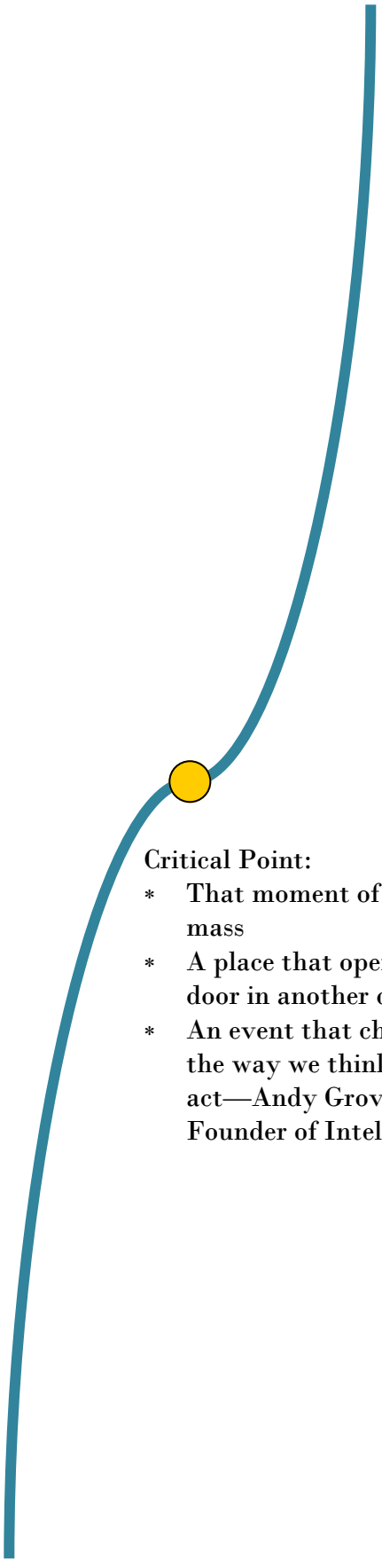
The Critical Point

Redesigning Developmental Mathematics Education in Virginia's Community Colleges



Critical Point:

* That moment of critical mass
* A place that opens the door in another direction
* An event that changes the way we think and act—Andy Grove, Founder of Intel

Report of the Developmental Mathematics Redesign Team
August 2010

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Acknowledgements

Under the leadership of Dr. James Perkins, president emeritus and mathematics professor at Blue Ridge Community College, with support from Dr. Frank Friedman, president of Piedmont Virginia Community College, the Developmental Mathematics Redesign Team (DMRT) reviewed developmental mathematics education policies and practices and considered steps Virginia's Community Colleges should take to redesign developmental mathematics. The team included representatives from 15 community colleges, the system office, and Virginia's Department of Education. In addition to mathematics faculty, the team consisted of representatives from student support services, workforce development, the K-12 sector, deans and vice presidents, and faculty from other disciplines served by developmental mathematics.

Acknowledgement and thanks are in order for Dr. Perkins, chair of the DMRT, who as a mathematician and lover of mathematics spoke eloquently for a vision of mathematics redesign. Thanks to Dr. Friedman, co-chair of DMRT, and to Dr. Wood, Vice Chancellor for Academic Services and Research, for their support and promotion of the work of the redesign team. Special thanks go to Elena Byrd, Jane Serbousek, and Dr. Donna Jovanovich, members of the writing committee, who had the task of summarizing the work of the DMRT and preparing drafts of the report and recommendations.

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Executive Summary

This report of the Developmental Mathematics Redesign Team, *The Critical Point: Redesigning Developmental Mathematics in Virginia's Community Colleges*, presents recommendations to refocus the goal of developmental mathematics to prepare students to do college work and to enhance student support services surrounding the delivery of developmental mathematics. It chronicles some of the forces that led to this critical juncture in the VCCS's history to serve the Commonwealth of Virginia's students more effectively and reflects national conversations and initiatives surrounding redesign of developmental mathematics.

As an outgrowth of Virginia's participation with other states in *Achieving the Dream: Community College Counts*, a national initiative on community college student success, progression through developmental education to college work and eventual graduation and/or transfer emerged as a top priority. In particular, most challenging is improving outcomes for students who place into developmental mathematics courses. In a report from Jobs for the Future, an analysis of the progress of 46,000 students enrolled in the first 27 institutions in *Achieving the Dream* found that more students needed developmental education in mathematics than in English. Over 70% were referred to developmental math, compared to 34% referred to developmental English. The analysis, conducted by the Community College Research Center at Columbia University, also found that nearly half of those referred to developmental mathematics were referred to courses three levels below college-level math. Of those, less than a fifth (18%) attempted and only 14% completed a college algebra course (Biswas, 2007).

In 2009, Virginia's Community Colleges (VCCS) embraced its next six-year strategic plan *Achieve 2015.* At the heart of the plan is student success—enabling more citizens of the Commonwealth of Virginia to gain the knowledge and skills needed to be successful in a global economy. An important component of student success is improving completion rates in developmental education. Charged with addressing this priority of improving success rates in developmental mathematics in the VCCS, the Developmental Mathematics Redesign Team (DMRT) began its work in January 2010 and posed several questions: What is the purpose of developmental mathematics? Are we teaching too much? What do students need to know in mathematics? The current developmental mathematics sequence was built from calculus backwards and resembled high school courses; however, not all Virginia's community college

students pursue calculus. It was clear that there was a disconnect between what was needed to be successful in college work and the content of the developmental mathematics sequence. As presented at the Developmental Mathematics Symposium at AMATYC 2009: "The existence of a course or program must be based on more than 'this is material that students should have had in high school'. This philosophy assumes that high schools and colleges have the same educational mission. One of the critical differences between high school and college is that college students are much more focused on occupational and professional preparation" (Karr and Rotman, 2009).

