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SYSTEMS THINKING TO TRANSFORM SCHOOLS

IDENTIFYING LEVERS THAT LIFT EDUCATIONAL QUALITY

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Executive summary

Nations around the world—whether they are rich or poor—have dramatically widened access to education over the last century. But results remain mixed and unfairly distributed in terms of basic literacy and human development. International voices grow louder to improve the quality of schooling and transform the core aims and practices of the education sector. Today's students face daunting global challenges: rapidly evolving job demands, worsening inequality, and doubts over economic sustainability.

This brief argues that policymakers and educators must grasp the levers of organizational change inside education institutions to rethink goals and lift school quality. *Systems thinking* offers key tools for leveraging gains inside classrooms and enriching the quality of teaching and student engagement. This brief shares differing pathways for sparking systems change and details country and state cases that have raised student learning by deploying the powerful tools of systems analysis.

Introduction

The United Nations has set forth an ambitious vision for education systems around the globe: cultivating life-long learning from early childhood through an individual's civic and work life. Schools must support children and youth in basic learning—including crucial socio-emotional, literacy, and numeracy competencies—to contribute to sustainable societies. State-run education systems and their communities must now engage these global goals by 2030.

But in the wake of the global pandemic, virtually every country in the world is far behind. Prior to the pandemic, a severe learning crisis held back hundreds of millions of children. Analysts project that 9 out of 10 children in low-income countries and 5 out of 10 in middle-income countries will not develop core secondary education skills in literacy and numeracy by 2030.[1] The pandemic has only deepened the learning crisis and widened achievement gaps.

Specific country cases remain distressing: More than half of fifth grade students in India are not proficient in second-grade literacy. In Nigeria, just 1 in 10 girls completing grade six can read a single sentence in their native language.[2] In the United States, children of African-American or Latino heritage attending fourth grade read at two grade levels below white peers on average.[3]

Beyond deepening inequality in foundational learning, calls to rethink the underlying aims of education grow louder and more urgent.[4] The next generation's future—marked by global warming, fragile economic sustainability, and worsening inequality—require new skills and wider awareness, too often poorly addressed in classrooms around the globe. The digital revolution has already shifted what and how children learn and explore and the knowledge pathways they maneuver—a radical change that many education systems fail to harness to advance learning.

Against this evolving backdrop, the global education community—catalyzed by the UN Secretary General's Transforming Education Summit (September 2022)—is looking past recovering from the pandemic to consider full scale *system transformation*.[5] This blossoming policy discourse is replete with hopes for radically improving and transforming education systems. But how to define educational systems and then reshape them remains poorly defined. We cannot merely utter this ambitious goal without precisely defining how to surround the system, identify potent levers for change, and rethink the aims and means of human learning on a fragile planet.

INFORMING POLICY DEBATES

This brief informs these discussions of system transformation by reviewing the historical roots of systems thinking and what they contribute to education reform. It draws primarily on the intellectual traditions and literature in the Global North but also illustrates how these ideas have traveled to the Global South, in part through the work of organizations such as the World Bank. We recognize how elements of education systems may unfold quite differently across diverse societies—for example, rethinking how teachers are prepared and motivated to recast what students are expected to learn—and can draw from a range of cultural traditions. Our goals are simply to lift up how we think about systems and harness their strengths to rethink what children should learn and how classrooms and communities can better motivate achievement and civic engagement.

The brief is arranged in the following four sections:

1. A *short history of systems thinking*, emphasizing the pressure points or organizational levers inside the education institution that touch classrooms.

2. How systems thinking *moved into the education sector* (from biology and mechanics), along with how *differing versions* of systems reform take root and are conceptualized.

3. *Clarifying the various concepts and pathways* associated with systems thinking in the education sector.

4. Concluding reflections, informing how education leaders might interrogate system improvement and transformation efforts.

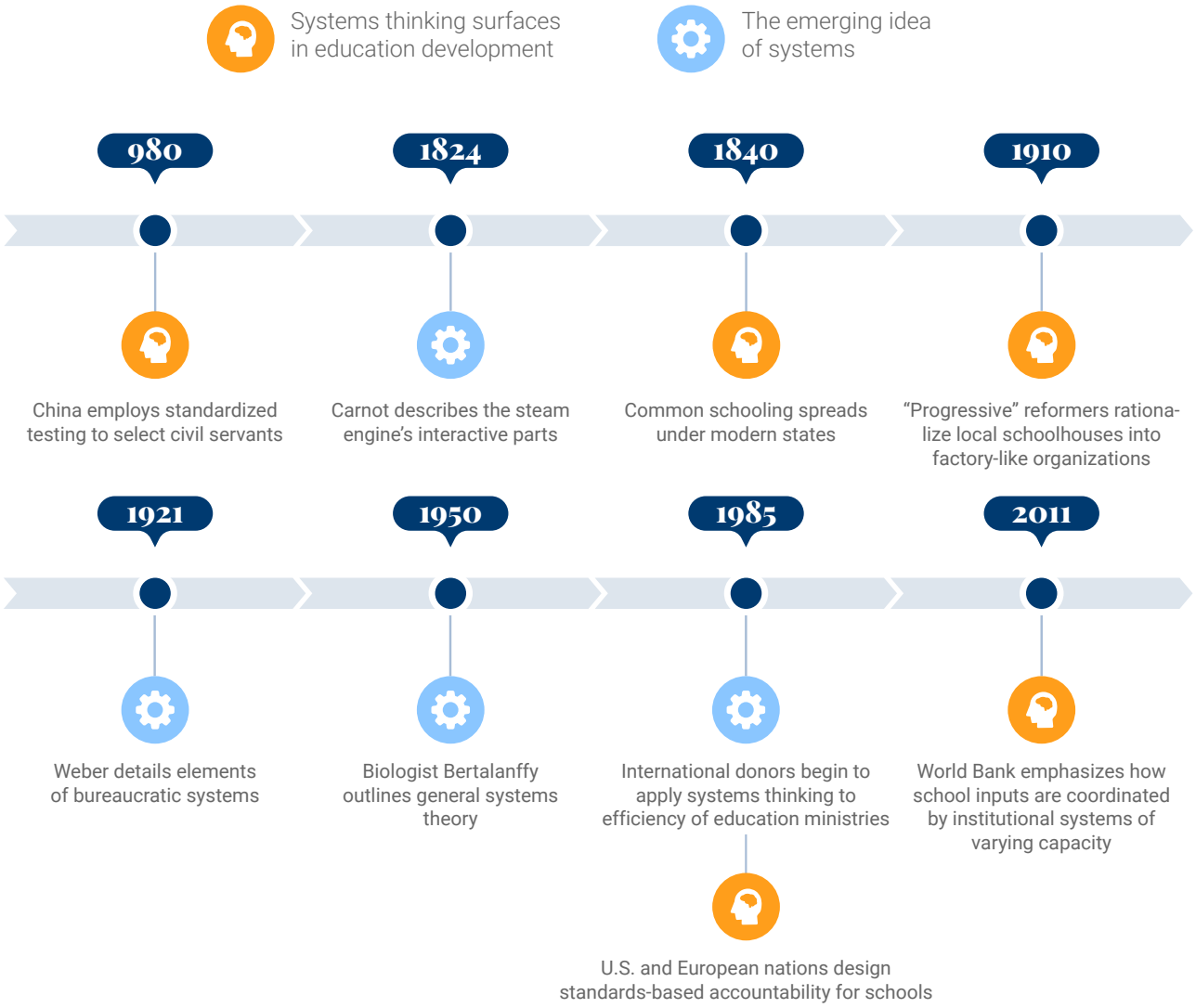
We summarize cases around the globe where systems thinking has yielded discernible gains for students and teachers. By crisply defining what systems entail in the education sector and which levers yield organizational change, education leaders and their partners can do better in rethinking the aims of schooling and raising student achievement.

