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## Exploring Computer Science Working Papers

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### Taking Root: The LAUSD/ECS Partnership Story

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## **ECS Working Paper # 2**

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#### **Introduction**

In this working paper we tell the story of how the Exploring Computer Science (ECS) program began and took root in the Los Angeles Unified School District (LAUSD), the second largest school district in the country.

While every ECS partnership has its own history, context, and ways of getting things done, we suggest that the history of ECS in LAUSD can help address questions such as: How do K-12/university partnerships start up and grow? What are some of the ways that educational reform gets sparked, launched, and institutionalized? Does reform happen top down, from the bottom up, through policy, or a combination of all three?

#### **Stage I: Identifying and Doing Something About the Problem**

ECS has its earliest roots in a research project. Funded by the NSF, our research took place from 2000-2004 in three LAUSD high schools. Conducted by a team of UCLA Graduate School of Education and Information Studies researchers, our overall research question was “Why are so few African-American, Latino, and female students learning computer science at the high school level?” The three schools we chose were different from each other, yet at the same time typifying the types of schools in the District. One school was an overcrowded school with a low-income Latino student population, another was a school with a relatively large working class African-American student population, and the other was in a white wealthy section of town, although many students traveled from various areas of the city to attend. We conducted three years of classroom observations in computer science classes, interviews with students, teachers, and school administrators. We contextualized all of our findings in the history and current events unfolding throughout the district at the time.

#### *Our Initial Research Findings*

At the time of our initial research, LAUSD was implementing the Digital High School (DHS) initiative. DHS was a program to “bring all students into the 21<sup>st</sup> century.” The focus was wiring schools and installing computers so that technology was available for all students. Despite the hope that computers would be a key to narrowing the achievement gap, we found the persistence of large disparities in computer science learning opportunities with lack of access falling along race and socioeconomic lines. Our research analysis found that too many schools were “technology rich, but curriculum poor.” Especially in schools with high numbers of African-American and Latino low-income students, only the very basic computing

skills instead of the rigorous problem-solving skills were being taught. In the three schools that we studied, only the school in the white wealthy section of town offered AP CS, and most of the students enrolled were white male residents of the wealthy surrounding community. Further, we found belief systems across all schools that deeply questioned the interest and abilities of African-American, Latino, and female students to become computer scientists, and educational policies that made it more difficult to introduce computer science into the schools. Our research findings are summarized in *Stuck in the Shallow End: Education, Race, and Computing* (MIT Press, 2008).

As a research team, we had always been committed to doing something about the problem. We did not want our research to just become another study sitting on the shelf. So we began to think about ways to remedy these disparities.

#### *A. Building a Partnership with LAUSD*

The ECS university/K-12 partnership between UCLA and LAUSD did not begin with an official contractual agreement. Rather, it began more as an informal process that we characterize as “in from the side.....up to the top.”

Throughout our three years of *Stuck in the Shallow End* research, we had regular meetings with the LAUSD Director of Science, Dr. Todd Ullah. Ullah has had a long history of working on technology initiatives throughout the District. As we reviewed our research findings, we obtained a deeper understanding about how the principal focus on computers (the tools and devices) was insufficient. What was critically needed was a focus on teaching and learning (i.e. curriculum, professional development, and changes in pedagogy). Yet, examining the curriculum offered, we witnessed how most students, especially those at schools with high numbers of African-American and Latino students, were only learning basic rudimentary skills instead of the creative, critical thinking and problem-solving at the heart of computer science. In actuality, despite the installation of computers, there was a big academic hole in the district in terms of *computer science* learning opportunities, and this hole was impacting students of color in low-income communities the most.

In response to these findings, Ullah worked with us to form a university/K-12 partnership (between UCLA and LAUSD), called the Computer Science Equity Alliance, to address these issues. We received an NSF Broadening Participation in Computing grant to further our efforts. With Ullah as the representative of LAUSD and our UCLA team comprised of Jane Margolis, Joanna Goode and Deborah Estrin we mapped out our initial strategy to address this problem.

In retrospect, it is important to note that our original partnership was launched through the efforts and initiative of one top district administrator. It was done informally at first, with outreach to other district leaders and district memorandums to follow. These documents and reach out to other top district officials helped bring awareness to our efforts and helped make the partnership initiatives part of the district efforts in a larger and more formal way over time.

