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Solving the Nation's Teacher Shortage

How online learning can fix the broken teacher labor market

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EXECUTIVE SUMMARY

As the link between teacher quality and student performance becomes increasingly apparent, education leaders have invested significant time and energy into recruiting high-quality educators. Unfortunately, chronic teacher shortages have undercut these efforts, and many school leaders continue to struggle with staffing each year. A closer examination reveals the causes and characteristics of these teacher shortages, as well as the promise online learning holds in resolving the most challenging teacher vacancies.

Teacher shortages: Defining features and driving forces

An aggregate teacher surplus masks four types of acute shortages. First, certain grade levels are harder to staff than others. Second, and closely related to grade-level shortages, particular subject areas within these grade levels go chronically understaffed. Third, some geographic regions of the United States face ongoing teacher shortages, whereas others report a regular surplus. Finally, empirical evidence suggests a decline in teacher quality since 1960 across all grade levels, subject areas, and geographies.

Policymakers' attempts to address these disaggregated teacher shortages have been relatively unsuccessful, largely because they fail to account for the three systemic issues driving these outcomes. First, the rise of women's rights has lowered the quantity and quality of the teacher labor supply at the same time that it has increased demand. Second, technological improvements in other industries have increased non-teaching wages relative to teaching wages, thus incentivizing many professionals—male or female—to forgo a career in education. Third, the family structures and social behaviors typical of those who teach are such that teacher labor tends to be highly localized and difficult to distribute to places in need of additional teachers.

The promise of online learning

A considerable body of research has already documented the ways in which online learning is disrupting the traditional K–12 model of learning. Interestingly, there is additional evidence that online learning is also disrupting the systems that place teachers within this traditional model. More specifically, online learning provides a new, more flexible and more productive way to match teachers with students, and this alternative approach already exhibits some of the same indicators as other disruptive innovations.

Policymakers should welcome this disruption, as online learning could hold the key to addressing the nation's most entrenched teacher vacancies; three recommendations in particular would help them to foster this trajectory. First, officials should establish "Course Access" laws that give students and schools the freedom they need to use online learning productively.

Second, policymakers should move from seat-time requirements to a competency-based method for awarding online class credit. Finally, in addition to making these policy changes, officials should support school and district leaders by providing them resources to evaluate and select the appropriate technology. Taken together, these actions would enable online learning to transform our teacher labor supply into the flexible and productive resource that 21st-century schools so desperately need.

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INTRODUCTION

The ongoing debate around education reform has illuminated an unfortunate paradox: at the same time that reform leaders are beginning to appreciate fully the true value of high-quality teachers, their district-level counterparts are reporting acute difficulty in recruiting and retaining such teachers. Indeed, although the United States may enjoy an aggregate teacher surplus, disaggregated analysis reveals that U.S. schools have experienced persistent teacher shortages by geography, grade level, and subject area for nearly 40 years. These shortages become all the more severe when viewed through the additional filter of teacher quality.

Such troubles are not lost on education leaders. According to the National Center for Education Statistics, 45 states reported that at least one of their school districts used some form of teacher recruitment incentive during the 2011–12 school year. And yet, these tactics—which ranged from relocation bonuses, to student loan forgiveness, to bonuses for current teachers who refer a friend—failed to address the schools' most troublesome vacancies in any lasting way. Even when coupled with non-pecuniary approaches, such as license reciprocity, alternative certification tracks, and "grow-your-own" teacher programs, recent policymaker efforts have not closed the long-term gaps between disaggregated supply and demand for quality teachers.

To understand why these shortages have been so stubborn and how they might finally be resolved, first it is necessary to unpack the underlying trends that drive them. More specifically, changes since the 1960s in 1) women's rights and 2) workplace technology have interacted with 3) teachers' most basic self-selection characteristics to create systemic teacher labor market failure. Because this failure is anchored in such deep-seated and closely interwoven historical forces, it is unlikely to respond to the modest policy efforts employed presently.

And yet, even though current efforts may not go far enough, the more drastic steps required to re-equilibrate U.S. teacher labor markets tend to be politically and/or economically unfeasible.

For example, the millions of dollars that would be required each year to make science teachers' pay commensurate with the pay typical of private research positions might be impossible for states already operating in a budget deficit.[1] As a function of these constraints, education policymakers find themselves in need of a new approach for teacher shortages, one capable of uprooting the deep drivers of vacancies without requiring unrealistic political or economic capital.

Within this light, online learning holds the potential to unlock new solutions to U.S. schools' stickiest, most troublesome teacher shortages. By allowing educators to reach students from anywhere in the country, online learning creates a new degree of flexibility and productivity among current teachers, while also making the field more attractive to teachers who have left and to non-teachers who have considered entering. If used effectively, and if coupled appropriately with other teacher labor policy efforts, it could hold the key to disrupting the nation's antiquated teacher recruitment and retention strategies. For this to happen, policymakers will need to recognize online learning's potential and legislate accordingly.

