sequence, and originally some colleges spread it over three quarters. However, it is now offered as a two quarter course sequences with 5 credits pre-college and 5 credits college level. One college allows students to take both courses in a single quarter by having students enroll in 10 credits and offering the pre-college content for two hours per day for the first five weeks of the quarter and the college level content for two hours per day for the second five weeks. Although all of the public baccalaureate institutions (BI's) in Washington have agreed to accept successful completion of the Statway sequence as meeting the Quantitative and Symbolic Reasoning (QSR) requirement of the DTA, it is not clear exactly which individual programs are accepting Statway as satisfying their degree requirements.





Math for Elementary Education

Many colleges have either stopped offering the Math for Elementary Education sequence or offer it very infrequently. This is a difficult pathway for colleges to support because enrollments at many schools are low, and therefore developing a special pathway or co-requisite supports for these courses are often a low priority. As the University of Washington does not accept these courses as QSR courses, Western Washington wants their Elementary Education majors to complete their own sequence, and some of our own Applied Baccalaureate Programs in Early Childhood and even Elementary Education allow the single Math for Liberal Arts instead of the Math for Elementary Education sequence for entry, only schools who have identified transfer pathways for these students have maintained healthy enrollments. Some colleges have found that this sequence is most popular in the evening or online when they are more convenient for students who already have professional roles in elementary schools and are looking for further credentialing.

It might be noted that there are two common course numbered sequences for Math for Elementary Education, a three-course sequence and a more common two-course sequence. Some colleges have chosen to offer only the first course and have identified it as the most appropriate course for entry into their own BAS programs in early childhood education.

Business Calculus

Most colleges offer the pathway to Business Calculus. Although many offer a special pre-Calculus for business or Finite Math as the preferred prerequisite for Business Calculus, some, usually because of size of student populations, require students to take the traditional first pre-Calculus course (Math& 141) before enrolling in Business Calculus. Almost, but not all, pre-Calculus for Business and Finite Math courses being offered have the same pre-requisites as Math& 141.

It is worth noting that students wanting to transfer to some highly selective programs in Business are being advised to enroll in the traditional STEM Calculus course to be competitive candidates. Some highly selective programs are also expecting students to have a statistics course that is more advanced than the entry level Math& 146 course. Thus, while the Business Calculus pathway is often the most appropriate for students interested in transferring to a baccalaureate program in Business, colleges should be aware of exceptions for their common transfer partners.

STEM

Every college in our system is offering some portion of the STEM sequence.

Almost everyone offers the two course pre-Calculus sequence in order, that is, Math& 141 as a pre-req for Math& 142, but some colleges allow students to take the courses in either order and a few colleges offer an accelerated course in a single quarter. Although only Math& 141 is required to satisfy the QSR requirements of the DTA, some of our BI partners do not separate pre-Calculus into two parts, and students may need to repeat pre-Calculus if they have not successfully completed the full sequence before transfer and want to be prepared for Calculus.

Although most colleges have adopted the course numbers Math& 151 and 152, for Calculus I and 2. Colleges are split over their use of Math& 153, 254 or Math& 163, 264 for the third and fourth quarters.

It is almost always easy to move from the STEM pathway to a non-STEM pathway without having to go backward, however the significant changes that have been made to the non-STEM pathways make changing from non-STEM to STEM more difficult. While some colleges don't believe that this is an issue and note that students are more likely to move out of STEM than into it, other colleges have built bridge courses to facilitate students moving into STEM.



What is College Algebra?

College Algebra was originally developed across the country as the first college level course on the pathway to Calculus. Over time, it became the default gateway math course for nearly all students. In Washington, colleges have done a great deal of work to move each student into a pathway that more closely aligns to the student's academic and career goals.

For many of our colleges, College Algebra courses disappeared from the books. Some Algebra skills traditionally found in College Algebra were cut from the curriculum and others were absorbed into Intermediate Algebra courses and others into pre-Calculus courses.

However, College Algebra courses are still being taught at some of our colleges. It is almost always taken after Intermediate Algebra, but there is not a common understanding of what this course should contain or even who should take it.

