Introduction

About California State University, Long Beach

Founded in 1949, California State University, Long Beach (CSULB) is the third-largest campus of the California State University school system, and one of the largest universities in the state of California. It serves a diverse student body of nearly 40,000 annually by offering 82 bachelor's degrees, 65 master's degrees, and four doctoral degrees. It has been recognized as one of "America's Best Values" by the *Princeton Review*.

Meet Professor Jen-Mei Chang

Jen-Mei Chang is an Associate Professor of Mathematics at CSULB. She is also the Coordinator of the Early Start Mathematics Program and the Course Coordinator of the entry-level Quantitative Reasoning course at the university. Jen-Mei grew up in Taiwan, received her Bachelor of Science degree at CSU-Sacramento and her Ph.D. at Colorado State University. Her primary research areas include the Scholarship of Teaching and Learning, and the mathematical analysis of human placenta and its connections to autism.

Why ALEKS PPL Was Chosen

Starting in 2012, CSULB began offering the Early Start Math Program (ESM program) to students who did not demonstrate college readiness by measures set by the CSU System. These are students that would typically place into Basic Math, so the challenge is to ensure they are college ready in a reasonable amount of time.

The ESM program consisted of 1-unit and 3-unit courses during the summer. Students in the 1-unit courses were initially expected to show improvement in their beginning or intermediate algebra knowledge after 15 hours of attendance within one week. Paper and pencil exams were used to demonstrate successful completion. However, the ESM program was proving to be ineffective, as the average pass rates for the 1-unit courses were consistently below 10 percent.

In the summer of 2017, CSULB implemented ALEKS Placement, Preparation and Learning (ALEKS PPL) into the 1-unit ESM courses after seeing the success that local peers had with the program at Long Beach City College and California State University, Northridge. The faculty were convinced that ALEKS PPL could provide them with a cost-effective alternative to what they had before, while drastically increasing the success rate.

Implementation

Cut Scores

Students who complete the ESM Program are placed into a variety of courses using the ALEKS PPL cut scores outlined in **Figure 1**. CSULB did a preliminary study to confirm that these cut scores are appropriate to ensure a reasonable success rate in the subsequent courses. The co-requisite courses are 1-unit support courses to the respective entry-level, general education math courses.

Figure 1: ALEKS PPL Cut Scores for CSULB

Course	ALEKS PPL Cut Score
MATH 94: Co-requisite for MATH 104	Below 46*
MATH 92: Co-requisite for MATH 112A	
MATH 95: Co-requisite for MATH 115	*Students who score below 46 are required to take the appropriate co-requisite with their GE math course.
MTED 90: Co-requisite for MTED 110	
STAT 90: Co-requisite for STAT 108	
MATH 112A: Essential Algebra A	
MATH 104: The Power of Mathematics	46 or higher*
MATH 111: Precalculus Trigonometry	
MATH 113: Precalculus Algebra	*These courses are General Education Category B2 at CSULB. Students must demonstrate they are college ready by SAT, ACT, CAASPP/EAP, AP/IB/CLEP, or transferrable college coursework to enroll in these courses.
MATH 115: Calculus for Business	
MTED 110: The Real Number System for Elementary and Middle School Teachers	
STAT 108: Statistics for Everyday Life	
STAT 118: Introductory Business Statistics	
MATH 119A: Survey of Calculus I	70 or higher
MATH 122: Calculus I	80 or higher

Initial Setup of ALEKS PPL (Summer 2017)

In the summer of 2017, the Early Start Math Program consisted of five courses that ran four weeks. ALEKS PPL was implemented into only the 1-unit ESM courses **(see Figure 2)**. Students who satisfied the university's admissions requirement without being ready for college-level math were required to participate in the ESM program.

ESM students could take up to five ALEKS PPL placement assessments, the first and last of which were proctored. The students were also required to complete at least five hours a week in the Prep and Learning Module between each assessment. The first placement assessment was taken in class and, depending on their scores, students were moved into the appropriate Prep and Learning Module. Students were then encouraged to practice and monitor their learning progress with up to three un-proctored assessments.

Figure 2: Early Start Math Program (Summer 2017)

Course	Units	Coverage
ESM 1	1	Basic Algebra
ESM 11	1	Enhanced Algebra
ESM 3	3	Elementary Algebra
ESM 21	3	Basic Intermediate Algebra
ESM 33	3	Enhanced Intermediate Algebra

There were several ways a student could complete the 1-unit ESM course:

1. Place out of the course at any time with an appropriate, proctored ALEKS PPL score.

2. Take an ALEKS PPL proctored assessment at the end of the course to place into a higher-level math course.

3. Work in the Prep and Learning Module for a minimum of 15 hours to receive an "RP" grade (met the ESM participation requirement without passing the course).