UNPACKING TEACHER SHORTAGES

At present, somewhere between 9 and 10 million Americans are qualified to fill the 3.7 million teaching positions listed within the U.S. K–12 school system.[2] Unfortunately, this aggregate teacher surplus masks acute local shortages, as school districts struggle consistently to staff particular types of teaching positions, especially within certain regions of the United States. Digging deeper, the academic literature uncovers four trends that characterize these disaggregated teacher shortages:

Grade level: Secondary school-level teachers are more difficult to find than elementary and early childhood education (ECE) teachers.[3]

Subject area: Science, math, world languages, and special education teachers are more difficult to find than social studies, English language arts, and other general education teachers.[4]

Geography: Teachers of all types are harder to find in the South, Southwest, and West than they are in the Midwest and Northeast; nationwide, rural and urban schools are more difficult to staff than suburban schools.[5]

Quality: The scholastic aptitude of the average teacher (which is empirically linked to student performance) has fallen considerably across all subjects, grade levels, and regions since 1960.[6]

In essence, the teacher labor market suffers from a massive coordination problem, with teacher certification programs over-producing in certain parts of the country at the same time that they are under-producing in other parts, and with programs nationwide over-producing ECE teachers but under-producing secondary school-level STEM, world languages, and special education teachers.[7] These coordination issues create a "worst-of-both-worlds" scenario, wherein

districts struggle to find one type of teacher at the same time that another type of teacher struggles to find a district that will hire her. Layered on top of these challenges, the falling quality of the average teacher only further exacerbates the consequences of resulting teacher vacancies.

Recent initiatives have failed to fill the shortages just described because they typically ignore the complex realities underlying teacher supply and demand. Far from being an easy fix, teacher shortages take root in a trio of long-standing societal forces. As a result, it is unlikely that we will resolve these shortages without a markedly new approach to managing teacher labor.

Coordination complexities lead schools to experience shortages by grade level, subject area, and geography—despite a national surplus of teachers.

Force one: Women's rights

Although the women's liberation movement signaled important social progress for the United States as a whole, it also triggered new types of complexity within the country's school system—complexity that policymakers still have not addressed fully more than 40 years later.

Looking first to teacher supply, the impact of women's rights is rather straightforward. Before the 1960s, schools had a monopsony over educated female labor—in other words, schools were one of the only buyers of this type of good and could pay relatively little for it. As time passed, however, educated women made inroads into new and, in many cases, higher-paying fields.[8] Despite these changes, policymakers did not adjust state-determined teacher pay scales to compete with now-rival industries. Mapping the consequences of this inaction, a report by the Association for Public Policy Analysis and Management found that women earned 35 percent more as teachers than as non-teachers in 1975; by 1992, they earned only 10 percent more; and by 2000, they earned five percent less.[9,10] Recent measures toward gender wage parity between women and men would only further exacerbate this trend, as females in non-teaching professions soon may see a steep increase in compensation.[11]

Basic laws of supply and demand predict that this flip in the pay differential between teaching and non-teaching careers would drive many educated women out of the teaching profession or keep them from entering it in the first place. As evidence of this trend, more than 50 percent of female college graduates entered teaching in 1960 but, by 1990, the number had fallen to less than 10 percent.[12,13] In particular, women with easily transferable skills (such as scientific and world languages training) have encountered more and higher-paying opportunities outside of the teaching profession, which has fueled the subject-specific shortages mentioned above.[14] Because this content-area expertise is required only for those seeking certification in secondary-

Female entry into the professional workplace has caused teacher supply to fall and demand to rise.

grade levels, subject-area shortages have become synonymous with grade-level shortages as well.[15] In this way, women's expanded opportunities in the professional workplace disproportionately impacted secondary schools, especially within their math, science, and world languages departments.

In addition to affecting the *quantity* of specific subsets of the teacher supply, women's rights also affected the general *quality* of this labor force. Several studies have found that the profile of the typical K–12 educator has shifted over the past 30 years, with considerably fewer high-performing students entering the profession to become teachers themselves. According to one study, "In the 1964–71 period, 20–25 percent of all new female teachers ranked in the top (10th) decile of their high school cohort; by 2000, this proportion dropped below 13 percent."[16] And, although academic achievement is not the only predictor of teacher quality, a teacher's academic success has been linked time and again to her students' academic performance.[17] As such, a fall in the average teacher's academic record can, in some scenarios, translate into a shortage of teachers sufficiently capable of producing student growth.

At the same time that the women's liberation movement decreased the quantity and average quality of the teacher labor supply (particularly in subject areas with readily transferable skills),[18] it increased the demand for teachers, albeit in subtler ways. Increased professional opportunities over the past few decades upset the prevalence of the "single breadwinner" household, such that significantly fewer children now have a full-time, stay-at-home parent. As this shift occurred, schools became the provider of "substitute services" for parental socialization, which placed additional responsibilities on teachers and staff. Schools required more staff members to meet these expanded responsibilities and, as a result, student-teacher ratios fell from 22.3-to-1 in 1970 to 15.4-to-1 in 2009. As further evidence of this trend, the *Wall Street Journal* reported in 2012 that, over that same time period, school-level employment grew 11 times faster than student enrollment in K–12 schools.[19]

The simultaneous increase in women's labor force participation and in school staffing demands is no coincidence, nor is it a matter of simple correlation. To the contrary, several studies have found evidence of a causal link between the former and the latter. Beginning in 1993, a study by Victor Fuchs and Diane Reklis found that, even when controlling for factors like educational attainment and socioeconomic status, children perform worse in school when they do not have a parent at home full time, and that schools have used smaller class sizes as well as more frequent student-teacher interactions to directly counter this effect.[20] Providing further evidence of causality, Frederick Flyer and Sherwin Rosen used quantitative regression modeling to map the

relationship between female employment and student-staff ratios on a state-by-state basis; according to their results, first published in 1994, school staffing trends across states were "consistent with substitution of staff and teacher time in school for parental time at home in the production of child services."[21] Given these and other studies like them, there is compelling evidence that women's workplace opportunities have contributed to the nation's increased demand for teachers.

