The Infrastructure of Accountability: Examining the Governance of Longitudinal Data Systems

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Abstract: The rise of performance-based accountability in tandem with technological advances in computing has spurred the creation of large-scale information systems designed to track the educational achievement of individual students from Kindergarten through college and beyond. While a number of studies have examined data use in Local Education Agencies (LEA) and schools, almost none have examined the ways state longitudinal data information systems have developed at the state level. This paper presents findings from a comparative study of State Education Agency (SEA) administrators in three US states and a country in the UK regarding the governance of their data systems. It focuses on the different ways the SEAs organized their governance structure, established policies, and developed processes regarding the organization and dissemination of the data systems. The comparative design of the study provides insight into the ways in which administrators in two accountability systems, the US and UK, coordinated activities within the SEA as well as with LEAs and school-level. The comparison is particularly interesting as longitudinal data systems represent a centralization trend in the US, while they are used as tools within a decentralizing context in England, where there is a current effort to give more authority to LEAs and schools.

The rise of performance-based accountability in tandem with technological advances in computing has spurred the creation of large-scale information systems designed to track the educational achievement of individual students from Kindergarten through college and beyond. As integral components of performance-based accountability, these systems are reshaping the ways in which schooling is organized, practiced, and regulated. The data these systems produce are increasingly used to determine how to distribute educational funds; promote or retain students; assign and pay teachers; reward and punish schools, and focus curriculum and instruction.

Though large-scale information systems are central to performance-based accountability, their design and operation have been largely overlooked by educational researchers. Current research focuses almost exclusively on data use. Yet data are not simply already there. Producing the information needed to measure and regulate individual student, teacher and school performance system-wide requires assembling a vast number of people and technical resources across organizational settings (LEAs, districts, testing companies, foundations, etc.) and geographic distance to select, collect, encode, process, and inscribe information into standardized forms that can be understood by educators and the broader public, alike. Educational data use is thus only one part of an information infrastructure that traverses multiple contexts and that implicates both system and non-system actors in efforts to measure, monitor, and rationalize education.

This chapter begins to address this knowledge gap by exploring how state-level actors design and operate large-scale information systems. On the face of it, creating and installing these systems are technical matters. They involve putting into place functional computer programs and algorithms for collecting, encoding, and processing information.

Yet, because these systems stretch across schools, LEAs, and state education agencies (SEAs) installing, operating, and maintaining such systems alters work practices and relationships across the educational system. In addition, because these systems are built on complex technologies and thus require high levels of technical expertise, they have expanded the role of non-system actors in the field. Designing and operating large-scale information systems thus pose significant challenges for state-level actors. The following research questions guide the present study:

1) Given coordination challenges inherent in designing SLSISs, what governance arrangements did state-level actors employ in the design and operation of large-scale statewide information systems?
2) How did SEA officials coordinate with other system actors in the development and use of the SLSIS?

We address these questions through comparative case studies of these systems in the US and a country in the UK. This comparison provides unique insight into the governance and politics of large-scale information systems. In the US, large-scale statewide information systems have been critical to the centralization of power upward from schools and LEAs to state and federal agencies. In the U.K., such systems are being used in current efforts to give more authority to LEAs and schools (Ozga 2009; Importance of Teaching: Schools White Paper 2010). A comparison of their governance structures and the political dynamics between governmental and non-governmental actors provides insight into the ways SLSISs are deploying resources and mobilizing support in the effort to develop and deploy data systems.

In the following section, we provide a brief overview of large-scale information

systems and their relationship to performance –based accountability in the US and the UK. We then draw on empirical and theoretical literature from studies of science and technology (SST) to contextualize the governance arrangements and attendant coordination challenges state-level actors in both contexts encountered. According to SST, large-scale statewide information systems are socio-technical networks. They both reshape work practices and politics and are reshaped by the existing practices and politics that exist within and across system and non-system actors. In particular, large-scale information systems position state-level actors as centers of calculation. State-level actors garner power through processing the data submitted by schools and LEAs into ostensibly objective measures that are used both to evaluate and potentially reward and sanction schools and LEAs and to guide their school improvement efforts. After we describe our research methods, we present our findings.

EDUCATIONAL INFORMATION SYSTEMS IN THE US AND UK

Performance-based accountability has evolved over the past three decades, in part, as advances in computer technology have enabled state and national agencies to collect, process, and store ever increasing amounts of data on individual students, teachers, and schools. It is now possible not only to track the progress of individual students from Kindergarten through college and beyond, it is also possible to measure the effects that individual schools and teachers have on students' achievement. This requires linking personnel, school, and student information systems. In this chapter, we focus particularly on the latter. Because they include student performance on state assessments, the primary indicator upon which teacher, school, and LEA performance are assessed, these

statewide student information systems are key components of the information infrastructure of performance-based accountability.

The Data Quality Campaign (www.dataqualitycampaign.org), a US non-profit aimed at encouraging state policymakers to "to improve the availability and use of high-quality education data to improve student achievement," has identified ten essential components of fully functioning statewide longitudinal student information systems or SLSIS. According to the DQC, fully functioning SLSIS include unique student identifiers that track individual students across multiple years, track students across multiple databases, data on each student including standardized assessments, demographics, program participation, grades and courses taken, drop out decisions, as well as data spanning a student's educational career from Pre-K through higher education. High quality systems also match individual teachers with their students. Finally, these systems have an audit system in place at the state level to maintain the quality of the data the systems produce.