Results

Summer 2017

CSULB compared the average percentage difference between students' topic mastery on the initial and final assessments for the 1-unit ESM courses. It was evident that the more time students spent in the Prep and Learning Module, the more topics they mastered on the final assessment **(see Figure 3)**.

Figure 3: Average Percentage Point (PP) of Topic Mastery

Time Spent in Prep & Learning Module	0–3 Hours	3–6 Hours	6–9 Hours	9–12 Hours	>12 Hours
Initial Topic Mastery	7%	7%	27%	21%	20%
Final Topic Mastery	8%	27%	48%	45%	52%
PP Difference	**1%**	**20%**	**21%**	**24%**	**32%**

CSULB also compared the initial and final placement scores, as well as the percentage growth between the two **(see Figure 4)**. Students advanced an average of 67% between their initial and final placement scores during the four weeks. In fact, all students made improvements in their placement result after four weeks regardless of hours spent in the Prep and Learning Module.

Figure 4: Average Initial and Final Placement Scores

Time Spent in Prep & Learning Module	0–3 Hours	3–6 Hours	6–9 Hours	9–12 Hours	>12 Hours
Initial Score	39%	15%	34%	30%	22%
Final Score	51%	40%	42%	44%	37%
% Growth	**31%**	**167%**	**24%**	**47%**	**68%**

It is important to note that students in the 0-3 hours subgroup had the highest initial placement scores and only made a modest improvement in their final placement scores. This is because the cut score was 30 for placing out of ESM 1 and 46 for ESM 11. The closer the initial placement score was to 46, the less time students were likely to spend in the Prep and Learning Module.

The average advance rate for the 1-unit ESM courses increased more than seven-fold in 2017 when ALEKS PPL was implemented; the pass rate increased by 2594% in 2017 when compared to the year prior that did not have ALEKS PPL **(see Figure 5)**.

Figure 5: Historic Advance Rates for 1-unit ESM Courses

Year	ESM 1		ESM 11		Average Advance Rate
	Enrollment	Advance Rate	Enrollment	Advance Rate	
2012	423	11.4%	308	4.9%	8.15%
2013	156	10.3.%	111	3.6%	6.95%
2014	178	10.7%	120	1.7%	6.2%
2015	258	5.8%	136	0.7%	3.25%
2016	283	3.9%	155	0.6%	2.25%
2017 (ALEKS PPL)	**213**	**77.02%**	**110**	**39.73%**	**58.37%**

Results (cont.)

Out of the students who advanced in 2017, roughly 86 received credit in their subsequent math class while only seven students did so in 2016. This amounts to a 37.5% increase in the throughput rate from 2016 to 2017 with the help of ALEKS PPL. That is, **ALEKS PPL helped save at least one semester of mathematics preparation** for roughly 80 students.

Out of the 109 students who received credit in ESM 1 , 78 enrolled in an Intermediate Algebra course and 41 passed. This translates to a **37.6% retention rate and a 52.6% completion rate.** Out of the 40 students who received credit in ESM 11, 18 enrolled in a subsequent STEMB math course and 13 passed. This translates to a **72.2% completion rate.**

It is too early to tell whether any improved student performance is attributed to ALEKS PPL; however, **ALEKS PPL has helped the institution to more accurately place students into the correct math courses.** In addition, the Prep and Learning Module has helped underprepared students refresh their mathematics knowledge within a short period of time, consequently allowing students to bypass a prerequisite math course when switching from non-technical to technical majors. The number of students needing to take pre-baccalaureate math courses at the end of the ESM Program drastically decreased, with enrollment down by 56.8% compared to the previous year.

Curriculum & Course Adjustments

At the end of summer 2017, Professor Chang worked with ALEKS' Director of Analytics and Math Assessment, Dr. Arash Karami, to study the distribution of topic mastery for subsets of students falling within the same cut score range **(see Figure 6)**. The horizontal axis represents the topic number (out of 314) for all topics assessed on the ALEKS PPL placement assessment. The vertical axis represents students' ALEKS PPL score within a pre-defined range at the end of the term. The percentage of students mastering a topic (within a vertical slice) is represented by the color. Red means no student masters that topic while green means all students master that topic.

This heat map reveals that certain topics are challenging for students at all levels of mastery, such as solving a basic trigonometric equation involving sine or cosine. A topic such as translating a phrase into a two-step expression is something that students can get better at as they learn more topics.

