INTRODUCTION

Higher education in the United States is facing a failure-rate crisis in entry-level mathematics courses, and influential reports published during the past decade have presented evidence that the number of U.S. graduates in natural science and engineering fields will fall far short of the trained professionals needed to replace the large number of projected retirees over the next 20 years. The CSUN-Consortium has developed an innovative, technology-enhanced hybrid course model that has significantly improved course completion and content mastery outcomes in entry-level mathematics courses. The model relies on five primary components that are carefully articulated to create a reliable “flow of learning” for students. The approach has proven both cost effective and scalable to other courses and institutions. (See figure below and Educause Quarterly article: http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazineVolum/CreatingaLearningFlowAHybridCo/242680.) It targets high failure rate, multi-section, gateway courses in which prerequisite knowledge is a key to success. To date applications have been in math, but in Phase II we expand to chemistry and will be looking for other subject areas that fit the above criterion.

1. ACTIVITIES AND ACCOMPLISHMENTS

The goal of the Wave I grant was to implement CSUN’s hybrid course model in other courses and at other campuses. The model pairs a parent course (such as our course, Mathematical Methods for Business) with a one-unit supplemental hybrid course. Combined, the parent and hybrid courses provide five key components shown in the diagram to the left.

The instruction is divided among faculty, who teach the parent course, and graduate teaching assistants (TAs) and/or undergraduate tutors who manage the supplemental contact hour and remediation. The coordination of materials, homework and exams is managed by a course coordinator. The day-by-day coordination is necessary to create a “flow of learning” which moves students actively and successfully through the course.

- Arrive at the supplemental contact hour ready to practice that concept in facilitated group work
- Approach their homework ready to work independently
- Return to the lecture ready for an expansion on that concept, the introduction of a new concept, or an assessment of retention

The learning flow is made clear to students through their interactions with instructors and coordination of the lecture notes, supplemental contact hour workbook, and homework. It is made clear to the faculty, graduate assistants, and tutors in pre-, post- and term-time training. It is essential that teaching staff are aware of the course materials, the course structure, and the coordination of these. The model components incorporate interventions and practices — such as support for mathematics success, problem-solving in teams, and interaction with instructors beyond the lecture setting — that have proven successful at CSUN and—during Wave I—at other campuses in supporting students, particularly those from underrepresented minority and disadvantaged economic groups.

Assessment studies of work that our original consortium members have done this year demonstrate the project’s success in achieving its goals along proposed timelines. They show that more than two-thirds of the 44,473 students in our six 2011-2012 courses achieved course mastery and deeper learning, and that 93% persisted from Fall 2011 to Spring 2012 in college studies, thereby increasing their chances of college degree completion (see Data Analysis concluding this report.). Moreover, these numbers dropped by only one or two
percentage points when we looked at low-income students. Additionally, longitudinal studies at CSUN and CSU Long Beach (CSULB) put the benefits of the lab model in perspective: At CSUN, Business Math (Math 103) went from two-thirds of students having to repeat the course prior to the model’s introduction, to 70% getting C or better post-reform. This dramatic reduction in the number of students repeating the class produces a net savings of $5000 per semester. In addition, variability in final exam scores among the 12+ sections of Business Math decreased drastically under the model, providing consistency of student experience. Similarly, the graph below shows that the model as implemented under the Wave I funding substantially decreased the number of repeaters and improved the number of students receiving A’s and B’s in Math 115 (Calculus for Business) at CSULB.

2. IMMEDIATE AND LONG-TERM IMPACT

The academic successes reported above in Item 1 represent the most immediate and important impact of our Wave I funding. However, the accomplishment that has the potential to have the greatest impact is the establishment of a consortium of campuses of the California State University (CSU) and California Community Colleges System (CCCS) working collaboratively to solve the entry-level math crisis using the Hybrid Model. Our project leaders have carefully fostered relationships with faculty and departments within the CSU and CCCS via organizations such as the CSU Council of Math Chairs and the Faculty Inquiry Team (FIT) of the Los Angeles-area community colleges. In all implementations, we modified and adapted the model to suit local needs, and we helped new adaptors get their programs started by providing help with materials and data analysis. We have learned how to use data, experience, and personal relationships to bring on new consortium members. Importantly, we have also established good working relationships with the system-wide administrations of the CSU and CCCS. This has helped in identifying campuses and departments where our model can help.