Technology has made other professions relatively more productive than teaching, thus contributing to the fall in educators' real earnings.

Force two: Technology

At the same time that greater women's rights placed competitive pressures on U.S. teacher labor markets, advances in technology outside of the teaching profession further exacerbated these strains. Within fields like nursing and accounting—professions often seen as the most direct competitors to today's teaching profession—new technology has made each unit of labor more efficient. That is to say, advances in medical records software allow a single nurse to manage more patient records with the same (or better) accuracy, whereas the advent of accounting software programs allows a single accountant to handle more transactions without error.[22]

And yet, although this technology has increased the productivity of professionals in comparable fields, flat productivity growth rates within the education sector[23,24] have caused teacher salaries to fall more than 13 percent relative to pay in otherwise comparable professions.[25] Technology has therefore reinforced the effects of the women's liberation movement: at the same time that women won the freedom to choose the careers they desire, technological advances outside of the education profession made non-teaching positions more financially attractive to them.[26] The net result has been an outflow of educated women in certain subject areas beyond what the growing demand for teachers can support.

This outcome has led some to ask why the rising tide of technology has not lifted all boats—that is to say, why a teacher's work has not benefitted from technological advances in the same way that an accountant's or nurse's work has. To a certain extent, the way we perceive the teaching profession—and, by extension, the way we pressure U.S. elected officials to legislate around it—precludes this. According to one labor economist, technological advances have not dramatically increased teacher productivity because Americans view K–12 education as a service-sector profession.[27] Following this theory, we hold preconceived notions about the nature of the field and, consequently, pressure elected officials to keep student-teacher ratios relatively low, regardless of what technological advances might otherwise allow. This has become especially true

A highly immobile teacher workforce contributes to geographic shortages.

since women's entry into the workplace created an expectation for teachers to act as a substitute for the traditional parenting role.

Outside of these perceptions, inefficient sector engagement with education technology has prevented productivity growth among teachers. Schools have invested an estimated $100 billion in K–12 education technology over the past few decades,[28] but not with much thought as to how this investment can actually translate into more cost-effective instruction. Technology is not inherently efficient; to the contrary, it drives productivity only when designed with productivity explicitly in mind. As discussed later in the section on policymaker actions, technological investments have rarely translated into increased teacher productivity because these investments are rarely selected and implemented with such goals.

Force three: Socio-familial drivers of teacher behavior

Equally important to the above explanation of who has been driven out of the teaching profession is an understanding of who has stayed within the field. In particular, researchers have identified several characteristics common to those self-selecting into K–12 education:

Household finances: The majority of teachers are married women who usually work as their household's secondary breadwinner.[29,30]

Family planning: Teachers (especially female) are more prone to leave the workforce to raise their own children than are women in comparable industries.[31,32]

Mobility: They tend to find work very close to the place where they grew up—in fact, 61 percent of all teachers live within 20 miles of where they attended high school.[33]

Taken together, these characteristics tell a common story. When a new teacher first enters the workforce, she seeks a job close to where she attended school herself. She eventually begins a family (most likely with someone who earns more than her) and, in many cases, leaves the workforce for at least some time to care for this family. Within this context, it is not surprising that many current teachers are unwilling to relocate to fill geographic shortages, as doing so would require them to uproot their families to a place far from home—in many cases, to a place where their partners may not have the same job prospects—to take a position that they might intend to leave (if only temporarily) as their family's needs change. To be sure, this narrative does not fit for all educators, but it applies to such a large share of the current teacher labor force that it renders the overall supply highly localized and generally unresponsive to relocation incentives.[34]

Because of this, regional teacher surpluses and deficits—which myriad factors help create, including state-specific education legislation, rapid demographic shifts, local career alternatives, and local perceptions of the teaching profession—are not easily filled because the behaviors and

characteristics of today's typical teacher make it incredibly difficult to redistribute physically the nation's teacher supply. These shortages become especially entrenched in rural communities (where there are few job prospects for the teacher's spouse) and in urban communities (where there are numerous higher paying alternatives for the teacher herself).[35] Thus, although the aggregate supply of teachers may be sufficiently large, it is too immobile and uncoordinated to meet the specific types of demand that characterize many local teacher labor markets.

TOWARD A NEW THEORY OF ACTION: ONLINE LEARNING AND TEACHER LABOR MARKET COORDINATION

Given these deep-seated causes, it is understandable that policymakers' modest responses have failed adequately to address teacher shortages. Indeed, the considerable mismatch between the causes and the most common solutions named in the introduction suggest a need for officials to develop a new theory of action for addressing the nation's most deeply entrenched teacher vacancies.

Given the issues discussed in the previous section, this need charges policymakers with identifying new, cost-effective tools that better distribute the teacher supply rather than merely grow it.[36] Online learning could be employed as just such a tool, one capable of making both supply and demand more flexible and productive in a way that facilitates the very coordination required to systematically fill teacher vacancies with high-quality professionals.

Online learning as a disruptive innovation

Online learning is emerging as a disruptive innovation within the traditional K–12 education system and is capable of fundamentally redefining education as we know it. A disruptive innovation begins as a small, seemingly inconsequential good or service, but eventually becomes good enough to displace the expensive, highly complex "Goliaths" of its field. When first developed, these innovations cannot perform sufficiently well to compete head-to-head for existing users of the dominant service, so their innovators prioritize simplicity and affordability to gain traction among people who would otherwise use no service at all— people who are "nonconsumers."