### *B. Our First Initiative: Expansion of AP CS*

Around the time of our research, there were acute district-wide concerns about issues of educational inequity (including the state of school facilities, instructional materials, and teacher qualifications) and the achievement gap. A class action lawsuit, *Eliezer Williams, et al, vs. State of California* (the Williams Case) had been filed in 2000 charging that state educational agencies “failed to provide public school students with equal access to instructional material, safe and decent school facilities, and qualified teachers.”

(<http://www.cde.ca.gov/eo/ce/wc/wmslawsuit.asp>).

Mapping onto this district-wide concern, we decided our first strategy for “doing something about the problem” was to increase the number of AP CS (the only college-credit CS course at the time) courses offered throughout the district, especially focusing on schools with higher concentrations of Latino and African American students. Advanced Placement course enrollment statistics across all subjects in the district were under scrutiny. AP classes were not equally available throughout the district, and were especially absent in schools serving low-income students of color.

Focusing on AP CS was not an easy decision for us because we were aware of deep inequities in the entire AP system. But, at the same time, AP CS was the only college preparatory CS course offered in the district, and we recognized that the unequal access to this course especially for students of color from low-income communities was something that needed to be addressed.

Todd Ullah, officially registering our concerns and focus as in line with district concerns, issued LAUSD Memorandum-556, *Student Achievement on the Advanced Placement Examinations 2003*. This memorandum included AP CS data revealing the low enrollment of African American, Latino, and female students<sup>1</sup>. This official memorandum, along with others issued by Todd Ullah over several more years served to frame our work as a district partnership as well as to increase awareness of the issue we were trying to address.

Over the next several years, Ullah organized meetings with us and top district officials and departments that had authority over technology-related issues, such as the Chief Technology Officer, the Director of Math, and the Director for the Office of Curriculum and Instruction. They provided critical information about how to expand AP CS throughout the district, and they were a source of making connections to principals and teachers who would then offer and teach the course.

### *C. From the Top Down and the Bottom Up: Reaching out to Principals and Teachers*

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<sup>1</sup> While 1,903 AP calculus examinations were taken by LAUSD students in 2003, only 201

In collaboration with Ullah and other district officials we began to reach out to teachers and principals to initiate our campaign to increase the presence of AP CS courses in the schools.

In the summer of 2005-2006, we successfully recruited approximately 20 teachers (primarily AP CS and Intro to Computers teachers) to come to AP CS professional development sessions and then to attend our first summer AP CS Summer Institute for Teachers. The institute was modeled after the LAUSD Science summer week-long professional development. At Ullah's suggestion, a requirement for teachers attending was that their principal be committed to placing AP CS on the master schedule for the following year.

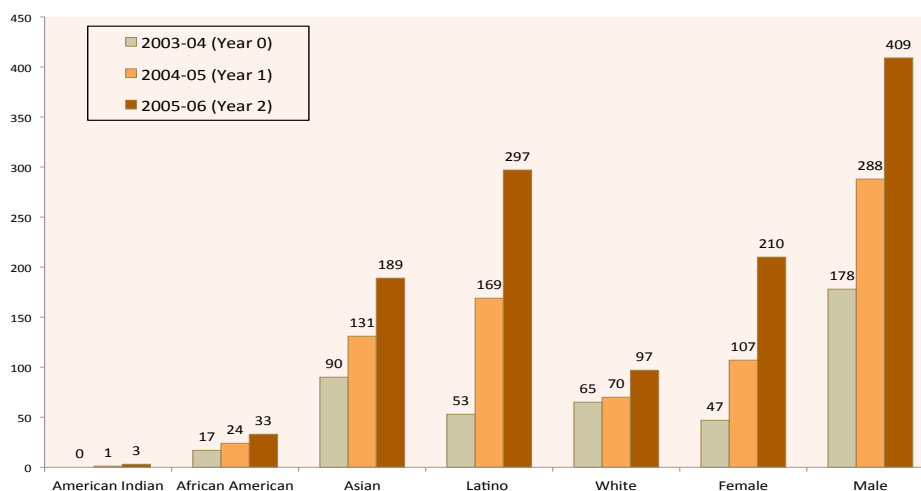
In addition to the summer institutes, we partnered with the UCLA Center X AP Readiness program, which offered Saturday AP CS test preparation sessions for students, with teachers in attendance. We noted however that most of the students in attendance lacked prior preparation such as a CS pathway of courses that would scaffold their knowledge, preparing them for successful completion of AP CS.