A short history of systems thinking: Levers of organizational change

Two forms of organization define how we envision school systems (Figure 1). The first goes back a millennium, when China created national exams to select civil servants. This was a potent lever in tying official knowledge to state-created jobs, providing upward mobility for meritorious students.[6] By the mid-nineteenth century, this picture of an education system—a bounded institution situated in the modern

FIGURE 1

The arrival of systems thinking to the global education field



Source: Authors' analysis.

state—was characterized by bureaucratic regimentation of knowledge and classrooms, along with rules and set roles for teachers and administrators.

The second school of thought took root with arrival of the industrial factory—viewed as the most efficient, even magical way of organizing production and work roles. This built on the key tenet of modernity that knowledge and the division of labor necessarily become more complex and specialized over time. Specialization arose first with the commercialization of agriculture and then intensified with complex machinery and standardized parts, requiring more specialized engineers and workers as well.

In turn, the means of production, engineering, and various intellectual fields came to be defined by highly variegated and atomized parts—characterizing mechanical and human arrangements from the Enlightenment in the seventeenth century through the digital revolution. Adam Smith's (1776) infamous description of a pin factory spotlighted the widening division of labor and fragmented work of industrial workers: "One man draws out the wire, another

straightens it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving the head; to make the head… making a pin [is] divided into about eighteen distinct operations, which, in some manufactories, are all performed by distinct hands."

By the 1920s, analysts like Max Weber were dissecting elements of the factory's bureaucratic system of control over steps in a production process—whether exemplified by a pin factory or state-run school system.[7] The modern state would borrow from the factory model as well, replete with bureaucratic forms of control, hierarchical roles, standardization of procedures, and sacred notions of efficiency. In fact, the creation of rationalized, government-run schools helped to signal a nation's arrival as a modern institution by the early twentieth century. The late American historian, David Tyack, critically dubbed the factory-like arrangement of schooling "the one best system" of modern education.[8]

Backing out of education for the moment, scholars began to worry in the 1950s about the growing specialization that marked key fields, including biology, mechanical engineering, and the study of breakdowns in human organizations. In response, theorists began to sketch distinguishing features of these complex entities, asking whether these systems of interwoven parts shared certain dynamics. For example, how did the elements of the human body or a train locomotive "talk" to each other, operating in synchrony to sustain the organism's vitality? It struck these early systems analysts that the functioning and performance of the larger entity equaled more than the sum of its parts—when subunits operated effectively in harmony with one another.

By the 1950s, biologist Ludwig Von Bertalanffy, the father of general systems theory, was identifying the key elements of any system—from a clock's inner workings to human physiology.[9] Bertalanffy and fellow critics of reductionism—fed by the factory model's specialization of knowledge and labor—spilled over to many fields as scholars dissected finer particles while missing the glue that animated the intertwined *system*. Pursuers of new knowledge (and engineers of industrial organizations) were missing the forest for the expanding variety of trees. "To study systems as an *entity* rather than a conglomeration of parts," Bertalanffy said, "is consistent with… no longer [isolated] phenomena in narrowly defined contexts, but rather to open *interactions*… to examine larger and larger slices of nature" (italics added).

By identifying the key elements (or levers of coordination) that Bertalanffy highlighted, we can analyze where organizational change breaks down inside education ministries or why networks of local schools fail to improve in quality or performance. Some systems are simple and mechanical without feedback loops—what system theorists refer to as clockworks. Others have feedback loops that regulate the system's inner workings such as thermostats. Complex systems—especially education institutions—display openness to a range of inputs that systems animate to produce outputs. So, school systems mobilize teachers, curricula, and human connections with students—ideally in meaningful synchrony—to "produce" student motivation and learning.

Complex systems are typically animated by these key features:

- **Subsystem interaction.** The system's vitality depends on the *interplay of specialized parts* or subsystems that communicate clearly (or vaguely) with one another. Think of the human body's organs working in synchrony, or software programs talking to other pieces of code to solve an engineering problem.

- **Communication between subsystems.** *Feedback among component parts* of the system is key to identifying breakdowns or ways of boosting effectiveness. This interplay of reliable information may drive predictable entities—for instance, a jet engine—or remain unknown and limit predictability—say, the human body's immune system.

- **Subsystem hierarchy.** Systems and component parts manifest a *hierarchical arrangement*, where "controls" or managing devices coordinate work and process inputs (yielding outputs). The heterogeneity of tools, subunits, and organic processes demand coordination. And this coordinating "mind" is required to govern how the

parts work together—from a hands-on manager on the shop floor to a nation's head of state.

- **Levers.** Certain parts offer *strong levers* for altering the behavior of other parts of the system. By relying on centrally set exams, for instance, governments enforce certain forms of knowledge on which teachers must focus. In contrast, fostering relationships with students that are caring and demanding require skilled teachers, an essential subsystem that is fostered but not controlled by the center.

- **Open systems.** Healthy and adaptive entities operate as *open systems*, acquiring nutrients and resources outside boundaries of the system—feeding internal processing, stability, and perhaps growth—what Bertalanffy called the system's "dynamic ecology."

- **Multiple goals.** Complex systems pursue *multiple goals*, often processing a variety of inputs to produce differing kinds of outputs. The fact that education institutions serve the interests of adults—employing thousands of teachers, managers, and staff—leads to multiple organizational aims, at times distracting from the official goal of elevating children's learning.

Landscape analyses of a nation's education sector may examine the above pieces of the system—identifying where efforts to improve quality break down, or pinpointing levers that drive organizational change and positive gains inside classrooms. Analysts and policymakers might even consider what key parts of the system must be altered to shift intended outcomes of the system to transform the aims and social means of children's learning. What is key is to scan the core elements of the organizational system (of the education institution, central to local) and then focus on points of leverage that advance or inhibit reform efforts.

How systems thinking moved into the education sector

By the early twentieth century, European and North American nations were expanding mass education and rationalizing its management, closely mimicking the bureaucratic structuring of factory systems. After all, modern nation-building implied the creation of large-scale public institutions–extending legal rights, welfare supports, and common schooling to a widening circle of citizens. Village or church-run schools were pulled into the state's organizational apparatus in the West, as Asia caught up soon after the second world war, encouraged by a new set of international agencies.