At some of our colleges, the first course in the two-course pre-Calculus sequence is called "College Algebra". For other colleges, the special pre-Calculus course that prepares students for Business Calculus is called "College Algebra". And at others, there is a course designed for students who have passed Intermediate Algebra but who are not quite ready for pre-Calculus which is called "College Algebra". While all three of these uses of the name "College Algebra" describe a course that is beyond Intermediate Algebra and can be thought of as the first college level course on a pathway to Calculus, they are very different courses with very different student audiences.

Shortening the Path

Even before the call to increase the number of students who get through their first college level math course within their first year, colleges had been working to shorten their pre-college math sequences. For many colleges, their pre-college math sequences were four or five courses long and covered topics from basic arithmetic through Intermediate Algebra. Of course, not all students started at the lowest level, but for students who did, the pathway to and through a college level math course could be nearly two years long, even if the student enrolled in and was successful in math every quarter. Sadly, not many made it.

From statewide enrollment data, it is clear that too many of our students don't ever get through their college level math course. It is difficult to know how many students never receive a placement, but nearly one quarter of our students do not enroll in a mathematics course at all within their first two years. Of the ones that enroll, not surprisingly, the students who enroll first in a college level course have a much better chance of getting through that one course than a student who must first navigate a sequence of pre-college courses before even enrolling in a college level course.

When colleges first structured their pre-college pathways, the hope was that although some students were not prepared for their college level course, after taking and passing a sequence of pre-college courses that



roughly mimicked what students would have seen in middle and high school, students would be prepared to take college-level courses on equal terms with their peers who were deemed college level from the start. When taking the narrow view of comparing students who are enrolled in a college level course after completing a pre-college sequence with their classmates who are enrolled in the same college level course as their first course, some colleges have found that the success rates are similar. Note that not all of our colleges have analyzed this data for their courses. Regardless, this leaves out the very large number of students who never enrolled in the college level course.

For every extra course in the pipeline leading to a first college level course, students who do not succeed and give up leak out, but students who do succeed but do not enroll in the next course leak out as well. Thus, analyses that only include students in a college level course leave out the large number of students that never enrolled in a math course at all or who leaked out somewhere along the way. With this understanding, people began asking, how long does the pathway really need to be? Is there any way we can make it shorter?

While everyone agrees that it is not reasonable to believe that a student who has little or no number sense will be able to complete Calculus in their first quarter of college, it is also the case that a student who doesn't have a complete grasp of some of the more abstract topics presented in intermediate Algebra may still be able to successfully complete Statistics in one quarter.

By either moving topics that were only needed for algebra intense pathways to the end of the pre-college sequence and allowing other students to "off-ramp" or by designing special algebra sequences that focused more on problem solving and less on traditional Intermediate Algebra content, most colleges were able to shorten the pathway for many students, especially those working in the Math for Liberal Arts or Statistics pathways.

In addition, many colleges looked for ways to move students through with fewer leaks. Some colleges have chosen to section the pre-college mathematics content into modules which allow students the flexibility to re-take parts of a course if they were unsuccessful without having to retake the entire course. Others have adopted Emporium or other self-paced models that, in theory, allow students to complete more than one course per quarter. These are almost always significantly supported by educational technology. Still others have chosen to put two courses together into "buckets" when the course outcomes sufficiently overlap so that a student could get credit for either the higher or lower course depending on their success at reaching certain benchmarks.

Some colleges offer a limited number of courses that can be taken together at an accelerated rate within a single quarter. That is, the first course is offered for two hours per day for the first half of the quarter and then the second course is offered for two hours per day for the second half of the quarter. The path, in this case, is not shorter in terms of credits but is shorter in terms of quarters.

Although some colleges have seen improvements in the number of students getting to and through their first college level math course, there are still a large number of students not completing their degree math. Many feel like the pre-requisite pipelines are still too long and simultaneously do not fully prepare



students for their college level courses. In addition, as colleges began to disaggregate their data, they noticed that students of color were more likely to be placed into these pre-college courses. In an effort to minimize the number of students enrolled in pre-college level courses and increase the effectiveness of pre-college instruction, many colleges are now implementing or developing co-requisite courses to support students. I explore the work with co-requisites in more detail in the next section.

Co-Requisites

A number of colleges have recognized the benefits of co-requisite supports to significantly shorten their pathways to college level math courses. As the number of interested colleges grew in the last couple of years, some with the support of Dana Center expertise and some with College Spark Washington or Title 3 grants, a small group of colleges began working together to support and learn from each other. This year, the Washington State Board of Community and Technical Colleges received a College Spark Washington grant to support a larger learning community who will in addition to learning from each other, create a critical mass of expertise within the state to support future work.

