Entrepreneurship, Federalism, and Chicago: Setting the Computer Science Agenda at the Local and National Levels[1]

Mark Johnson, John Wachen, and Steven McGee
The Learning Partnership

Introduction

From 2012-13 to 2018-19, the number of Chicago Public Schools (CPS) high school students taking an introductory computer science course rose from three thousand per year to twelve thousand per year. Our analysis examines the policy entrepreneurship that helped drive the rapid expansion of computer science education in CPS, within the broader context of the development of computer science at the national level. We describe how actions at the national level (e.g., federal policy action and advocacy work by national organizations) created opportunities in Chicago and, likewise, how actions at the local level (e.g., district policy action and advocacy by local educators and stakeholders) influenced agenda setting at the national level. Data from interviews with prominent computer science advocates are used to document and explain the multidirectional (vertical and horizontal) flow of advocacy efforts and how these efforts influenced policy decisions in the area of computer science. These interviews with subsystem actors—which include district leaders, National Science Foundation program officers, academic researchers, and leaders from advocacy organizations—provide an insider's perspective on the unfolding of events and highlight how advocates from various organizations worked to achieve their policy objectives.

Research Questions. The following research questions guided the design of the study and the development of the research instruments.

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- To what extent did local policy entrepreneurs in Chicago draw upon interest and capacity at the national level (e.g., the federal government's funding streams and initiatives) to push computer science higher on the local policy agenda?
- To what extent did the federal government, and computer science advocates at the national level, draw upon the movement at the local level (e.g., district initiatives) to push computer science higher on the national policy agenda?
- What does the computer science movement in Chicago reveal about policy entrepreneurship and the agenda-setting process?

Context and Theoretical Framework

In February 2016, the Chicago Board of Education approved a policy that made computer science a graduation requirement for all high school students. This decision followed years of advocacy by a group of computer science teachers, district leaders, computer science university faculty, and researchers in Chicago (Reed, Wilkerson, Yanek, Dettori, & Solin, 2015). With funding from the National Science Foundation (NSF), these actors engaged in collaborative efforts to champion and institute new professional development opportunities for CPS computer science teachers and a new curriculum (Exploring Computer Science or ECS) that was designed specifically to increase opportunities for students to experience a high quality, equity-focused computer science education.

The rise of computer science in Chicago that culminated with the graduation requirement is an interesting policy case study, but it is important to recognize and explore how these local events occurred within the broader context of a national computer science movement. Approximately two weeks prior to the Chicago Board's graduation requirement announcement, President Obama announced the launch of a federal initiative called Computer Science for All (Smith, 2016). This initiative called for additional federal funding for expanding access to high-quality computer science instruction, including approximately $125 million from the NSF. In much the same way as the CPS computer science policy followed years of entrepreneurship at the local level, this federal computer science initiative may be

viewed as an event within a longer trajectory at the national level (e.g., NSF had helped shape policy decisions by way of multi-year program solicitations).

In this study, we draw primarily on the theory of *borrowing strength* (Manna, 2007) to frame our analysis. The process of borrowing strength involves *policy entrepreneurs* at one level of government (i.e., federal, state, or local) seeking to influence policy agendas (i.e., the interests and actions of policymakers) by "leveraging the justifications and capabilities that other governments elsewhere in the federal system possess" (Manna, 2007, p. 5). Rather than depicting intergovernmental relationships in education as being either top-down or bottom-up, the borrowing strength model recognizes that the influence of policy entrepreneurs is dynamic and multidirectional—with actors at the different levels sometimes borrowing strength from each other simultaneously.

Manna (2007) conceives of policy entrepreneurs as being "individuals inside or outside government who champion particular ideas and attempt to increase the agenda status of policy areas they care most about" (p. 15). In the case chosen for this analysis, there were multiple individuals and groups working in and around the education system who participated in advocacy work championing the broadening of opportunities for participation in CS. These entrepreneurs engaged in parallel and coordinated efforts, which, ultimately, were successful in raising the status of computer science in CPS. Our study constructs a timeline of the events leading up to the adoption of the computer science graduation requirement and explores the ways in which policy entrepreneurs working in local government, the school district, higher education, the non-profit sector, and the federal government played a role in setting the agenda.

Manna's (2007) borrowing strength theory of agenda setting was developed to explain how when one level of government within a federal system lacks the necessary *license* (arguments to justify governmental action) or *capacity* (ability to act), entrepreneurs seek to leverage these ingredients from other levels of government. A major goal of this research was to map out how the computer science movement unfolded at the national and local levels of governance in the years leading up to the CPS

policy and look for specific examples of how policy actors at different levels imitated ideas and borrowed strength from each other.

Methods

This qualitative research consisted of a thematic analysis of interview data and a content analysis of documents from various organizations. Interview protocols were developed to address the research questions outlined above and were piloted with individuals who shared some of the same knowledge as the interview participants. Interviews were conducted face-to-face or over videoconference calls, and all interviews were audio recorded and transcribed. Where necessary, organizational gatekeepers were used to help gain access to prominent actors. A thematic analysis was then conducted, in which codes identified within the data were compared and categorized using NVivo software.[2] These categories were used to identify meaningful patterns and themes across the interview data. In addition to gathering interview data, we gathered documents from the different organizations in order to conduct a parallel content analysis. The findings from this content analysis were triangulated against the thematic analysis findings in order to check for validity and trustworthiness. During the analysis phase, members of the research team met regularly to compare interpretations gleaned from the interviews and documents and, when necessary, revised the coding framework.