For educators, the metaphor of *systems* became tied to the modern preference for publicly financed and large-scale forms of infrastructure. And public institutions–sculpted as hierarchical bureaucracies–ensured fair access by standardizing local services, consisting of tightly aligned subsystems intended to perform with efficiency. Mass infrastructure became fused to systems thinking by the mid-twentieth century–whether government pressed to better organize postal services, social welfare, or public schooling.

Faced with flagging educational quality and uneven student performance in the 1970s, renewed interest in systems thinking began to shape a variety of reform models in the Global North. Core tenets of systems thinking were percolating more deeply into the education sector. Certain elements had long played key roles: centralized testing in East Asia over the past millennium, or standardized curricula and didactic teaching that became institutionalized in common schools. But in much of the Global North, schools proved impotent in reducing inequality; student achievement hit a flat plateau in western Europe and the U.S.

Soon, the ills of public education came to be defined through the lens of systems thinking. Parts of the education institutions were viewed as "loosely coupled," necessitating tighter alignment of the system's parts.[10] Or, by narrowing learning objectives

and curricula, national exams were thought to assess how well students soaked up knowledge—often leaving behind complex forms of learning or social engagement. Rather than picking off a slice of the institution to remedy—a new math curriculum, in-service training for teachers, or bright new facilities—reformers aimed to surround and address the entire system, finding organizational levers that could nudge positive change inside classrooms. They tacitly adopted systems thinking.

STANDARDS-BASED ACCOUNTABILITY: A POPULAR VERSION OF SYSTEMS THINKING

Standard-based accountability (SBA) offers a case of government seeking to remedy the uneven performance of schools. This popular version of systems thinking sharpens learning aims and then aligns curricular materials and teaching methods with specified forms of knowledge or analytic skills. Policy leaders in the U.S. and Europe, seeking to address the "loosely coupled" problem of a decentralized network of schools, have tried to tighten those linkages via centralized management—France or Japan, historically—that were founded upon classic bureaucratic principles seeking to accomplish institutional unity and higher productivity.[11]

Tightening the interplay among levels and subunits of the education institution, SBA built from key principles:

(1) start with a central specification of what children should learn (in reading and mathematics), known as *learning standards* or proficiencies;

(2) set achievement goals (*performance standards*) and the proficiency level that all students are expected to clear,

(3) *align* school resources, curricular content, and teaching to performance standards, and

(4) press for *accountability measures* to enforce the standards set in place, and then identify where breakdowns in the organization system can be discovered.[12]

An early adopter of SBA, Texas crafted an SBA strategy in the 1980s that the OECD would mimic in subsequent decades (Box 1). It also provided the top-down systems model later adopted under No Child Left Behind in the United States. Texas policymakers manipulated several levers within the sector: enlivening curricula in reading and mathematics, upgrading the subject-matter knowledge of teachers, expanding instructional time and preschool options, and improving management information to identify how schools often yield unequal results.[13] To this day, Texas students outperform similarly diverse pupils in states like California, especially in mathematics (Figure 2).

Advocates for SBA tend to emphasize conventional academic subjects: raising achievement in reading and math. But rethinking the ultimate aims of schooling rarely bubbles up from within this method of systems reform. At the same time, the SBA focus on "basic skills" has yielded discernible results in several countries, at least for children from low-income families.[14] OECD analysts find encouraging results from tighter accountability measures across west European nations, with some visible progress in reducing learning disparities.

"Rather than harming disadvantaged students, accountability, autonomy, and choice appear to be tides that lift all boats," reads one OECD report on international achievement data from the Programme for International Student Assessment (PISA). Looking more carefully among regions of the world, a second OECD study finds that pupil achievement ranges higher under firmer accountability regimes, but mainly in lower-income nations.[15]

SYSTEMS THINKING TRAVELS TO MIDDLE- AND LOW-INCOME COUNTRIES

Core tenets of SBA and systems thinking emerged within development banks and bilateral donors, as well. The United States Agency for International Development (USAID) invested heavily in management information systems for central ministries in the 1980s, aiming to track student progress and teacher characteristics over time.[16] Rather than buying a variety of school inputs (such as textbooks, desks, and teacher training), these early system strategies aimed to build

BOX 1

Texas pioneers systems reform in the United States, 1981

The state of Texas crafted standards-based accountability—one contemporary version of systems thinking—in the early 1980s, aiming to raise pupil achievement and narrow disparities among ethnic groups and social classes. The state's legislature seized on specific levers or subsystems within education institutions—first in 1981 to create a standard curriculum, increase "time on [instructional] tasks," and intensify standardized testing to gauge student progress.

A variety of collateral reforms gained approval during the subsequent decade, mostly intending to generate more robust data on what kids were or were not learning, and then hold local school districts accountable for producing stronger results. Pre-K programs were created for children from non-English speaking families; the financing of public schools was revamped to allocate more dollars to districts serving disadvantaged students; and teacher candidates were required to become expert in a particular discipline or subject area. The state also set an exam that must be passed to graduate from high school.

These policy efforts stemmed at first from systems thinking—leveraging a core set of subunits to set in motion other complementary changes inside schools. This centered on more valid student testing by the state, along with an effort to clarify learning aims that all children should master. One policy review cited Smith and O'Day's (1991) blueprint for systems reform in the U.S., a reference point for evaluating the coherence of the decade-long flurry of institutional change in Texas.

"Noting the fragmented education policies of most states, they [Smith and O'Day] propose a systemic reform approach which combines coordinated state policies with restructured governance," wrote Clark, Dougherty, Hobby and Tolo (1994:5), "an alignment of state policies would offer an understandable structure to support schools and teachers as they provide the upgraded curriculum to all students. Systemic reforms would simultaneously increase coherence in the system through centralized policy coordination (the top-down element) and increasing professional discretion at the school site (the bottom-up element)."