From the teachers attending AP Readiness, we learned: 1) how much teachers valued the learning community, 2) how isolated computer science teachers had been in their schools, and 3) how teachers' enthusiasm for our program was an important part of advocating for our program within the district.

#### *D. Dramatic Growth, But Changing Course*

After only a couple of years of our program focusing on AP CS, the number of AP CS courses in LAUSD dramatically increased as did the enrollment of girls and Latinos.

**Students Taking AP CS in LAUSD from 2003-2006**



This growth was the result of an increased number of APCS classes. Yet, it did not offset other deep inequities that were part of the AP system (such as prior preparation and quality of learning opportunities). While the number of AP CS courses was increasing, district test scores on the AP CS exam remained low.

From our research, we also witnessed how the design and content of the course was only serving a narrow strata of students, mostly white and Asian males who had some prior “preparatory privilege”----parents with resources and knowledge that could provide out of school computing experiences through summer camps, computers and software at home, private tutoring etc. In addition to the unequal course preparation, we became more and more critical about the content of the AP CS course, with its traditional programming-focused content and pedagogy. All this combined to reveal the inadequacy of AP CS as the sole college-preparatory CS course to broaden participation in computing.

Coinciding with our questioning about AP CS, was a broader critique coming from the larger CS education community (specifically SIGCSE). Jeannette Wing, in her article, Computational Thinking (Wing, 2006), articulated the belief that computer science education must move beyond the narrow focus on programming and syntax. She presented instead “computational thinking”--- the problem-solving and critical thinking that really lies at the heart of computer science---as what should be the focus of computer science education.

## **Stage II: Exploring Computer Science Created**

### A. ECS Curriculum Created

Responding to this larger questioning going on in the CS education community and our own critique of the AP program, we decided that our work must not remain focused primarily on AP CS. Rather, what was needed was a new course that would introduce all students to the breadth of computer science and computational thinking, taught in a way that was engaging for a diverse population of students. But, one simply did not exist. It was at this point, taking a big leap into uncharted territory, that we decided to write a curriculum. We also knew that the traditional pedagogy of CS (more of a delivery model) would need to change and that an inquiry model tied to an equity mission was what was needed.

Exploring Computer Science was then written by Joanna Goode and Gail Chapman. Goode was co-PI on our NSF grant, co-author of *Stuck in the Shallow End*, and also a former AP CS teacher; Chapman, was a longtime CS educator, CSTA leader, and former Math and AP CS teacher. While Goode and Chapman designed the scope and sequence of ECS, they recruited several high school teachers to write drafts of specific units of the curriculum. The curriculum was revised and vetted by leaders from the CS educational community. Many revisions later, we released version 1 of ECS. It was placed on the Computer Science Teachers Association website and made available for national distribution.

### B. Starting with a Small Pilot and Small Successes

Dr. Todd Ullah, at the time serving as the Director of Science, assigned an LAUSD course code for ECS. He decided that a Math course code was best as it would

probably be Math teachers who would be the ones teaching it. We also decided that it would be best as a full year course targeting 10<sup>th</sup> graders.

In 2008, we recruited 5 pilot teachers from our pool of AP CS teachers. Co-PIs Jane Margolis and Todd Ullah collected written agreements from the 5 school principals that ECS would appear on the upcoming year's master schedule. We had a first summer of PD with the 5 teachers in 2008. Our ECS community was born.

Throughout the year we noted the on-going support that teachers needed. ECS was a new curriculum, with an inquiry-based pedagogy at the core and equity as its mission. It was not scripted in the same way as AP CS, and it was aimed at a much broader segment of the student population. The focus was on problem-solving and computational thinking practices for the introductory learner of computer science.

Because this was the first implementation of ECS in the schools, we encouraged teachers' feedback about the curriculum. But, as we then discovered that some teachers would tinker with the curriculum, sometimes to avoid the inquiry based approach to pedagogy that they were unfamiliar with. These teachers were not used to the inquiry model of instruction and found this approach to be very challenging.

To support this shift in teaching practices, we drew from the educational research (Bess, 2007; Showers, 1984; Feldens & Duncan, 1978; Karan, et al., 1971; Good & Brophy, 1974) showing that an effective PD program (truly focusing on pedagogy, teaching and learning) needs to be based on more than one-time events, but rather is an on-going process that is best supported by in-classroom support. We applied for a Teachers are Key NSF grant that focused on building an on-going PD program as well as funds to initiate a coaching program that would conduct an in-classroom coaching program working directly with teachers.