Figure 6: ALEKS PPL Topic Mastery Heat Map for 2017 ESM Students
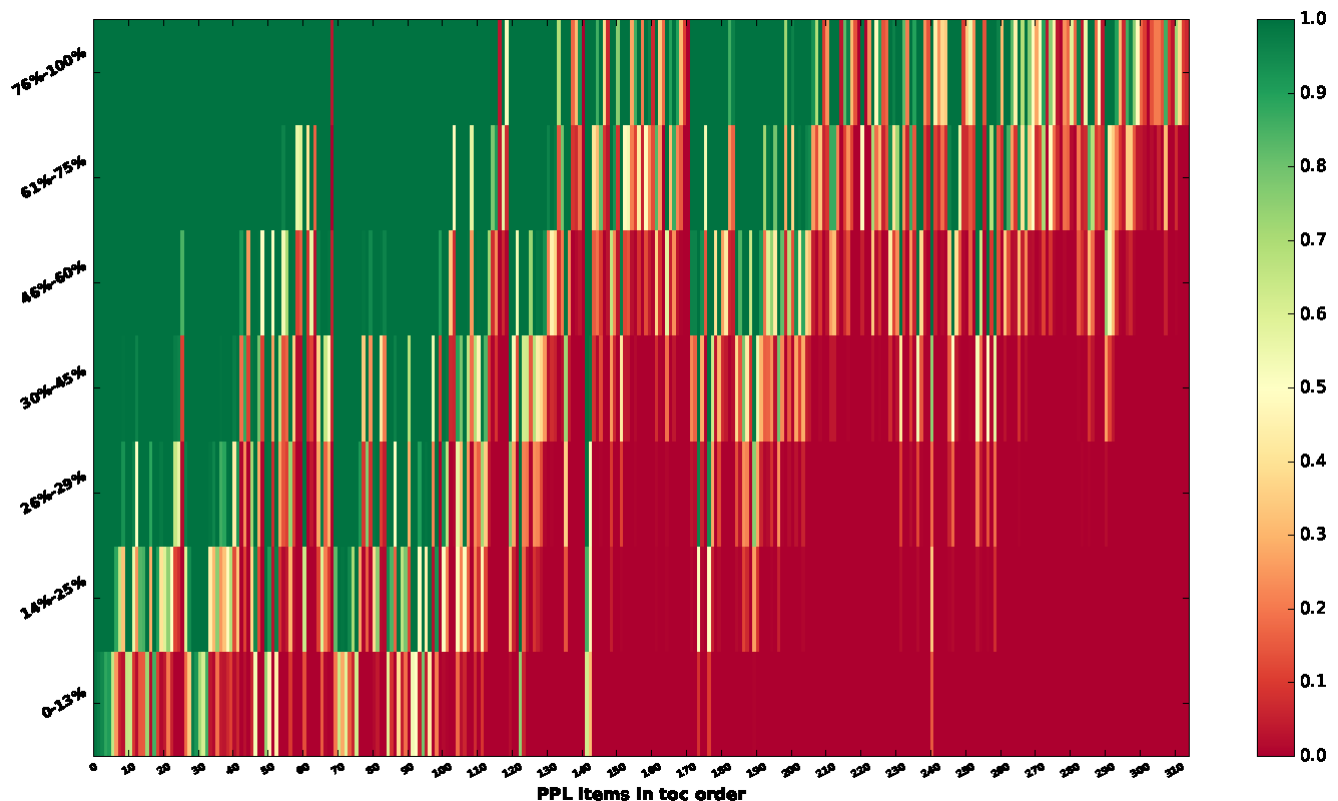
Results (Cont.)

This data inspired Professor Chang to redesign the ESM program for the summer of 2018. The program is now just one, 1-unit ESM course designed to allow opportunities for students to master roughly 100-150 topics that cover arithmetic, number sense, algebra, and geometry. The result is a hybrid program that maximizes ALEKS PPL's placement and diagnostic utilities, while simultaneously supporting students with face-to-face instruction that focuses on study skills and transitions to college life.

Students are required to attend all five class meetings, as well as spend at least 20 hours actively working in the ALEKS Prep and Learning Module prior to taking the final assessment. At the end of the five weeks, students earn one of three grades:

- CR (02): Student scores 46 or above on a proctored, on-campus placement assessment (1st or 4th). This enables the student to enroll in a GE B2 course at CSULB (see Figure 1).

- RP (01): Student satisfies the course requirements but did not score 46 or above on a proctored assessment. Student is then required to register for an appropriate co-requisite class when enrolling in a GE B2 course.

- NC (00): Student does not satisfy the course requirements. Admission to the university is rescinded.