These nonconsumers give innovators the revenue and the motivation they need to stay in business and to refine their product until it becomes good enough to tackle more complex tasks. Eventually, the new good or service develops enough to handle the same tasks as the "Goliath," but with the greater simplicity and affordability that kept it alive in the first place. Once this tipping point is reached, the innovation disrupts its field and supplants existing options to become the new market leader. This pattern has played itself out time and again—from the steamboats that overtook traditional sailing vessels, to the personal computers that displaced

seemingly untouchable minicomputers. Using disruptive innovation theory, we can now predict which innovations could become truly disruptive even before they have fully developed.

Like the disruptive innovations before it, online learning first served nonconsumers. More specifically, online learning began in the 1990s as a service for students who could not be served in the traditional setting, either because they were unable to attend school or because their school could not provide the courses they desired.[37] The program offerings may not have been very good—and certainly not as good as the traditional classroom experience—but they were better than nothing, which is what these nonconsumers otherwise would have received. With time, online-learning programs have improved both the quantity and quality of their offerings to bring them closer and closer to competing with the traditional classroom experience.

As these programs improved, they grew rapidly to serve an increasing share of the K–12 population. From 2007 to 2012, K–12 enrollments in online-learning courses grew more than 230 percent in the United States, from 750,000 students in 2007 to 2.5 million just five years later.[38] To keep up with this demand, 31 states and Washington, D.C. all now contract with online-learning providers to offer full-time online schools to K–12 students, and there is compelling reason to believe that half of all K–12 classes will be taken online in some form or fashion by 2019.[39]

The vast quality improvements that have fueled this growth suggest that online learning will disrupt the K–12 classroom by "unbundling" the learning experience to provide students high-quality options that are more convenient and customized for them[40] and more affordable and flexible for the district.[41] According to the theory of disruptive innovation, these options will only improve with time and draw more students into fully online and blended[42] alternatives until they eventually supplant the traditional model of learning.

Disruptive innovation in the teacher labor market

In addition to disrupting the traditional classroom, a growing body of evidence suggests that online learning could also transform the nation's teacher labor markets in the process. Emerging patterns in online-learning enrollments suggest that districts are already using online courses to fill their demand for teachers when the traditional disaggregated teacher supply cannot meet specific needs. It is no coincidence that online learning has grown the most to serve content area, grade level, and geographic shortages. Looking first to subject area shortages, a survey of school districts across the United States found that, by 2007, their number one reason for offering an online-learning option was to provide subject areas that could otherwise not be staffed.[43] This same study went on to find that 73 percent of students taking online classes were in secondary school (a response to grade-level shortages) and that these courses were most prevalent in small rural districts (a means of accommodating geography-specific teacher vacancies).[44]

As additional research produces similar findings,[45] it is increasingly clear that districts use online learning to fill the gaps from specific types of teacher shortages. Additionally, if managed appropriately, online learning could address questions of declining teacher quality. According to an OECD report published in 2004, initiatives that make teacher employment terms more flexible have proven to be the best means of attracting and retaining high-quality educators.[46] Traditional and online classes both provide a space for connecting teachers and students, but the latter does so with far more of the flexibility that highly talented professionals desire: in online courses, students in any subject area at any grade level can connect with an appropriate teacher from anywhere in the country. Thus, although online learning has not raised teacher pay, it could still ameliorate the relatively uncompetitive position of the teaching profession by providing more freedom to highly talented professionals considering the field.

Schools are using online learning to fill positions where shortages would otherwise force them to be nonconsumers—the first signs of a future disruption.

To be sure, simply making the field more attractive to talented individuals would not immediately solve districts' staffing woes. Among other reasons, districts do not presently see online learning as being as good a conduit as the traditional classroom for student-teacher interactions. That said, the online-learning use-patterns mentioned above suggest that they do see it as a good enough alternative when the right teacher cannot be matched with their students directly. Put in the language of disruptive innovation, online learning offers districts a solution in the subjects, grade levels, and geographies where teacher shortages would otherwise force them to be nonconsumers of teacher labor. As online learning continues to improve, disruptive innovation theory predicts that districts will eventually adopt them to fill broader quality concerns (the fourth type of teacher shortage) and, ultimately, to supplant traditional staffing methods altogether.[47]

Thus, in the same way that online learning unbundles the education experience to make it more flexible for students, it also unbundles the teacher labor market to make it more flexible for teachers and districts. On the supply side, teachers no longer have to serve a single district or live within driving distance of any school where they are employed. On the demand side, districts are no longer compelled to hire only those local teachers for whom their schools have a full-time (or even sufficient part-time) need. Rather, online learning can allow a district to contract with any teacher in the country to provide services to as few or as many students as they see fit. In this way, online learning gives districts the opportunity to overcome the coordination problems of traditional teacher labor systems.

POLICY RECOMMENDATIONS

Taken together, these improvements could disrupt the outdated methods currently used for matching teachers with schools to create instead the fluid, highly productive labor marketplace that has propelled rival industries into the 21st century. To unlock such potential, however, policymakers should legislate around online learning in new ways to prioritize technologies that make the teaching profession more flexible and productive.