### C. Growing the Program, Fits and Starts, Leaps and Bounds

From that first pilot of 5 teachers, the number of schools offering ECS grew. Jane Margolis and Todd Ullah made numerous school visits and phone calls, talking with principals about the program and encouraging participation by their school. Ullah made numerous presentations and issued memos similar to what he had done around our AP CS initiative. While many of the district leaders came and went over the years, Ullah was a consistent advocate for bringing computer science to all students in the district. This message was more widely received as the importance of computing to innovation across all disciplines became more widely understood and school leaders and teachers learned more about the content and approach of the course.

We had several strategies for growing the program within the district. All strategies were designed with Ullah's guidance, and all involved mapping onto district needs and priorities including:

- a. LAUSD's Applied Technology graduation requirement  
When we first considered how ECS might map onto existing LAUSD policies we saw a natural fit with the district's applied technology high school graduation requirement. Many schools were using the Intro to Computers (ITC) course to fulfill this requirement so in a sense there was a "place" that ECS could fit in to student schedules. The existence of the Applied Technology requirement helped us to get our foot in the door of school schedules as they saw ECS as a way to help students fulfill graduation requirements.
- b. LAUSD's A-G policy  
Key to our expansion was our successful effort to get "a-g" status for ECS. In California, the University of California determines which high school courses will qualify for college admissions and they must come from a set group of subjects (referred to as "a-g"). This application had to be drafted and submitted by LAUSD to the University of California Office of the President (UCOP). This became a two-year process from submission to completion. In 2009 "g" status was awarded. This was probably the most important strategic move we made to help secure the presence of ECS in the schools. This was critical because a Board of Education resolution was passed in 2005 that focused on all students having access to and passing a-g courses. As a result many schools chose to implement ECS at their sites due to the college prep status of the course in line with the district priorities. In May of 2012 the Board voted to move forward with implementing this resolution. As a result many non "a-g" computing courses have been dropped from schools, but ECS has remained and even increased due to the g credit status of the course.
- c. Converting Intro to Computing classes to ECS—  
Prior to ECS, many schools offered Introduction to Computers (ITC) to their students. This course focused on typing and applications. Many schools used this course to fulfill the applied technology requirement. With the push for students to have access to a-g courses however this course has dramatically decreased in enrollment over time as it was not an a-g course. Due to the g credit nature for ECS many schools made a move to convert their ITC courses to ECS so that students could both have access to computing while also fulfilling the Applied Technology graduation requirement and linking to a-g priorities.
- d. Gaining CTE approval for ECS—  
ECS was also declared by the UCOP office to be a model "linked learning" course---one that carries both a-g and CTE status. While this "linked learning" and CTE status did not immediately impact our ability to expand ECS, over time it has shown to be very important. The California Department of Education IT lead has promoted ECS as an ideal introductory course, thus increasing awareness for ECS across the state. We have also worked with him



to obtain an official course number for an ECS CTE course, which in time will become important in terms of expansion and access to Perkins funding.

### **Stage III: Expansion, Consolidation, and Institutionalization**

#### *A. Expansion throughout the LAUSD*

To recruit principals and schools and teachers to offer ECS, Dr. Todd Ullah as Director of Science for 5 years (2003-8) and then Principal of Washington Prep High school (2009-13) was our chief internal district advocate and champion. He spoke at many meetings, with many leaders and administrators about our mission, and issued several official district memorandums in support of ECS. In collaboration with Ullah, we created a school contract for principals to sign: UCLA would provide the ECS curriculum, the teachers' professional development, stipends for teachers, in-classroom coaching, and resources such as robotics kits; principals would commit to identifying a teacher to teach ECS, and assure that the course was on the Master schedule for the following year. Principals also committed to ensure that the assigned teacher would attend the week of summer PD and follow-up sessions throughout the year as well as participating in follow-up interviews with the UCLA educational researchers on the team.

The growth of ECS (numbers of schools, teachers, students) has been dramatic, as has the success in broadening participation in computing.