This method of building trust and relationships is slow work, but we have avoided the trap of advocating that the two systems simply mandate that an innovative model that has worked on one or several campuses be implemented throughout a university system—a posture that would ignore both practical and institutional obstacles. From a practical standpoint, mandating solutions tends to underutilize local talent and empower resistance. A solution that works well for a class on one campus will have been finely tuned to the personnel, culture, and infrastructure of that campus and department.

Moving a program elsewhere requires a careful retuning of the components and materials, such that all stakeholders in the new environment (students, staff, and instructors) see it as easier to follow the model to success than to continue with unsuccessful but familiar strategies. However, the process demands that a course coordinator—one who also has the clout to ensure buy-in by all faculty colleagues—devote time and talent on a scale beyond most adjunct faculty. Thus, involving tenured faculty is essential to success, which can be achieved only by building consensus around ideas and evidence, not by mandating external solutions.

On the institutional level, the campuses within the CSU and the CCCS have a policy of faculty governance. Their respective chancellors’ offices set campus budgets and determine policy on system-wide issues such as student remediation requirements, when that remediation must be complete, and what happens to students who fail to complete it. Similarly, the central offices set regulations and restrictions to guide general education requirements. However, the central offices do not directly mandate how these academic programs are realized on given campuses, and thus do not mandate solutions. Nevertheless, there are many mechanisms that central offices employ to encourage and promote solutions that have proven effective.

The strength of our consortium is that it is trusted by faculty, respected by the local and central administrations, and credible to funding agencies. Our consortium founders have worked hard to be sure that our statements are factual and based on good data, that our promises have been deliverable, and that we are respectful of the culture and resources that exist in each campus, department, and course. Thus, we are uniquely positioned to have a strong impact on entry-level courses in mathematics as well as in other areas such as chemistry and economics, where early student academic success profoundly impacts college completion rates.

3. ACHIEVEMENT OF GOALS AND DELIVERABLES
In all areas we met our goals and deliverables, and in several areas we exceeded them. For example, Humboldt State University (HSU) and Los Angeles Pierce College (LAPC) got their courses up and tested one whole semester ahead of schedule. At CSUN and CSULB we achieved all the goals and saw some good improvement in most cases. CSUN’s Math 103 had slightly lower than expected mastery rates, but better than expected DLOs. The issues with mastery were analyzed and are being addressed this semester with additional TA and faculty training and support. The one area in which we did not accomplish as much as we had hoped was in surveying students’ attitudes, behaviors and beliefs. We did do all that we had indicated we would do in the grant proposal; however, none of it seemed to help improve or inform our programs. We are working with Prof. James Stigler (Chair of Developmental Psychology at UCLA) to determine what further steps to take in this direction.

4. MOST- AND LEAST-EFFECTIVE STRATEGIES.

Looking at the student learning data from all the courses that use some form of the model, it becomes clear that each of the components of the model is essential and that the coordination and articulation of the materials used in each component are fundamental to the model’s effectiveness. The best strategy seems to be to put aside all existing materials and get down to a list of what tasks students should be able to perform at the end of the course. This is a department- and even university-level discussion that must foster buy-in among all the stakeholders, including not only faculty teaching the course, but also those who teach subsequent courses (e.g., Calculus). It should also include TAs and staff members. Once this task list is done, it serves as a guide in choosing, or writing, a textbook. The task list gets replicated and divided into exercises for the lecture notes, the lab workbook, the homework assignments, and the common test-bank and exams. The lecture notes are then supplemented with theoretical or explanatory sections.