In 2008-09, the Developmental Education Task Force (DETF) examined the state of developmental mathematics in the VCCS and presented its recommendations in the report *The Turning Point: Developmental Education in Virginia's Community Colleges. The Turning Point* affirmed three goals for the VCCS: 1) to reduce the overall need for developmental education, 2) to design developmental education in a way that reduces the time to complete developmental reading, writing, and mathematics requirements for most VCCS students to one academic year, and 3) to increase the number of developmental education students graduating or transferring in four years from one in four students (25%) to at least one in three students (33%). *The Turning Point* recommendations led to the formation of the DMRT, and these three overarching goals guided the work of the DMRT.

Initial work of the DMRT focused on the mathematical skills needed to be successful in various curricula (liberal arts; career/technical education; science, technology, engineering, and mathematics; and business administration). Structure, alternative delivery modes, placement, student support services, and transfer issues were also considered. DMRT members conducted their work through face-to-face meetings, conference calls, and email. Subcommittees examined certain topics in more depth. Notes from conference calls, documents and other resources were shared on Blackboard.

DMRT members regularly solicited input from faculty at their institutions. In addition, all Virginia community college faculty were invited to comment on a DMRT-hosted blog and to complete a content survey. Presentations, made at VMATYC, VCCS New Horizons, and CFAC, provided further opportunities to inform faculty about items being considered and to solicit feedback on what is needed to improve student success in developmental mathematics. This feedback, together with information gathered from the survey and the blog, informed DMRT members as they formulated preliminary recommendations.

The DMRT concluded that the goal of the developmental mathematics program was to prepare students for college-level mathematics courses, for other courses dependent on a mathematical curriculum foundation, and for general education purposes; i.e., quantitative literacy. In order to redesign developmental mathematics to improve student success, the DMRT presents the following recommendations:

- The content of the developmental mathematics curriculum will be revised to reflect what is needed to be successful in college mathematics and college curricula.
- The content will be organized into pre-college units that are equivalent to one credit hour (16 contact hours) of study. The VCCS will charge a faculty group to write student learning outcomes for each unit and determine the level of mastery needed to be successful.
- The VCCS will develop and implement new web-based, adaptive placement and diagnostic instruments for use throughout the system in order to identify better the units that students need to complete. In addition, practice tests with review materials will be made available to prospective students to enable them to be better prepared for placement and diagnostic testing.
- The VCCS will investigate the use of a system-level, enterprise system for early alert and tracking to strengthen student services.
- The VCCS will enhance its ability to conduct research, provide analytics, and track developmental education student success and the VCCS's progress toward meeting the three overarching goals in *The Turning Point.*
- Within the overall system-wide framework of redesign, each college will be able to select a delivery mode that best supports and enhances the pre-college mathematics program at its institution. Colleges will incorporate interactive technology and mathematics software to support student learning.

The DMRT also discussed recommendations from *The Turning Point*, which complement the recommendations above. To support the developmental mathematics redesign, these recommendations from the DETF must be implemented as well.

- *Program Evaluation*: An internal, college-level program review of developmental education should be developed. The program review should contain both qualitative and quantitative data that will lead to quality improvement and address accountability issues for developmental mathematics students' success.

- *Professional development*: Professional developmental opportunities for full-and part-time faculty teaching developmental courses should be available on a regular and consistent basis. Items to consider in professional development include faculty attention to the affective domains; understanding of many developmental mathematics students' poor self-image, the need for reinforcement to do well, and students' understanding of what it means to be successful; and the importance of hands-on activities.
- *Cooperation with local school divisions*: Colleges' cooperative efforts with local school divisions should be enhanced and expanded upon to reduce the need for developmental mathematics prior to student enrollment in a community college. These efforts include early placement testing, development of capstone courses in the senior year, and opportunities for summer fast track or bridge courses.
- *VCCS policy review and development:* With the redesign, various VCCS policies may need revision or may need to be developed. A comprehensive review of policies that directly or indirectly affect developmental education success will need to occur.

The DETF commended developmental education faculty for their hard work, dedication, and innovations. This developmental mathematics redesign represents a transition in focus from covering material to assisting students with learning, and faculty are an integral part of that process. Instructional pedagogy is a powerful complement to system-level redesign. Colleges will continue to take the lead in supporting faculty in improving instruction.

Forces Leading to Change

It is important to note many forces have been at work throughout the system and the nation that have led to the *The Turning Point*, to the developmental education initiatives that are underway in the Commonwealth, and in particular to the recommendations in this document. *The Critical Point* is the result of many conversations, efforts, and ideas throughout the VCCS: at State Board and presidents' meetings, at convenings of the Academic and Student Affairs Council of vice presidents and provosts, at deans' meetings, through various task forces and reports, at faculty peer group meetings, and through college initiatives. Important policy changes have stemmed from these conversations. There is an enhanced data capacity throughout the system to use data to inform policy discussions. Fig. 1 illustrates some of the major forces that have provided the momentum for the VCCS to address developmental education issues and to make changes to improve student success.