Currently twelve colleges who are working at different stages of implementation are working together and learning from each other as they work to document, develop, implement, scale, and iterate their work with co-requisites.

In addition, there are at least ten other colleges who are currently either implementing a limited number of sections of co-requisite supported courses or are in the planning stages.

Just to be clear, when I say co-requisites here, I mean:

A course design in which students who are assessed below college-ready in Math are enrolled in a first-level college credit-bearing course and receive additional academic support concurrently with the college-level material.

The idea is that we can, with just in time academic support, give most students access to college level courses without having to first enroll in stand-alone pre-college pre-requisite courses. Although many colleges are experimenting with co-requisites, there is no perfect model, and even colleges who have been offering co-requisites to large numbers of students are finding ways to improve and iterate and sometimes completely redesign their implementations.



One big question that faculty struggle with is which students should co-requisites be designed to serve. While some only offer co-requisite supports in some pathways, others are working to scale to every pathway. Colleges are also split over whether to design co-requisite support that would support only a narrow band of students who are “close” to college-ready, eliminate one pre-requisite course, or eliminate the entire pre-requisite pathway and place nearly every student into a college level course with support.

Another big question is how much and what type of support is appropriate. Is it enough to have an embedded tutor who then offers supplemental instruction or will students need a separate support course? If an extra course is appropriate, how many credits should it be? We have colleges who are offering co-requisite courses that range from two to five credits linked to five-credit college-level course. These extra courses may be taught by the same instructor as the college level course, sometimes with cohorts of students, which allows for a very fluid integration of college level material and just in time support making the two courses feel more

like a single high-credit course. For courses with small enrollments, this cohort pairing is often not possible. In these cases, the instruction in the support and college level courses are highly correlated but they are clearly two different classes. A small number of colleges are using academic I-Best for their co-requisite support.

Some faculty are concerned that this model pushes students too quickly through content that requires time and reflection. Others have found that the just in time nature of the co-requisite support is not only as good as pre-requisite learning but better. They note that students are motivated to understand the supporting content because they recognize it as being necessary for their success in engaging with the college level content that is right in front of them instead of trusting that the content from their current pre-college course might be useful several quarters down the road. They also note that students who have demonstrated that they have “learned” some algebraic skill by passing a quiz or test months or even years before are not likely to have retained that learning when they need it for their college level course and thus critical pre-requisite skills often need to be retaught anyway.

As more colleges have started designing co-requisites, they have recognized the need to transform entire systems as opposed to just linking courses. Each college must consider how placement, advising, financial aid, and courses outside of the mathematics department that have traditionally counted on pre-college math course pre-requisites will be affected. This is in addition to determining course structure, setting course objectives and obtaining approval of new courses through curriculum committees, developing new pedagogies, staffing and scheduling the new courses. Add to this the daunting realization that the decisions must be made for each pathway independently and what might be possible and appropriate in a Math for Liberal Arts pathway might be totally different than what is suitable for a STEM pathway. It is no surprise that some colleges have determined that they are not prepared to invest in this massive undertaking right now. Luckily, we have a great deal of in-state expertise at colleges who have worked through the major issues on their campus. This expertise has been invaluable in the early work of the learning community to support colleges who are committed but are just getting started.

Although there is a great deal of national research about the success of co-requisite models at increasing the number of students who ultimately succeed in their college-level courses and in closing equity gaps in mathematics, early work has been done almost exclusively at colleges who teach on semester schedules. Thus, colleges in Washington who have managed to implement co-requisites beyond small experimental or pilot stages are collecting some of the first real results for students on the quarter system – and the early results are good.

[Math as Related Instruction in Career and Technical Education Pathways](#)

As mentioned in the Executive Summary, colleges usually have students meet their degree math requirement for Career and Technical Education (CTE) pathways in one of four ways: a pre-college math course, a traditional college level math course that could be used for transfer, a college level math course taught within the mathematics department that cannot be used for transfer, or a college level course taught outside of the math department - sometimes with significant coordination with the mathematics department and sometimes with very little or none at all.

