



Exploring Computer Science Working Papers

The Revolving Door: Computer Science for All and the Challenge of Teacher Retention

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Momentum behind increasing K-12 computer science (CS) learning opportunities is rising, resulting in more school districts agreeing that CS is an important component of students' academic and career pathways. Yet, as this is happening, particular attention must be paid to recruiting, mentoring, supporting, and retaining CS teachers. In this paper we discuss our investigation into the factors that have threatened the staffing and retention of ECS teachers in LA schools. This is especially the case in schools serving low-income African-American and Latino students, schools that are already challenged with recruiting and retaining effective STEM educators [1]. In this paper we offer considerations for addressing these challenges in the work to broaden participation in computing.

An Overview of The Exploring Computer Science Program

Exploring Computer Science (ECS) was developed in response to previous research, detailed in *Stuck in the Shallow End*, which identified disparities in CS learning opportunities that fall along race and socioeconomic lines [2]. Schools with high numbers of low-income students of color were found to offer keyboarding and other basic rudimentary computing skills dressed up as “computer science.” Most students were not being adequately prepared for the only available college preparatory computer science course, AP Computer Science (AP CS). In response to these findings, to carry out our mission of broadening participation in computing, the ECS curriculum was written by two of our team members, Joanna Goode and Gail Chapman in collaboration with secondary CS teachers and CS college professors, to fill a much needed gap.

ECS focuses on the foundational concepts of computer science. It consists of six units of approximately six weeks each, covering: Human Computer Interaction, Problem Solving, Web Design, Introduction to Programming, Computing and Data Analysis, and Robotics. The ECS curriculum is structured to facilitate inquiry and equity-based instructional practices so that *all* students are introduced to the problem solving, computational practices, and modes of inquiry associated with doing computer science. See: www.exploringcs.org

In addition to the curriculum, the Exploring Computer Science program includes a teacher professional development component. This consists of a week-long summer institute for prospective ECS teachers followed by four face to face follow-up sessions throughout the year. During all of the PDs, teachers engage in

teaching and learning centered on the ECS inquiry and equity-based practices. We also support in-classroom coaching, monthly “department meetings,” opportunities for peer observations, and other opportunities for teacher professional growth such as speaking at conferences. Building an active teacher community of practice is a critical part of the ECS program.

ECS has experienced dramatic growth within LAUSD over the last five years (from 5 to 33 schools). In 2013-14, amongst the approximately 2500 LAUSD students enrolled in ECS, 75% are Latino (72% of district population), 10% are African American (10% of the district population), 9% are Asian (6% of district population), and 5% are White (10% of school population). Girls represent 43% percent of enrolled ECS students. These enrollment statistics are dramatically different from the participation rates of girls and students of color in national and state AP CS statistics. In California in 2013, out of nearly 5,000 AP CS exam-takers, only 8% were Latino, 1% African American, and only 22% of exam-takers were girls [3].

The LAUSD ECS teachers’ “revolving door”

In many high-need schools, there is a “revolving door” of teachers. These problems are especially found in staffing of secondary Math and Science courses nationwide, and are true in our ECS program as well. Following is the data we have collected about our ECS program in Los Angeles and our analysis of the situation.

In the last five years in our ECS Los Angeles program 81 teachers have participated. Participation for our purposes counts as having attended the ECS summer institute, participating in the ECS coaching program or attending at least two follow up professional development sessions. Our intention is that teachers would actively participate in all three of these areas. The vast majority of teachers have been involved with at least two of the three activities.¹

Of the 81 teachers who have participated in the ECS program over the last five years, 40 are currently teaching ECS in LAUSD. These numbers reveal that we have “lost” more teachers than we have “retained.” Of the 40 teachers who are currently teaching the ECS course, 5 of them had a 1-2 year interval in which they did not teach the course. This means that fully 45 of the 81 teachers who have participated in the ECS program have experienced a teaching “disruption” which has ended their participation in the ECS teacher community for a year or longer.