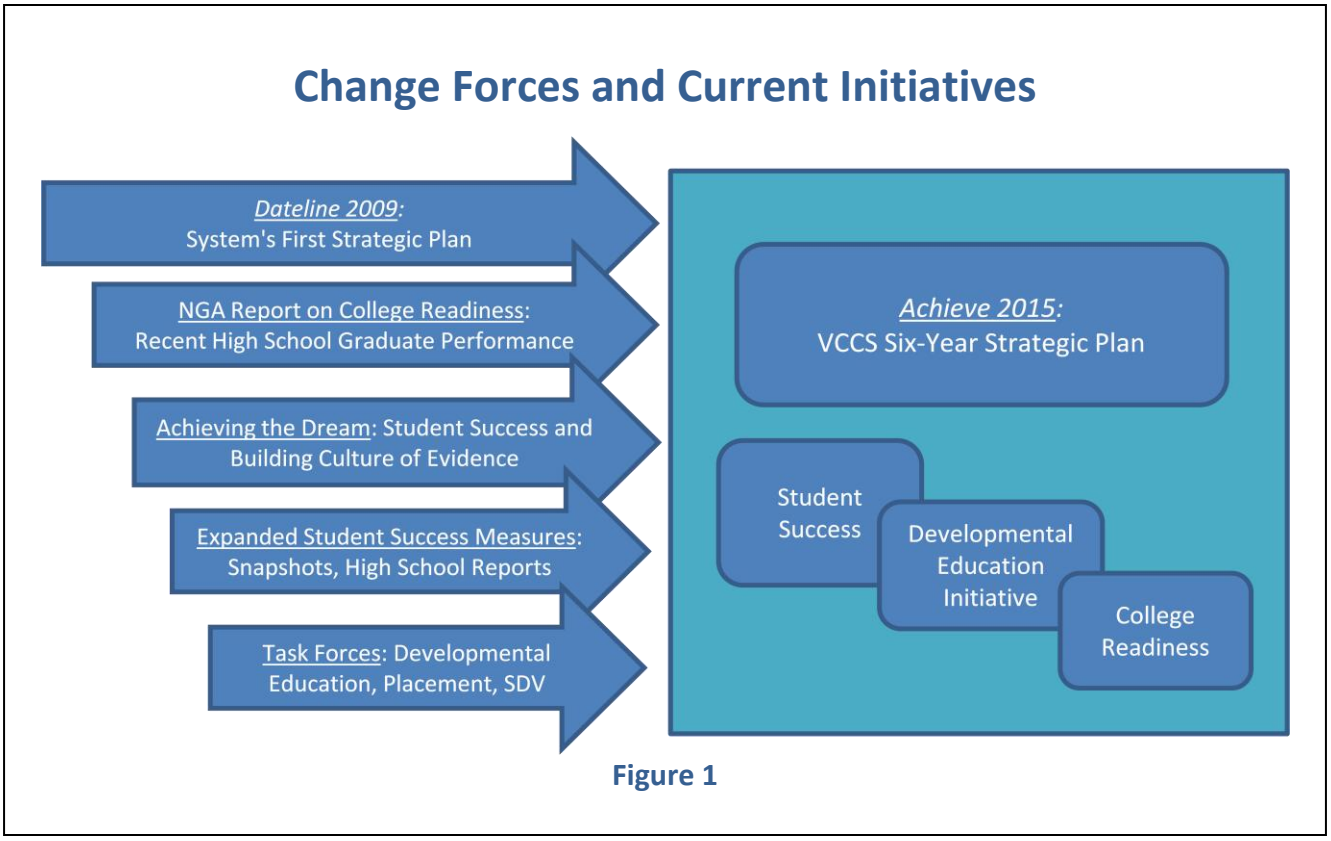

Figure 1

In 2003, the State Board for Community Colleges approved *Dateline 2009*, the VCCS's first strategic plan designed to propel Virginia's community colleges forward, to create more

opportunities for all Virginians, and to create the economic vitality and skilled workforce that Virginia needed (*Dateline 2009*, n.d.*)*. Enrollment, retention, graduation, transfer, and workforce training were key components of that plan.

In 2005, the state-level dialogue centered on college readiness and Governor Warner appointed the P-16 Council to improve connections and ease the transition among all sectors of education. Concurrently, Virginia received funding through the Honor State Grant Program of the National Governors Association to implement a redesign initiative to increase high school graduation rates and improve college readiness. Part of the grant work included a study focusing on the academic preparedness of recent Virginia high school graduates. That study resulted in the 2007 *College Readiness Report: How Virginia's Community Colleges Are Addressing the Academic Weaknesses of Recent High School Graduates*.

The Spellings Commission Report of 2006, *A Test of Leadership: Charting the Future of U.S. Higher Education*, stated that remediation had become far too common an experience for American post secondary students, a result of substandard preparation and poor alignment between high schools and colleges. According to the report, , some 40 percent of all college students end up taking at least one remedial course—at an estimated cost to the taxpayers of $1 billion" and in addition, industry spends significant financial resources on remediation and retraining (U.S. Department of Education, 2006, p. 9).

In 2005, the VCCS joined four other states in the *Achieving the Dream: Community Colleges Count Initiative*, a national initiative focusing on student success, which now has 18 states participating. The focus on student success was critical, but VCCS Chancellor DuBois felt participation in *Achieving the Dream* gave the system something equally important: "a framework for using data to drive an agenda with student success as a goal. *Dateline 2009* laid out a vision for the system, but the system was not ready to articulate how colleges could meet the plan's goals" (Mills, 2009, p. 8). The goals of Achieving the Dream now have become part of the fabric of the work of the system, reflecting a deep commitment and strategic action for a student success policy agenda. Mills quoted John Dever, executive vice president of Northern Virginia Community College and chair of the 2008-09 Developmental Education Task Force (DETF), that former Vice Chancellor Sullivan put "'the success of our students at the center of every meeting. He made us focus on indisputable data' and asked how the system could use the trail of evidence that it was producing to improve the delivery of the service" (p. 5). Today,

student success snapshots highlighting various dimensions of student success and providing actionable data are presented at leadership meetings and spark conversations throughout the system.

