



Is there a national teacher shortage? A systematic examination of reports of teacher shortages in the United States

Tuan D. Nguyen
Kansas State University

Chanh B. Lam
Kansas State University

Paul Bruno
University of Illinois at
Urbana-Champaign

Teachers are critical to student learning, but adequately staffing classrooms has been challenging in many parts of the country. Even though teacher shortages are being reported across the U.S., teacher shortages are poorly understood. Determining and addressing teacher shortages is difficult due to the lack of data. Neither the federal government nor the majority of states have provided sufficient information on teacher shortages. To address this gap, we systematically examine news reports, department of education data, and publicly-available information on teacher shortages for every state in the U.S. We find there are at least 36,000 vacant positions along with at least 163,000 positions being held by underqualified teachers, both of which are conservative estimates of the extent of teacher shortages nationally. We discuss the implications of our findings for a robust data system, including more specific and consistent reporting of shortage, as well as implications for teacher preparation and education in the United States.

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**Is there a national teacher shortage?
A systematic examination of reports of teacher shortages in the United States**

Tuan D. Nguyen¹, Chanh B. Lam¹, and Paul Bruno²

¹Kansas State University

²University of Illinois at Urbana-Champaign

+Corresponding author: nguyetd1@ksu.edu

Abstract

Teachers are critical to student learning, but adequately staffing classrooms has been challenging in many parts of the country. Even though teacher shortages are being reported across the U.S., teacher shortages are poorly understood. Determining and addressing teacher shortages is difficult due to the lack of data. Neither the federal government nor the majority of states have provided sufficient information on teacher shortages. To address this gap, we systematically examine news reports, department of education data, and publicly-available information on teacher shortages for every state in the U.S. We find there are at least 36,000 vacant positions along with at least 163,000 positions being held by underqualified teachers, both of which are conservative estimates of the extent of teacher shortages nationally. We discuss the implications of our findings for a robust data system, including more specific and consistent reporting of shortage, as well as implications for teacher preparation and education in the United States.

Keywords: teacher shortage, teacher vacancy, teacher qualification,

Introduction

As teachers are critical to student learning, adequately staffing classrooms with highly qualified teachers has been at the forefront of concerns in education for decades (Carver-Thomas & Darling-Hammond, 2017; Ingersoll, 2003). However, recent news and policy reports suggest there are shortages of teachers in many parts of the country (e.g., Arizona School Personnel Administrators Association, 2021; Hall, 2021; Illinois State Board of Education, 2021; Learning Policy Institute, 2019), especially in high-need subject areas and hard-to-staff locations (Aragon, 2016; Carver-Thomas et al., 2021; García & Weiss, 2020). These shortages are thought to be related to—and driven by—falling enrollments in teacher preparation programs (Will, 2022). In response to staffing difficulties, states and districts have issued emergency and probationary certificates, hired teachers who are not certified to teach in their area, cancelled courses, filled teaching positions with substitute teachers, and even left positions open throughout the school year (Aragon, 2016; Castro et al., 2018; Darling-Hammond et al., 2016). Moreover, with the increasing staffing difficulties due to the COVID-19 pandemic, some states have substantially lowered requirements for certified and substitute teacher qualifications, called on retired teachers to come back, used administrators for teaching duties, asked parents to assist, and even put the National Guard in the classroom (Jung, 2020; Poff, 2022; Sandoval, 2022; Wiedmann, 2022).

With many positions either left vacant or filled with less qualified or uncertified candidates, teacher shortages are likely detrimental for students and schools. In particular, schools with consistent teacher shortages are more likely to have lower levels of student achievement and less positive student outcomes overall (Castro et al., 2018; García & Weiss, 2019a). Additionally, since underprepared and less qualified teachers are more likely to turn over (Nguyen et al., 2020), these schools are more likely to have to spend more time and resources to

replace their short-term hires (Aragon, 2016; Carver-Thomas & Darling-Hammond, 2017; Castro et al., 2018; García & Weiss, 2019; Ingersoll, 2003; Ronfeldt et al., 2013).

Such severe impacts of teacher shortages on both schools and students have prompted substantial research around teacher preparation pipelines as well as recruitment and retention policies (e.g., Cowan et al., 2016; Darling-Hammond, 1984, 1997; García & Weiss, 2020; Glazerman et al., 2013; Goldhaber et al., 2015; Hussar, 1999; Ingersoll, 2003; Ingersoll et al., 2017, 2019; Podolsky et al., 2016). These concerns have also driven concerns about declines in the production of new teachers, fueling calls to bolster the supply of teachers (Dean, 2022; Will, 2019, 2022). However, teacher shortages are still poorly understood (García & Weiss, 2020), and it remains unclear whether there is a shortfall of teachers on the national scale or if shortages are localized—a key component of the current debate around teacher shortages (Cowan et al., 2016; Loewenberg, 2016; Sutchter et al., 2019). Some have argued that there has been a national teacher shortage and that it is getting worse over time (e.g., García & Weiss, 2020; Sutchter et al., 2016a), while others have posited that there is not a nationwide shortage but rather an imbalanced distribution of teacher candidates across districts, states, and subject areas (e.g., Cowan et al., 2016; Goldhaber & Theobald, 2016). The difference between the two perspectives is important as it directs diagnoses of and solutions to the long-lasting staffing issue that many schools in the country have been facing. For example, policy efforts to increase the rate at which workers are willing to work in teaching jobs, and thus to complete teacher preparation programs, may need to look very different depending on whether they need to address a generalized teacher shortage or to target specific kinds of teachers needed in specific kinds of school (Cowan et al., 2016; Goldhaber & Theobald, 2016). In other words, whether scholars and policymakers should