This process of working from tasks to exercises to explanations seems obvious, but it is generally the opposite of how faculty typically work: have a loose syllabus, choose a book, write lecture notes that may or may not follow the book, and look for problems in the book that may or may not match our lectures. As a case study, consider CSUN’s College Algebra (Math 102), where the model’s class/lab format was implemented in Fall 2011 (this was not a goal or deliverable of the grant). Disappointingly, we did not see any significant improvement. We asked the aforementioned Prof. Stigler to help us look at the question. In Spring 2012, he taught a graduate class in Improvement Science, and the class adopted CSUN’s Math 102 and 103 as case studies for the term. Class members interviewed faculty, TAs, and students, and they analyzed homework grades, remediation scores, and final exam scores. Their conclusion was this: The Hybrid Model’s strength depends not only on the class + hybrid lab format, but also on the materials and the coordination of those materials across the class structure. These UCLA graduate students found that Math 103 students, faculty, and TAs usually knew what their next steps were; they were also able to articulate how the components of the course fit together. However, this was not true in Math 102: There were more discrepancies in 102 regarding which material faculty covered and in what depth. Students in 102 were more likely to report inconsistencies among lecture, lab, and homework, and did not feel that the lecture and lab prepared them for exams. In fact, Math 102 uses the class-lab format, has a common exam, and a common lab workbook, but it does not have common lecture notes, and the course materials do not coordinate to the level achieved in Math 103. From this case study, we concluded that the best practice with course materials is to make them so easy to use and so well coordinated that it becomes easier for faculty, staff and students to do the right thing than the wrong thing. This fall, CSUN is working to address both of these issues before including Math 102 in the follow-on funding. Moreover, this experience guides our interactions with all new implementations as we can point to evidence showing that the very hard work of coordinating materials is fundamental to the model’s (and students’) success.

5. PROBLEMS, OBSTACLES AND LESSONS LEARNED

Ironically, the most difficult problems and obstacles that we initially faced arose out of what we now regard as the key accomplishment (see Item 6) of our Wave I project: establishing a working consortium of three CSU campuses plus one community college working to solve the entry-level math crisis using the Hybrid Model. The fact that this collaboration spanned diverse campus organizational structures was a significant challenge. For example, getting the various institutional research offices to cooperate with the SRI data format or getting the money from CSUN, thorough the other campus’ financial systems, and to the people doing the work required patience and persistence.

In addition to implementing the model in specific courses, this newly formed consortium completed two consortium-wide efforts to develop assessment tools and training programs for scale-ups. Both of these efforts will aid in scaling up the model by making our system-changing innovation more accessible to newcomers. There were bumps in the road, yet in overcoming these obstacles and problems we learned valuable lessons that
**pointed toward even more effective practices.** First, we have come to understand that the management of project data is essential, so having one person who has the education and capability to oversee all of our campuses is critical. Our project data expert, Michael Crosswhite, who holds an MA in Statistics and teaches mathematics at CSUN, has set up a database for collecting campus institutional research, exam results, homework, and remediation data. Moving forward, we will have all campuses use his database system to manage their data more efficiently and effectively. Under the guidance of our informal advisor, Dr. James Stigler, we are also developing analysis tools for comparing the effects of model components across the consortium. Dr. Stigler has trained Crosswhite as a data specialist for course redesign projects. This collaboration began in Spring 2012 and is continuing into the current academic year. It will improve staff training and data collection and assessment tools on all of our campuses. CSUN’s Hybrid Model Math 103 class serves as a case study for Dr. Stigler’s “Complicated Educational Structures” graduate course in psychology and education.

The second lesson learned was the importance of training programs in scaling up. In Summer 2011 we developed a Web-based training video (see link to video in EDUCAUSE Quarterly article cited above.) Embedded in a Moodle Training Site, this video was used at CSUN to train instructional staff in Fall 2011 and Spring 2012, and was deemed helpful in providing the instructors with a clear initial idea of the model. It forms the basis for the Training Template developed from Wave I.