While a large number of colleges have designed applied math courses that emphasize problem solving and applications with very low or no pre-requisite mathematics requirements, only a few have seen how the skills developed in these courses could prepare students in their transfer mathematics pathways and have

developed a crosswalk that allows students who decide that they don't want to stop after their CTE degree to use these courses as pre-requisites for more advanced courses.

Many colleges are struggling with balancing the desire to maximize completions while keeping doors open for students. While crosswalks from applied courses back to transfer pathways mitigate this struggle, it seems that colleges who are able to simultaneously identify appropriate transfer courses for CTE pathways and shorten the paths to these transfer courses so that the pathways are no longer than the existing applied mathematics pathways will be best positioned to keep options open for students who might eventually want to transfer without decreasing the number of students able to complete their credential.

While finding an appropriate transfer math course for some CTE pathways is not difficult. One significant issue that was repeated by many colleges was that many technical programs students need triangle trigonometry. And, in the transfer pathways, trigonometry often does not get introduced until the second quarter of their pre-Calculus sequence. As an alternative, a small number of colleges have looked to Math& 107. The common course description for Math in Society identifies a core focus but leaves room for additional topics, and one of the suggested additional topics is trigonometry. For the colleges who have both chosen to include triangle trigonometry in Math& 107 and significantly decreased the number of pre-requisites to Math& 107, it is possible for a student to get the appropriate mathematics content for these programs in a transfer course with few or no pre-requisites.



Regardless of how CTE students are asked to meet their degree math requirements, regular communication between CTE program faculty and mathematics faculty allows for a better understanding of how these students are being served and exposes ways that these faculty can learn from and support each other.

Basic Education for Adults (BEaA)

Conversations about “shortening the pathway” almost always lead to discussions about Basic Education for Adults. With the sometimes significant overlap in content between pre-college tuition bearing courses and BEaA, there are real questions about duplication of services. It might seem that faculty teaching pre-college courses and BEaA courses would be close colleagues, sharing materials and pedagogy. On some campuses this is exactly what is happening, however, for many of our colleges, these two groups are completely isolated from each other and sometimes have never met.



When some of our math faculty think of BEaA, they picture courses with students working independently on stacks of basic computational worksheets with an instructor sitting at the front of the room answering questions as they arise where students may join the class at any point in the quarter and attend whenever it works for their schedule as they prepare for the GED. With these outdated and distorted ideas, it is not surprising that math faculty would see their own work as being significantly different than their BEaA colleagues.

In reality, BEaA faculty, like traditional math faculty, participate in professional development, have a wide variety of teaching styles, understand the power of contextualized problem solving, and use a diverse mix of materials and technology

with their students. They see their purpose as providing the necessary early instruction so that adults can move through college and into careers. Although BEdA courses are designed for adults with low academic skills or who need to improve their English language skills, the goal is not to get students to pass the GED but to prepare students who plan to go on to earn degrees. Notice that this is exactly the goal of pre-college math faculty.

Probably the biggest questions for faculty who are working to better serve students with some combination of BEdA and traditional pre-college math are: Which students should start in BEdA vs. pre-college or co-requisite supported college level math? And when and how should students transition from BEdA to tuition bearing courses?

Except for students interested in dual enrollment programs, students who do not yet have a high school credential are almost always directed to BEdA for initial advising. However, there are many students with high school credentials who are not deemed college level and some that do not have even basic mathematics proficiency.

At most colleges, students who have a high school credential begin by going through the placement process. At some of our colleges, the students who do not show even arithmetic or pre-Algebra proficiency are immediately referred to BEdA. Once there, they are likely to begin with another round of testing (CASAS) before being placed into an appropriate BEdA course. At other colleges, students with high school credentials are never placed in BEdA courses, and depending on the college, the lowest scoring students may be placed into a stand-alone arithmetic or pre-Algebra course, an Emporium style self-paced course, or a more advanced course where they will receive extra support. A small number of colleges have aligned the outcomes of their pre-college tuition bearing courses with BEdA courses and work directly with students to determine which course is most appropriate based on style of course, student confidence, and financial aid considerations.

If a student is working on coursework in BEdA to complete a high school credential, it is the awarding of their diploma that acts as a natural indicator that the student is ready to move into tuition bearing courses. For students who already have a high school credential before enrolling into a BEdA pathway, they often rely on the advice and prompting of individual faculty to let them know when it is time for them to transition.