In the US, these systems developed differently across the fifty states. Texas and Florida, for example, have a long history of building extensive data systems that include multiple indicators, where as other states such as Montana and Maine have been slower to adopt them (www.dataqualitycampaign.org). Beginning in 2005, the federal government offered state education agencies funds, via a grant competition, for SLSIS development. Since then, the federal government has awarded over a half a billion dollars through these grants. In 2009, the Obama administration further incentivized the expansion of these systems by stipulating that states would only be eligible for federal stimulus or "Race to the Top" funding if they included, in their grant applications for the

funds, plans to improve the collection and use of data. Specifically, the federal government called for improvements in both statewide longitudinal data systems and instructional improvement systems in order to assist teachers, principals, and administrators to use data to "identify student needs, fill curriculum gaps, and target professional development" as well as foster a culture of continuous improvement among schools and LEAs. Among the more controversial requirements called upon the states to build their systems' capacity to link individual student information with individual teacher information as part of the administration's efforts to promote the use of teacher pay-for-performance policies (US Department of Education, 2009). The federal government would only grant funds to those states that had enacted laws that enabled this linkage. As of 2012, all but seven of the fifty states now have fully functioning SLSIS.

In addition to spurring the development of state-level information systems, a U.S. Department of Education 2010 Institute of Education Studies (IES)-sponsored report that surveyed 529 US LEAs and conducted in-depth qualitative case studies in ten, found that federal accountability requirements were driving LEAs and schools to integrate data collection and analysis into their daily operations (Means, Padilla and Gallagher 2010). LEAs and schools did this largely through installing their own local-level information systems that were operable with but extended those operated by the states. The same study found that the properties and capacities of these data systems varied considerably and were shaped by constraints on local collection capabilities as well as by limited analytic capabilities among LEA and school personnel. Importantly, the study also found that state education agencies (SEAs) also had limited analytic capabilities. This reduced the accessibility and usefulness of the data SEAs provided schools and LEAs.

In the UK, data systems do not figure as prominently in current policy initiatives. A 2010 English White Paper on the Importance of Teaching published by the current conservative government does not identify longitudinal data systems as a key feature of educational improvement. The English government refers to data as a feature of the accountability system that both allows "everyone (including teachers, governors and the public) to benchmark schools' performance" (White Paper 2010, pg.1) and to facilitate the comparison of English students with students of other countries. Unlike in the US, however, where the federal government conceives of these as systems constructed by SEAs, the White Paper is less explicit on the loci of control. Instead the paper reports that the government will focus more on student assessment and "legislate to require schools to take part in international tests such as PISA, TIMMS and PIRLS" (pg. 18). While data is identified as a tool in which to achieve school improvement goals in this White Paper, it is not conceived of a system. Indeed, the Paper warns schools against using data to supersede local improvement efforts. The two national contexts, therefore, differ in the ways in which they frame the production and use of educational data.

Both countries, however, use student assessment and demographic data as a feature of their accountability systems. In the U.S., both federal and state accountability systems use annual state-mandated standardized student test scores as well as demographic data to determine district and school's Adequate Yearly Progress (AYP) status. Many states use student assessment data to grade or rate schools. SEAs can intervene in, take over, and potentially close LEAs and schools that do not meet the AYP goals established by the state and federal governments. In the U.K., school inspections overseen by the Department for Education assess schools on students' performance on

national exams. The inspections also include assessments of the quality of teaching and of leadership and management at the school, and the behavior and safety of students. Low performing schools are inspected more frequently and, similar to the US, can be placed under the intervention of LEAs or the Secretary of State and potentially closed.

CURRENT RESEARCH

Most educational research on data focuses not on state-level actors, but rather on data use in LEAs or schools. These studies find that data use in LEAs and schools is shaped by individuals' conceptions of evidence and political and instrumental goals, organizational structures and norms, resource constraints, and federal and state policies (Corcoran, Fuhrman and Belcher 2001; Honig and Coburn 2005, 2008; Kerr, Marsh, Ikemoto, Darilek and Barney 2006; Young 2006; Ingram, Louis and Schroeder 2004; Marsh, Pane, and Hamilton 2006; Coburn, Toure and Yamashita 2009). Importantly, they find that data accessibility, timeliness, and comprehensiveness shape data use (Dembosky, Pane, Barney and Christina 2005; Ingram et al. 2004), suggesting that how data is produced and the forms it takes matter for school improvement.

Data use is also a reflection of the larger accountability context. Studies over the last fifteen years have consistently found that the structure of performance-based accountability policies themselves not only leads to the classification of schools and students according to standardized test scores but also has a strong effect on administrators' and teachers' instructional efforts (e.g., Anagnostopoulos and Rutledge 2007; Au 2007; Booher-Jennings 2005; Firestone, Mayrowetz & Fairman 1998). Some studies find that schools, in an effort to improve standardized test scores, direct instructional resources towards students categorized as "low-performing"

(Anagnostopoulos & Rutledge 2007). Others find that schools divert resources from these students, directing them towards students most likely to be deemed "proficient" (Anagnostopoulos 2006; Booher-Jennings 2005). Such findings illuminate the material and moral force of the classification and standardization processes that SLSISs entail.