An example of the new ESM program setup is given in **Figure 7**. Students start the class by attending a break-out session based on their most recent PPL score. There, a small group of students work to increase understanding on the 10 topics that they are ready to learn. The way those 10 topics are picked is guided by **Figure 6**. Students then rotate to a different break-out session during the next time-block to learn another set of 10 topics. All students return to the computer lab during the last time-block to continue advancing in their Prep and Learning Modules. During this time, instructors circulate the class to discuss learning progress with individual students, answer questions, and provide students with guidance on college-related matters.

Figure 7: Early Start Math Program Sample Resources & Time Allocation

| Week 2/3/4	Break-out class 1 Instructor 1	Break-out class 2 Instructor 2
9:05 - 10:00	PPL range 1	PPL range 2
	Learn 10 topics with activities	Learn 10 topics with activities
10:05 - 11:00	PPL range 2	PPL range 1
	Learn 10 topics with activities	Learn 10 topics with activities
11:05 - 12:00	All students work in their Prep and Learning Module in the computer lab	

Results (Cont.)

Summer 2018

For the summer of 2018, students gained an average of 14 percentage points in ALEKS PPL in four weeks, which is equivalent to mastering 44 additional topics. There was a total of 404 students who completed the ESM program. Out of these students, 20.1% placed into an entry-level math course, meaning they no longer need a support course in the fall; 45.1% placed at the Intermediate Algebra level; and 34.9% placed at the Beginning Algebra level.

It is worth noting that the ESM student populations are very different between 2017 and 2018. In particular, the students who began the ESM program in 2017 were comparable to the students who finished the program in 2018. This explains the difference between the disparity in pass rates (2017: 58% received CR; 2018: 20% received CR) **(see Figure 8)**. The reason why the populations were drastically different is because the placement mechanism changed from ELM to multiple measures.

Figure 8: Distribution of Pre- and Post-ESM ALEKS PPL Scores
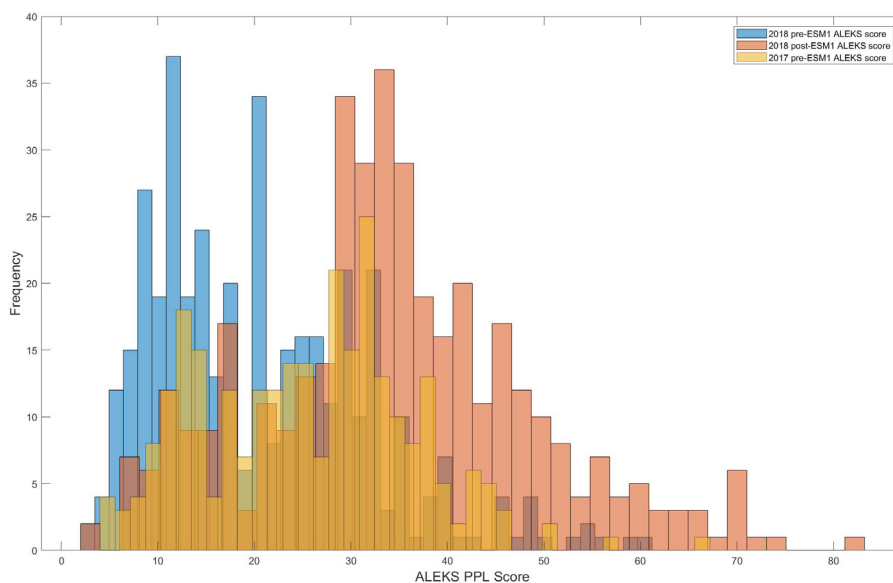
At the end of the 2018 program, students were given a survey and 95% said that the ESM program met or exceeded their expectations. A large majority also said that the combination of the 2-instructor format, ALEKS PPL, and break-out activities worked to prepared them for the fall.

Looking Forward

Today, ALEKS PPL is the only tool used in the Early Start Mathematics Program. In fact, ALEKS PPL is also used exclusively to place students in all entry-level math courses, including first-semester Calculus. CSULB is likely to make a budgetary commitment to continue using ALEKS PPL in placing all pre-STEMB (B for Business) and technical students into Algebra-dependent courses.

Dr. Chang has also collaborated with her colleagues at Long Beach City College and Long Beach Unified School District as part of the Long Beach College Promise partnership to advocate that ALEKS PPL gets implemented into the entire Mathematics Remediation Pathway for K-18 in Long Beach.

"I really love the adaptive nature of ALEKS PPL, which is unparalleled in its industry. The student interface is intuitive and almost addicting — students would rather work in ALEKS. Questions are clearly written; students rarely ask clarifying questions or seek help in data input.

The administrative support is phenomenal — my questions are always answered in a timely fashion, and the people at ALEKS welcome any opportunity for collaboration."

— Jen-Mei Chang, Associate Professor, Coordinator of ESM Program