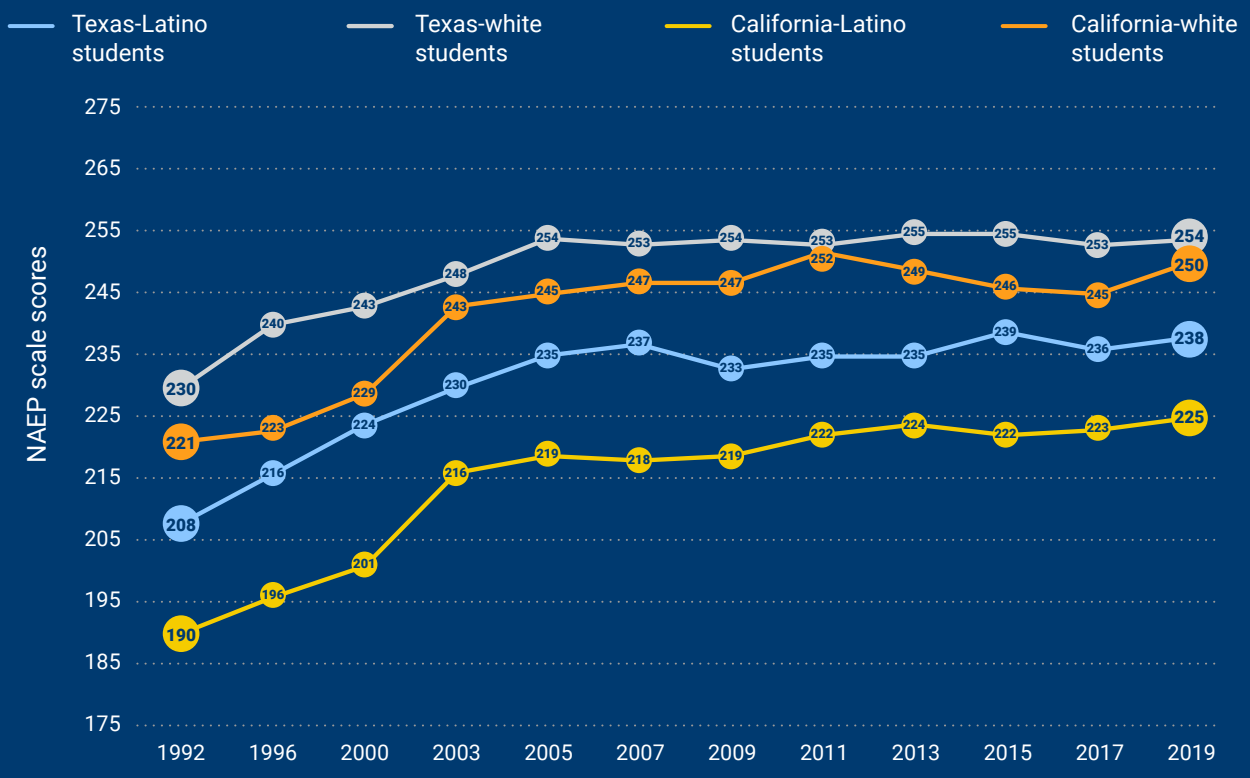
What became known as "The Texas Miracle" in some circles did manifest remarkable gains in the mathematics learning of many students, as traced by the National Assessment of Educational Progress (Figure 2). By 2019, over half of Texas fourth-grade pupils (53 percent) were proficient or higher in mathematics, compared with 40 percent in California, a state that shares similar demographic features of students and families. Similar average gains in reading did not persist over time. Yet, Texas shows narrower disparities in learning among social classes and ethnic groups relative other large states in the U.S.

The Texas policy logic remained anchored to accountability and results. But the focus shifted to local-level discretion and responsibility. "It is difficult to hold individuals responsible for outcomes unless they have the authority to make decisions which affect those outcomes." In 1990, the state began requiring each school principal to set performance goals for their students, embedded in a school improvement plan. A year later, the legislature required local school districts to consider delegating various responsibilities to school sites, including curriculum, budgeting, and staffing decisions. Incentive

payments were awarded to schools that displayed marked growth in student test scores. And the state embarked on defining "essential skills" that all Texas students should learn, aligned with a revised state testing system.

FIGURE 2

Systems thinking pays off in Texas: Outpacing California students in raising student learning



Source: Clark et al. (1994), Klein, Hamilton, McCaffrey, and Stecher (2000), NAEP (2022), and Wicks and McKenzie (2021).

a ministry's capacity to track resources and student learning over time, ideally linked to how allocation patterns shaped achievement trends.

The World Bank renewed this "institutional capacity building approach" in the 2000s when this influential donor moved past its long-held faith in buying school inputs and systems thinking gained further credibility. Articulating a fresh investment strategy for the Bank, Elizabeth King (2011) argued that "Improving education systems means moving beyond simply providing inputs." World Bank analysts emphasized how "learning levels… in many developing countries are alarmingly low," despite the Bank's massive investments in educational quality—joined by bilateral donors—over the past six decades.[17]

The Bank's "systems approach… focuses on increasing accountability and results." It closely resembles the SBA strategy that had taken hold in the West two decades earlier. "Strengthening education systems means aligning their governance, management of schools, and teachers, financing rules, and incentive mechanisms." And alignment "entails reforming

relationships of accountability among the various actors…in an education system so that these relationships are clear, consistent with functions, measured, monitored, and supported." Rather than reverting to a "structural adjustment" strategy, by which the World Bank nudged policy change in the education sector back in the 1980s, the contemporary approach focuses on improving the inner workings of ministries and local schools, finding those organizational levers that lift school quality and learning curves.

Several countries in the developing world have applied systems ideas to improve schools and raise student learning. In Kenya, for example, education and civic leaders have grasped key levers in the education institution to episodically improve learning and school quality. In 2010, the national constitution was amended to improve the governance of local schools with authority now shared between the central ministry and county offices. An independent national exams council was established to professionalize assessment and insulate this subsystem from political pressure. The testing authority simplified exams to assess pupil progress in five, not the previous seven, subjects (Box 2).

The Kenyan government reorganized the Teacher Service Commission and set higher standards for new teachers entering the profession. By 2017, the creation of a management information system was underway, allowing the education ministry to track student achievement over time and identify geographical areas or groups of children that lagged behind. Government spending on early childhood centers for 3-5-year-olds also grew. The government identified and strengthened key organizational levers, aiming to enrich classroom practices, over the past generation.

Vietnam offers another case of systems-driven gains, as ministry leaders have grasped points of leverage to enrich the preparation of teachers, then attached them to experienced mentors who fostered effective pedagogical practices (Box 3). The ministry has leaned on complementary subunits within the ministry over the past quarter-century, such as collecting management data from local communities, assessing the efficacy of local schools, and even gauging family practices that constrain or enhance children's growth. One study finds that Vietnam has been able to reduce class size, deploy more highly qualified teachers, and reduce

BOX 2

Kenya: Grasping system levers to raise education quality and achievement

Heading into the 1990s, Kenya faced enormous challenges: pallid economic growth set against high birth rates and a society of 27 million residents segmented along linguistic and tribal lines. Yet, government had committed to a new 8-4-4 structuring of school grade levels, seeking universal access to eight years of primary schooling.

Kenya's policy leaders seized on key levers inside the education system, clarifying learning aims and working to sharpen management of local schools. National exams were simplified to assess pupil progress in five—not the previous seven—subjects. A management information system was underway by 2017, able to track achievement over time.

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Government spending on early-childhood care centers has grown for kids 3-5 years of age and are run by county officials.