We know little, however, about how the state level organizes and mobilizes support for the SLSISs or how the classification systems get embedded into SLSISs. Further, more needs be understood about who decides what and how information is collected, who is successfully or unsuccessfully mobilized in these efforts as such dynamics shape who and what counts in school improvement efforts.

While there are few details on the inner-workings of SEAs and the organization and development of these data systems, a number of researchers have raised concerns about accountability systems generally and their reliance on quantitative performance measures to monitor, evaluate and sanction administrators, teachers and students. Ball (2003), for example, raises concerns about the effects of performativity in education, specifically when governmental organizations, particularly those by central management agencies such as SEAs, use rewards and sanctions to incentivize the performance of its workers. In particular he argues that SEAs draw on information technologies tools in their monitoring systems, in what appears to be objective and hyper-rational approaches to monitoring students and teachers. Mintrop and Sunderman (2013, forthcoming) argue that performance targets orient school, district and state administrators towards measured outputs, rather than on the quality and value of their work.

Existing research therefore highlights the political, social, and moral dimensions of data use, particularly how it is used and understood by different stakeholders. The

meaning of data is constructed by people in the context of local practices, norms, and relations of power as well as within the broader policy context. Existing research tells us little, however, about the governance arrangements and political dynamics of data systems. We turn next to empirical and theoretical literature in Science and Technology Studies (SST) for the conceptual tools to explore these properties and dimensions. In this discussion we also highlight political implications of SSST largely missed in current analyzes.

CONCEPTUAL FRAMEWORK

SST highlights the mutual constitution of the social and the technical (Latour 2005; Bjiker and Law 1992). Grounded in numerous intellectual traditions, including ethnomethodology, symbolic interactionism, activity theory, and post-structuralism, SST provides evidence as to how material technologies inscribe the practices, social relations and knowledge used to create them and simultaneously mediate the production of new practices, relations and knowledge (Clarke and Fujimara 1992; Epstein 2009).

SST casts SLSISs as infrastructure (Star 1999). Like water and sewer systems beneath our streets and homes, SLSIS are largely invisible to us. Embedded in objects and forms, such as software programs, user manuals, and reporting procedures, they tend to disappear into the background. Yet, SLSISs must be made operable with and fitted into the existing technologies, work practices, and social relations in the numerous settings that they traverse, including schools and LEAs as well as testing companies, private consulting firms, students' homes, etc. As such, state-level actors must rely on people across these settings to utilize, interpret, and repair glitches in software, etc.

While not explicitly a political lens, SST can be employed to understand governance arrangements and dynamics. SST, for example highlights how SLSIS pose challenges of long-distance control for state-level actors. Through governance arrangements and mobilization strategies, state actors regulate the work of both school and LEA personnel as well as the work of non-system actors from afar. On the one hand, as large-scale information systems position state-level actors as centers of calculation, they centralize power to state-level actors. Performance-based accountability endows state-level actors with the power to demand that personnel in schools and LEAs, as well as those in non-system entities, collect, encode, and submit information to them. State-level actors then process this information into particular performance measures, reports, and data files that get sent to national policymakers as well as returned to schools and LEAs and disseminated to others, including parents, the news media, and researchers. As such, state-level actors establish the goals that schools and LEAs must meet and the rules by which their efforts to do so will be assessed. As centers of calculation, state-level actors gain power not only through using data to assess school and LEA performance, they also gain power through the processes of data production in which they both mandate and regulate the type of information that schools and LEAs must collect and how they must encode it.

On the other hand, because large-scale information systems stretch across numerous schools, LEAs, and other organizations, central control by state-level actors is never entirely settled. Long-distance control is not established once and for all. Instead it must always be constructed and maintained. SST identifies three types of work that state-level actors must engage in to maintain large-scale information systems like SLSIS.

Problematization involves state-level actors convincing personnel in schools and LEAs, as well as those in non-system settings that their interests can only be secured by going through the SLSIS. *Enrollment* involves state-level actors ensuring that personnel in schools, districts, and within SEAs, collect and report information accurately and in the correct forms. This requires both embedding SLSIS into everyday work practices and tools and standardizing how people engage in these practices and utilize these tools. Finally, *mobilization* refers to identifying groups and individuals who will act as spokespeople for the SLSIS. SST researchers have further identified three types of strategies that state-level actors can employ to attain the goals of these processes. These strategies include *coercion* by physical force, legal statute, or incentives; *communication*, including written and electronic communication; *standardization* of personnel training and tools. SST thus provides us with conceptual tools to explore how state-level actors design, install, and operate SLSIS within the context of performance-based accountability. These tools provide insight into the ways in which SLSIS shift work practices and relationships within and beyond the educational system. In particular, these tools illuminate the politics these shifts give rise to.