A final obstacle was the budget crisis in California and in the CSU and CCCS generally. This seemed to impact some campuses more than others. CSULB and LAPC were particularly hard hit with vastly increased class sizes and cuts in funding for tutors and teaching assistants. At campuses where the labs were organized as separate from the units for the “parent class” the funding seemed to be more stable. We will recommend this separate unit model to all new consortium members.

6. MOST IMPORTANT ACCOMPLISHMENTS

As noted above in Item 5, the key accomplishment of our Wave I project was the establishment of a consortium of diversely organized institutions from two postsecondary educational systems that has nonetheless successfully and purposefully collaborated to employ the Hybrid Model. What has developed from this collaboration are the supportive infrastructures necessary to share and adapt materials and expertise with unprecedented openness and effectiveness, and we are proudest of this accomplishment. In time, it will be this network of expertise and shared concern for student learning that will have the greatest impact on the CSU and its sister community colleges. This collaboration's impact on our project's progress and success was fundamental: It resulted in the implementation of the Hybrid Model in many lower-division math courses at consortium campuses. At CSUN all lower-division math classes from college algebra through the calculus sequence now employ the model’s structure; several courses also now use the model at CSULB, HSU, and LAPC. Student academic achievement in model math courses increased significantly, as did retention and enrollment in follow-on courses, as instructor, campus institutional research and SRI evaluations for Fall 2011 and Spring 2012 demonstrated (see Data Analysis section below). Notably, discussions between math and chemistry faculty at CSULB indicated that the model would be successfully applied in General Chemistry (Chem111), where students struggling with the math content benefited from the added lab section. General Chemistry courses too often act as “gateways,” affecting degree completion and access to STEM majors and future careers. In Phase II, this will be our first expansion beyond mathematics.

7. IMPACT OF COLLABORATION

Immediate systemic change: Our anticipated as well as actual project outcomes have catalyzed important adjustments in our consortium campuses. Lead campus CSUN has changed the entire mathematics learning delivery system by designing pathways for students tailored to their individual needs, and the other consortium campuses are following suit. The consortium’s campus-wide committees responsible for undergraduate curricula have endorsed the Hybrid Model for redesigning math classes at all of our current campuses. Mathematics department chairs are overwhelmingly supportive of course redesign employing hybrid lab sections with technology enhancements. Facilities changes described in our follow-on proposal are part of this response. As noted, at CSUN the model’s course structure is adopted for the entire lower-division math sequence. CSULB co-PI Newberger has found that the model’s structure aids in analyzing program effectiveness and indicating course corrections, and that ALEKS has proven critical. ALEKS is used for initial assessment of students’ math knowledge, and is used to guide revision of topics and exam scheduling based on students’ performance on homework sets. At-risk students have particularly benefited from this close scrutiny. ALEKS is also used effectively in academic advisement at CSULB. LAPC reports that the administration there is now more open to data-based reform efforts, thanks to participation in both our consortium and in the Achieving the Dream program (which provides no funding for course redesign but encourages seeking grants). LAPC has designed “just-in-
time” materials for math remediation, and math instructors are using computer-aided instruction with xyzhomework (rather than ALEKS).

8. FUTURE PLANS FOR PROJECT

**Plans for long-term systemic change:** The original consortium has now expanded into the “California State University (CSU) Consortium” and it is has been granted $2.3 million from NGLC as follow-on funding. The goal is to expand the CSUN-Consortium’s Wave I Hybrid Model for student success in introductory mathematics courses. Over the course of the next five years, the new CSU-Consortium will seek to scale the model to eventually reach students in entry-level math and “gateway” science courses at 80% of the CSU campuses and at 40% of the Los Angeles-area community colleges. This will be accomplished via a partnership of the CSU Chancellor’s Office, the CSU Council of Math Chairs, and the Faculty Inquiry Team (FIT) of the CCCS. The project has three phases:

* **Phase I** was funded by the Wave I NGLC grant during the academic year 2011-2012 and is completed. It expanded the model beyond CSU Northridge (CSUN) to three other collaborating campuses.