Increased flexibility and productivity will modernize the teacher labor market and resolve shortages in two ways. First, this focus fills teacher vacancies in the short term by promoting greater use of the existing labor supply. Second, it improves teacher quality in the long term by making K–12 education more attractive to highly skilled professionals; similar to the OECD report referenced in the previous section, findings from the Opportunity Culture Initiative suggest that increased flexibility and productivity help to recruit and retain the next generation of highly skilled teachers by offering them more freedom around location, more career advancement within the classroom, greater salary potential and, ultimately, more respect as members of the teaching profession.[48]

Current outcomes and next steps

State policymakers have a mixed record of promoting flexibility and productivity through online-learning legislation. On the one hand, the increasing number of schools that use online learning to meet their subject-, grade level-, and geography-specific needs suggests that states have made considerable progress in providing the flexibility required for districts to fill teacher vacancies. On the other hand, online-learning options have not been able to achieve their full impact on market flexibility in states where legislative restrictions limit online options by provider, school, grade level, and/or the number of courses allowed per student.[49] Similarly, online learning has not impacted teacher productivity to its full potential, as state-mandated seat-time requirements still limit the ways in which an online-learning teacher can personalize student learning in some states.

Online learning has the potential to disrupt the nation's teacher labor markets, and policymakers can expedite this process by removing outdated legal constraints. Moving forward, officials committed to transforming the reach and impact of the nation's teacher supply through online-learning opportunities should prioritize three specific initiatives.

First, state policymakers should **develop "Course Access" programs,**[50] which allow students to be enrolled in a combination of traditional and online settings. In Louisiana, for example, districts can use state funding to enroll students in online-learning courses through the state's Course Access program, called the Supplemental Course Academy (SCA). In 2014, SCA legislation poured an additional $7.5 million into course access programming to provide online

courses with roughly the same per-student funding as traditional brick-and-mortar programs—$393 per student enrollment, compared to $492 per student enrollment, respectively.[51] As a result, enrollment in online courses grew eightfold within the first year of the SCA program alone.[52]

Such promising results demonstrate the great potential of Course Access programs, and it is important to note that Louisiana is not the only state to have developed this type of initiative. As of October 2014, Florida, Michigan, Minnesota, Texas, Utah, and Wisconsin all had established some form of a statewide Course Access program, and many other states have introduced similar types of legislation.[53] As Course Access becomes increasingly widespread, it will allow online learning to promote flexibility by giving districts access to highly qualified teachers across a wide array of courses, regardless of their geographic location. Additionally, these programs could allow high-quality teachers to increase their reach (and compensation) without leaving the classroom. In these ways, Course Access may play a critical role in redistributing the reach of the nation's teacher labor supply.

Policies that enable Course Access programs and/or remove seat-time requirements will allow online learning to make K–12 education more flexible and productive.

Second, state officials should **remove seat-time requirements** for online and blended learning, as well as any other policies that set unnecessarily rigid regulations around the time that teachers spend with their students; in place of such policies, content and skill-mastery requirements should be further developed for online- and blended-learning courses.

In this context, teachers can use software to collect and analyze real-time information about student growth in specific skill and content areas, thus allowing them to monitor students as they move through the curriculum at their own pace. Similarly, this software could allow online-learning funding models to track outcomes (successful course mastery) rather than inputs (the number of students in that class). By increasing the flexibility of students' and teachers' time while also realigning financial incentives, policymakers could use content and skill-mastery requirements to reward innovation in blended and online classes.

Nearly 40 states have already taken steps to eliminate seat-time regulations for online-learning courses[54] and have opted to put content-mastery requirements in their place. If leveraged in conjunction with the appropriate new technologies and learning models, this mastery-based approach could increase teacher productivity in blended and online classrooms in two ways: first, it would incentivize schools to focus on student outcomes rather than inputs; and second, it

Beyond policy creation, officials should develop resources that empower school leaders to align technology decisions with a broader teacher labor strategy.

would allow teachers the flexibility and resources required to achieve these productivity-based ends.

Finally, although the first two recommendations target formal legislative policy, there also is a need for more informal guidance and support around the ways in which schools and districts evaluate potential technology solutions. As mentioned previously, U.S. schools have invested roughly $100 billion in K–12 education technology with relatively few notable improvements in student outcomes or cost savings to offset the investment. According to a recent interview with Allison Powell, a vice president of the International Association for K–12 Online Learning (iNACOL), these investments have produced lackluster results largely because education leaders have not developed a clear strategy for focused selection. "I get five or six calls a day from different principals or superintendents saying, 'I bought all this technology, now what?'" she said. "They're buying the technology without thinking through what their specific learning goals and outcomes are."[55]

Districts and schools seek to use technology effectively, but they typically do not have the time or expertise to develop guiding criteria on their own. In light of this challenge, officials should **develop rigorous metrics** for evaluating K–12 technology options that education leaders can use to ensure that their finite resources are invested wisely. Such metrics should not be enshrined in policy or used to regulate technology purchases; instead, they should serve as the flexible resource school and district leaders need to identify online- and blended-learning technologies that grow student access to high-quality teachers' time and expertise.

These metrics should enable education leaders to weigh easily the trade-offs between various technology options. A school leader struggling with teacher shortages, for example, should be able to use this resource to determine that electronic white boards may not be a worthwhile investment for her school because this technology would not give students more access to expert teachers. Alternatively, the evaluation metrics should also allow her to see that investing the same amount of money in a set of computers and high-speed Internet service could be a powerful investment for her school, insofar as students could use these resources to take courses online with a high-quality online teacher.