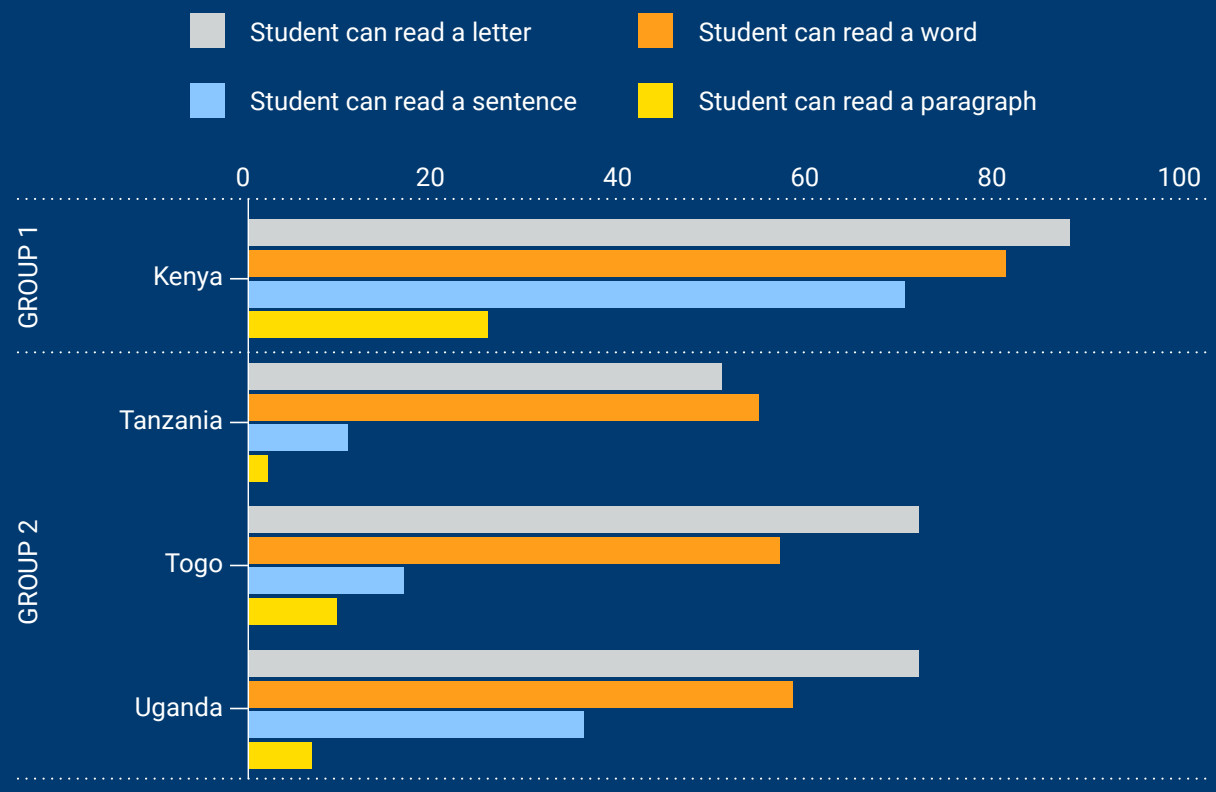
A reformed Teacher Service Commission in 2012 was mandated to set standards for new teachers entering the profession. Clear career steps were established, and this office was awarded fresh resources to monitor teacher conduct and performance.

In turn, levels of reading and math achievement range high in Kenya relative to other sub-Saharan African nations (Figure 3). Child assessments show that over three-fourths of Kenyan children reached minimal proficiency in reading and math in the last decade.

Kenya has yet to approach a "transformative" step, that is, rethinking the range of academic and social-emotional outcomes intended for students. We do not yet understand how classrooms and teacher practices may have improved over the past quarter century (as illuminated in Botswana). Still, Kenya's capacity to focus on key levers within the education system—renewing their organizational strategy over time—remains instructive.

FIGURE 3

Kenyan students have stronger reading skills compared to other sub-Saharan nations, 2017



Sources: Bashir et al. (2018), Fuller, Hua, and Snyder (1994), and Southern and Eastern African Consortium for Monitoring Educational Quality (2018).

teacher absenteeism. These school factors explain about a third of the variation in student exam results, indicating that key levers inside the organization do wield discernible gains for children.[18]

School feeding programs have proved effective as well, guided by local data that illuminate areas in which poverty most restricts children's development and pinpoint disparities linked to student gender or ethnic heritage. What distinguishes Vietnam is that education leaders have invested in a decentralized network of government and nonprofit schools. This departs from a state-run or bureaucratic system of governance, while lifting the quality of varying types of schools, which appears to explain rising levels of student achievement.

Systems thinking, especially when deployed and deepened over long stretches of time, has contributed to success stories like Kenya and Vietnam. Laboring over decades to improve the quality of teachers and

BOX 3

Vietnam: Continuous diagnosis of the system

Students in Vietnam have achieved well beyond expectations in recent PISA assessments, given historical levels of illiteracy and family poverty. These results hold even after accounting for the composition of children that sat for the PISA exams.

How to explain this dramatic improvement of the education institution, and how might a systems strategy—animated by the government and supportive stakeholders—have proved influential? Nearly a decade of research and reflection points to key elements of systems thinking—strong accountability mechanisms that link the central ministry and local schools; data from student assessments; a budget for basic education; investment in selecting high-quality teachers; and expansion of preschool. Cultural factors appear to play a role as well, including documented investments by families in their children's schooling.

Education leaders and government would eventually adopt a systems perspective—considering key levers that could motivate positive change on the ground, inside schools. The civic strategy arrived in three distinct stages (Figure 4).

First, soon after the Vietnam War ended (1975), the government incorporated more than 1,000 schools run by nonprofit, religious, or private organizations. The unified nation placed high priority on eliminating illiteracy for adolescents and adults. Initially, the government placed strong faith in grassroots efforts—a mass mobilization to raise literacy skills. But this effort floundered due to a shortage of able teachers. This prompted the government to apply systems thinking and ask how broader education infrastructure could be created over time.

In 1986, a second reform phase began as the nation moved to a less centralized and mixed market economy under the Doi Moi policy shift. Students attended nine compulsory years of schooling, with specialized curricula not pursued by pupils until grade 10. The economic opening spurred a return to diverse private schools, which now operated with quasi-autonomy from the central ministry. This decentralizing reform—moving back from a unified systems approach–was dubbed the "socialization of education," meaning that all civic stakeholders and families should be committed to learning and