* **Phase II**, recently funded by a follow-on NGLC grant for the period between January 1, 2013 and December 31, 2014, will expand the model from the core consortium campuses to a quarter of the CSU campuses and 15% of the L.A. District’s community colleges.

* **Phase III** will seek to achieve the scaling goal stated above during the academic years 2015-2017, transferring “ownership” of the project from the campuses to the systems.

The CSU has 420,000 students enrolled on its 23 campuses statewide, and the CCCS has nine campuses in the L.A. District enrolling 250,000 students. A successful follow-on project will have an impact on approximately 68,000 students annually in the CSU and 20,000 students annually in the CCCS.

With NGLC follow-on funding for **Phase II**, the CSU-Consortium will employ a two-pronged strategy to expand and amplify the accomplishments begun in Phase I: (1) by scaling out our Hybrid Model to other CSU and CCCS campuses; and (2) increasing the Hybrid Model’s positive impact on student success and persistence (see Data Analysis section) by adding more courses (including courses in chemistry and other sciences); providing more instructor training and more classroom facilities; improving assessment; providing professional and student staff salaries; and improving data collection and analysis. Activities will be focused on:

- **Implementing the Hybrid Model at all consortium campuses.**
- **Recruiting new consortium member campuses** from within the CSU and CCCS by leveraging the influence of the chancellors’ offices, the Council of Math Chairs, and FIT. This will build upon the community of professionals established in Wave I that is dedicated to improving student learning in entry-level math and science by sharing and improving the model’s components.
- **Creating the Hybrid Model Resources Repository (HMRR),** containing:
  * Class Materials - Developmental Math, College Algebra, Trigonometry, Pre-Calculus, Chemistry.
  * Training Tools - Coordinators, instructors, staff, graduate students and tutors.
  * Assessment Tools - Data management tools to collect and compare: final grades in past, current, and subsequent courses; scores on exams, homework, and remediation; and student background information (ethnicity, economic status, first-generation college student).

Strong support for scaling-up the model from the present CSU and CCCS campuses is more than token. The CSU Chancellor’s Office believes that propagating the Hybrid Model to other **CSU campuses** will help solve a chronic problem with gateway and bottleneck courses, that is, those that are: high-volume, multi-section, high failure rate courses. Levers the system office will use to promote this will include:

- Promoting the expansion of the Hybrid Model in business math classes across the CSU by presenting it to a meeting at the Council of Business Deans.
- Beginning advocacy and recruitment at the fall meetings of presidents and provosts.
- Using the Hybrid Model as the tool of “best practice” when addressing the growing State concern over cost of instruction and student graduation rates. Through Access to Success (locally branded as the “Graduation Initiative”), the system office is in regular contact with all CSU campuses, and will explore the Hybrid Model with those that have the most to gain.

**In the CCCS**, the recruitment of additional campuses will be focused on the L.A. Community College District. A Faculty Inquiry Team composed of representatives from each L.A. community college, will manage this activity. FIT was established under the leadership of Vice Chancellor Yasmin Delahoussaye and has the goal of improving the developmental math program. LAPC campus lead Katherine Yoshiwara is on this team and will lead recruitment in coordination with FIT.

Our future plans will vastly expand the scale of our innovation to **realize NGLC’s goals**. Students in our publicly funded consortium campuses are diverse and are often the first in their families to attend college. All of
our original and expansion campuses are federally classified as Hispanic Serving Institutions (HSIs), a
designation that also indicates the high financial needs of most students. Students enrolled in our consortium
 campuses who enter with math learning deficits will spend less time in remediation, and progress rapidly to
meeting degree requirements. These students will graduate sooner, lowering total educational costs to themselves
and to their financially stressed families. Our Hybrid Model course offerings are also cost-efficient for
educational providers: Increased student success in these courses reduces the number of students repeating
classes, realizing substantial institutional savings from offering fewer course sections. Such savings will
contribute to the sustainability of the Hybrid Model and incentivize further scaling up: By lowering the number of
math courses that institutions need to offer for remediation, institutional funds are freed up for implementation of
more Hybrid Model courses, without recourse to external grant awards.