Again, it is important to stress that these new metrics will only be useful if they serve as a flexible support rather than a rigid constraint. Though all education leaders should evaluate education technology based on its potential to make teacher labor more flexible and productive, the specific metrics for doing so will vary depending on local resources and needs. For example, education

leaders in an isolated rural community may prioritize technologies that fill teacher shortages by connecting students with educators from other parts of the country, whereas those serving a more metropolitan community with a large English Language Learner (ELL) population may prioritize technologies that help students practice basic vocabulary and grammar on their own and thus free up the school's existing teacher labor to provide more specialized services. Metrics that become too rigid or prescriptive will only undercut school and district leaders' abilities to discern such particular needs.

Whatever the needs, state-level officials should develop broad technology investment guidelines that help superintendents and principals to make technology purchases with a clear teacher labor strategy in mind. By developing productivity-focused selection criteria that inform and support these leaders, policymakers can help to ensure that their finite resources are invested efficiently and effectively and with a specific teacher labor outcome in mind.

CONCLUSION

Rapid improvement has placed online learning on a path to disrupt the traditional K–12 experience. Though important in its own right, a more careful consideration of when and how this innovation has penetrated K–12 education also reveals evidence of a second form of disruption, one that moves beyond classrooms and into the labor markets behind them. With time, these changes could modernize the nation's antiquated systems for filling teacher vacancies, but only if policymakers replace outdated legislative barriers with more pragmatic guidelines for determining when, why, and how technological investments should be made.

This transition will be difficult at times, as the many relationships between teacher supply, online learning, and student growth are not yet wholly clear. Moving forward, policymakers will need to develop rigorous metrics for monitoring the direct and indirect effects online learning has on shortages. Additionally, further research will be required to determine when and how online learning can be used in conjunction with other teacher recruitment and retention policies to create a more comprehensive approach to filling teacher vacancies.

By exploring carefully these and other related issues, education reformers can begin to redefine the nation's teacher labor markets and, by extension, what it means to be a member of the teaching profession. This shift will prove critical to the future of schooling, as it could hold the key to drawing more highly skilled professionals back into the field. In so doing, online learning could ensure that all children have the access they need to the teachers they deserve, regardless of their age or geographic location.

NOTES

[1] As will be discussed later in the paper, teachers earn a significantly smaller wage than individuals in professions requiring comparable skill. Academic researchers have found empirical evidence that this imbalance lowers the flow of highly qualified individuals into the teaching profession. See Andrew Leigh, "Teacher Pay and Teacher Aptitude," *Economics of Education Review,* June 2012, 31 (3), pp. 41–53.

[2] The roughly 6 million individuals qualified to teach but not currently serving as such typically could not find work as a teacher, chose to pursue another profession, or chose to leave the workforce entirely. See Frederick M. Hess, "Revitalizing Teacher Education by Revisiting Our Assumptions About Teaching," *Journal of Teacher Education,* November/December 2009, 60 (5), pp. 450–457.

[3] Richard J. Murnane and Jennifer L. Steele, "What is the Problem? The Challenge of Providing Effective Teachers for All Children," *The Future of Children,* Spring 2007, 17 (1), pp. 15–43.

[4] David H. Monk, "Recruiting and Retaining High-Quality Teachers in Rural Areas," *The Future of Children,* Spring 2007, 17 (1), pp. 155–174.

[5] Monk, pp. 155–174.

[6] Caroline M. Hoxby and Andrew Leigh, "Pulled Away or Pushed Out? Explaining the Decline of Teacher Aptitude in the United States," *American Economic Review*, May 2004, 94 (2), pp. 236–240.

[7] Carla McClure and Cynthia Reeves, "Rural Teacher Recruitment and Retention Review of the Research and Practice Literature," Appalachia Educational Library, November 2004, http://files.eric.ed.gov/fulltext/ED484967.pdf.

[8] Sarah E. Turner, "The Training of Teachers: The Changing Degree Output in the Area of Education," paper presented at the 1998 Association for Public Policy Analysis and Management Meeting in New York, N.Y.

[9] Turner.

[10] These statistics compare women's earnings in teaching and *all* non-teaching professions—including those that require considerably different skills and education. As we will see later in the paper, earnings in the teaching profession have also fallen considerably relative to earnings in other comparable professions.

[11] Namely, a pair of executive orders issued in April 2014 by President Barack Obama promoted gender wage parity and prohibited retaliation against employees demanding transparency about gender wage parity. Because the teacher workforce is still overwhelmingly female, the gender wage gap is smaller and so too will be the increase in pay for female teachers.

[12] Frederick Flyer and Sherwin Rosen, "The New Economics of Teachers and Education," *Journal of Labor Economics,* January 1997, 15 (S1), pp. 104–139.

[13] We have maintained a surplus of teachers despite this fall because the total share of Americans earning a college degree has risen considerably; according to the National Center for Education Statistics, these rates have risen from only six percent in 1950 to 34 percent in 2013. For more on these growth rates, see Sandy Baum, Jennifer Ma, and Kathleen Payea, "Education Pays 2013: The Benefits of Higher Education for Individuals and Society," The College Board, 2013, http://trends.collegeboard.org/sites/default/files/education-pays-2013-full-report.pdf.

[14] For example, a nationwide principals' survey in the 1999–2000 school year found that 75 percent of schools experienced difficulties in filling special education teacher vacancies and 77 percent struggled to fill math vacancies whereas only 30 percent had any trouble in filling social studies vacancies. See Murnane and Steele, pp. 15–43.