focus on increasing the supply of teachers to meet the rising demand or by addressing location-specific and subject-specific supply problems remains a crucial question.

One of the primary challenges in this work is the lack of data, especially at the national level (Aldeman, 2016b; García & Weiss, 2019a; Ingersoll, 2003). To date, neither the federal government nor the majority of states collects and provides sufficient information on the extent of teacher shortages in every state or nationally (Walsh, 2016). Some states keep track of their teaching force, but not all track how many teachers their classrooms need each year or how many positions are left unfilled, and such information, if available, is scant and usually not available longitudinally (Education Commission of the States, 2019; Learning Policy Institute, 2017). The only estimate of state-by-state shortages comes from a report from the Learning Policy Institute (Sutcher et al., 2016a), but this report is outdated and includes unfilled vacancies from just eight states. The U.S. Department of Education does collect and report the subject areas in which states report teacher shortages. However, they do not indicate the magnitude of shortages or even define “shortage” precisely or consistently (U.S. Department of Education, 2022). Due to the Covid-19 pandemic, addressing teacher shortages has become more urgent now than ever, as it is becoming more difficult for districts to find candidates to fill vacancies, potentially undermining efforts to expand their staffs and accelerate student learning to make up for disrupted education (e.g., Berman, 2021; Bisaha, 2020; Chacko, 2021; Martin, 2021; Singer, 2021; Stuart, 2021).

Thus, even though there are many policy and news reports of teacher shortages, these often focus on specific districts or states, and as of yet, there has not been a concerted and systematic effort to examine what teacher shortages look like nationally. This both hampers research into the teacher shortages and complicates potential policy efforts to addressing them, for instance by making it difficult to know whether and how to encourage prospective teachers to

complete teacher preparation programs and take jobs in schools experiencing shortages. To address this gap, we have systematically examined news reports, department of education websites and presentations, and we have documented every publicly-available source of information on statewide teacher shortage for every state in the U.S. Additionally, we have also contacted state departments for their vacancy/shortage numbers when they are not available online or in print. We then merge these vacancy and underqualification information with the Common Core of Data, the Civil Rights Data Collection, and Title II data to create a unique dataset to provide a comprehensive picture of teacher shortages across the U.S. We hope this work can be used to inform policymakers and researchers of the extent to which states are experiencing teacher shortages and what we can do to address this challenge for the future of public education.

Background

The alarm of a national crisis

Recently the discussion of teacher shortage as a national crisis began in earnest with the 2016 Learning Policy Institute (LPI) report (Sutcher et al., 2016a). Since its release, there has been intense attention to the issue of teacher shortage and related problems in the teacher pipeline, including teacher recruitment, retention, and attrition (Dee & Goldhaber, 2017; García & Weiss, 2019a). Relying on historical data, projections of educational statistics, and national and local trends that drive supply and demand in teacher labor markets, the LPI team estimated a nationwide shortage of 64,000 teachers as of the 2015-2016 school year, projected an annual shortfall of 112,000 teachers across the country by 2018, and predicted a persistent supply-and-demand gap at that level thereafter (Sutcher et al., 2016a). In their 2017 review of state teacher workforce reports, the LPI presented statistics in support of their shortage estimates: about 6,400

teaching vacancies from eight states of the U.S., 87,000 instructional positions filled by underqualified teachers across 36 states including those eight, and a minimum estimate of 109,000 underqualified teachers in all 50 U.S. states plus D.C. (Learning Policy Institute, 2017). This 2016-2017 figure of 109,000 underqualified teachers was deemed by the LPI authors to match their shortage projection of 112,000 from the 2016 report (Sutcher et al., 2019).

Following the report, researchers have examined the severity of teacher shortages in multiple ways, such as by documenting declines in teacher training program enrollments across the country (Partelow, 2019), increases in annual shares of schools reporting instructional vacancies, struggling to staff their classrooms despite active recruitment efforts, and leaving their instructional positions open throughout the school year (García & Weiss, 2019b). The portions of under-qualified teachers, alternatively certified teachers, and teachers who taught out-of-field have increased over time and are disproportionately concentrated in high-poverty schools (Bettini et al., 2022; García & Weiss, 2019a; Nguyen & Redding, 2018).