Data Sources

Interview participants in this study were individuals with expert knowledge of events in the computer science movement. We interviewed 10 people, representing the various groups that we identified as being key idea champions, or policy entrepreneurs, at the local and national levels. The positions of the individuals in the purposeful sample are listed in Appendix A.

In order to improve the validity of our findings, the interview data were triangulated with various other data sources. Examples of the data gathered are listed below:

[2] The coding framework combined prefigured codes based on frameworks drawn from the literature (e.g., Manna's concepts of license and capacity) and inductively derived codes.

- Archived solicitations on NSF website
- CPS and federal policy documents
- Mayoral addresses/press releases
- Presidential addresses/press releases

Findings

A major theme from the analysis was the importance of framing. Our analysis revealed that license to act at the district level in Chicago was bolstered by the entrepreneurs' framing of computer science as an equity issue. Moreover, the local entrepreneurs' discovery of *Stuck in the Shallow End* (Margolis, 2010) was central to this framing: Margolis' text added to the moral suasion behind the movement and generated a greater sense of urgency. In addition to using an equity frame, local entrepreneurs emphasized computer science as being a workforce issue and a public good (beneficial for the city). As described by Sheingate (2003), the potential for entrepreneurial success is significantly enhanced when political entrepreneurs can consistently present their single innovations "from multiple perspectives and points of view…[thus] building robust coalitions in support of institutional change" (p. 193). The equity/economy framing used by the computer science champions borrowed themes with broad appeal, thereby increasing license. Our interviews with advocates from the national level also revealed how entrepreneurs have proactively sought to identify frames, or narratives, that build consensus around the importance of computer science education.

Another major theme that emerged from the analysis was that capacity to act can change over time. Capacity to act at the district level was initially low. District advocates noted that funding was nonexistent during their early advocacy efforts and an appropriate computer science curriculum had not yet been developed or identified. However, local advocates eventually received funding from the NSF (after several attempts), which, along with other non-fiscal support from the national level, strengthened the district's capacity and laid the foundation for the graduation requirement. This non-fiscal support included help with developing a compelling message about the importance of computer science for

audiences within the district (i.e., district leaders, school administrators) and the introduction of the ECS curriculum and teacher professional development.[3] [4]

One of the most influential entrepreneurs described in our data was an NSF program officer who played a central role in the development of CS-focused program solicitations: BPC, CE21, CS10K, STEM+C, and CS for All RPP. This program officer also facilitated community building efforts that brought like-minded computer science advocates together. Our analysis shows the multiple ways in which this one actor helped, directly and indirectly, build capacity in CPS. The work of this program officer does not exactly fit with Manna's (2007) definition for describing policy entrepreneurs. The program officer's position at NSF was not one that allowed for advocacy concerning specific policy ideas; rather, the program officer described being able to help organize and cultivate a network of computer science advocates who then engaged in policy work in different regions of the country. Thus, despite not acting as a traditional policy entrepreneur, this program officer played a critical role in facilitating the processes of borrowing strength for entrepreneurs at the local, state, and national levels.

Consistent with Manna's (2007) theory on borrowing strength, a further theme was that the influence of entrepreneurs and the diffusion of ideas is multi-directional. For example, regarding the setting of the policy agenda at the national level, our analysis revealed how initial and ongoing successes in computer science education in Chicago created positive feedback that, in turn, provided policy entrepreneurs in the federal government with increased license to act. At the local level, meanwhile, the sustained support provided by national actors (e.g., the creators of ECS) helped the district build its capacity to act.

Our analysis also provided insights into the challenges and strategies associated with the spread and scale (Coburn et al., 2013) of computer science in a large, urban district. One of the challenges to implementation of computer science in the district was the high level of leadership turnover in schools. District advocates described working to build relationships with school leaders and helping them to see

[3] Messaging support included resources developed by Code.org
[4] Exploring Computer Science had been funded through a prior NSF grant.

the value of implementing computer science programming in their schools. These successes were often short-lived, however, due to turnover, when new school leaders would step in with new priorities. This challenge brought into clear focus the need to develop a computer science graduation requirement policy for the entire district.

Another challenge was a lack of understanding among school leaders and educators about computer science and a lack of appreciation of its importance as an academic discipline. District advocates recognized a need to alter their messaging on the importance of computer science for different administrators and educators across the district. Often this involved emphasizing the benefits to other disciplines (e.g., math or literacy) or other outcomes of education (e.g., attendance) while deemphasizing computer science education itself. By framing the issue according to the priorities and needs of specific schools, advocates were able to position computer science as a solution to numerous problems (e.g., improving math performance and increasing student engagement and attendance at school). This strategy was particularly critical during early efforts to implement computer science in this district, when many principals and school leaders did not have a firm understanding of computer science.