For a student coming out of BEdA and looking to enroll in a tuition bearing course, some colleges have very clear articulation agreements. For some, BEdA courses serve as alternate pre-requisites; although, it is not uncommon to have students “move back” a little to account for the movement from the high touch, slow pace, flexible environment of BEdA to the more structured, faster pace of tuition bearing courses. For others colleges, particular GED or CASAS scores can be used for seamless placement. Still, the majority of our colleges treat students transitioning from BEdA as if they are brand new students. That is, if they would like to enroll in a tuition bearing course, they are asked to go through the placement process.



Pedagogy

When asked to describe a traditional math class, many would say something like: Each class starts with a review of the previous night’s homework or a chance to ask questions, then a lecture that includes students following along as the teacher works out examples, perhaps a chance for the students to work on a few problems on their

own, and then class ending with students being sent off to practice. This model allows for relatively large class sizes and allow classes to be exposed to a large number of topics.

Interestingly, when faculty deviate from this formula, they are frequently criticized by students who believe that they aren't really teaching. Even students who are not served well in a traditional format may find comfort in knowing what to expect. They are comforted by watching someone apply algorithms and are excited when they can memorize enough to replicate the processes. These students may assume that their inability to do well on tests or failure in future classes has more to do with not really liking math, not being a math person, being anxious or forgetful, or just being a bad test taker than recognizing that they only ever had a superficial grasp of the content that was presented. Don't misunderstand, I believe that faculty who provide direct instruction and who show students how to compute examples can be excellent teachers whose students are fully engaged with their course content and are able to demonstrate deep learning.



I just want to be careful to note that if we celebrate a faculty's ability to break down every problem into sufficiently small pieces that a student is not required to think but merely to memorize and mimic in an effort to maximize some version of student success, we have chosen to honor a type of teaching and learning that does not fully prepare students for future classes and for the complicated world we are asking them to navigate. However, deep thinking is difficult and takes time. Thus, unless we are careful to limit the number of topics, objectives, and students in each course, it is not reasonable to expect students to fully engage with the material.

In addition to some outstanding lecturers who are able to motivate and inspire their students to think beyond the computation of routine exercises, we have faculty implementing countless strategies to engage their students in real learning.

At nearly every college there is at least one math faculty who is implementing a Flipped Classroom where students are asked to read texts, watch videos, and answer basic knowledge or understanding level questions as homework and then use their class time to participate in active learning, group tasks, working through applications of the underlying content, practicing communication and the use of precise language, and analyzing their own and other students' work.

Many faculty are employing "mini lectures" as introductions to new content and then spending the majority of class time on more student centered activities and asking students to do more routine problems as homework.

A few faculty, mostly in more advanced courses, are implementing inquiry based curriculums like the Inquiry-Oriented Differential Equations (IODE) developed at North Carolina State University.

While faculty still use and debate the use of calculators in their classrooms, calculators seem to represent a small fraction of the technology use across the state. Faculty have created course shells in Canvas, WAMAP, and publisher specific systems which may include homework, videos, chats and discussions, quizzes, calendars, and places for students to upload and download files. The creation and upkeep of these shells is time consuming, but their value in onboarding new and adjunct faculty and as critical tools as we moved to remote instruction cannot be overstated.

In addition to the learning management systems mentioned above, faculty have engaged students using a variety of educational technologies including clickers, Cahoots and other instant feedback systems; Geogebra and Desmos and other simulations; Maple, Mathematica, Matlab, Sage and other computing systems, Webworks, MyMathLab, EdReady, WAMAP and Alex for online homework and problem sets, interactive notes and textbooks and on and on.

Faculty have created their own sets of notes and workbooks and have adopted and sometimes significantly adapted Open Educational Resources to create the best experiences possible for students while simultaneously decreasing costs to students. Only a few colleges are using open resources for a majority of their classes, but the number is growing.

Transparency in Learning and Teaching (TILT) appears to be more popular on most campuses in departments other than math, but there are a few math faculty that have participated in professional development and have been “TILT-ing” their assignments. When discussing the purpose of TILT, many other math faculty noted that even though they had never participated in professional development for TILT, they had been working to make their expectations clear on assignments, to be explicit about what learning was supposed to take place, to offer samples of work that meets expectations, and to develop rubrics for their activities and projects.