It is important to note that the teachers we have been working with are primarily teachers with five or more years of teaching service. Of the 71 teachers

¹ Thirteen teachers who at one point attended the summer institute did not end up teaching the course. As such they did not participate in the coaching program or follow-up PD.

that we have this data for only 10 had 5 years of service or less at the beginning of their participation in the program and 4 of those were from a recent cohort (summer of 2013). This shows that by and large the ECS teachers we have been working with have a longer time of service, and are therefore more stable in the profession and not as likely to leave teaching as those who are just starting their teaching career [4]. Yet, even in spite of this we have experienced numerous challenges to maintaining a stable CS teaching force.

Teacher Credentialing

To teach Computer Science in California, regulations state that a teacher should have a credential in Math, Business, Industrial Technology or a supplemental authorization in Computer Concepts and Applications (which currently focuses on computer applications only and does not address Computer Science nor prepare teachers to teach CS courses). As such, many ECS teachers are teaching out of subject. Of the 81 teachers that have participated in the ECS program over the last 5 years, 37 (46%) have a background/credential in Math, 12 (15%) have a credential in Business, 9 (11%) have a supplemental authorization in Computer Concepts and Applications, and 5 (6%) have a credential in Industrial Technology. 17 (21%) teachers do not have a credential in any of those areas, having credentials in various subject areas such as Chemistry, History and Spanish. These 17 teachers have been able to teach the course through a Board of Education waiver process or other means as a temporary solution.

Reasons for Teacher Turnover

Of the 41 teachers who are no longer teaching ECS we have categorized their reasons for departure as either “forced” or “chosen” exits. “Forced exit” identifies a situation where it was the decisions or policies of the school or district that led to the teacher’s departures from ECS. These are usually factors beyond the individual teacher or program’s control to change. We have used the term “chosen exit” to delineate when it was the teachers decision to do something different that resulted in a discontinuation of teaching ECS. In two cases there was a combination of the two, but for the most part these categories capture the general nature of the departures from ECS teaching.

“Forced” Exits from ECS Teaching

Twenty-seven of the 46 teacher changes were “forced” exits from ECS teaching. The reasons include the effects of severe budget deficits which resulted in teachers being displaced from their school due to their lower seniority, the discontinuation of “elective” courses including ECS, declining school enrollment at school sites resulting in the displacement of the ECS teacher, teachers needing to teach “core” courses and being forced to discontinue teaching the ECS elective. The details for these changes can be categorized as follows:

- Reorganization of school – 8 teachers

- Not being assigned the course – 6 teachers
- Declining school enrollment resulting in course/teacher change – 3 teachers
- Low seniority – 2 teachers
- Need to teach another non-elective subject – 1 teacher
- Cutting of elective courses due to district policy – 1 teacher
- Poor teacher evaluation – 1 teacher
- Internal school politics – 1 teacher
- Not having the right teaching credential – 1 teacher

“Chosen” Exit

Nineteen of the 46 changes were made by teacher choice. The majority of chosen changes had to do with teachers making career moves either to take an out of classroom position at the same school (Title I, Magnet, Testing coordinator, etc.) or to move to a new school outside of LAUSD. These reasons are categorized as:

- Taking an out of classroom position/opportunity – 8 teachers
- Choosing to teach a different course/program – 5 teachers²
- Leaving teaching – 3 teachers (1 retirement)
- Changing schools/districts – 2 teachers
- Extended maternity leave – 1 teacher
- Health issues resulting in teacher leaving teaching – 2 teachers

In many of the cases where teachers took an out of classroom position or moved to another district they have told us how they have struggled with the decision but felt that it was the right personal decision. A few teachers have attempted to transplant the ECS program into their new schools and districts so this has had an unanticipated positive effect.

Teacher Retention and Program Continuity

It is important to note that without our LAUSD partnership efforts the number of forced changes may have been even higher. Annually the ECS team has attempted to work with school leaders and teachers to save ECS teacher positions. We have written letters, met with principals and counselors, talked about additional courses the teacher could teach, highlighted the college prep status of the course and offered reasons and ways to keep the course. In many instances we have been successful in temporarily saving positions or in reinstating the ECS program after it was discontinued but every school year in the beginning and end of the year we hear about changes beyond our scope of influence that are largely dictated by budgets, HR policies, and competing interests at the school and district levels. It is

² One teacher at an Engineering focused academy decided to implement the Project Lead the Way Engineering program; one returned to being a full time Math teacher; one decided to continue teaching AP CS instead of ECS; one created his own computer science course; one went on leave and the school dropped ECS for a period of time.

important to note that all of these “forced” exits occurred while district support for our program was high. These types of departures reflect the range of pressures and constraints that principals and district leaders must navigate.