A series of task forces dealt with issues surrounding developmental education. The 1998 Developmental Education Task Force produced a report in 2000 that recommended standards for developmental education in the VCCS and provided best practices to ensure quality of the developmental education teaching-learning environment. In 2002, the COMPASS Task Force recommended placement cut-scores, and in 2008, the Placement Review Task Force made a series of recommendations to improve the practice of placement throughout the system. The DETF, commissioned in 2008, laid the foundation for current developmental education efforts throughout the system. Its first recommendation in *The Turning Point* was that the VCCS must redesign English, Mathematics and Reading developmental education" (Virginia's Community Colleges, 2009, p. 14).

Remarking on the proposed American Graduation Initiative in July 2009, President Obama called upon the nation's community colleges to "figure out what's keeping students from crossing that finish line, pursue innovative strategies that promote student completion, and make informed choices about which programs work" (The White House, 2009). These are demanding, yet exciting, times for the VCCS as it grapples with how to effectively meet the needs of its developmental students, pave the way for change, and improve success rates. The VCCS is at a turning point in its developmental education efforts. It is no longer just about opening doors and providing access, but it is also about improving the educational experiences and success of VCCS students" (Virginia's Community Colleges, *Turning Point,* 2009, p. 13). For mathematics, it is the critical point, the VCCS must redesign developmental mathematics to help students be more successful and to prepare students effectively for college work.

Developmental Mathematics in Context

Virginia's Community Colleges provide many meaningful learning experiences for students, and many students have been able to reach their educational goals through the work of dedicated faculty and staff. However, data show there is more work to be done. Reports about the lagging U.S. economic competitiveness and the need to provide better education for everyone are headline news. Coupled with louder calls for accountability, community colleges are challenged to help students complete their higher education goals. Furthermore, in the next few years, there will be major shifts in the populations that community colleges serve. The VCCS will need to adapt and meet college participation and attainment needs of under-represented populations, such as minorities, low-income, and first-generation students.

In 2008-09, the DETF researched, discussed, and compiled information related to student success in developmental education. The focus throughout the process was on how Virginia's Community Colleges can have a greater impact on the success of those students needing developmental coursework upon enrollment at our institutions and resulted in the September 2009 publication *The Turning Point: Developmental Education in Virginia's Community Colleges.* Three overarching goals guided the work of the DETF:

- to reduce the overall need for developmental education
- to design developmental education in a way that reduces the time to complete developmental reading, writing, and mathematics requirements for most VCCS students to one academic year
- to increase the number of developmental education students graduating or transferring in four years from one in four students (25%) to at least one in three students (33%)

Implementation of the recommendations is critical in helping Virginia's Community Colleges meet the student success goal of *Achieve 2015*. Increasing educational attainment is also an economic development issue for the Commonwealth. According to Governor McDonnell, a "college diploma is one of the keys to the good-paying jobs of the 21st century, and businesses seek to operate where there are well-educated workers with the skills necessary to make their enterprise successful" (Shapiro, 2010).

> Community colleges serve as a workforce engine for their communities, providing pathways to high-skill, high-wage occupations. Community colleges also serve as a major pathway for students to attain a baccalaureate degree. It is imperative that community colleges and other higher education institutions in the Commonwealth significantly increase their degree production in the coming decade if Virginia is to remain a competitive force in the global economy and if its citizens are going to have the capacity for advancement. Increasing the rate of students attending college must be accompanied by a corresponding focus on helping students complete their college degree. Success in developmental education is essential to positively impact degree completion rates. (Virginia's Community Colleges, *Turning Point*, 2009, p. 6)

Change throughout the system is underway also with the work of the VCCS Reengineering Task Force, created to rethink every aspect of the VCCS's organization and operations. The Reengineering Task Force is charged "to seek new ways of doing our work, to become smarter in our investments of people and talent and technology, to better leverage our combined size and resources, to restructure our work patterns and habits, and to break down barriers to change and improvement, without making changes to our fundamental governance and organizational structure that has remained a constant and enduring backbone since the inception of our system" (Virginia's Community Colleges, 2009). Developmental mathematics redesign is an important component of re-engineering efforts.

Charge to the VCCS Developmental Mathematics Redesign Team

The Developmental Mathematics Redesign Team (DMRT) was charged to review developmental mathematics education policies and practices and to make recommendations on what steps the system should take to redesign developmental mathematics, with the ultimate goal of improving student success and creating more streamlined and efficient ways of delivery. Through data, the DMRT examined the role that developmental mathematics plays in student success. As part of its redesign efforts, the DMRT considered the following:

- Content within developmental mathematics courses and in developmental mathematics course sequences
- Alternative structures for delivering developmental mathematics education
- Methods to integrate technology into developmental mathematics education

- Student support services and placement and diagnostic testing

Basic Assumptions

In reviewing its charge, the DMRT agreed to several tenets or underlying principles that were accepted as true without proof. These tenets guided the DMRT's work:

- The purpose of developmental studies is to prepare students for academic success in postsecondary education. This represents a shift in purpose from replicating the high school curriculum to enabling students to gain the skills they need to be successful in their college careers.
- Simply tweaking what is in place is not enough. Substantive change is needed in order to meet the *Achieve 2015* goal of wholesale change in student success.
- Students need to move quickly and successfully into college work. It is important to reduce the time needed in developmental mathematics to no more than one academic year enabling students to maintain their momentum.
- Faculty have facilitated the successful movement of many students through the current curriculum and have enabled developmental students to perform comparably to college-ready mathematics students. Faculty are recognized for their hard work, dedication, and innovations. This redesign represents a transition in focus from covering material to assisting students with learning, and faculty are an integral part of that process. Instructional pedagogy is a powerful complement to system-level redesign. Colleges will continue to take the lead in supporting faculty in improving instructional pedagogy.