The contentions and on-going debate

There were, however, disagreements about whether there is a national teacher shortage. This included at least two critiques of LPI's reports. First, critics targeted the sensitivity of LPI's use of a 15.3-to-1 student-teacher ratio to model demand in the national teacher labor market. The use of this value was deemed impractical as the expectation to return the nation's classrooms to pre-recession conditions—specifically by reducing the current 16:1 student-teacher ratio to 15.3:1—may not be realistic (Antonucci, 2016). Modeling teacher demand with this 16:1 student-teacher ratio, critics asserted, would wipe out the LPI's 2018 teacher shortage estimate (120,000) by more than 100,000 positions (Goldhaber & Theobald, 2016; Walsh, 2016). The LPI team, in response, argued that shifting this parameter would not greatly affect their estimates as

they had modeled changes in student-teacher ratio to occur over eight years instead of a single year, and there had been heavier-weighted factors within the model, especially the average rate of annual teacher attrition nationwide (Sutcher et al., 2016b).

The second, and arguably more critical, criticism of LPI's work focused on the characterization of the national teacher supply. To start, critics asserted while recent figures showed declines in teacher education enrollment, the U.S. had produced more potential candidates than needed in the overall market for decades (Goldhaber & Theobald, 2016). Annual national numbers of education graduates had steadily increased since the mid-1980s, and over the last four decades only half of graduates entered teaching positions upon graduating (Cowan et al., 2016). With the increasing size of K-12 public school teacher workforce and a decline in the nationwide student-teacher ratio from over 18-to-1 to around 16-to-1 during this time, critics further argued that, as far as the overall teacher labor market was concerned, one could plausibly argue that there was a surplus of teachers instead of a shortage (Aldeman, 2016a; Antonucci, 2016). Pushing back on these arguments, the LPI team contended that including all education graduates in the teacher supply is misleading because in practice the teacher supply is the pool of "qualified individuals willing to offer their services under prevailing wages and conditions" (Sutcher et al., 2016a, p. 10). By this definition, the team projected teacher supply in the overall market using historical entry (and reentry) rates into the workforce, including that of newly-minted and former teachers (Sutcher et al., 2016b). The use of these (re)entry rates, however, was also deemed problematic, because the annual supply of teachers should be estimated using the number of potential candidates holding a teaching credential who can fill a suitable teaching position (Goldhaber & Theobald, 2016). This is because an entry rate into the workforce depends

on the demand for teachers at a given time; estimating supply sizes using historical (re)entry rates independently from corresponding demands could lead to serious mis-estimation.

Despite discrepancies, there is one point that both sides acknowledged: teacher supply and demand on the national scale are challenging to characterize and project simply because there is not a national teacher labor market (Goldhaber & Theobald, 2016). There may be as many teacher labor markets as there are states within the U.S. (Sutcher et al., 2016b), and potentially many more when we consider the different grade levels, subject areas, or geographical areas within a state. National-scale estimates of teacher supply, either by accounting for the whole pool of education graduates and teaching-credentialed individuals or only the portion currently employed with historical entry and re-entry rates are therefore prone to flaws. Both sides agree there are teacher shortages across the U.S., and each of which is subject-area specific and local in nature (Cowan et al., 2016; Sutcher et al., 2019). Their difference, however, is about the approaches to understand and address the issue. While one side focuses on factors general to the teaching profession that decrease teacher preparation enrollment, willingness to teach after being certified, and intention to leave teaching positions (García & Weiss, 2020; Sutcher et al., 2016b, 2019), the other emphasizes imbalanced distributions of teachers over geographical locations, schools with specific characteristics, perennially difficult-to-staff subject areas, and policy barriers between states and disciplines that impede teacher movement and constrain the labor market (Aragon, 2016; Cowan et al., 2016; Loewenberg, 2016; Walsh, 2016).

Adjudicating these debates is difficult because there is scant evidence on teacher supply problems across the country, and the evidence that exists is often difficult to interpret. For example, according to the U.S. Department of Education (2022), 41 states and D.C. are reporting

teacher shortages in at least one subject area or grade level. However, this does not provide any information on the magnitude of the shortage, or even how “shortage” is defined, only that some actors or agency report a shortage of teachers in a given area. Similar considerations and definitional ambiguity complicate our understanding of teacher shortages in the U.S. To address this, we discuss the main definitions of teacher shortage and how we operationalize shortages in our study.

Defining teacher shortage

As defined by the U.S. Department of Education (2017), a teacher shortage area can be operationalized in three ways: (1) teaching positions that are unfilled; (2) teaching positions that are filled by teachers who are certified by irregular, provisional, temporary, or emergency certification; and (3) teaching positions that are filled by teachers who are certified, but who are teaching in academic subject areas other than their area of preparation. Of note, these definitions refer to the status of teaching positions after the start of a school year. Specifically, a teaching position that is still vacant into a school year despite the school’s active recruitment effort is an unfilled position. In this same vein, a teaching position filled by a teacher who is not fully certified by the respective state’s standards, or certified but in a subject area other the respective teaching assignment is referred to as an underqualified hire.