DATA AND METHODS

We explore these processes through an exploratory comparative multiple case study design (Merriam 1998; Yin 2003) that examines the design and operation of SLSIS in three states in the US and in a country in the UK. The comparative multiple case design allows for insight into the particularities of each site as well as comparisons across sites that reveal the properties and dimensions of the politics of large-scale information systems in the context of performance-based accountability. More broadly, the national

policy contexts in the US and the UK differ in the degree to which performance-based accountability is centralizing or decentralizing power and authority as we note above. The comparative case study design thus provides a multi-dimensional view of performance-based accountability that highlights the similarities and differences in how it gets enacted within and across national borders.

Participants in the US case studies were state-level officials from three states chosen to reflect variation in state-level development of large-scale information systems at the time of our initial study, 2007-2008. The three case study states included an emergent state in the beginning stages of constructing its SLSIS, an accelerated state that had rapidly installed its SLSIS and was seeking to expand the system at the time of our study, and an established state that had a fully functioning SLSIS that was among the oldest in the nation. Participants in the UK were state-level actors chosen based on their participation in the development of the nation's information system using a snowball sampling approach. We conducted three interviews in the Developing State, three in the Emergent state, and four in the Established State in the United States as well as two interviews with state-level actors from one of the four countries in the United Kingdom. While the two participants interviewed in this country were not Ministry for Education staff or administrators, like our participants in the US, both held important positions of authority in relation to the country's accountability information infrastructure.[iii] One participant held a central role in an organization that served in a consultancy role to all of the country's Local Education Authorities (LEA). In this role, the consultant drew on data from the national data set, described as containing student assessment scores as well as some demographic data, and data from LEAs to construct an SEA-sanctioned data set.

With this data set, the consultant oversaw the analyses and production of value added estimates that were shared with LEAs and schools. The other participant, a program director, had recently played a key role in a government initiative aimed at improving the students' literacy and numeracy. Like the consultant, he had drawn on the national data specifically with the goal of building a data set aimed at understanding the levels of low income and minority students. He worked with program teams that, in turn, worked with LEAs and schools to improve student performance. In their positions, the consultant and the program director participants worked closely with SEA officials. Unlike in the US context, where participants described the construction of one database at the state level, the participants in the UK described constructing multiple data sets to meet different goals. All participants were interviewed using semi-structured interviews. The US participants were interviewed in 2007. The UK participants were interviewed in 2011. In addition to interviews, we collected legislative, policy, and procedural documents regarding the SLSIS in each site.

We analyzed the data using both open and pattern coding (Corbin and Strauss 2003; Miles and Huberman 1994). This allowed us to identify both themes particular to each site and the work processes and strategies that central actors engage in to install and operate SLSIS as identified in SST research. We jointly coded the interview data and created data matrices and used counting to check our interpretations and identify disconfirming evidence (Miles and Huberman 1994).

FINDINGS

In this section, we begin with our U.S. case studies and then move to the UK case study. We begin each case with a description of each SEA context, its governance

arrangements, as well as the coordination challenges that state-level actors encountered and the problemazation, enrollment and mobilization strategies they used to resolve these challenges. Given that state and/or national performance-based accountability policies held schools and LEAs accountable both for meeting state and national performance goals and for participating in collecting the data necessary to establish and monitor these goals, the challenges of problematization were the least contentious. State and national mandates ensured, through coercion, that schools and LEAs could secure their interests in avoiding sanctions and retaining funding, only by collecting, encoding, and reporting information through the SLSIS.

In the US, governance arrangements reflected a central authority over collecting and processing performance data. At the same time, they faced on-going challenges associated with the governance of fiscal, political, and organizational resources for the SLSIS. In the UK, while the national ministry maintained auditing authority through the school inspections conducted under the auspices of OFSTED, data processing occurred both within the ministry and in entities external to it. These external entities served as parallel centers of calculation. While they utilized the data collected through the ministry's student information system, these external entities used different algorithms to process this data and thus provide schools and LEAs with different and sometimes competing analyses of performance data than those produced by the ministry. In the US, the rise of large-scale information systems both reflects and contributes to a politics of reporting. In the country in the UK, the decentralization of processing authority gives rise to the politics of numbers.

EMERGENT STATE

The Emergent State had been slow to adopt, design and coordinate their SLSIS. The emergent nature of the SLSIS reflected, in part, the state's political, organizational, and fiscal contexts. The state legislature had not enacted any legislation regarding a SLSIS at the time of our study. Unlike in the Accelerated and Established States in which participants' characterized state legislators as having "huge appetites for data," SEA participants reported that state legislators in the Emergent State were largely uninterested in SLSIS. They also identified the decentralized nature of school governance in the Emergent State as impeding the development of the SLSIS. There were over 700 LEAs within the state. Ensuring that all 700 LEAs had the requisite technology and human resources and that they utilized these resources in ways that ensured data accuracy posed significant challenges for SEA staff. The state also faced some fiscal constraints; it had less than a 10% total state general fund balance as a percent of its total expenditures. At the time of the study, the state's data system fell within the lower end of the DQC's 50-state ranking. It contained just between 1 and 4 of the 10 elements of fully functioning SLSIS.