The Work of the DRMT

The DMRT began meeting in January 2010 under the leadership of Dr. James Perkins, who retired from the presidency at Blue Ridge Community College and currently teaches mathematics at the college, and Dr. Frank Friedman, president of Piedmont Virginia Community College. The charge of the DMRT was to review developmental mathematics education policies and practices and make recommendations on what steps the system should take to redesign developmental mathematics, to include improved student success and more streamlined and efficient ways of delivery. The DMRT met face-to-face and via conference calls. Much of the in-depth work was carried out in subcommittees. First, content committees reviewed developmental mathematics content areas and sought input from faculty throughout the system in all disciplines to determine which mathematical topic areas were needed to be successful in college work. It was quickly recognized that the VCCS may be "over-mathing" students. Then the DMRT regrouped into two subcommittees to consider structure/alternate delivery modes and placement/student support services/transfer issues.

During the content exploration phase, DMRT members polled faculty at their own colleges and an email was sent to all faculty, not just mathematics faculty, requesting input as to what content was needed to be successful in college work in their respective programs or disciplines. A blog was initiated asking for comments on all dimensions of the DMRT's work. The second phase of the process involved subcommittees dealing with structure and student support/financial aid issues. During this process, the structure subcommittee organized the general mathematics content areas into one credit units. The student support/financial aid subcommittee participated in webinar presentations on several software products and developed a set of criteria for a new, customized placement and diagnostic instruments. The committee also examined software solutions for tracking student interventions and advising recommendations.

Presentations were made at various meetings including the Virginia Mathematics Association of Two-Year Colleges (VMATYC), VCCS New Horizons, Chancellor's Faculty Advisory Council (CFAC) and the Advisory Council of Presidents (ACOP). These sessions provided further opportunities to inform faculty about items being considered and to solicit feedback on what was needed to improve student success in developmental mathematics. This feedback, together with information gathered from the survey and the blog, informed DMRT members as they formulated preliminary recommendations.

The Path to Redesign: The Critical Point

Students who enter college through developmental education are at much greater risk of leaving college without obtaining a certificate or degree than their better prepared counterparts. This is particularly true for those enrolled in community colleges**.** Of all newly entering students, 80% are assessed into remediation. Of those assessed into remediation, 83% attempt one course and 67% complete one course. Even fewer reach the gatekeeper course (35%) and only one in twelve (8.5%) completed any credential in four years (Fig. 2). Only 17% of students who enroll in a remedial reading course receive a bachelor's degree within eight years, compared to 58% of students who take no remedial education courses. When underserved populations are considered, similarly only 8.5% of low-income and minority students referred to developmental education complete any credential within four years (Developmental Education Toolkit, 2008).

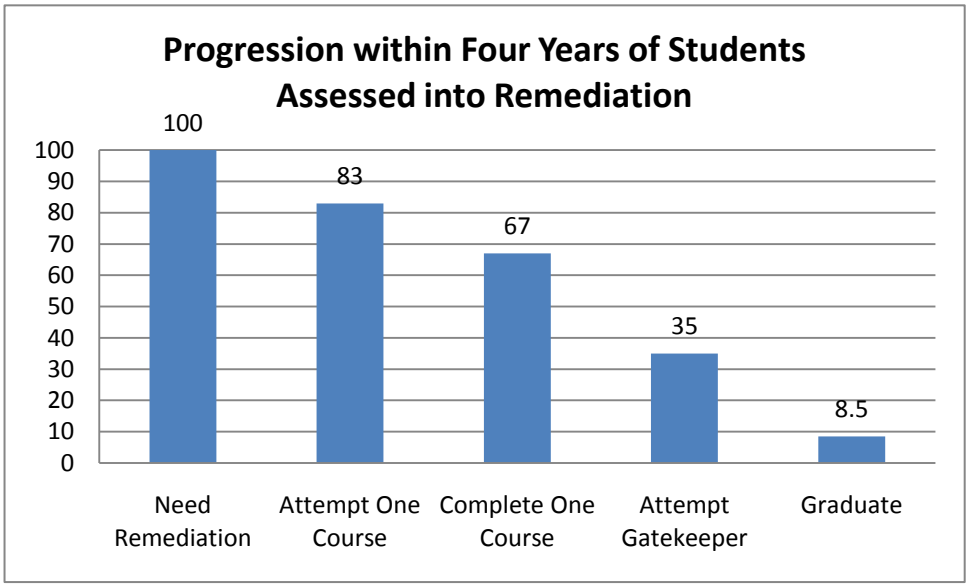

Figure 2.

These dramatic figures underscore reform efforts for developmental education underway throughout the nation. The Lumina and Bill and Melinda Gates Foundations, the American Mathematical Association of Two-Year Colleges (AMATYC), the National Center for Academic Transformation, and other organizations are developing and pilot testing plans to revise content, streamline developmental mathematics education, and provide opportunities for the majority of developmental mathematics students to complete successfully their developmental mathematics requirements and enroll in a college level mathematics course within one academic year.