In light of all of the teacher movement our program has experienced one may rightly wonder how this has impacted the continuity of the ECS course at the schools where ECS has been offered. Over the last 5 years 42 schools have offered ECS at one point or another (not all at the same time). 11 of the 42 schools discontinued offering ECS (see earlier sections for reasons) although 4 of those schools may be resuming participation next year (2014-2015). 9 schools have had disruptions (either dropping the ECS program for a year or having a change in teacher etc.) but continued with the program and offered it this school year (2013-2014).

The schools that continued offering ECS despite teaching disruptions were largely due to the efforts of the ECS team and/or leaders on the school sites who worked together find a replacement teacher or to ensure that the course was still offered. Schools that discontinued offering the ECS course were largely due to a lack of a strong connection between the ECS team and an administrator/leader on the school site, forces beyond schools' and our control (enrollment, budgets, HR policies), and teachers wanting to go another direction. This shows the importance of having a strong understanding of and support for CS education from a variety of school leaders and of having clear and regular communication with supporting organizations such as the ECS team. In short it is not good enough to get a CS course in a school but there needs to be an ongoing effort to ensure the support and commitment for CS courses even when teachers and administrators change positions or schools face budgetary challenges, elements which are unfortunately constants in urban schooling.

Illustrative examples of the “revolving door” of teaching

To illustrate how the issues of teacher retention plays out, *particularly at schools with large numbers of underserved students*, we have selected three schools that exemplify the factors and challenges to implementing and sustaining a program such as ECS. These factors are not unique to computer science or to Los Angeles and are likely to exist in other urban areas.

- *Jackie Robinson High School* is a Title I school that has long held “Program Improvement” status. In the 2012-2013 school year, 53% of the students were Latino/a, 45% were African-American. After securing a commitment from the principal to offer ECS, the Science Department chair attended our summer training in 2011, but at the end of the summer he informed us that he had been given an offer he could not refuse and left the school. As we very much wanted to have our program at that school with its large numbers of African American students we worked with the Magnet Coordinator to find another ECS teacher. The school selected a Teach for America Chemistry teacher to teach ECS. He attended our follow up PD and worked closely with one of our CS coaches making significant

progress over the course of the year. At the end of the year however he decided to leave teaching to pursue a medical career.

The school was unable to find a new teacher in time to attend the summer institute for 2012 so we connected with another new teacher at the beginning of the school year. After a few months however this teacher left the school to take a position at the district level. The ECS position then shifted to a Math teacher at the school. The math teacher worked with the coach and attended the PD and was very supportive of the ECS program however she had a baby at the end of the school year and went on an extended maternity leave. Again the school was unable to find a teacher to attend the summer institute.

At the beginning of the 2013-2014 school year we worked with the Magnet Coordinator to select a new ECS teacher. On “norm day” (the day in the Fall when school-wide enrollment and staffing allotments is determined) the school enrollment figures were lower than district benchmarks resulting in this teacher being forced to drop ECS to teach a science course instead as another science teacher had been let go. The Magnet Coordinator who was our champion at the school also left the school to taking an administrative position at another district. We are working with the administration to identify a teacher to participate in the ECS program next year.

- *Dolores Huerta High School* is located in East L.A. with a student population of over 2,000 students, 99% of which are Latino/a. In 2010, after conversations with the Principal and computing teachers, we were able to substitute ECS for all the basic, Intro to Computers courses. Two teachers attended our 2011 summer institute and began to teach ECS at the school in the fall of 2011. Two more teachers were added the following year. In the spring of 2012 one of the four teachers took an out of classroom position at the school (instead of being forced to leave the school and teach middle school Math) as her Academy decided to focus more on electives related to the academy theme of Law and Government and dropped ECS. An additional teacher decided to go back to teach Math full time so a new teacher was brought on board to take his place. This new teacher attended the summer 2012 institute and began to teach in the fall of 2012. In the spring of 2013 however she was offered and accepted the position of Magnet Coordinator. At the same time the entire school was reorganized due to budget cuts, low test scores, and changing priorities (the school decided to place more of a focus on intervention). This resulted in the displacement of the two remaining ECS teachers. One teacher left the district to teach at a school closer to home while the other was assigned as a long-term substitute at another school. As a result, there has been a dramatic reduction of ECS courses offered at the school. While 6 different teachers have participated in ECS over the last couple of years, only one currently remains.