Many faculty expressed frustration with trying to make their classes fully accessible. They felt like the resources that they needed and the time to use them were insufficient and yet they were committed to trying. This was exacerbated this spring as faculty moved to remote instruction and tried to keep up with generating quality new content quickly and making sure that the content was accessible to all students. When I visited in



the fall and winter, the anxiety was focused on making sure every document was screen reader friendly and every video had quality closed captioning. By spring, the anxiety had broadened to focus on those things but also to reaching students with significant technology limitations.

Colleges and individual faculty understand that students are motivated differently when the mathematics that they are being asked to learn is meaningful for them. While nearly all colleges include problems and projects in their courses that ask students to apply their mathematical learning, for some this doesn't mean much more than solving some standard “word problems”. For others, significant effort has been expended to inspire students to think about their math as it relates to broader questions and how it can be used to solve bigger problems. Some colleges have chosen to pair math courses with non-math courses (Statistics/Nutrition, Math in Society/History,). In these linked classes, students work on multidisciplinary projects that encourage students to think differently and more deeply about the content in both courses. Other instructors have created courses around a theme that is of special interest to the faculty member or around a theme that is of particular interest to a special cohort of students, allowing them to connect problems throughout the quarter by asking students to continue exploring in deeper and more meaningful ways as new content is introduced. Faculty have recognized the value in using real data sets instead of small contrived data sets to expose students to both the complexities of working with real data and to the variety of conclusions that can be drawn from the same set of data. When preparing for math courses for CTE students, some faculty meet regularly with program faculty to generate problem and project ideas.

Effects of Covid-19 on Instruction

The move to remote instruction was astounding. As colleges tried to triage student needs, faculty tried to reimagine their classes. Online instructors became campus gurus while senior, experienced faculty who had never used technology in their teaching scrambled to adapt.

Faculty redesigned syllabi, tried to imagine how their students would navigate their courses, and worried a lot about assessment. As the early quarter panic began to subside, faculty began to take stock and realized that the move to remote instruction had uncovered and exacerbated many of the challenges that our students face. They also recognized that managing the technology and keeping students engaged primarily through their course shells was difficult and time consuming and felt sometimes that they were managing a class rather than teaching. They mourned the lost student contact.

Faculty who were accustomed to writing on a classroom board experimented with document cams, home whiteboards, tablets, and makeshift apparatus. Successes and failures were shared freely with faculty realizing that we didn't have time to each learn every lesson on our own. Faculty trying to mimic group work employed breakout rooms, small group meetings, Desmos activities, and shared Google Docs. While most agreed that they were able to find some success, some felt that these activities paled in comparison to the class communities where rich, deep discussions took place that they had managed to create in their face to face classes.

Many faculty held synchronous classes with their students, often recording classes for students whose lives made attendance impossible. Others developed fully asynchronous classes but held virtual office hours.

As faculty are planning for online classes for the fall, many are shifting away from the emergency remote instruction that defined the spring quarter and working to develop high-quality online instruction.

Assessment

In addition to the variety of instructional initiatives, faculty have implemented many types of assessments to try to accurately assess student learning.

In terms of formative assessment, in addition to encouraging students to ask questions, many faculty use more intrusive models like collecting instantaneous feedback with polls, clickers or mini whiteboards, or collecting exit tickets with feedback about the day's class, or assigning entry tasks to identify places where instruction will need to be adjusted or supplemented. Faculty have expressed frustration with their ability to efficiently administer these formative assessments in their new remote classes.

Most faculty collect homework, either online or written or both. Individual and group projects are common in Math for Elementary Teachers, Math in Society, and Statistics courses. At all levels, faculty engage students in graded class activities, but they are most common in pre-college and co-requisite support courses. Faculty teaching online, flipped and hybrid courses often assign quizzes based on out of class readings or videos. Many faculty give frequent quizzes over small amounts of material where the quizzes might be online or handwritten and might be intended for individuals or might be worked on in groups. It is also common for faculty to give at least one, but up to four or five, exams each quarter that cover multiple topics. These exams range from closed book, timed, proctored events to open book, untimed, unproctored exercises. While some faculty have policies that allow students to retake exams or correct mistakes to earn more credit, most do not.