The Emergent State's approach to developing a SLSIS had thus been tentative and incremental and its governance arrangements at the SEA level reflected fragmentation. As of 2007, governance over the SLSIS was located in the fiscal, curricular and special education offices with the SEA. While formal authority of the system's operations was located within the fiscal offices, policy oversight was located within the offices of curriculum and special education. Complicating this arrangement, the SEA hired an external consultant who was housed in the SEA because they did not believe they had the technical knowledge to design and coordinate the system in house. One SEA staff

member acknowledged this, noting that SEA staff members "don't have the knowledge to provide (LEAs) the assistance that's necessary with the SLSIS." While this multi-office organization of the SLSIS was intended to facilitate knowledge and communication across SEA offices, SEA administrators also reported, "no one wanted to own" the SLSIS, leading to major coordination challenges.

Participants also identified a statewide testing failure as significantly affecting support for the SLSIS. Prior to the study, the SEA had hired a vendor to manage its testing system. Over the course of the multi-year contract with this vendor, several problems arose including the mis-scoring of tests, failure to administer the tests on time, and loss of tests. While this testing failure would loom large in the SEA's relationship with LEAs and schools, as we will discuss shortly, it also lead to difficulties in garnering support for the system within the SEA itself. According to SEA staff, the director of the SLSIS resigned as a result of the testing failure. SEA staff reported, "no one wanted to own the SLSIS" as it created tensions between different offices within the SEA.

SEA staff in the Emergent State described problematization, enrollment and mobilization challenges when working with LEAs and schools. At the time of the study, they found it difficult to convince personnel in LEAs and schools to participate in the SLSIS. Despite increased federal policy demands by NCLB, LEAs and school administrators and teachers in the state had not overwhelmingly embraced the need for the SLSIS nor had they incorporated data use into their routine activities. SEA staff identified limited and variable capacity in LEAs and schools as a major challenge in designing and operating the developing SLSIS. They noted that in order to submit data accurately, many LEAs would need to devote significant resources to purchase the

hardware and software necessary for data gathering, storage and organization. In addition, one staff member noted that many LEAs had high staff turnover, making it difficult to build staff capacity related to working with and using the state's SLSIS. Some LEAs, according to this staff member, did not have staff designated for such work and the people who interacted with the SLSIS ranged from secretaries to superintendents.

The SEA attempted to address these challenges primarily through communication and standardization strategies. During the first years of implementing its SLSIS, state staff offered training sessions throughout the state. The state also provided technical assistance to the LEAs and schools on a just-in-time basis through the help desk that was managed by the consultant team. Members of the consultant team interacted daily with LEA and school personnel through the help desk, addressing their questions and helping them to resolve problems.

In sum, governance of the SLSIS in the Emergent state was fragmented, shared between multiple offices in the SEA as well as a consultant housed within the SEA. Participants identified the lack of support from the legislature as well as the highly publicized testing failure as reasons for the slow development of SLSIS. Further, due to these as well as the lack of resources by some LEAs, SEA officials reported that LEAs and schools were hesitant to participate in the SLSIS. To address the resistance, the SEA and, particularly the consultant, sought to build relationships with LEAs and schools through communication and standardization strategies, however at the time of the study, these remained strained.

ACCELERATED STATE

In the Accelerated State, governance of the SLSIS was housed in the Information Technology (IT) department in the division of fiscal administration. While the state's SLSIS was only one year old, members of this department had addressed issues of governance from the beginning by taking ownership of the SLSIS through a three-part governance structure, the Data Governance Board, which included directors from all program areas, IT and Auditing. The Board met monthly to develop policies related to the SLSIS. The Data Managers team oversaw the data elements and the security. Finally, the Data Request Board managed requests for data from both internal sources, such as the SEA program areas, and external sources, including the state legislature, the federal government and researchers.

The Accelerated State had strong legislative support for the development of its SLSIS. The state legislature had enacted legislation establishing a state student-level data system and had provided fiscal support for it. When the SEA failed to win a federal grant to develop the SLSIS, the state legislature allocated $25 million to this work. SEA staff attributed this to the former and current state superintendents' views of data systems as integral to improving the state's school system. The state superintendents were critical spokespeople for the SLSIS. This was enabled by the state's relatively strong fiscal conditions; the state had a roughly 15% total state general fund balance as a percent of its total expenditures. At the time of this study, it already, however, contained between 5 and 7 of the 10 elements of comprehensive SLSIS. Like the Emergent State, the Accelerated State was relatively decentralized. SEA officials noted that the state had a long tradition of local control. The SEA was thus reluctant to regulate LEAs and schools' work with the SLSIS too closely.