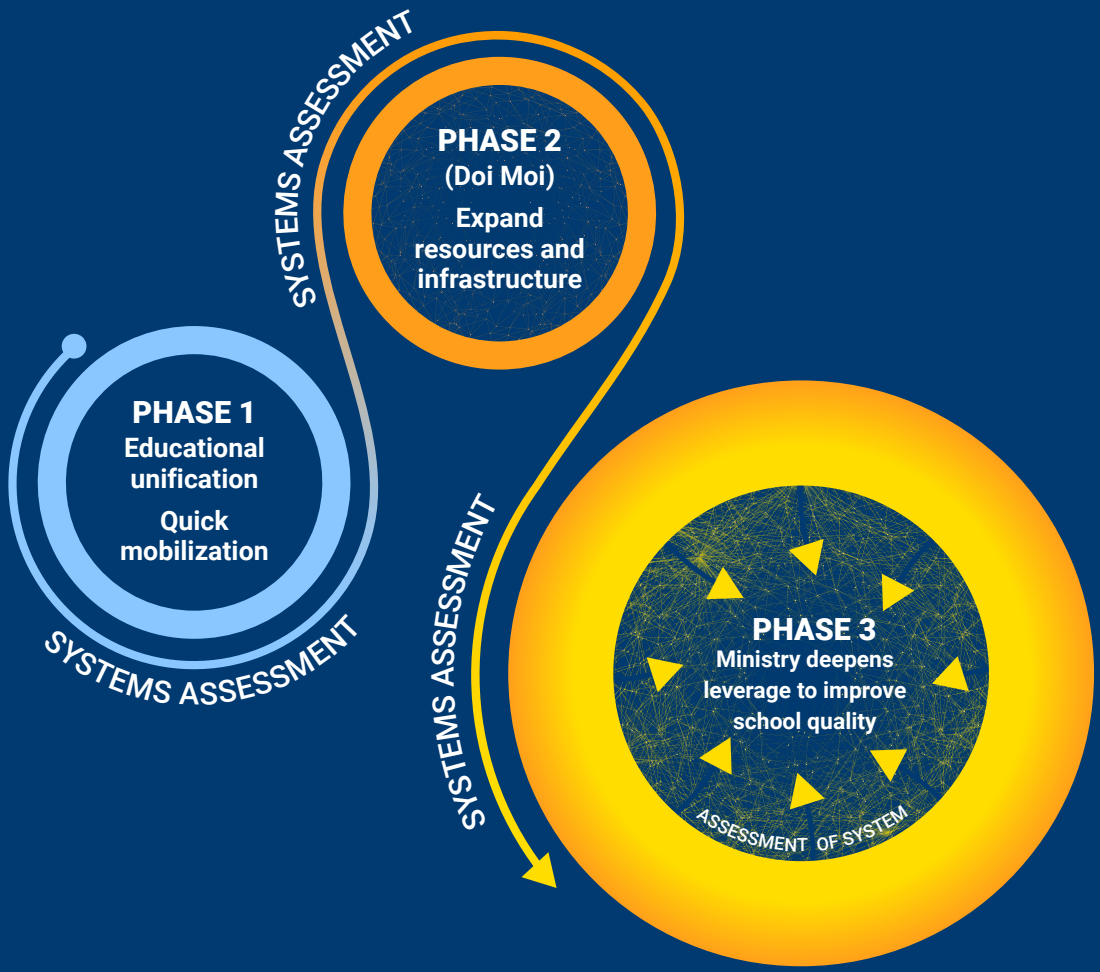
schooling. The count of elementary and secondary schools doubled in subsequent decades, and the number of small colleges quadrupled.

Vietnam entered a third reform phase early in the twenty-first century, focusing on improving educational quality. Enrollment rates had grown dramatically, yet at the cost of thin or uneven quality among the diversity of schools that had blossomed. One common systems lever—valid student assessments that allow tracking of pupil progress—was grasped by systems thinkers inside the ministry. This evidence helped spotlight effective schools, along with revealing disparities in school funding and student achievement.

Education leaders also returned to the family to gauge out-of-school factors that shaped school attendance and rates of learning. School feeding programs, for instance, were introduced. Thick management data helped government focus resources on poor communities and reduce disparities among gender and ethnic groups. Vietnam sustains a variety of school types, while encompassing these various campuses, applying systems thinking to lift educational quality.

FIGURE 4

Vietnam leverages systems change over four decades



Sources: World Bank (2020) and Dang, Glewwe, Lee, and Vu (2020).

classrooms, these education leaders went beyond the conventional remedy of buying more school inputs, while ignoring institutional capacity and those pivotal levers of institutional change. Instead, these nations boosted their investment in education *and* focused on strengthening organizational units—from the central ministry to the local management of teachers and schools.

THE INSTRUCTIONAL SUB-SYSTEM: SYSTEMS THINKING FOR THE EVOLVING PURPOSE OF EDUCATION

After three decades, SBA systems reform began to face criticism in the U.S., offering new lessons for other countries that may consider this model. Critics of the SBA approach worry that large, bureaucratic governments will inevitably enforce mechanical means of controlling teachers and their pedagogical practices, rather than foster professional craft and commitment. Tightening the education system also seems to distract policymakers from the pressing question of what children should be learning for their uncertain futures. Systems reform often emboldens central planners, rather than equipping teachers on how to enrich their local classrooms.

True to classic systems theory, SBA's contemporary adherents do claim that the organization's goals and means should be defined at the top of the system, with central actors allocating key inputs and guiding the content and pedagogy delivered by teachers—then pressing school-level managers for results. These system reformers have seen few difficulties in reducing complex learning goals and instructional content down to bite-size pieces, delivered by didactic teachers who labor as interchangeable parts of a vertically arranged system. Under the SBA systems model, learning goals are typically simplified, not reconsidered or enriched for evolving societies.

A less mechanical systems approach might first ask whether these old-line learning aims are sufficient for a nation or planet that's facing evolving challenges? Will SBA approaches further institutionalize traditional learning goals, distracting countries and local communities from the essential question of whether we are preparing and socializing the next generation for the futures they face?.

Focusing on the *instructional sub-system*—labeled by some analysts *as restructuring*—yields a second variant of systems reform, one that focuses on the resources and social dynamics found *inside schools*, a popular way to conceive of reform arising in the 1990s, mostly in the U.S. and Europe. Rather than starting with the central ministry, where influential levers might be grasped, earlier restructuring advocates began by identifying constraints inside schools and classrooms. So-called school-effects researchers had empirically associated school-level factors with varying levels of student achievement (after accounting for pupils' social class). Eager to import econometric methods, scholars then surveyed or observed a variety of possible determinants—principal leadership behavior, class size, staff cohesion, teacher motivation and experience to name a few—then tested which factors contributed to higher achievement.[19]

As findings accumulated from this line of research, other analysts began to ask how educators or policymakers might "map backwards" up and out into other subunits of the system to enhance the clout of these positive school factors. This conceptual framing "questions the assumption that explicit policy directives, clear statements of administrative responsibilities, and well-defined outcomes will necessarily increase the likelihood that policies will be successfully implemented".[20] In this way, backward mapping turns the system's affection for hierarchy on its head, while searching for subsystems, proximal to the classroom, that enhance teaching and learning.

Separating the instructional subsystem from logistical maintenance of schools has proved useful in reform circles. The "educational work of central offices and schools often stopped at classroom doors," as Don Peurach emphasizes.[21] Rather than starting with management or data breakdowns in central offices, the instructional subsystem strategy begins inside schools—asking about teacher motivation, pedagogical effectiveness, and student engagement—and then looks into surrounding units (e.g., local education offices or the state ministry) that enhance or impede dynamics inside the school. This backward-mapping strategy returns to key levers of the larger system, yet reform advocates first discover what works or doesn't inside classrooms.

For some this means carefully experimenting with a discrete innovation and then taking it to scale. Rising faith in random control trials (RCTs) adds elegance to this strategy of formally testing a pilot intervention—from school feeding to in-service teacher training, even experiments that nudge students to bicycle to school.[22] The underlying assumption of these innovators is that engineered experiments will conquer all, that the education system will learn and overcome deep-seated institutional habits.