Within the VCCS, data on success, or rather, lack of success for developmental mathematics students point to similar trends. For the fall 2004 first-time-in-college, program-

placed cohort, 60% of students in basic arithmetic are successful on the first attempt, while 49% are successful in basic algebra, and 52% in intermediate algebra. Of 100 students who attempted a developmental mathematics course, 63% eventually were successful in that first course, and 22% eventually completed a transfer curriculum or career-technical education gatekeeper mathematics course. Levels of student success in developmental mathematics need to be improved in order to increase the flow of students through developmental coursework, into college-level work, and through graduation or transfer.

The table in Appendix A compares current developmental practice throughout the VCCS and redesigned expected outcomes. There are several large issues with the current delivery of developmental mathematics. Not all transfer curricular students need a repeat of high school curriculum through intermediate algebra. If students fail to complete a developmental course, they must start again at the beginning of that course, which may be four or five credits, and also incur the expense of having to pay for the entire course. Students may need only parts of a course to complete their developmental work. The current placement instrument does not have an effective diagnostic component nor are prescriptive results of placement tests available. Placement practices differ among the colleges, recommendations are not enforced consistently throughout the VCCS, and content of developmental courses is not consistent across the VCCS.

Redesign of developmental mathematics is needed for more VCCS students to be successful. The following section outlines recommendations to change the ways developmental mathematics is structured, presented, and experienced throughout the VCCS. The ultimate goal is to increase student success for developmental mathematics students within developmental courses, through gatekeeper mathematics courses, and to graduation or transfer.

Recommendations

In order to meet more effectively the mathematical needs of VCCS students and their programs of study, the DMRT recommends a redesign of the current developmental mathematics curriculum and enhancements of corresponding support services for faculty, staff, and students including professional development, placement, and student support services. The following set of recommendations provides the framework for the next steps to be taken to create a redesigned developmental mathematics curriculum and foundation.

1. **The content of the developmental mathematics curriculum will be revised to reflect what is needed to be successful in college mathematics and college curricula.**

   Figure 3 shows the three different pathways that will be available to a student depending on his/her chosen program of study. One path follows the traditional sequence for science, technology, engineering, and mathematics (STEM) and business administration programs; while the liberal arts studies pathway reflects less algebra and more critical thinking problems, and the career technical education pathway can be customized based on individual program demands. Although the selection of units differs among the pathways, the curricular content of the units will remain consistent and allow for smooth transitions to other pathways should a student change his/her curriculum.

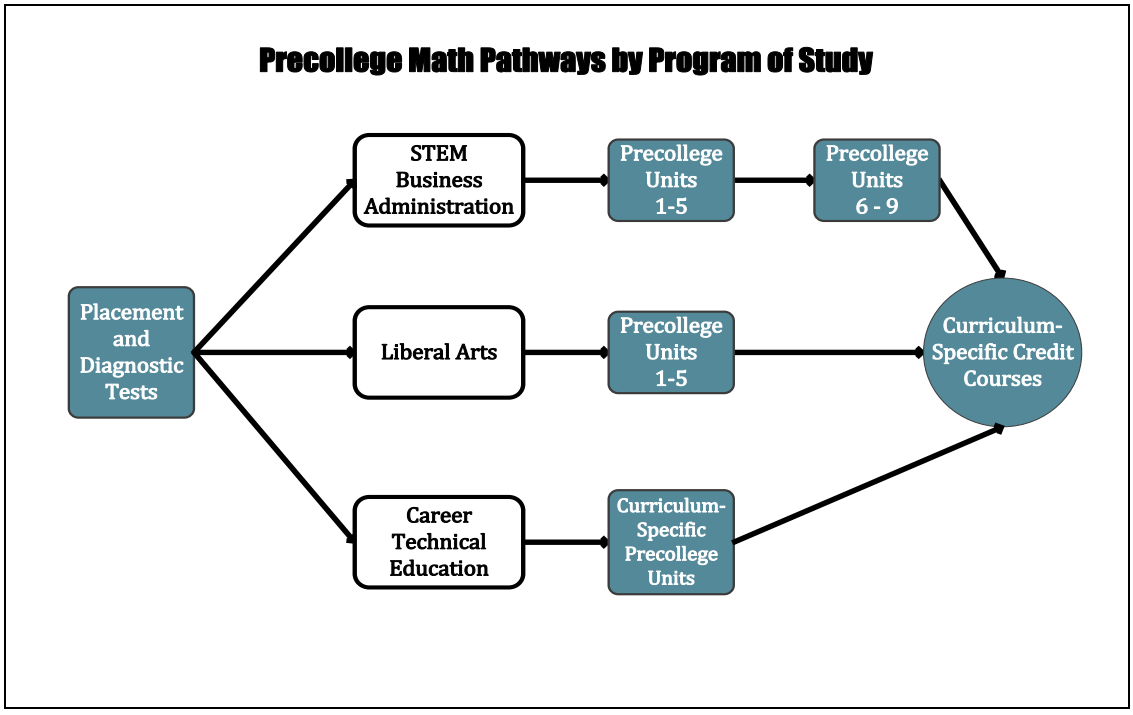

Figure 3.

The reader should note that the developmental mathematics content assumes skill with whole number operations and that the entry-level unit is operation with fractions. Positive and negative numbers are introduced in the basic algebra unit. Should students need to gain skills in whole number operations, other options are available. Those options include offering a basic skills course in whole numbers, providing independent study tutorials such as Key Train or Win, or sending students to adult basic education services in their communities or at their colleges.

It is imperative that critical thinking and contextual problems be infused throughout the units. The DMRT notes that while skills are important, additional emphasis needs to be placed on mathematical literacy and solving problems in context.