Like the Emergent State, the Accelerated State hired multiple consultants to assist with different stages of design and implementation of the SLSIS. Unlike the Emergent State, though, consultants in the Accelerated state were outsourced. Consultants, therefore, were not involved in the governance of the SLSIS, nor were they housed in the SEA. While the SEA staff was positive about some of these consultants' work, it was less pleased with others. For example, they were generally satisfied with the consultant who oversaw the creation of unique student identifiers, even though state staff members had had to alter the consultant's program to integrate multiple state applications into a comprehensive, K-20 SLSIS. SEA administrators, however, were less pleased with the consultants hired to collect student-level discipline data. They initially hired two consultants to provide guidance and technical capacity. SEA staff was, however, disappointed with the consultant's products explaining that the products did not go to the level of specification that the SEA wanted. SEA staff reported other incidents in which these consultants offered products that were not flexible enough to meet the state's needs and that were simply too expensive. As a result, the SEA hired consultants primarily on a short-term basis to assist with the implementation of highly specialized technologies and to train state staff to utilize and manage these technologies.

The state's decisions regarding consultants reflected the SEA's efforts to hire staff with the requisite expertise and to build the capacity of current staff to create, install, and manage its SLSIS. While the SEA had legislative support and generally few problems convincing members of the importance of the SEA, it faced challenges maintaining the quality of its staff related to the SLSIS. Significantly, some of the personnel initially involved in creating the state's SLSIS left the SEA to pursue higher salaries in the private

sector. Thus, while SEA staff in the Accelerated State had mobilized legislative support for the SLSIS and, as a result, had expanded the number of staff working on the SLSIS significantly, enrollment within the SEA remained a problem. The non-competitive state salaries made it difficult to tie highly skilled staff to the SLSIS.

The staff in the Accelerated State had originally planned to build and implement its SLSIS over several years. The pilot was abandoned, however, when the state's superintendent decided to attach the unique student identifiers immediately to the state's restructured assessments. The same year, the state legislature used it coercive power to tie school funding to participation with the SSIS in the first year of the system's implementation. All LEAs and schools were thus compelled to go through the SSIS to secure state funds. Given these high stakes, these decisions placed considerable pressure on the SEA to ensure that the SLSIS operated successfully. With LEAs and schools compelled to participate by the state, the Accelerated State sought to build capacity through communication and standardization strategies.

The SEA established several communication strategies with LEA and school personnel to address these challenges. SEA staff held weekly conference calls opened to every school in the state to field questions, established a help desk, and created specific list serves to provide relevant information to superintendents, principals, curriculum directors, technology coordinators, and all personnel dealing with the SLSIS. In addition to these communication strategies, the SEA further attempted to standardize LEA and school personnel's work with the SLSIS through trainings. Through their on-going contact, state staff realized that the LEA and schools often did not have IT staff. In many cases, the SEA found that front office secretaries in schools were reporting data to the

SLSIS. In response, the SEA established a voluntary certification program for LEA and school staff involved in such reporting. The communication strategies and the certification programs reflected the SEA's efforts to create reciprocity with LEAs.

ESTABLISHED STATE

The Established State in our study was at the vanguard of the movement to create SLSIS in the US. The state began creating the system in the 1980s. Governance of the SLSIS in the Established State was housed in the assessment department of the school division with the SEA because the data system was seen as a critical activity of the SEA. Staff across the state agency used data from the SLSIS as part of their routine activities. At the time of our study, its SLSIS was already highly comprehensive. It had between 7 and 10 of the essential elements.

The state legislature was very supportive of the state's SLSIS from its inception. Early in the SLSIS development, the legislature tied school funding to SLSIS data and mandated that LEAs contribute part of their funding to the creation and maintenance of the SLSIS. At the time of our study, the state was healthy in terms of its fiscal conditions, with over a 15% state general fund balance as a percent of its total expenditures. School governance was highly centralized in the Established State. There was less than one LEA for every 10,000 students in the state. This reduced the number of LEAs with whom the SEA had to work.

The approach undertaken by SEA staff in Established State was highly centralized, planned and occurred over several years of piloting. Unlike the Emergent and Accelerated States, the Emergent State located governance in one office, thus reducing potential competition and confusion among different stakeholders. In the late

1980s, SEA staff developed the technological infrastructure that enabled school LEAs to provide student-level, computerized data rather than aggregate, paper-and-pencil data to the state. Early successes of the SLSIS in pilot LEAs facilitated LEA participation and support. Since its inception, the SLSIS in the Established State had grown to integrate data across program areas, institutional domains, including higher education and the workplace, and time. Indeed, the system was truly K-20 plus as it had begun to track students into the workforce.

The development of the SLSIS in the Established State was almost entirely in house. The decision to develop this system in-house was initially due, to the environment in which the state first initiated its SLSIS. At that time, data collection and reporting in the state was still new and there were few consultants prepared to assist the state in creating a student data system. The SLSIS thus emerged, in large part, from efforts by SEA staff to systematize data collection efforts through using computer technologies. Overtime, the SEA used consultants but only to provide short term, task specific support.

The Established State implemented its SLSIS in an environment in which the standards and accountability movement in education was just emerging. When the Established State first announced its plans to establish such a system, it met with considerable resistance from LEAs across the state. This resistance stemmed, in part, from the system's novelty. LEAs saw the system as an "add on" that would exact costs in terms of work effort and technology without yielding any clear benefits to them. SEA staff members involved in the SLSIS's inception still refer to the meeting with LEA personnel where the staff presented initial plans for the SLSIS as "Bloody September."