9. DISSEMINATION
Our work has already influenced national discussion and interest in adopting technology-enabled
innovation, such as our model promotes. The Educause article cited above has generated many contacts with
PI Stevenson. She was invited to speak about the Wave I project at the Gates Foundation’s 4th Annual
Postsecondary Success Grantee Convening and in October spoke at the Sloan-C International Conference on
Online Learning in collaboration with Nancy Millichap and Pratibha Varma-Nelson. Support from the CSU and
CCCS chancellors’ offices for program expansion is noted above. That the CSUMB co-PI Hong-De Ho was urged
by the CSU Chancellor’s Office to join our consortium evidences system-wide recognition and promotion of the
Hybrid Model’s potential to reform lower-division mathematics teaching. The CSU Chancellor’s Office has begun
awarding COMPASS grants to some campuses to spur lower-division math course redesign, along the lines of
CSUN’s Math 103 as detailed in the Educause article and also in a forthcoming Society for College and
University Planning (SCUP) article by PI Stevenson, Diane Stephens (CSUN Director of Academic Resources),
and Sean Clerkin (Architect, Clerkin & Clerkin Architechs). PI Stevenson spoke at the CSU Monterey Bay’s
(CSUMB) Conference on Collaborative Alliance for Postsecondary Success (CAPS) on June 12, 2012.

10. EFFECT OF NGLC PARTICIPATION
Participation in NGLC helped move our project from a small, successful, local endeavor to a nationally
recognized program that is playing a significant role statewide through the CSU and CCCS. As can be seen from
the conference invitations and published article listed in item 9, our project is influencing the thinking in
postsecondary education. The networking opportunities that NGLC afforded our project leaders with counterparts
in other Wave I projects, as well as with those under other funders, were invaluable. The CSU is looking at
collaborating with Bridge to Success, a Wave I grantee, for our Early Start program, and we have talked to
Beverly Woolf, another Wave I grantee, regarding help with a test prep course for the ELM (the test that places
students into or out of developmental mathematics in the CSU. Neither of these projects is directly related to our
Wave I project, but they support programs that feed into it. In addition, NGLC’s mentorship in honing our
message has been clear, concise and focused. In February 2011 we participated in “shark tanks” exercises at our
Convening. We were to give five-minute “pitches” of our projects in front of an audience that had been seeded
with aggressive questioners (“sharks”). Our team did well but was somewhat resistant to the exercise and queried
the NGLC staff as to its purpose. The NGLC response was that this exercise was intended to help us hone our
message down to a sound bite that could be used when we found ourselves face-to-face with potential donors or
participants. One day later, PI Stevenson was approached by a donor on the floor of the EDUCAUSE conference
and initiated a contact that may become fundamental to the success of our program.
**CSUN – Math 103 – Business Mathematics**

**Longitudinal grade data:** The grades from fall 2006 to spring 2012 as reported by Institutional Research show remarkable and steady improvement since Spring 2008 when the model with all its components and materials was first implemented. The red line shows students who received D’s, F’s or who withdrew. The blue line shows students receiving A’s or B’s. The C’s are not represented.

The data for Fall 2012 was very positive both on the final exam and the final grades. Spring 2012 common final exam scores hit an all-time high of over 80%; thus, students who persisted did better. However, the number of students who gave up on the course and did not take the final increased. We have taken measures this fall to improve the coordination of the labs and the term time tests in an effort to keep students in the class.

**Pre-/Post-implementation final exam histograms:** Spring 2008 was the first time in which the model with all its components and materials was implemented. Results for the Spring 2012 exam were even stronger, with the median score across all sections at 80% (highest to date).