The DMRT asks the VCCS to examine the feasibility of providing colleges with the option to offer a college-level algebra course, such as MTH 158-College Algebra, in lieu of proposed units 6 through 9.

2. **The content will be organized into pre-college units that are equivalent to one credit hour (16 contact hours) of study. The VCCS will charge a faculty group to write student learning objectives for each unit and determine the level of mastery needed to be successful.**

Appendix B contains an outline of content to be contained in the proposed nine units. It is suggested that the units be offered in intensive three-week sessions, equating to 16 hours of instruction time per unit, enabling most students to complete the entire sequence in one term if in liberal arts or CTE pathways and in one year if in STEM or business administration pathways. Colleges will have the option to package units in shell courses ranging from one to five semester credits to address the logistics of scheduling and financial aid.

The master course file must be revised to reflect the new unit structure. A new prefix will be created to distinguish the current developmental mathematics (MTH prefix) courses from the new pre-college units. Suggested prefixes include MTE, Mathematical Essentials, and MTG, Mathematical Gateways. Prerequisites for college level mathematics courses must be updated and be made consistent across the VCCS. Also, careful consideration will be given to the possibility of enrolling students in credit courses and pre-college units concurrently or

two pre-college units concurrently. To facilitate transfer among colleges, the content in the units will be consistent across the VCCS.

A mastery approach for each unit will be taken. Faculty will determine the criteria for a student to complete successfully a unit. Furthermore, the DMRT recommends an examination of changing the grading scheme from S, R, and U to A, B, C, R, and F as a motivation for students and also as an aid to track more effectively student success in subsequent courses. Following current practice, the grading scale change for developmental courses would not be included in GPA calculations.

3. **The VCCS will develop and implement new web-based, adaptive placement and diagnostic instruments for use throughout the system in order to better identify the units that students need to complete. In addition, practice tests with review materials will be made available to prospective students to enable them to be better prepared for placement testing.**

The current placement instrument places students into broad categories based on the high school curriculum. The new placement instrument will also place students into broad categories; however, in addition, within those broad categories, diagnostic instruments will identify the specific units that students need in order to develop proficiencies in skills and mathematical understanding based on their selected program of study. This will enable students to take only the units they need to be successful in their college careers, instead of an entire course.

The DMRT recommends that the VCCS search for a testing vendor that will provide: 1) an adaptive placement instrument reflecting the revised developmental mathematics curriculum, 2) customized diagnostic instruments based on pre-college unit content, 3) an item analysis of test results, indicating areas of remediation needed for the student, 4) web-based access from any computer using secure log-ins, and 5) the capability to upload placement and diagnostic scores into the Student Information System.

4. **The VCCS will investigate the use of a system-level, enterprise system for early alert and tracking to strengthen student services.**

The DMRT recognizes the important role that wraparound student services play in overall student success. Early and frequent student services interventions are critical to the success of students in developmental math. In *The Turning Point*, the DETF recommended

that within the first six weeks of class, developmental education students were to participate in at least three academic support interactions, including but not limited to tutoring, mentoring, coaching, career counseling and advising. These interventions and critical accompanying information should be captured and shared among various student support services.

5. **The VCCS will enhance its ability to conduct research, provide analytics, and track developmental education student success and the VCCS's progress toward meeting the three overarching goals in *The Turning Point.***

   Regular reporting on the progress and success of developmental mathematics students is essential to understanding student progression and to informing improvement efforts. Data from placement and diagnostic testing, course-taking patterns, gatekeeper course performance, and achievement of intermediate milestones and successful outcomes will be collected and included in regular reporting. The DMRT recommends that benchmarks for student success be established to monitor the impact of task force recommendations. Student success measures will address: a) reduced need for developmental mathematics, b) improved success rates for students enrolled in developmental mathematics, c) success in college level mathematics following completion of developmental mathematics, d) improved retention of students first enrolled in developmental mathematics, and e) increased graduation and transfer rates for students first enrolled in developmental mathematics.

6. **Within the overall system-wide framework of redesign, each college will be able to select a delivery mode that best supports and enhances the pre-college mathematics program at its institution. Colleges are encouraged to incorporate interactive technology and mathematics software to support student learning.**

   Although many promising teaching and organizational strategies are now in place in community colleges across the country, the DMRT does not recommend or endorse any single strategy. The DMRT respects college autonomy in selecting delivery modes and in packaging modules within Student Information System (SIS) guidelines. VCCS colleges and faculty should implement teaching and organizational strategies that best fit the needs of their

students and communities. Diverse teaching strategies and interactive classroom activities should be incorporated into each unit's delivery.

Other Recommendations from *The Turning Point*

The DMRT also discussed recommendations from *The Turning Point*, which complement the recommendations above. To support the developmental mathematics redesigns, these recommendations from the DETF must be implemented also.

- *Program Evaluation*: An internal program review of developmental education that contains both qualitative and quantitative data will lead to quality improvement and address accountability issues for developmental mathematics students' success.
- *Professional development*: Professional developmental opportunities for full-and part-time faculty teaching developmental courses must be available on a regular and consistent basis. Items to consider in professional development include faculty attention to the affective domains; understanding of many developmental mathematics students' poor self-image, the need for reinforcement to do well, and students' understanding of what it means to be successful; and the importance of hands-on activities.
- *Cooperation with local school divisions*: Colleges' cooperative efforts with local school divisions must be enhanced and expanded upon to reduce the need for developmental mathematics prior to student enrollment in a community college. These efforts include early placement testing, development of capstone courses in the senior year, and opportunities for summer fast track or bridge courses.
- *VCCS policy review and development:* With the redesign, various VCCS policies will need revision or may need to be developed. A comprehensive review of policies that directly or indirectly affect developmental education success will need to occur.