The SEA met this resistance through different enrollment and mobilization

strategies. First, it installed its SLSIS over the course of several years. Second, SEA staff met with LEAs around the state on a regular basis to inform them of the planning and to solicit their support. The state also identified receptive LEAs, of different sizes and geographical location, to pilot the SLSIS. According to SEA staff, these LEAs felt that the SLSIS increased the efficiency and accuracy of their data reporting procedures. These LEAs became spokespeople for the SLSIS, or as SEA staff called them "our stars." They played a key role in mobilizing support for the SLSIS among the state's LEAs.

Given the SLSIS's established status at the time of our study, SEA staff members described most LEAs as "cooperative." In 2007, participants reported that LEAs had built up their capacity to participate in the SLSIS, though the SEA continued to provide technical assistance through communication and standardization strategies including conferences, help desks, list serves, and an extensive electronic documentation archive.

The state's plan to move to a transactional system in which local data changes were immediately registered at the state level was one way that the SEA was seeking to up-date its system to make it more user friendly for the LEAs and schools. Given the system's expansiveness, SEA staff members noted that they tried to avoid requesting that LEAs send data not tied directly to a state or federal legislative mandate. At the same time, the staff members acknowledged that such mandates were continually increasing. SEA staff members acknowledged, however, that they were often in the position of being "the messenger" of increased state and federal demands placed on LEAs and schools. While over time, the SLSIS had become embedded into the everyday work of LEAs and schools in the Established State, the politics of reporting remained somewhat contentious.

UK CASE STUDY

The country in the UK in our study began creating their system in the 1990s. While not included in the DQC index, the country's SLSIS ranking would be similar to Accelerated State, with the country having between 5 and 7 of the 10 elements identified by the DQC as essential to comprehensive SLSIS. According to the participants, the country had initiated its data system at the same time as it had been establishing its national curriculum in the 1990s. At that time, the national government had sought to publish tables on school performance and the data systems were seen as complementary. More recently, however, participants reported that the SLSIS had become a tool for the SEA, LEAs, and schools both to examine their own progress and to respond to competition that had arisen from international comparisons (e.g. Trends in International Math and Science (TIMSS); Program for International Student Assessments (PISA).

Both participants in our study explained that a national data set was compiled at the SEA level. This was comprised of student test score data from the Stage 1, 2 and General Certificate of Secondary Education (GCSE) exams that students take at age 7, 11, and 15, respectively. However, instead of matching the student test score data itself with other school and student characteristic data such as student demographics, the SEA turned to external agencies including an internal government agency, the outside consultancy that one of the participants in this study belonged to, and a university to create "independent data sets." So while the SEA developed a national data set, it outsourced the work of with the data set to governmental and non-governmental actors.

The two participants in this study described drawing on the national data set to build their own data systems for the specific goals of their different agencies. The consultant in the study reported extracting student test scores from the SEA's SLSIS and

then matching it with student demographic, socioeconomic, and special education data provided by the LEAs. Drawing on the two data sets, the consultant described processing and updating the data for the LEAs from the previous year. LEAs paid for a subscription to access the processed data as well as for consultants to help analyze the data and answer specific questions regarding them. In the last five years, the process had gone online and was competing with an online database developed by the national ministry also available to LEAs and schools.

The second participant, the project director, was involved in a major government initiative aimed at improving numeracy and literacy. He described the initiative as separate but complementary to the SEA and having the specific goal of improving national scores on assessments used in international comparisons (such as for TIMMS) as well as helping LEAs and school improve the performance of low income and minority students. After collecting the basic student and demographic data from the SEA, he described the initiative as supplying data and data sets to different program teams within the initiative. In turn, the initiative would set floor targets for schools in these areas. He said that through the initiative, students' test scores were tracked from the Pre-K through the GCSE. The initiative also supplied data to schools to enable them to build continuous assessments on each child. Initially, schools were given excel sheets with test score data, however, schools and LEAs would often lose the sheets. These teams from the government initiative worked with LEAs and schools to improve data management.

Both study participants described working with LEAs and schools to provide and analyze data. However, LEA and school-level officials drew on their different data sets—from the consultancy and from the national initiative, as well as other sources such

as the aforementioned government's online program—to make school improvement decisions as well as track individual groups of students. Both participants described a process where LEAs and schools, depending on their organizational capacity, would engage in a number of activities with each sets of data, ranging from analyzing their own to requesting external analyses.

Unlike the centralized systems described by US SEA participants, the participants in the UK described a much less centralized system in which student and demographic data was collected by the SEA, but made available to other constituencies including the consultancy and the national initiative aimed at improving numeracy and literacy. The SEA as well as the different constituencies, in turn, developed their own data sets. As a consequence of this organization, the project director explained that LEAs and schools were often presented with data from different agencies. Schools, for example, would receive data and data analysis from both the consultancy as well as the SEA office providing online data. As the consultancy and the SEA used different algorithms in their analysis, they would provide schools with different, and sometimes conflicting results. Both described how schools undergoing inspection would draw on the data analysis from the organizational entity that would frame student progress in the most favorable light.