**Pre-/Post- Wave I final exam histograms:** During the 2011-2012 academic year we revised most of the course materials for Math 103 to fit with the newly revised book. These materials were introduced in Fall 2011, revised in Winter 2012, and implemented in all sections in Spring 2012. Below are the histograms for the final exam in Spring 2011 and Spring 2012. Comparing the two, we see a rightward shift indicating improved course mastery. In addition, new materials focused on improving exposition and practice in problem areas in Math 103. Chief among these were piece-wise functions and solving equations, and we saw the median score on the final jump...
from 8/10 to 10/10 on this problem

Longitudinal Deeper Learning Outcomes: Mastery on deeper learning outcomes (DLOs) is measured by the aggregated score on final exam questions that are cumulative in nature (maximizing profit and elasticity). Here again we see steady improvement over time.

CSUN – Math 104 - Trigonometry

History: Math 104 was first offered at CSUN in Spring 2003. From that time until Fall 2011, the only common elements of the course were the final exam, textbook selection, and sections covered. During this time period no data on student performance was collected.

New implementation: In the Spring and Summer of 2011 new course materials were developed. These included selection of a new textbook, creation of correlated online homework exercises and quizzes, and creation of a lab workbook designed to support student mastery of essential skills and concepts. In Fall 2011 the common elements of Math 104 were expanded to include:

- Use of online homework and quizzes
- Common grading of final exam
- Collection of final exam data (scores per test item per student)
- Basis of grading
- Lab Model - Students who earn less than a B in the prerequisite course must enroll concurrently in a one-unit lab designed to promote mastery of prerequisite skills as well as Math 104 coursework.

Data: Median final exam scores for Fall 2011 and Spring 2012 are summarized below. The consistency of scores from section to section and semester to semester is a positive sign. It suggests that instructors who implement the common elements of the course will have similar results.

<table>
<thead>
<tr>
<th>Median Final Exam Scores (out of 100)</th>
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<tbody>
<tr>
<td>Section 1</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Fall 2011</td>
</tr>
<tr>
<td>Spring 2012</td>
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</tbody>
</table>

Median percent scores of final exam test items are summarized below. This data provides important information that will motivate the refinement of the course and thus improve student performance. Trends in test item scores show areas of student strength and weakness. Solving trigonometric equations (test items 9 and 10 in Fall 2011 and 8 and 9 in Spring 2012) as well as graphing tangent/cotangent functions (test items 6 in Fall 2011 and 5 in Spring 2012) are consistent areas of weakness. These areas can be improved with additional instructional time and emphasis, resulting in significant overall improvement.

<table>
<thead>
<tr>
<th>Median Percent Score Per Final Exam Test Item</th>
</tr>
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<tbody>
<tr>
<td>Test Problems</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>Fall 2011</td>
</tr>
<tr>
<td>Spring 2012</td>
</tr>
</tbody>
</table>

HSU Math 115 and LAPC Math 115

Humboldt State University (HSU) did excellent work on materials, prototyping all those necessary for the planned implementation in Fall 2012 of Math 115, HSU’s only Pre-Calculus course: lecture notes, supplemental instructional exercises, online homework, and ALEKS remediation. At its own initiative, Los Angeles Pierce College (LAPC) piloted a prototype of Intermediate Algebra (Math 125), but without the separate lab, in preparation for planned implementation of the redesigned Math 125 course in Fall 2012. While there was some
improvement in student performance in that experiment, the results underscored the importance of applying the model’s structure of separating group work from classwork.

**CSULB - Math 115**

**Longitudinal grade data:** Despite moving to large lectures, under the Hybrid Model, grades from Fall 2007 until Spring 2012 in all sections of Math 115 show a noisy but steady failure (D, F and W) rate of about 40%, until a dramatic improvement that accompanied what we call “Prerequisite Ready” Testing, in Spring 2012. This new testing strategy is to test mid-unit, after the fundamental concepts but before the most difficult applications.