While all three definitions of teacher shortage have their own merits, our main analysis focuses on the first definition of teacher shortage for three reasons. First, we want to take a conservative approach to examine teacher shortages, so the consideration of unfilled teaching positions gives us a conservative estimate of what teacher shortages look like in the United States. Second, since credential requirements vary across states, the numbers for the second and third definitions are less comparable across states relative to unfilled vacant positions. Third,

some states, such as Louisiana and Alaska, can fill vacant positions in various alternative ways, including with less-than-fully certified teachers, teachers teaching out-of-field, or by importing teachers from overseas (Carver-Thomas & Darling-Hammond, 2017; Louisiana Department of Education, 2021; State of Alaska Office of the Governor, 2022).

When we consider teacher shortage at the state level, it constitutes the total number of vacant positions that schools in the state are unable to fill. This definition of teacher shortage represents, in some ways, the baseline of teacher shortage as states are unable to fill them even with non-standard certification and using teachers who are teaching outside their area of preparation. This inability to fill positions corresponds perhaps most clearly to the idea of a “shortage.”

From this definition of teacher shortage, we can then estimate the number of vacant teaching positions for every state in the United States. We note that we are agnostic as to what would precisely constitute a national teacher shortage, particularly in light of the lack of consensus as discussed previously. From our perspective, the “national” teacher shortage is simply the sum of teacher shortages for every state. In other words, we provide a conservative estimate of the magnitude of the “national” teacher shortage by summing up vacant positions for each state.

Data and Method

The key challenge in measuring teacher shortage at the state level as well as the national level is that there is not a national database on the magnitude of teacher shortages. This lack of nationally representative data systems contributes to the difficulty in reaching consensus as to whether there is a national teacher shortage. We endeavor to address this challenge by painstakingly attempting to determine the number of vacant teaching positions for every state in

the United States and D.C. To do so, we take on two concurrent internet searches: (1) using a common search string to retrieve vacant teaching positions as reported by the news or by the state using Google search; and (2) by using information provided by state Departments or Boards of Education for every state provided that they exist, either via websites or correspondence directly with state officials.

In our first approach, we use the following search string: *“state name” AND (“teacher vacancies” OR “teaching vacancies” OR “teaching positions to fill” OR “teacher shortage”)* with Google Search to seek reported numbers of vacant teaching positions in the state. We conduct this search for every state between January 2021 and February 2022. For example, to search for California data, we would use the string *“California” AND (“teacher vacancies” OR “teaching vacancies” OR “teaching positions to fill” OR “teacher shortage”)*. When Google returned search results, we would go over as many sites and news reports as possible until we find the state’s vacant teaching positions in the current school year. As this information is not always available, we also collect the state’s vacant teaching positions in previous years. In instances where a total number is not provided, we would calculate from the reported vacancy, such as by school district or sometimes by subject area. We also search for estimated figures of the state’s annual teacher supply and demand, either aggregated or by subject area, and any information that is relevant to the state’s teaching force.

This Google search approach did not generate results for every state. For instance, even if a news report suggested there is a teacher shortage in a state, no specific numbers or estimates were provided. We therefore take a second approach to examine the official state education website for every state to find documents and reports that provide estimates of vacant teaching positions. If no such document could be found, we would contact one or more of the officials in

charge of vacancy and shortage data. If we did not receive a reply, we would follow up after a few weeks.

With our two-prong approach, we are able to find estimated vacant teaching positions for all but thirteen states. We then compare the reported vacancy numbers from each source to ensure they match. The references for these reports can be found in the Appendix Reference in the Supplementary Materials. When there is a disagreement in the reported numbers, such as with the news reports of Florida teacher shortage and the official state report (e.g., Golgowski, 2021), we use the official state report. As there has been substantial interest in the question of teacher shortage in the news and among policymakers, we have also endeavored to make this timely work available through a website (www.teachershortages.com). On this website, we provide a brief summary of this work and provide a state-by-state interactive map of the most current raw numbers of reported teacher vacancy as well as a relative vacancy map where we divide the number of reported vacancy by the number of students in the state to provide a more apples-to-apples comparison among states. Despite the limitations of this work which we detail next, to the best of our knowledge our work presents the most up-to-date and comprehensive data on the extent of teacher shortage for every state and nationally.

As an additional step, we leverage federal educational data including the Common Core of Data from the National Center for Education Statistics, the Civil Rights Data Collection (2018), and the Title II data collected under the Higher Education Act. We use the Common Core data to retrieve student and teacher populations, the Civil Rights data to retrieve state-level teacher qualifications, and the Title II data to examine the extent to which teacher shortages are reflective of supply-side problems. More specifically, Title II provides the annual completion numbers for teacher certification programs in each state, which then represents the number of

potential new teachers for the next school year (e.g., the 2019-2020 Title II graduate counts represent the potential 2020-2021 supply pool). We acknowledge the potential discrepancies among federal and state-specific data (i.e., our searched results), and though we attempted to match the time frames and data entries from each of these sources for every state, a perfect match is not feasible for every state. For example, the latest updates of the Common Core and Title II were released for the 2019-2020 school year, whereas many of our shortage measures were retrieved from 2020-2021 and 2021-2022. Nevertheless, being analogous to last-available data imputation, and given the critical need of interpreting shortage data in context, this is the best possible method to provide a comprehensive picture of the nation's teacher shortages.