Next Steps

During fall 2010, teams of VCCS mathematics faculty experts will lead the curriculum and placement test design efforts. These teams will develop student learning outcomes for the topic areas in each developmental mathematics unit and determine what mastery in a unit means. Thought will be given to assessments needed within the units to address mastery of content. Another mathematics faculty team will work with a testing vendor to create placement and diagnostic instruments to parallel the content and learning outcomes of the developmental mathematics units. Other disciplines will identify pre-college mathematics units as prerequisites to their college level courses.

In tandem with the curriculum and testing development, student information system modifications and financial aid implications will be studied and updated as needed. Policies, master course file additions, and appropriate modifications to prerequisites will be reviewed and addressed.

It is tentatively planned that piloting of the units will take place in spring 2011, with the goal of a system rollout in fall 2011.

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Appendix A

A Comparison of Critical Redesign Elements to Current Practice

Current Model	Redesigned Model	Outcome
Placement instrument administered (COMPASS)	Placement/diagnostic instrument administered (not COMPASS)	Better determination of student's readiness
Content aligned with traditional high school courses	Content aligned with what is needed for student to be successful in college curriculum	Student studying content appropriate for curriculum entry
Content packaged in courses of 3, 4, or 5 credits	Content structured in 1-credit modules	Flexible structure for customizing student prescription
Students placed into "one size fits all" courses	Students enroll in selected modules based on diagnostic instrument	Streamlined developmental experience
Uneven college practices in early alert/tracking systems	Enterprise early alert/tracking system	Greater efficiency in identifying at-risk students for intrusive support
Uneven emphasis on professional development for full-time and adjunct faculty teaching developmental courses	Systematic professional development including "train the trainer" opportunities for full-time and adjunct faculty teaching developmental courses	Greater faculty capacity in teaching excellence leading to student success
College readiness issues raised; some colleges with innovative programs	College readiness efforts at all colleges advanced through coordinated efforts	Reduced need for developmental courses
Policy implications identified and addressed	Policy implications identified and addressed	Ongoing in order to support student success
College determines instructional delivery method(s)	College determines instructional delivery method(s)	Ownership by colleges of instructional delivery preserved

Appendix B

Developmental Mathematics Pre-college Units

Critical thinking and contextual problems will be infused throughout the units. Each unit is one credit. All units beyond Unit 1 assume competency with fractions, decimals, and percents. Master of basic operations with whole numbers is presumed for unit 1. For students needing help with whole numbers, other options will be made available through online tutoring software, adult basic education, or a basic skills course such as the current BSK 1.

Unit	Unit Name	Topics Include
Unit 1	Operations with positive fractions	Fraction notation, prime numbers, prime factorization, least common multiple. Addition, subtraction, multiplication, division and simplifying of proper fractions, improper fractions and mixed numbers. Ratios. Applications and problem solving including English units of measure.
Unit 2	Operations with positive decimals and percents	Decimal notation, place value, Addition, subtraction, multiplication and division of decimals. Rounding and estimation. Converting from fraction notation to decimal notation. Percent notation and operations with percent. Applications (e.g. medical applications) and problem solving such as percent increase, percent decrease, sales tax, commission, pie charts, Unit conversions, English and metric units of measure, weight and mass, capacity, time and temperature.
Unit 3	Algebra basics	Operations with signed numbers, definition of absolute value, exponents, scientific notation, order of operations, evaluating algebraic expressions, combining like terms, properties of real numbers, solving one step equations using integers, decimals and percents, solving proportions. Applications and problem solving including geometry (perimeter, area, volume of basic shapes).
Unit 4	Linear equations and inequalities in one variable	Solving linear equations by the addition and multiplication principles, solving literal equations (formulas) for a specified variable, solving linear inequalities, introduce basic absolute value equations and inequalities. Interval notation. Applications and problem solving
Unit 5	Graphing Linear equations in two variables	Graphing lines using table of values, interpreting bar graphs and line graphs. Graphing linear equations, naming intercepts, slope, parallel and perpendicular lines, graphing using slope and y-intercept, writing equations of lines using point-slope. Relations, functions, domain, range. Applications and problem solving

Unit 6	Exponents, polynomials, and factoring. Solving equations by factoring.	Simplifying expressions with integer exponents. Introduction to polynomials, addition, subtraction, multiplication, division by monomials, special products. General strategies for factoring, factoring trinomials and special products, solving equations by factoring. Applications and problem solving.
Unit 7	Rational expressions and equations	Determining values of a variable for which the expression is undefined, simplifying rational expressions, addition, subtraction, multiplication and division of rational expressions, division by binomials (long division). Synthetic division, simplifying complex fractions, solving rational equations. Applications and problem using rational equations, proportions, solving including geometry problems and variation.
Unit 8	Rational exponents, radicals, and complex numbers	Rational exponents, evaluating and estimating radicals, simplifying radical expressions, addition, subtraction, multiplication and division, rationalizing the denominator with one or two terms, radical equations, definition of complex numbers, simplifying complex numbers in the form of solutions of quadratic equations. Applications and problem solving including right triangles, Pythagorean theorem and the distance formula.
Unit 9	Quadratic equations, parabolas, and systems of linear equations and inequalities	Solving quadratic equations by the square root method and the quadratic formula. Graphing parabolas, finding the vertex of a parabola or center of a circle by completing the square, naming the intercepts. Applications and problem solving including mathematical modeling with quadratic functions. Solving systems of linear equations by graphing, elimination and substitution, applications including geometry problems. Graphing systems of inequalities in two variables.