![Prerequisite Ready Testing](image)

With this strategy, students have studied the fundamental concepts in depth before they encounter the advanced content, and they have longer to prepare to be tested on the advanced topics. Problem-by-problem data in the period marked “Exam 3” above shows the improvement in student performance between Spring 2011, during which we tested at the end of each unit (in the 5<sup>th</sup>, 9<sup>th</sup> and 13<sup>th</sup> week), and Spring 2012, during which we implemented Prerequisite Ready Testing.

![Percentage of Enrollment](image)

This data is from one large section in Spring 2011 (172 students) and one large section in Spring 2012 (170 students), taught by the same professor, with comparable exam problems and similar rubrics.

**CSULB 113 – Pre-Calculus Algebra**

When we started the Wave I grant in Math 113 we had a common course outline and a common textbook. With NGLC funding in Fall 2011 we were able to add in:

- Uniform online homework (WebAssign)
- Supplementary Instruction for at most 25 volunteer students per section (through Learning Assistance Center)
- All students complete individualized remediation (ALEKS)
- Two common problems on the final exam

**Results from Fall 2011:** The rate of students receiving grades of A, B or C from Fall 2011 is 79% among all students, and 78% among students receiving the Pell Grant. While this seems evidence of success, it is these students’ success in Calculus 122 and 123 that will indicate the success of the 113 program. During the first week

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of classes, students in Math 113 take a test, called an Initial Assessment, through the online tutoring system, ALEKS. We use the results on the Initial Assessment to divide 246 students from one section of Math 113 in Fall 2011 into three proficiency levels: at-risk, intermediate and proficient.

By their performances on Exam 1, most of the students that we identify as at risk are indeed in need of advising and support, having an average score on Exam 1 of 68%, which is 10% lower than the average attained by the 246 students enrolled. In fact, 80% received a C, D or F on Exam 1. Figure 1 shows percentages of students in each of the three proficiency levels attaining each letter grade on Exam 1. On the other end of the scale, the ALEKS Initial Assessment did a reasonable job identifying the proficient students, as well; 84% of the 109 students identified as proficient passed the first exam with a C or better, with 68% receiving a B or an A.

![Exam Grades within Each Proficiency Level](image)

This figure shows percentages of students in each proficiency level receiving each grade on Exam 1. Of the students we identify as at risk, 80% indeed received a C or lower on Exam 1.

**New components added in Spring 2012**

*Advising Workshops: reaching out to students with lower ALEKS scores*

We added mandatory advising workshops in Spring 2012 for students scoring lower than 50% on the ALEKS initial assessment. This identified about 70 students across the three sections as needing advice and guidance. Students were awarded 1% of their course grade for either achieving 50% on their initial assessment or attending the advising workshops. All 113 students regardless of their initial assessment scores were welcome at the workshops. The goals of the workshops were to 1) help students connect with resources from within their colleges, including the college advisors, and 2) advertise the opportunity to participate in Supplementary Instruction, and other services offered by the Learning Assistance Center (LAC). Unfortunately, but not surprisingly, less than half of the 70 students we invited chose to attend a workshop. In Fall 2012, we plan to try to have all students participate in the workshops by visiting the large lectures during the first week of classes.

**New components to be added in Fall 2012**

Following our work in Math 115, we plan to implement the following activities in Fall 2012, focused on adding guidance for students’ independent, outside-of-class work through Off-line Homework, and adding a focus on productive study habits by requiring notebooks.

- Hold an in-class advising workshop featuring visitors from the LAC, College of Engineering, College of Natural Science and Mathematics and the Math Department. (This expands our workshops for at-risk students from Fall 2011 to reach all Math 113 students.)
- Off-line homework: Required write-ups of select online homework problems, spot-checked for completeness and correctness during weeks with midterms
- Graded notebook of course materials: Students are required to have an organized binder that includes lecture notes, off-line homework, activity worksheets i>Clickers