Limitations

As mentioned, the first limitation of our study is the unavailability of data. We cannot find the numbers of vacant teacher positions for every state in the most recent school year. We also do not have evidence to confirm no vacancies exist in states where such data were unavailable. For these reasons, we choose to use the most recent available information on the teacher workforce of each state to gain insights regarding its teacher shortages, though vacancy numbers may have evolved in subsequent years. We also review multiple sources of information, including state departments of education, independent institutions, and media outlets to determine whether it has any vacant teacher positions or positions filled by underqualified individuals.

Another limitation of the study is the inconsistency between the ways teacher vacancies are defined with respect to the sources of information. For example, the Nebraska Department of Education (2020), in their teacher vacancy survey report, the term “unfilled” was used for “a position that was filled by someone other than a fully qualified teacher or a position that was left

vacant,” (p. 7) while the term “vacant” referred to “a position that was not filled at all” (p. 7). Meanwhile, the 2017 report by the Office of Public Instruction under the Montana Board of Public Education (Mohr & Furois, 2017) provides that the state had 638 full-time educator for the 2016-2017 school year, yet this figure included personnel who were not holding instructional positions, such as school counselors and support staff. When these are excluded, we are left with 328 teacher FTEs for the state’s shortage. In another case, the 2019 report by the University of Maine System Board of Trustees (Kimball et al., 2019), indicates Maine was short of 599 teacher positions for the school year 2017-2018. However, this figure is calculated by subtracting the total size of teacher demand by that of supply, which may effectively obscure shortages in some areas or schools behind surpluses in others. When the surpluses are excluded, we arrive at 689 vacant teacher positions. Relatedly, not all sources of information define their terms or indicate how their numbers have been generated. For instance, many news reports provide an estimate without a documented source of their information.

Results

Our systematic search returns at least some information on teacher shortages for all 50 states and D.C., most of which comes from the last two school years. Specifically, 19 states have shortage information for the 2021-2022 school year, 13 states have information for 2020-2021, and nine and ten states are have data dated back to the periods of 2018-2020 and 2014-2018 respectively (Figure 1). Regarding the sources, the majority of the data, 22 states (41.18%), come from news reports, while 23 (45.10%) and seven (13.73%) are reported by Departments/Boards of education and research institutions. For Massachusetts, the latest information comes from our correspondence with the Department of Education and is not documented elsewhere. Diving deeper, data for recent school years, from 2018 to 2022, are overwhelmingly provided by news

reports (Figure 2), whereas states and institutions are the majority sources for data dated back to 2014-2018, suggesting these offices lag behind news agencies in reporting teacher shortages.

[Figures 1 and 2 here]

Reports of vacancies and underqualified teachers

We report teacher vacancy, underqualified hire, the respective school year, and the primary data source in Table 1 (Appendix Table 1 provides additional details including references, descriptions of the data, and how we resolve differences for each state). To compare differences among states, we group them into three categories. Group one consists of states where vacancy and underqualification counts are found in the same school year from state-specific information sources. All but one state in this group, Oklahoma, have data from either government offices or research institutions with details on how the data have been processed, allowing us to confirm vacancy and underqualification counts. For states in group two, we find a vacancy count for only certain subjects such as math and science (e.g., Alabama), or find a count that may include underqualification (e.g., Mississippi, West Virginia), or vacancy counts provided without any further details (e.g., Delaware, Georgia). Finally, group three includes states where no vacancy number can be found or that the information is not sufficient to determine vacancy numbers (e.g., Alaska, California, Iowa). Additionally, some states in this group report contradictory information (e.g., New York, Wyoming).

[Table 1 here]

Group 1: States with clear vacancy

Among these states, Florida ranks highest with 3,911 positions being unfilled for the school year of 2021-2022 (Florida Department of Education, 2022), followed by Illinois and Arizona, respectively with 1,703 and 1,699 vacant positions in the same school year (Arizona

School Personnel Administrators Association, 2021; Illinois State Board of Education, 2021) (Figure 3). The other eight states within this group had relatively fewer vacant teacher positions. Utah, Missouri, and Nebraska report 37, 38, and 42 vacancies respectively for school years from 2021 to 2022 (Nebraska Department of Education, 2020; Missouri Department of Elementary & Secondary Education, 2021b; State of Utah Office of the Legislative Auditor General, 2021a, 2021b), while Minnesota, Colorado, Connecticut, Pennsylvania, and Oklahoma report from one to five hundreds vacant positions for school years from 2014 to 2021 (Colorado Department of Education, 2021; Connecticut State Department of Education, 2015; Eger, 2018; Minnesota Professional Educator Licensing and Standards Board, 2021; Pennsylvania Department of Education, 2018).