[15] Teachers seeking certification to teach in secondary schools must, among other things, pass the PRAXIS exams for their content area; in contrast, elementary school teachers take only those exams that relate to their understanding of the practice of primary education (not to a particular subject area).

[16] Sean P. Corcoran, William N. Evans, and Robert M. Schwab, "Changing Labor-Market Opportunities for Women and the Quality of Teachers, 1957–2000." *American Economic Review,* May 2004, 94 (2), pp. 230–235. Caroline M. Hoxby and Andrew Leigh, pp. 236–240.

[17] For example, see Todd R. Stinebrickner, "Serially Correlated Wages in a Dynamic, Discrete Choice Model of Teacher Attrition," The University of Western Ontario Department of Economics, November 1998, http://economics.uwo.ca/econref/WorkingPapers/researchreports/wp1998/wp9821.pdf.

[18] Murnane and Steele, pp. 15–43.

[19] Andrew Coulson, "America Has Too Many Teachers," *The Wall Street Journal*, July 10, 2012, http://www.wsj.com/articles/SB10001424052702303734204577465413553320588.

[20] Victor Fuchs and Diane M. Reklis, "Mathematical Achievement in Eighth Grade: Interstate and Racial Differences," National Bureau of Economic Research, June 1994, http://www.nber.org/papers/w4784.pdf.

[21] Frederick Flyer and Sherwin Rosen, "The New Economics of Teachers and Education," National Bureau of Economic Research, August 1994, http://www.nber.org/papers/w4828.pdf.

[22] For a more thorough explanation of the link between technology and employee productivity in fields similar to teaching, see Hsihui Chang, Jengfang Chen, Rong-Ruey Duh, and Shu-Hsing Li, "Productivity Growth in the Public Accounting Industry: The Roles of Information Technology and Human Capital," *AUDITING: A Journal of Practice & Theory*, 2011, 30 (1), pp. 21–48.

[23] Shawna Grosskopf, Kathy J. Hayes, and Lori L. Taylor, "Efficiency in Education: Research and Implications," *Applied Economic Perspectives and Policy*, May 2014, 36 (2), pp. 175–210.

[24] Eric A. Hanushek, "The Economics of Schooling: Production and Efficiency in Public Schools," *Journal of Economic Literature*, September 1986, 49 (3), pp. 1141–1177.

[25] Sylvia A. Allegretto, Sean P. Corcoran, and Lawrence R. Mishel, *How Does Teacher Pay Compare? Methodological Challenges and Answers* (Washington, D.C.: Economic Policy Institute, August 2004).

[26] For a discussion of how rising productivity is linked to rising wages, see James Sherk, "Productivity and Compensation: Growing Together," Heritage Foundation *Backgrounder* No. 2825, July 17, 2013, http://www.heritage.org/research/reports/2013/07/productivity-and-compensation-growing-together.

[27] Darius Lakdawalla, "Quantity over Quality," *Education Next,* Fall 2002, 2 (3), pp. 66–72.

[28] Sean Kennedy, "School Tech Plan Unlikely to Help Blended Learning," Lexington Institute, May 9, 2013, http://www.lexingtoninstitute.org/school-tech-plan-unlikely-to-help-blended-learning/.

[29] William H. Baugh and Joe A. Stone, "Mobility and Wage Equilibration in the Educator Labor Market," *Economics of Education Review,* Summer 1982, 2 (3), pp. 253–274.

[30] Mallory Dwinal, "Teach For America and rural Southern teacher labour supply: An exploratory case study of Teach For America as a supplement to teacher labour policies in the Mississippi-Arkansas Delta from 2008 to 2010," Diss. Oxford University, 2012.

[31] Solomon William Polachek, "Occupational Self-Selection: A Human Capital Approach to Sex Differences in Occupational Structure," *The Review of Economics and Statistics,* February 1981, 63 (1), pp. 60–69.

[32] Michelle J. Budig and Paula England, "The Wage Penalty for Motherhood," *American Sociological Review,* April 2001, 66 (2), pp. 204–225.

[33] Michelle Reininger, "Hometown Disadvantage? It Depends on Where You're From Teachers' Location Preferences and the Implications for Staffing Schools," *Educational Evaluation and Policy Analysis*, June 2012, 34 (2), pp. 127–145.

[34] Darius Lakdawalla, "The Declining Quality of Teachers," NBER Working Paper No. 8263, National Bureau of Economic Research, April 2001, http://www.nber.org/papers/w8263.pdf.

[35] Dwinal.

[36] This is not to say that they should not try to grow the teacher labor supply, only that they should do so in a way that targets precisely the disaggregated supplies that need to be grown and in a way that allows those additional teachers to be matched in the areas where they are required.

[37] For a detailed account of this evolution within the Florida Virtual School, the first statewide, Internet-based public school in the United States, see Katherine Mackey and Michael B. Horn, "Florida Virtual School: Building the first statewide, Internet-based public high school," Innosight Institute, October 2009, http://www.christenseninstitute.org/wp-content/uploads/2013/04/Florida-Virtual-School.pdf.

[38] "Growth in K–12 Online School," Connections Academy, 2013, http://www.connectionsacademy.com/resources/infographics/k-12-online-school-growth.aspx.

[39] Clayton M. Christensen, Michael B. Horn, and Curtis W. Johnson, *Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns* (New York: McGraw-Hill, 2008).