#### **Growth of ECS in LAUSD from 2009-2014**

	2009-10	2010-11	2011-12	2012-13	2013-14
Number of ECS Students	921	1,377	2,136	1,927	2,375
Number of ECS Courses	17	36	67	63	80
Number of ECS Teachers	16	18	30	32	38
Number of ECS Schools	16	17	24	25	33

#### *B. One Step Forward, Two Steps Back: Constant Advocacy and Vigilance Required*

Despite a steady rate of expansion, it has taken constant vigilance to make sure ECS is not eliminated and/or marginalized or regarded as expendable since computer science is still not a core subject (such as Math, English, Science, History). This marginal, non-core status increases ECS vulnerability at times of school budget crises, school re-organizations, and subsequent teacher reallocations and reassignments etc. For instance, in 2010-2012 California and LAUSD were hit with a severe budget crisis. Teachers were laid off, and classes were cut. Courses that were "a-g" (college preparatory) had some level of protection due to the district support for them however we still experienced the displacement of some ECS teachers thereby resulting in ECS discontinuing at their schools.

In the spring of 2012, the LAUSD Applied Technology graduation requirement was eliminated. This requirement had allowed us to introduce ECS into the schools as some of them saw ECS as a way to help fulfill this requirement while also linking to “a-g” requirements. Due to our concerns over the potential ramifications of this decision we met with the Executive Director of Curriculum and Instruction. He indicated that the Applied Technology requirement was very broad and could have been fulfilled by a wide array of courses from Home Economics to Landscaping so there was not a definite CS connection that was going to be lost due to this change. We concluded that the “g” credit status of ECS would help the course to exist after this change but that there was a need to do more to build a pathway of CS courses for the long-term survival of the program. We have begun to do this in collaboration with the LAUSD CTE office. As the graduation requirement officially ends with the class of 2014 we will see in time how the end of this requirement affects things. To this point we have not seen detrimental outcomes.

In addition to larger policy and budgetary forces buffeting ECS there is no centralized Computer Science Department (as there are for other content areas such as Math or Science) in LAUSD, so our partnership must be constantly vigilant. With Todd Ullah serving as a principal of a large school, and without a CS Specialist in the District, this responsibility has fallen onto the university side of the partnership.

Over the last three years, it has been largely the efforts of our ECS Project Manager, David Bernier, who is constantly networking within the District, keeping his pulse on what is developing in the classrooms, in the schools, and in the District and analyzing how this all will affect the survival of ECS. He has interacted with numerous administrators and teachers to maintain the existence of ECS at specific schools while also spearheading expansion to new schools within the district by collaborating with various district and school site leaders. In spite of this vigilance we have often experienced a sort of whiplash of starting and stopping of ECS at various schools due to the tenuous nature of CS courses in general combined with budgetary winds and tough decisions that school leaders must make.

#### Teacher Revolving Door

In addition to the larger policy matters which have resulted in “forced” changes on the ECS teaching force there are also the very real matters of teacher choices related to their personal and professional lives, which have impacted ECS in LAUSD. Over the past five years we have had close to forty teachers who have participated in ECS professional development who either did not end up teaching ECS or discontinued doing so after a number of years. Reasons range from moving to out of classroom positions, moving to other schools, retirement, disability, need to teach other core courses and a number of other reasons which will be detailed in another paper. Thankfully some of these teachers have returned to ECS as circumstances at their school changed or opportunities opened up at another school but still this shows that in spite of our best efforts the nature of urban schooling is one of constant change.

Clearly, this raises the importance of a public policy agenda to help secure the presence of CS in the schools and to provide the necessary support and incentive for teachers to teach CS courses. Until state policy changes about the status of CS and who can teach it CS courses will continue to hold a precarious position in schools. Despite these constraints and developments that challenge the existence of ECS in certain schools, our partnership has successfully expanded and deepened. Together, in 2013, we sponsored a code.org Hour of Code Kickoff event and currently in 2014 we are taking steps to develop a formal partnership with code.org that will include support for ECS, CS Principles course, and teacher professional development within LAUSD.

### **Summary: Lessons Learned**

#### **1. Importance of the Higher Ed/K-12/NSF Partnership**

LAUSD has a culture and history of valuing partnerships with higher education. Partnerships, when done right can bring resources, new ideas, and optimism to the district. And, our partnership did that. Further, since we were connected to UCLA Center X, which had a long history of partnership with the district, networking and trust was facilitated. But, as Ullah emphasized, it is critical that the partnerships be mutual and programs be co-developed. The district has experienced too many “partnerships” initiated by outsiders who “just throw their programs over the wall” largely for the purpose of research. It was clear throughout our working relationship together that this partnership was a relationship that would be mutual, long term, and respectful. In this way, quality relationships have been a key to sustaining a successful partnership.