[Figure 3 here]

Group 2: States with less clear vacancy

Twenty-seven states belong to this category (Figure 4). Georgia is reported with the highest number of vacancy, 3,112 positions for the 2019-2020 school year (Williams, 2020), followed by Mississippi and Alabama with over 3,000 vacancies, both in 2021-2022 (Alabama Political Reporter, 2021; James, 2021). Wisconsin is the only state with vacancy count in the range 2000s (Wisconsin Policy Forum, 2021). Seven states, North Carolina, Virginia, Tennessee, Kansas, New Mexico, West Virginia, and Maryland had over 1,000 vacancies for the 2020-2021 and 2021-2022 school years (Boren, 2021; Denis, 2020; Hall, 2021; Masters, 2021; McCormick, 2021; North Carolina Teachers of Tomorrow, 2020; The Kansas City Star Editorial Board, 2021). Sixteen states are reported with under 1000 vacancy counts for school years from 2016, including 93 in Rhode Island in 2021-2022 and 980 in Indiana in 2020-2021.

[Figure 4 here]

Group 3: Unknown vacancy

In this category, most states have some information regarding their teaching force, but no firm evidence about vacancy. For instance, information on Arkansas (2017-2018), California (2018-2019), Louisiana (2019-2020), Massachusetts (2020-2021), Oregon (2015-2016), Washington (2019-2020), and Wyoming (2020-2021) suggests these states have a substantial amount of underqualified teachers, ranging from under 200 to over 20,000 positions¹ (Arkansas Department of Education, 2018; California Department of Education, 2019; Louisiana Department of Education, 2021; Lovett, 2016; Washington Office of Superintendent of Public Instruction, n.d.; *Wyoming 2020-21 Report Card*, n.d.).

In Alaska (2021-2022), even though there are no reports of vacancy, some positions are filled by international teachers (State of Alaska Office of the Governor, 2022). Meanwhile, New Hampshire has not reported teacher shortage areas to the U.S. Department of Education since the 2019-2020 school year (U.S. Department of Education, 2022), despite recent news about teacher shortages (e.g., Albertson-Grove, 2020; Green, 2022).

For New York and Ohio, the situation is more unclear, as we could not find any specific vacancy or underqualification information and there are contradictory data regarding their teaching force. News reports suggest there are teacher shortages in New York (e.g., Chacko, 2021; Rivas, 2021), yet a 2018 report by the Rockefeller Institute of Government suggests New York has not experienced a teacher shortage, rather a growing imbalance between the number of teachers and that of public school students that could potentially lead to an eventual teacher shortage (Gais et al., 2018). Meanwhile, the New York State Education Department (2019) indicates the challenge of its teaching force is about the lack of teachers of color and staffing

¹ Oregon is one of the few states with information dating back to more than 5 years, and the information for Massachusetts comes from our correspondence with their department of education.

difficulties in high-need areas, not overall shortage or retirement surges. Similarly, Ohio is reported to have increasing teacher resignation, shrinking applicant pool for teaching jobs, decreasing number of students enrolling in teacher preparation programs, but no numbers of vacancies or underqualified hires (Hawk, 2022; Jarvis, 2022; Poiner, 2021). The Ohio Department of Education has not provided any vacancy and underqualification numbers but it does report teacher shortage areas and staffing challenges (Ohio Department of Education, 2021, 2022; U.S. Department of Education, 2022).

In general, it is unclear the extent to which these states have teacher vacancy due to dated information, lack of reporting, and other strategies used to fill vacant positions.

Geographical distribution of teacher vacancies

To examine how teacher vacancies are distributed across the country, we generate a map using the latest information on teacher shortages reported for every state (Figure 5). The color code includes five categories: unknown vacancy (gray), less than 1000 vacancy (green), 1000-1999 (dark green), 2000-2999 (blue), and above 3000 (dark blue). The map shows a geographically skewed distribution of reported vacancy. Specifically, raw vacancy counts are concentrated in the South and Atlantic regions, including states such as Mississippi, Alabama, Georgia, and Florida. Nearby states, including Tennessee, North Carolina, South Carolina, Virginia, West Virginia, Maryland, and Pennsylvania, also report high levels of vacancy.

[Figure 5 here]

Using the last available year of vacancy data for each state (analogous to last-available data imputation), summing up reported vacancies there are approximately 36,500 vacant teacher positions across the U.S. (Appendix Table 3), where the southern region, by U.S. Census, accounts for the highest portion, 22,600 vacancies, which is almost three times higher than the

Midwest at the second place with only 7,400 vacancies. At the regional level, the South Atlantic has 13,444 vacancies, while Pacific region has 364 positions, the lowest level among the divisions. We note these estimates depend on whether there is any reported information about vacancies for each state. We also recognize that the raw numbers do not account for the number of students in the state. To make a more apple-to-apple comparison, we next examine vacancy relative to student population.