According to the project director, a similar issue arose between the national initiative he was involved in, and the OFSTED inspectors. The project director explained that in their organization they had a large team whose goal it was to support schools improving the performance of the lowest performing students. Sometimes, however, their analyses of schools based on the lowest performing students, would differ from the assessments of the inspectors who were drawing on school-wide data. As the goal of the

initiative was to raise student scores, schools would report that the inspectors had given them strong ratings, while actors from the government initiative would identify shortcomings based on the performance of the lowest performing students. The program director explained that the inspectors would take the "school context" into account whereas the government initiative was interested in the gains of particular groups of students. He explained about the annual school inspections:

> so there would be OFSTED telling a head teacher 'You're good' or in some cases 'outstanding' which is the top judgment they could provide to a head teacher. And then we would come in and say, 'Well, you're not doing the job well enough'…so there was a tension.

As in the case with the consultancy, the decentralized nature of the data production and analysis by multiple agencies and actors could result in conflicting conclusions. The project director explained that all three entities—the government initiative, the consultancy and the Department for Education which informed OFSTED data—were "drawing from the data to kind of create their own information data systems as it were."

Neither the consultant nor the project director viewed the multiple sets of analyses as a problem. However, they both expressed concern that local authorities were not using data "sensibly" and "doing the right things with it." The consultant, for example, described working with approximately 150 LEAs and their schools, helping them making decisions about whether certain data analyses would actually be useful to the schools. He was particularly concerned with how school-level actors used the data. Similarly, the project director complained that while the LEAs and schools had access to the data sets from the online program and from the consultancy, "they're not readily understood through the system. So there's a need to actually train people on interpreting them and understanding."

DISCUSSION

Though, given the dearth of studies that examine the design and operation of SLSISs, our study is only exploratory, the findings presented here provide evidence that the construction of SLSISs need to be understood as socio-technical networks whose design and operation are shaped by local and national policy contexts. SLSISs have largely been taken for granted as neutral, technical components of performance-based accountability policy. Yet, as our case studies indicate, these data systems require governance arrangements that oversee the assembling and coordination of multiple resources across SEAs, LEAs, and schools and across private and quasi-public entities as well. The governance arrangements and the data systems themselves, therefore, reflect work practices and social relations as well as political and economic contexts.

In the case studies presented here, we have paid particular attention to the governance arrangements and related political dynamics that have shaped the development and use of SLSISs by SEAs. These findings illustrate important differences in the ways these systems have developed in the US and the UK. In the US, the governance of the SLSIS has been centralized in the SEAs. SEA administrators in each state described multiple strategies and activities aimed at integrating data from multiple sources. While participants in both the Emergent and Accelerated state described challenges working with numerous offices and consultants and they all described major challenges in certifying software, reporting data and lobbying state legislatures to tie funding to system participation, they all sought to become centers of calculation by managing the reporting of data and the standardization of data practices.

In the UK, student data was housed within the SEA, however it was quickly outsourced to and shared with different governmental and non-governmental actors. Governance over the data, therefore, resided in multiple centers of calculation. U.K. participants described quasi-marketplace of data, where different governmental and non-governmental agencies drew on the same national student database, but used different algorithms and analyses to make sense of the data for LEAs and schools. LEAs and schools drew on different analyses strategically to defend school performance based on the most favorable analysis. This approach is generally consistent with the decentralization trend in the U.K. in which LEAs and schools are given more authority in the school inspection and evaluation process.

The national cases further illustrate how SLSISs are enacted differently in different contexts. While this needs to be explored further, this study finds that in the US, SEA administrators were primarily occupied with the politics of reporting. They described challenges related to collecting quality data, coordinating data, enrolling LEAs and schools in the data system, and mobilizing spokespeople for the data system. The SLSIS was seen by all stakeholders as a unitary system whose legitimacy depended on accuracy and public trust. In the UK, in contrast, SEA-level participants were occupied with the politics of numbers. With different agencies analyzing the data, LEAs and schools contested the analyses and conclusions of the agencies to make their cases during inspections. Unlike in the US, SEA-level actors used the data in different capacities, sometimes in ways were not consistent with other agencies goals.

While the cases can be understood within their national contexts, they can also be understood as four distinct cases. As four cases, the evidence underscores the socially

situated nature of SLSISs. All four organized the governance of their systems differently and faced different challenges enrolling and mobilizing support for their systems. They faced different legislative challenges. While the contrast between the US and the UK is the most stark, together the findings point to the mutual constitution of the social and the technical identified by the SST theorist. Like school and LEA actors, SEA administrators' design and use of data is shaped by political and technological context, organizational structures and norms, resource constraints, and federal and state policies.

CONCLUSION

State Longitudinal Student Information Systems are critical to the larger transformation of education currently reshaping how learning is publically defined; how teaching and teachers are evaluated; how rewards, sanctions, responsibility, and blame are meted out; how institutions are articulated with one another. Current policy and reform efforts promote data use to improve school efficiency and effectiveness. While much attention has been directed towards developing educators' capacity to utilize and interpret data, less has been directed toward understanding the situated and contextual nature of these systems as well as to the governance arrangements and politics that emerge as these systems are built. This study clearly shows the need to attend to the socially situated nature of SLSISs to understand their larger technical and political implications.

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