As part of our analysis, we constructed a timeline of the major events in computer science education advocacy and policy in Chicago and nationally from 2008 to 2018 (see Appendix B). We developed this timeline from the analysis of the interview transcripts and content analysis of supplemental documents.

Significance

There have been few applications of the theory of borrowing strength in the education policy research literature. Our study is, therefore, significant because it provides illustrative examples of the influence of entrepreneurs across and within different levels of the education system—as described by prominent subsystem actors with direct knowledge of events.

Our analysis revealed three major themes that contribute to the knowledge base on borrowing strength:

1. *Entrepreneurs' license to act can be strengthened by the construction and borrowing of themes with broad appeal.* By connecting ECS education to the issues of equity and economic competitiveness, the entrepreneurs at the local and national levels that we interviewed described how they were able to generate the necessary support for policy action.
2. *Building the capacity to act can take time.* By borrowing the capacity of national actors and organizations (e.g., the NSF-funded ECS program's PD and curriculum), district advocates in Chicago were gradually able to institute the structures needed to support the graduation requirement.
3. *The interactions between, and influence of, officials and policy entrepreneurs advocating on behalf of computer science education at the different levels of government and the education system are multidirectional (vertical and horizontal) as well as dynamic (the direction of influence change over time).* This finding supports Manna's (2007) claim that relationships between different levels within the American federal system are best characterized as interactive in both directions, rather than top-down or bottom-up.

In addition to these major themes, our analysis sheds light on the role that federal funding agencies play in facilitating the process of borrowing strength. In the case outlined here, a program officer was identified as being central to building capacity and license in Chicago. Though this officer did not act as a policy entrepreneur advocating for specific policy ideas, the officer's work building national networks of researchers and practitioners focused on computer science education—by way of NSF solicitations, awards and convenings—was essential in shifting computer science up the policy agenda both locally and nationally. Overall, our findings provide evidence that the borrowing strength theoretical model can be productively applied to explain agenda dynamics in intergovernmental systems, and, specifically, the computer science education movement in the U.S.

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Appendix A

Interview Participants by Level and Position

Participant Number	Level of System	Position
1	Local	District computer science teacher
2	Local	District leader
3	Local	District leader
4	Local	University computer science professor
5	Local	Mayoral office advisor
6	National	NSF program officer
7	National	Presidential administration advisor
8	National	University computer science professor
9	National	University computer science professor
10	National	Non-profit organizational leader
11	National	Non-profit organizational leader

Appendix B

Timeline of Relevant CS Events and Policies in Chicago and Nationally

National Events=Orange; Chicago Events=Green

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
NSF Broadening Participation in Computing										
		NSF Computing Education in the 21st Century			Renamed STEM-C	Revised & renamed STEM+C				
Stuck in the Shallow End published	Congress passes resolution for Computer Science Education Week	NSF, CSTA, and ACM launch CS10K initiative	Computer Science Education Act of 2011 reintroduced - HR 3014	NSF begins funding CS10K projects	Launch of Code.org	Obama becomes first president to write a line of code (part of CSEdWeek)	Passage of Every Student Succeeds Act (ESSA) includes CS in definition of well-rounded education	Obama SOTU includes CS	CSTA releases revised K-12 CS standards	CPS offers ECS to more than 10K students in 2018-19 school year
Exploring Computer Science founded	First Computer Science Education Week	Computer Science Education Act introduced in House - HR 5929	NSF funds "Taste of Computing" in Chicago (2011-2015)	CPS begins offering ECS	"What Most Schools Don't Teach" video from code.org (15M views)	Google/Gallup national survey of CS education landscape	Expanding Computing Education Pathways national initiative	Obama admin announces CS for All national initiative	NSF funds "Chicago Alliance for Equity in Computer Science (CAFECS)" in Chicago (2017-2021)	
Chicago teachers meet at SIGCSE in Oregon	Obama video asking students to learn CS (part of CSEdWeek)	*Running on Empty* report released			"Hour of Code" included in CSEdWeek	ECS becomes required first-year course in CTE sequence in CPS	NSF funds "Accelerate ECS4All" in Chicago (2015-2020)	K12 CS Framework initiative announced	NSF funds "Advancing High School Computer Science Through Math and Science Integration" in Chicago (2017-2021)	
Chicago CSTA chapter forms	Chicago CS group applies for NSF funding (not funded)	Computing in the Core coalition formed			Computer Science Education Act of 2013 introduced in House		NSF funds "What Features of the Exploring Computer Science Course Equitably Inspire Students to Pursue Further Computer Science Coursework?" In Chicago (2015-2019)	CSTA releases interim K-12 CS standards		
		Chicago teachers attend ECS PD			Make Computer Science Count initiative launched (Code.org & Microsoft)			ISTE releases revised Student and Educator standards		
		Chicago CS group applies for NSF funding (not funded)			CS4All initiative launched by CPS and Chicago Mayor Emanuel ($1M/year to CS education)			CSforAll consortium launched		
								Chicago BoE approves CS grad requirement		