- *Wilbur Wright High School* has always been one of our priority schools since it has one of the highest percentages of African American students in the district. The principal sent a teacher to the summer institute of 2009 and placed ECS on the

master schedule in the fall of 2009. This teacher was teaching the course when norm day hit and the declining enrollment of the school resulted in her being displaced. We were unable to find a replacement both for that school year as well as for the subsequent three years.

After much effort working with the principal, counseling coordinator, principal leader, and local superintendent we were able to find a teacher to attend the summer 2013 institute. The teacher was a good fit as he was a math teacher with a social justice teacher preparation background and readily identified with and supported the mission and pedagogy of ECS. At the close of the summer of 2013 however he decided to be a stay at home dad and so the program did not get off the ground for the 2013-2014 school year. We had a commitment from the principal to send a teacher to participate in our next cohort but the principal left the school to become a principal at another school and efforts to find a teacher in coordination with the lead counselor were unfruitful.

While these three cases could be considered extreme examples of the “revolving door” (with multiple and compounding retention issues), they also help illustrate the current precarious state of Computer Science education especially at schools with large numbers of low-income (Title I) Latino/a and African American students [5]. These are the schools that especially need stable and well-prepared teachers to enable equitable opportunities for students.

What Remedies are Called For

Educational researcher, Linda Darling-Hammond, is a national leader on the subject of teacher retention and recruitment. She has found that retaining teachers is a larger problem than recruiting new ones. She writes that:

*“The main problem is an exodus of new teachers from the profession, with more than 30% leaving within five years, and higher rates of turnover in lower-income schools. An additional problem is the flight of teachers from less-affluent schools to more-affluent schools. This is strongly tied to **working conditions** – including administrative support and strong colleagues as well as tangible teaching conditions and salaries. Research also finds that teachers leave the profession much faster if they have less preparation before they enter and less mentoring support when they arrive.” [6]*

Supplementing Darling-Hammond’s findings, we suggest several specific changes that we believe are called for to address CS teacher retention challenges:

- School reforms need policy change to help sustain and institutionalize CS learning opportunities at the K-12 level for all students [7]. For this reason, we have been active in the CS education policy community. We actively support state and local educational policy that will designate CS as a core course so that CS moves from the margins to the center of education. We have collaborated with Computing in the

Core, code.org, and helped found the Alliance for California Computing Education for Students and Schools (ACCESS). ACCESS is a California statewide network of computer science education leaders that is dedicated to advocating for high-quality K-12 computer science education in California and ensuring its accessibility to all students. (<http://access.ics.uci.edu/index.html>)

- For introductory courses such as ECS, school, district, and state policies are needed to allow teachers certified in subjects other than CS to be able to teach the course (with the appropriate professional development and resources). This is supported by our research showing how ECS can be effectively taught by a teacher with high interest in the subject and committed to inquiry-based pedagogy even though they may be technically teaching out of subject. Resources for supporting these teachers must be available, including professional development, an in-classroom coaching program, on-line resources, and a professional learning community of teachers.
- Agencies such as the California Commission on Teacher Credentialing must look for ways to upgrade existing certifications and authorizations like the Computer Concepts and Applications to have a greater focus on Computer Science. This will enable teachers with existing single subject credentials in areas outside those currently approved to teach CS to gain the learning and authorization they need to do so.
- Schools of Education that are preparing teachers must also look for ways to embed computer science in their Technology and Methods courses particularly those for Math and Science teachers as computing is increasingly integrated to all areas of learning. Furthermore the Common Core State Standards and Next Generation Science Standards also align strongly with computational thinking practices and computation so it behooves schools of education to make these linkages and provide this preparation for their pre-service teachers.
- School districts need to ramp up their commitment to protect CS courses in times of budget crises and school reorganizations, as courses designated as electives are often the first to go. This may involve changes to HR policies that support the retention of CS teachers particularly at underserved schools. In addition, leaders from CS education organizations and district leaders must work with school principals and counselors so that they understand how they might position CS courses in the master schedule and effectively integrate the course into their schools' programs of study and academy themes.
- Intentional efforts by district leaders must also be made to ensure that the infrastructure (appropriate technology etc.) and support for CS courses in these schools is made as opposed to simply leaving it up to a dedicated teacher or school site leader, as we have observed many cases of CS programs ending when a key individual leaves the school. Having a dedicated individual or team at the district level that is focused on supporting CS education and is in constant communication with teachers and administrators to monitor needs and provide support is essential.