This issue of support from the university/K-12 partnership cannot be underestimated. Because CS has been on the margins, and ECS is an elective, district officials and many principals are not able to spend much time or resources on protecting and monitoring the program. The UCLA part of the partnership was invaluable for doing much of the “heavy lifting,” taking the burden off the individual principals and schools. Left to individual schools and principals, it probably would not have grown the way it has.

Todd Ullah, in an interview, expressed how he strongly believes that at the time we started our programs around CS learning, the district could not have initiated any of these programs. But since UCLA brought support from the NSF, our interdisciplinary expertise, our understanding of the larger CS educational community, our time and organizational assistance, a partnership was possible. Further, without NSF funding, ECS would not have been maintained as the district survived budget crises etc.

In summary, NSF and UCLA partners have brought much needed resources, interdisciplinary perspectives and expertise to the table with the district; LAUSD partners brought their much needed support, experience, deep historical

knowledge, and help with navigating the bureaucratic structure for getting ECS launched into the district.

## 2. Mapping onto District Priorities

Central to our success, and probably central to most partnerships, is an alignment of missions, goals, and concerns. Our partnership for increasing access to CS learning is an example of this. Because of its equity mission, ECS aligned with numerous district initiatives, including the district response to the Williams Case (with its focus on equity in access to college-going courses), the District Action Plan for Culturally Relevant Education that Benefits African American Students and all Other Students” (Tenet 1: Student Opportunity to Learn), all federal, state and district initiatives to “eliminate the achievement gap,” college going curriculum for all students, and a focus on inquiry instruction (the 5 E model in Science). This continues today as ECS learning objectives align closely to the Common Core standards focus on inquiry learning, problem-solving, and computational thinking.

## 3. All You Need Is One Champion To Begin With, But More Must Join

It takes an insider in the district to really have the authority to run with a program, especially one that because of its “non-core” status sits at the margins of district concerns. Having an advocate in the Director of Science opened up the doors we needed to get the first pilot study going.

But, all eggs cannot be placed in just one basket. While our LAUSD partnership story began with really only one insider champion, Ullah was someone who was constantly championing our cause and reaching out to the District leadership network, getting other leaders involved. The array of top District leaders who he conferred with regularly about our project included LAUSD Chief Instructional Officers; Superintendents Romer, Brewer, Cortines; Deputy Superintendents; District Superintendents; College coordinators, Gifted and Talented office, Career Technical Education, Chief Technology Officer and team; Principal Executive Council and individual Principals and Assistant Principals. On the UCLA side, we were benefitting and sharing the expertise of the CS educational community, educational equity and pedagogy expertise that resides in UCLA Center X and other educational higher education institutions.

As our experience has shown us, there is much movement within districts and officials come and go. In 2009, Dr. Ullah moved from Director of Science to principal of one of the most challenging schools in the District. As a result, our UCLA Project Director has spent much time on developing and nurturing a wider network of supporters and advocates. This includes individual meetings with district leaders, principals, teachers, counselors, events around CS education, and meetings with CTE advisers and counseling coordinators for the district.

## 4. Advocacy from Top Down and Bottom Up

While some partnerships may be launched through an official top-down formal contractual agreement, or through co-submission of a grant (a more common way),

our partnership was sparked by a commitment to do something about an identified problem, and launched by university researchers and by one top District administrator. In the case of LA, it was the consistency of the partnership over time that helped eschew the “outsider” status that can afflict many good initiatives. And it was this consistency over time that allowed us to advocate for ECS and for the teachers at many different bumps along the road.

Advocacy also came from the “bottom up.” Support for ECS was also expanded by teachers, who became advocates with their principals and counselors to keep and grow the course at their schools and beyond. As teachers witnessed how students were benefitting, and as they themselves were helped from the professional learning community, they fought for the course to be offered.

Our message to our community is this: We must remember that bringing ECS and CS education in general into urban schools is not an overnight process. One thing is clear: the story of how ECS came to be in LAUSD shows a process that is neither quick nor easy. It requires many partners; multiple doors to open and walk through together; trusting, mutual, and authentic relationships; a common mission; patience and commitment to the long haul.

Getting ECS established in the LAUSD is a true accomplishment, but it is only the beginning. Programs must now take root nationwide. ECS has existed in LAUSD now for over 6 years, and for each of those years we have had to be continuously supporting the teacher community as they weather the storm that is urban education. There will be many strategies for accomplishing this depending on the various local contexts, but we hope that the LAUSD ECS history and lessons learned will be instructive and useful.

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