[Figure 6 here]

When student population is taken into consideration, the distribution changes substantially, and there is less of a geographical concentration of vacancy (Figure 6). In particular, there is no longer a cluster of high vacancy states in the southeastern area. Mississippi becomes the state with the highest number of teachers needed for every 10,000 students; specifically, there are about 69 teacher vacancies per 10,000 students in Mississippi. The next highest rate of vacancy, physically adjacent to Mississippi, is in Alabama where there are 41 vacancies per 10,000 students. Georgia and Florida drop into the third quartile with 18 and 14 vacancies per 10,000 students respectively. A handful of states, namely Montana, Kansas, New Mexico, Kansas, and Maine, with “low” raw count of vacancy actually belong to the fourth quartiles of relative vacancy, ranging from 22 to 38 vacancies per 10,000 students. In other words, once we account for the size of the student population, these five states actually have substantial vacancy issues relative to other states. Some states shift from one category to another relative to other states, but some, such as Hawaii, jump across more than one category. This hints at the importance of viewing numbers of teacher vacancies from multiple perspectives and how dramatic teacher shortages may look from different angles.

In light of the relative vacancy analysis, we also compare the numbers of teacher underqualification, as defined by individual state's standards, per 10,000 students. The highest quartile includes six states in the South, three states each for the Northeast and the West, and one Midwest state. The third quartile includes five states of the South, five of the West, two from the Northeast, and also one from the Midwest. This cluster-like geographical distribution is illustrated by Figure 7. Diving into the numbers, we observe relative underqualification ranges from 1.17 position per 10,000 students (Illinois) to 348.79 positions per 10,000 students (New Hampshire). Utah has the next highest underqualification rate at 58.27 positions per 10,000 students. Interestingly, New Hampshire has not listed teacher shortages areas on the national board for at least three years (U.S. Department of Education, 2022), while Utah has recently celebrated strong staffing levels even amid Covid-19 (Reed, 2021a, 2021b; State of Utah Office of the Legislative Auditor General, 2021b). Next, states with somewhat higher numbers of underqualified hires, such as Texas, which ranks sixth in raw underqualification counts (8,697 positions, Civil Rights Data Collection, 2018), is listed in the upper half of the ascending relative underqualification (16.19 underqualified hires per 10,000 students, which is less than the median of 19.45). This result illustrates how we need to take the number of students into account when we compare vacancy and underqualification across states (or other jurisdictions).

[Figure 7 here]

Last but not least, we consider the relationship between the number of teacher preparation program completers in a state and the number of vacant positions as well as underqualification, controlling for the number of students in the state (Appendix Table 4; Figure 8). The result suggests that, on average, for every additional completer in the state, there is a corresponding decrease of 0.31 vacant position. Similarly, an increase of one completer is, holding the number

of students constant, is associated with a decrease of 0.95 underqualified hire. Though these results are descriptive and not causal, it does suggest that teacher vacancy (and underqualification) is negatively related to teacher production. In other words, these results suggest states that produce fewer new teachers are more likely to have more vacant positions and more underqualification hires in their states.

[Figure 8 here]

Discussion and conclusion

There are several important takeaways from these analyses. First, we provide a plausible and approximate lower bound on the extent of teacher shortages nationwide. By our count, at least 36,500 teaching positions are vacant nationwide. If we extrapolate the vacancy *rate* (i.e., on a per-student basis) to states where we were unable to find data, the national vacancy count is closer to 52,800. Using the Civil Rights data and reports of underqualification, we estimate there are 163,650 positions filled by underqualified teachers. Stated otherwise, some back-of-the-envelope math implies teaching vacancies amount to 1.67 percent of positions nationwide and about 5.16 percent of positions are held by underqualified teachers.

Yet our results also underscore the crucial point that “teacher shortages” defined in these ways vary substantially across regions and states. For example, the vacancy rate per 10,000 students is more than 159 times as high in Mississippi as it is in Missouri. Even this likely understates the extent of the variation since we do not have evidence about within-state variation between metropolitan areas, districts, schools, and teaching roles. Thus, efforts to characterize a “national teacher supply” or “nationwide teacher shortage” are likely to obscure considerable nuance and may confuse discussions about policy solutions.

By comparing states' vacancy rates to their new teacher production rates, we find some suggestive evidence that teacher shortages are driven to a substantial degree by limitations in the teacher supply. This, in turn, suggests that states struggling with teacher shortages might benefit from investments in their new teacher pipelines, such as financial incentives for prospective teachers or the promotion of Grow Your Own programs and alternative certification (Darling-Hammond, 2010; Gist et al., 2019). However, as we discuss above, teacher labor markets can vary across regions, communities, and teacher roles. It would therefore be wise to ensure such investments prioritize producing the types of teacher that are most needed (e.g., secondary vs. elementary) for the schools that most need them (e.g., low-income schools in rural regions) as others have suggested (Cowan et al., 2016; Goldhaber & Theobald, 2016).