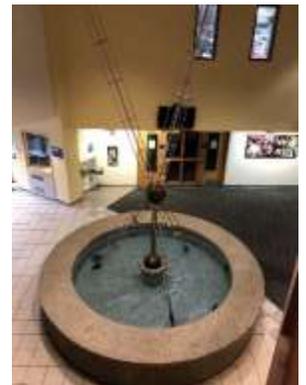


A small number of faculty assess students using less common techniques: having students write papers, give presentations, create videos or podcasts, submit their own exam questions, or compile portfolios.

When faculty spoke about their reasons for giving assessments, most spoke about determining which students were prepared for future courses or motivating students while others spoke about giving students feedback to help them assess their own learning. Many faculty are intentional about aligning assessments with course objectives. However, when assigning final grades, it is also not unusual for faculty to include things like participation, effort, and attendance in order to motivate good student habits but which do not align to any course objectives.

Although a few faculty have experimented with alternate grading practices like mastery grading and grading contracts, the idea that some traditional elements of grading might further course inequities has not been identified as a concern for most faculty.

When faculty moved all of their courses to remote instruction due to Covid-19, anxiety about quality assessment ran high. Some faculty tried to keep their grading policies and assessments as close to those that they had employed in previous quarters as possible. For many of these faculty, that meant employing a proctoring tool like Honorlock, Respondus, or ProctorU or live proctoring their students through a ZOOM call. Although some faculty had good success with these methods, most expressed concern about technology problems and significant student anxiety. Many faculty determined either from the start or during the quarter that for their classes, proctored exams would need to play a smaller role in this environment. Most of these faculty increased the frequency and decreased the stakes of their assessments, collected and graded more written work from students, and asked more open-ended and analytic questions that could not be typed into an online calculator. Faculty found that this shift required much more time both in the development of quality assessments and grading, and it is not clear how many of these changes will persist when classes are allowed to be held again on campus or testing centers reopen.



Equity

While discussions of equity almost always centered around students, a small number of faculty expressed frustration with the ways that inequity affects faculty as well. The different contracts for BEdA versus math department faculty, the low number of Black and Latinx math faculty, differences in access to professional development that are not correlated to need, the reliance on adjunct faculty who have little or no job security, and inequitable access to technology resources were all identified as issues for faculty. It is not hard to imagine that these “faculty issues” have an effect on students as well.

Faculty and staff almost universally expressed a desire for equity for their students. Beyond these expressed values, it was not unusual to hear faculty acknowledge that they were at a loss about what to do about it or if they, within their classes, had any part to play. Many believe that their course sequences and their classes in particular offer a pure meritocracy that rewards students who “care” and “work hard” and “come to class prepared”. When asked directly, faculty agreed that microaggressions were bad and overt racism was intolerable, but many struggled to see their role in perpetuating systems which did not serve all students.

Other faculty, however, expressed an almost desperate desire to understand how the policies and procedures on their own campuses and even in their own classrooms affect students. These faculty have invested in their

own professional development through reading, webinars, meetings and workshops and then fought to change policies and experimented with new and sometimes uncomfortable practices in their classrooms in an effort to create more equitable colleges and classes. In addition to small faculty groups and individuals, some colleges have done significant work with culturally responsive teaching, others with the 4 connections, and others with the 5 dimensions of equity in support of transforming their colleges and classes.

Although data is readily available and shared on some campuses, this is far from universal. It is easier for faculty who can readily see and trust their own data to acknowledge where change is needed. For colleges to identify gaps, they will need to collect and share data not just about enrollments, and pathways, and course success but about placement, and transitions, and pedagogy as well.

Once gaps have been identified, we must not try to explain them away nor rationalize the inequities but instead confront them and find ways to offer truly equitable opportunities for success even if it means facing the uncomfortable fact that things we have done for years with the best of intentions were hurting some students.

[Working Together For Change](#)

In order for large scale change to take place, teams have to feel empowered to make changes, have the expertise required to both understand the problems and the systems in which they are embedded, and be creative in their approaches.

Each of the colleges in our system will ultimately be responsible for finding and implementing practices that will best serve their students. And, although decisions will be made locally, they need not be made in a vacuum. Together we can challenge each other to imagine better systems for all of our students and support each other by sharing our expertise to create the systems that we have imagined.