- Professionalization of teaching is a must. This involves increase in salaries, mentoring, professional development opportunities autonomy to innovate solutions in the schools, opportunities to collaborate and reflect with colleagues, leadership opportunities in the schools, and of the utmost importance, respect. [8].

Recently we had an illuminating conversation with a teacher leader in the district. He had recently attended an industry-sponsored conference that encouraged teachers to think big and bold to further their commitment for broadening participation in computing. This thinking space so inspired the teacher, that it made him question his choice of teaching as a profession, thinking that he could possibly do more good outside the constrained structures of traditional educational models.

Teachers should not feel that they must leave teaching to “think big” and be bold about improving education. Until our society figures out how to increase funding to schools, professionalize teaching and compensate teachers with a professional salary, give teachers time to collaborate and think big (along the Google model of employees having 20% time to work on their personal projects), teachers are going to leave the profession and years of wisdom will be lost from the classroom. And, who is hurt the most is the children in the schools with the “revolving doors.”

Conclusion

As we were finishing up this working paper, we received word that one of our most active ECS teachers, had been hired by an on-line computer science education program to help lead their professional development program. For this teacher, who had returned to graduate school in computer science as a direct result of the interest and support she had received while participating in the ECS community, this new opportunity was personally rewarding. Teachers have families to support as well! We also received word about another ECS teacher who has recently been offered a position in the District headquarters to help with the new one-to-one computing rollout plan. As it turns out, the ECS teachers who we invest in also enter a pool of potential leaders for out of classroom positions within the District or in industry or non-profits. This is more evidence why the production of more CS teachers is a critical task.

If computer science is going to move beyond treading water in our schools several things have to be seriously considered and advanced: Computer science needs to be built into pathways of study and count towards graduation in every high school. If computer science is an essential part of the career/academic courses a school chooses offers its students then there must be the commitment to the staffing and course offerings needed. As with many issues associated with computer science education, the issue of teacher retention hits hardest in schools with high numbers of low-income African-American and Latino students. In urban schools these issues are exacerbated even more with the additional factors of the working conditions

and lack of incentive and support for teachers to stay at a “low performing school” particularly when pulled in so many directions with so many pressures beyond just teaching.

In response to scaling up challenges, we can expect a rise of “quick-fix” solutions that have a potential to undercut progress. One quick-fix “solution” to address CS teacher shortage or the need for deepened teacher content knowledge are programs that bring industry professionals to assist teachers in CS classrooms. While we are interested in learning more about the outcomes of these programs, because there can be value in students hearing from experts in the field, there are also risks to having industry professionals take on a teaching role in the classroom without professional development in effective and relevant pedagogy and belief systems and equitable practices. Will industry professionals deliver content knowledge the way they were taught, not having had experience working with the novice learner? Will they focus on working with the students who think more like they do, to the neglect of the other students? In short quick fixes like these may inadvertently perpetuate the persistent divides in the field.

While we recognize the need to rally all resources to fill a need for CS teachers, these quick-fixes do not deal with the heart of the matter--- the need for highly skilled professional educators working full-time in schools particularly those that are underserved. What is needed is state, local, national policy that supports the professional development of computer science teachers. And, all efforts to increase teacher retention must give determined attention to the schools that suffer the most from the “revolving door.” If we do not do this the doors of opportunity will remain closed to the most underserved amongst us.

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