Yet, since the 1970s, neo-institutional scholars have detailed how normative beliefs about how work gets done in schools often buffer the acceptance of proven innovations.[23] Recent work in the Global North and South on the process of scaling, drawing from change management approaches, has urged innovators and the RCT faithful to attend to the stickiness of institutional practices so they can do more than "tinker toward utopia".[24]

Advocates of restructuring also define *new forms of schooling*, as well, such as charter, magnet, dual-language, and other forms subject to less bureaucratic regulation. These alternative schools typically boast a distinct curricular mission—from theater arts to STEM to high schools that apprentice students in particular occupations.[25] Note the system now encompasses an array of diverse schools that populate a community or region—what Bruce Fuller identifies as *organizational pluralism*.[26] We witnessed this diversity of school types in the case of Vietnam, as we do in Scandinavia and the U.S.

The *restructuring* approach also connotes the curricular mission or normative commitment of a school—for example, focusing on dual-language instruction, fine arts, or computer science—sharply departing from the hierarchical structuring of schools and the teaching role under classic systems theory. Understanding the diversifying population of schools requires setting aside the internal dynamics of the state-run system and instead considering organizational variety in the wider field of play. This organizational pluralism invites rethinking the ultimate aims of schooling, perhaps transforming the purposes and pedagogical means of education.

Many argue that this pluralism also lends agency to parents in selecting among diversifying forms of schooling. Nonprofit activists and inventive educators have pressed for diverse forms of schooling, aiming to motivate students or families who express differing interests or have diverse needs for their children. This argument also comes from market advocates, those seeking to place educators in a competitive dynamic, embraced by economists holding faith in liberal family choice and greater productive efficiency for schools.[27]

THE TEACHING GUILD: SYSTEMS THINKING AS NETWORKS

Students of modern organizations initially assumed that key elements of systems theory energized human organizations, much like physiology or computer programming. "Hierarchic systems," for example, "have some common properties that are independent of their specific content," Herbert Simon argued in 1967. A more complex "intelligence" or capacity operating at the firm's headquarters—presumably not found locally—acted to coordinate "elementary subsystems" down below.

Yet, "not all large systems appear hierarchical," Simon observed, whether in the mechanical or social-organizational realm. Simon emphasized that one's position in a human system conditioned access to information and resources. And in firms where the essential craft and discretion occurs locally—for example, teaching inside a classroom—pivotal information is held by those at the bottom of the system's pyramid. This runs counter to classic systems where the coordinating "mind,"—those who engineer work processes—rests atop the factory-like structure or state bureaucracy.

The earlier rise of *human relations* thinking in the 1930s, hosted in the fledgling field of "management science," emphasized how members arrive to organizations with their own predilections and intrinsic motivations. They pursue personal goals or alliances with nearby workers, from a feeling of belonging to laboring in cooperative fashion. Subunits may cultivate knowledge, technology, or priorities that become competitive—not necessarily in synchrony with other subsystems. The "logic of sentiments" inside firms was juxtaposed to the "logic of cost and efficiency," in the words of management scholars Roethlisberger and

Dickson.[28] That is, systems are not merely dedicated to pursuing official goals, like boosting student achievement; the adults work toward their own social or material aims as well.

From this perspective, human systems rarely operate in mechanical fashion (as assumed by the SBA approach), especially school systems in which the pivotal work is done inside classrooms where teachers exercise much discretion behind closed doors. The formal structuring of job roles and core tasks—defined high above in the education bureaucracy—may direct the work of teachers. But it is their professional commitment, norms, and tacit culture inside schools that matter more than the official organizational chart. In this way, human systems differ as to whether core work is governed through material controls, or instead by the underlying commitment of artisans dedicated to their craft.

The word *system* is often equated with *structure*, the underlying rules, job roles and normative expectations that govern the behavior of teachers or school managers. But when mechanical reforms are attempted, deploying classic systems logic, the underlying culture of local schools and didactics of teachers may remain invisible. System reformers may encourage more interactive forms of classroom pedagogy, for instance, yet the taken-for-granted practice remains didactic and directive in the minds of teachers. Collateral elements of the education system may block well-intentioned reforms. The central ministry in China has attempted to foster less didactic instruction and award students a wider choice of classes over the past quarter-century. But these efforts remain subverted by government's reliance on highly institutionalized and consequential national exams.[29]

The very meaning of other reforms can be distorted by the prior training of teachers—the interpretive lens they wear to make sense of organizational change pressed from above. Teachers with earlier training in phonics and didactic delivery interpret a progressive reading reform differently, compared with teachers with earlier exposure to holistic pedagogical strategies.[30] Signals and normative rules become noisy in complex institutions like schools. Electronic engineers talk of the signal's strength relative to ambient noise in the environment.[31] This ambiguity is familiar to school principals who receive hazy signals from above regarding budget procedures, the latest curricular idea, and testing schedules.

Here a systems-grounded reform–new textbooks or better assessment data–fails to disrupt a less visible structuring of everyday work inside classrooms. Who exerts real authority in this pyramid turned upside down? It is the artisan on the ground—inside the health clinic, carpentry shop, or classroom—who advances the work and requisite skill or technology, not the manager who operates far above at the purported top of the system. So, we must distinguish between which sub-systems offer influential levers, and whether they touch material and more subtle structures inside schools.

Perhaps schooling is better framed as a loose-knit guild of professional teachers. This requires setting aside deep-seated assumptions about bureaucratically regulated local units. That is, teachers are viewed as caring professionals with specialized expertise, based upon formal training and apprenticeship with master artisans. In secondary schools, government could provide facilities, instructional materials, and social glue to foster collaboration among teachers, while granting them considerable autonomy. From this vantage point, the hierarchical character of systems is set aside. Instead, novel learning aims or pedagogical practices may be introduced by the central ministry. Then, nurturing these fresh ideas requires professional dialogue, not regulated controls from above that may fail to alter teachers' everyday culture.

THE ECOLOGICAL APPROACH: ORGANIZATIONAL THINKING AS LOCAL LANDSCAPES OF LEARNING

Another approach builds on theories of *organizational fields* to postulate that behavior inside the firm is motivated, even controlled by labor norms, material supplies, and political legitimacy that take shape *outside* the firm's border.[32] Agile education ministers and non-governmental partners have long formed alliances with external reform groups, labor associations, or business leaders to rally civic support for education. These constituencies may advocate for stronger teacher quality, STEM forms of curricula, or apprenticeship options outside the conventional academic track.

Moving one step farther from a bounded system of state-run schools, education ministries and their partners may consider the proliferating settings for learning afforded by digital media, apprenticeships, community spaces such as parks and museums, and even informally arranged lessons. These novel locations for learning and teaching break from prior assumptions regarding a tightly bounded system, explored by proponents of "local learning ecosystems".[33] The expanding field of *learning situations* includes educational television, digital software in which learning or peer interaction occurs, community-rooted teachers, and employer-created apprenticeships. These actors may interact—seeking clients or competitive advantage. But any notion of a hierarchical and regulated system can no longer be assumed. Instead, a variety of learning situations operate in a wide-open and contested organizational field.