[40] "Convenient" in the sense that students can take these courses at any time, from any place with an Internet connection, and at whatever pace they need.

[41] According to a 2014 report by the Boston Consulting Group, instructional materials and delivery in the traditional classroom cost 38 percent of districts' total spending, whereas online-learning registration fees cost only a fraction of that. See Allison Bailey, Peter Davis, Tyce Henry, and Kristen Loureiro, "The Digital Disruption of Education Publishing," The Boston Consulting Group, January 30, 2014, https://www.bcgperspectives.com/content/articles/education_media_entertainment_digital_disruption_education_publishing/?chapter=4.

[42] Blended models use some combination of brick-and-mortar classroom teaching with online-learning material to educate students.

[43] Picciano and Seaman.

[44] Picciano and Seaman.

[45] For example, see Wallace H. Hannum, Matthew J. Irvin, Jonathan B. Banks, and Thomas W. Farmer, "Distance Education Use in Rural Schools," *Journal of Research in Rural Education*, 2009, 24 (3), pp. 1–15; Michael K. Barbour and Thomas C. Reeves, "The reality of virtual schools: A review of the literature," *Computers & Education,* 2009, 52 (2), pp. 402–416; and Barbara Means, Yukie Toyama, Robert F. Murphy, and Marianne Baki, "The Effectiveness of Online and Blended Learning: A Meta-Analysis of the Empirical Literature," *Teachers College Record*, 2013, 115 (3), pp. 1–47.

[46] OECD Education Committee, "Teachers Matter: Attracting, Developing and Retaining Effective Teachers," OECD, June 28, 2005.

[47] In this sense, "traditional staffing methods" are the ways in which districts typically find and hire their teachers. At present, this requires limiting the search to traditionally or alternatively certified teachers who are already living in the area or willing to move there to take a full-time position within the district.

[48] For a more thorough discussion of the links between flexibility, productivity, and a high-quality teacher supply, see http://www.opportunityculture.org.

[49] John Watson, Butch Gemin, Jennifer Ryan, and Matthew Wicks, "Keeping Pace with K–12 Online Learning: An Annual Review of State-Level Policy and Practice, 2009," Evergreen Education Group, 2009, http://www.kpk12.com/wp-content/uploads/KeepingPace09-fullreport.pdf.

[50] Digital Learning Now defines Course Access as follows: "Regardless of where they live, students have access to a menu of academic and career/technical courses that have been vetted for quality and are online, in-person, or some combination thereof. The course providers can include non-profit organizations, individual teachers, and education software providers. They offer students rigorous classes for course credit or industry certification, aligned to state standards. All course providers are held accountable for making sure students succeed. Students still attend their local schools where they can continue to learn from their schools' teachers…" See "Course Access Statement of Principles," Clayton Christensen Institute, Digital Learning Now, Thomas B. Fordham Institute, and iNACOL, July 16, 2014, http://digitallearningnow.com/news/blog/course-access-statement-principles.

[51] The $393 was derived by dividing the $7.5 million SCA funding by 19,068, the number of SCA registrations reported by the Louisiana Department of Education as of January 7, 2015. In contrast, the $442 was estimated by using state funding data from a National Center for Education Statistics report. The report finds that schools in Louisiana receive $6,288 per student for instruction (out of the $10,799 total per-pupil allotment); the government contributes approximately 42 percent of this amount. Dividing that share ($2,653) by the minimum six credits Louisiana state law requires students to complete each year, we come to an average state funding of $442 per student enrollment in each one-credit course. For details on both, see: "Course Choice Funding Leads to Eight-Fold Increase in Enrollment," Louisiana Department of Education, January 7, 2015, http://www.louisianabelieves.com/newsroom/news-releases/2015/01/07/course-choice-funding-leads-to-eight-fold-increase-in-enrollment. "Revenues and Expenditures for Public Elementary and Secondary Education: School Year 2010–11(Fiscal Year 2011)," National Center for Education Statistics, July 2013, http://nces.ed.gov/pubs2013/2013342.pdf.

[52] Louisiana Department of Education.

[53] For further information, see Maria Worthen and Susan Patrick, "Course Access: Equitable Opportunities for College and Career Ready Students," iNACOL, October 2014, https://www.inacol.org/wp-content/uploads/2014/10/iNACOL-Course-Access-Equitable-Opportunities-for-College-and-Career-Ready-Students.pdf.

[54] For a deeper exploration of which states are eliminating seat-time requirements and in what ways, see "State Strategies for Awarding Credit to Support Student Learning," National Governors Association, http://www.edweek.org/media/23biz-state-1202educreditbrief.pdf.

[55] Ross Brenneman, "Before Buying Technology, Asking 'Why?'" *Education Week Teacher,* June 18, 2014, http://www.edweek.org/tm/articles/2014/06/18/gp-definitions.html.

About the Institute

The Clayton Christensen Institute for Disruptive Innovation is a nonprofit, nonpartisan think tank dedicated to improving the world through disruptive innovation. Founded on the theories of Harvard professor Clayton M. Christensen, the Institute offers a unique framework for understanding many of society's most pressing problems. Its mission is ambitious but clear: work to shape and elevate the conversation surrounding these issues through rigorous research and public outreach. With an initial focus on education and health care, the Institute is redefining the way policymakers, community leaders, and innovators address the problems of our day by distilling and promoting the transformational power of disruptive innovation.

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