New technologies and forms of learning now spread around the globe, including in middle- and low-income countries. Sesame Street, for example, has adapted and spread its core production and collateral digital material around the world, financed by private capital and support from international agencies.[34] The marketing of educational software to families and education authorities is altering the character of classroom learning, as well—hurried by reliance on remote instruction during the pandemic, along with increasing hours that children spend online each day.[35] Formal controls, long inherent in human systems, are giving way to less formal networks and markets for learning.

Digital technology, of course, decentralizes learning settings way beyond the walls of state-run schools. This is not new in how donor agencies have worked with education leaders in low- and middle-income countries. USAID and other donors invested heavily in "distance learning" two generations ago, distributing radios to students in rural areas.[36] Yet, the contemporary ecology of digital providers is far from engineered; instead, it is a feisty field of market players and nonprofit producers of educational content. This rainbow of learning settings may operate in an ecological fashion—a variety of networks compete to engage a diversifying range of children and families. This influences the modes of learning that penetrate into otherwise staid classrooms. At the same time, no one agency can coordinate or engineer these proliferating learning arrangements.[37]

Digital learning dynamics depart radically from the core tenets of a classic system.

Simultaneously, the formal education sector can play a role in linking students to learning situations that provide high quality and integration into the workforce. Estonia's education ministry, for instance, offers grants to schools—shared with employers—that facilitate apprenticeships for secondary students. Not more than 2,000 youths presently participate in this small country, although the government aims to expand this option for vocational students.[38] Magnet schools in the U.S. and parts of Latin America similarly organize real-world apprenticeships for high school pupils.[39]

Government leaders and their partners may calculate higher odds of moving the education system by strengthening elements of civil society and the private sector and building political support for reform inside the system. From this pragmatic vantage point, one need not assume clear boundaries around the education institution. Instead, government leaders and partners help shift sentiments in the wider society over the aims and means of formal schooling by altering the mix of forces operating in the surrounding organizational field. Public health officials attempt to advance human well-being by treating the context, not the human body directly. So, too, school reformers might learn from the open-systems facet of classic theory, and consider how much change can occur within the education institution absent prodding from the outside.

Differing pathways for improving and transforming systems

Proponents of systems reform typically assume that human learning must be arranged in classrooms, led by a teacher and managed by rules and norms enforced by hierarchically organized subunits (i.e., the vertical organization chart). Efforts to improve the system's apparatus assume that state-run structuring is the optimal way to coordinate teaching and learning on a grand scale. These assumptions took root more than a

century ago when the industrial factory, then the welfare state, were considered the premiere way to organize.

We argue that transforming education systems requires thawing out these highly institutionalized habits and routines. We have seen how hierarchical or centralized systems run into political opposition and may undercut the motivation and innovative potential of local educators. By attempting to improve subunits in the central ministry, do we squander resources better aimed at improving classroom conditions on the ground? As many societies become more diverse—powered by the global migration of labor and the diversifying range of organizations outside the state apparatus—should education leaders and their partners award greater authority to local schools and communities when capacity to innovate and improve appears sufficient?

We do not argue this is an "either, or" situation. Systems thinking opens new possibilities—building from the basic tenet that certain parts of the education institution can leverage other subunits in ways that improve conditions and professional norms for teacher. For starters, we should be clear on the multiple pathways that education leaders can explore for systems:

- **State-run (bureaucratic) systems.** Civic authorities have long financed "government schools," going back to the sixteenth century. The modern nation-state then coordinated the work of educators placed in multi-layered bureaucracies, typically modeled after factory or military organizations.[40] This implies that the education system is tied to local schools held together by some kind of central authority.

- **SBA.** An ancient idea, focused on centrally prescribed learning aims and a standard testing regime, dates back at least a millennium, when China selected civil servants through national exams. This systems-like model spread more widely in the 1980s, as governments set down uniform curricular goals and accountability pressures for local educators to show results.

- **Accountability with deeper learning.** In the wake of SBA, next-generation advocates emphasize a "common core" that centers on analytic and problem-solving skills. A deeper learning that puts core areas of study (reading, math, and civics) to work on applied problems, which students will soon face in evolving societies. This avenue invites education leaders and teachers to rethink the ultimate goals of education.

- **Taking innovations to scale.** After establishing benefits of a classroom or school innovation–a science curriculum is effective and embraced across a small count of classrooms–implementation on a large scale can falter when the ministry fails to sustain necessary teacher training or materials. Or, pedagogical reformers may convince government to advance less didactic, more inquisitive teaching practices. But the ministry shows little interest in altering centralized examinations. Systems thinking spotlights these interwoven links within the sector.

- **Instructional (sub)systems.** Precisely how central education managers–laboring far from local schools–can enrich working conditions for, and demands placed on, teachers remains an organizational puzzle. This strategy focuses on what's working (or not) inside classrooms and mapping backwards into other parts of the system to support quality teaching

- **Professionalized networks of teachers.** Revisiting teaching as a local guild of thinking professionals offers another pathway for school improvement. This sets aside the systems assumption that teachers are to be regulated at the bottom of the hierarchy. Instead, ask how can the central ministry and regional offices nurture high commitment and deeper knowledge of teaching and student motivation–fostering inquiry about classroom practice and student engagement.

- **Ecological networks of schools.** Extending from early systems thinking, some planners recognize that the education institution operates in complex environments which include a variety of settings in which children and youth learn far from state-run schools.[41] The proliferation of community sites for digital platforms, hosting an infinite array of learning options, highlights how state-run schools operate in a complicated ecology, no longer directed by a central authority.

Concluding reflections

We have reviewed how several models of systems thinking in education have taken shape over the past half-century. These variants—along with insights on the ways in which teachers inside systems are motivated by a variety of factors—can inform how education leaders and their partners design consequential reforms. Systems thinking offers a framework and focus on powerful levers that move beyond narrow project designs to identify and remedy pivotal parts of the institution that advance or impede change.

The *so-what* question, however, remains for education leaders—those responsible for lifting school quality and tangible results for children and families. When you arrive at work tomorrow, what might you do differently? We suggest that the four questions below provide useful starting points for reflection:

1. **Learn about key parts of the education system:** What is the interplay among key components? Do offices talk to one another? Who is keenly focused on improving the conditions in which teachers work, the rigor and caring qualities of their classrooms?

2. **Investigate the levers for affecting positive change in the system:** Which organizational levers inside the ministry foster gains for teachers and classrooms, and which organizational mechanisms only serve to distract you?

3. **Consider how the objectives will contribute to society's sustainable future:** Do the end-goals of education—what children are to learn in school—truly fit what is relevant for their local context and the vitality of your society?

4. **Find partners:** Who outside the state-run system is shaping children's learning and deeper socialization that could aid school-improvement efforts?[42]

Think carefully about whether the goals of your schools truly speak to the aspirations and challenges the children of your nation now confront. Then, grasp those levers inside the education institution that can lift quality and adapt your schools to local and global developments.

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