While we present what we believe is the most comprehensive nationwide evidence to date about the scope of teacher shortages, perhaps the most important takeaway from our analyses is how limited the data are. There are many states for which we are unable to find credible estimates of the extent of teacher shortages. This includes thirteen states for which we are unable to find any credible estimate of vacant positions, and these states collectively represent approximately 30.47 percent of the roughly 50 million public school students in the country (per latest Common Core of Data). This is on top of the incompleteness that exists in our state-specific data sources (e.g., not all districts response to staffing surveys, Hays et al., 2018). Moreover, even when we can find individual states' latest official documents that addresses teacher shortages, they are often substantially out of date such as Connecticut and Oregon (see Figure 2).

Other challenges arise when trying to compare numbers across states, over and above the fact that data for different states come from different years. There are at least two general types

of challenges for comparing—or combining—teacher shortages across states. First, data are collected in different ways (when they are collected at all), in different times of year (e.g., before or after the school year has begun), via different mechanisms (e.g., survey vs. administrative records), and by different parties (e.g., state offices vs. research or advocacy institutions). Second, different data sources define vacancies and underqualifications in different ways. For instance, states not only differ in the circumstances in which they grant certification waivers, their requirements for “full” certification vary. This makes characterizing teachers’ “qualifications” across states complex at best. Similarly, what constitutes a “vacancy” may vary depending on whether vacancies are defined only as officially-existing positions or if they include positions that administrators would create if they believed they could fill them. So while we generally find that individual states provide data consistently (i.e., providing consistently high-quality or consistently low-quality data) year after year, differences in data quality between states are substantial.

In sum, what our data cannot tell us about teacher shortages is in many ways more important than what they can tell us. This motivates several recommendations. First, we recommend state policymakers make school-level data on teacher qualifications readily and promptly available. This is possible because states typically already have statewide longitudinal data systems for public elementary and secondary education and already play major roles in issuing authorizations to teachers and monitoring teacher quality (e.g., pursuant to highly-qualified teacher requirements introduced under the No Child Left Behind Act; Remer, 2017). Indeed, California has annually made public staff-level data files that include information on teacher education and certification and that can be linked to individual schools and even individual course assignments (though reporting has slowed down in recent years, perhaps due to

the COVID-19 pandemic). Such reporting would not only address the lack of state-level data on the teacher supply we document above, but it would allow teacher qualifications to be assessed at a much more local level. This is essential for accurately characterizing teacher shortage issues that are known to vary substantially, even for different positions in the same school. It would also facilitate putting teacher shortage issues into richer context by allowing teacher qualifications (or other shortage issues) to be linked to factors like school funding levels, local teacher compensation levels, and so on. This kind of context is often important both for research and for effective policymaking. Indeed, without this kind of detailed, readily-available data on which schools are experiencing shortages of which kind of teacher, state policymakers themselves are likely to struggle to make targeted investments in teacher preparation that we recommend above.

Similarly, states could require districts include in public-facing report cards detailed information on staff shortages and qualifications at the school level like Florida. This could include a relatively simple set of metrics, including the total number of full-time equivalent teaching positions at the school, the numbers that are completely unfilled, and the numbers filled by (i) teachers who have completed their teacher certification and are authorized for their subjects; (ii) teachers enrolled in an alternative certification program (i.e, who are in the process of earning certification); (iii) teachers who are neither fully certified nor earning an alternative certification; and (iv) teachers who are not authorized to teach the courses to which they are assigned. This would be well aligned with recent efforts to document expenditures at the school level, rather than only at the district level, and could serve similar purposes (e.g., examining issues of equity and ensuring that resources are targeted where they are needed).

To promote understanding of teaching vacancies, we also recommend districts or other relevant regional or statewide authorities maintain and make accessible data on job postings and unfilled teaching positions. Unlike teacher certifications, which are often subject to considerable regulations, this may not be information that education agencies currently maintain in a consistent format. However, without this kind of information it is challenging to know how difficult it is for schools to hire teachers. For instance, the employment of teachers who lack a standard certification is sometimes taken as evidence of the existence of a teacher shortage, and it may very well be, especially when teachers need to be issued certification waivers that can only be obtained after administrators demonstrate they were unable to fill a position with a fully certified teacher. However, it is not always clear how much effort administrators put in to filling a given position, and they may in some cases genuinely prefer candidates with weaker credentials because they have other desirable attributes (e.g., shared affinities with the community and students). More data on actual job openings and posting—and ideally detail such as the number of applicants—could help illuminate the extent to which weaker teacher certifications indicate true teacher shortages. Data of this sort may be increasingly available as districts use electronic job boards to post openings and solicit applications. States may also find it worthwhile to bolster district capacity to collect these data because additional evidence on local teacher labor markets could be useful for developing state policy aimed at addressing teacher shortages.

As more detailed and timely data on teaching vacancies and teacher credentials becomes available, we make two general recommendations to help interpret data pertaining to teacher shortages for a wide range of audience including policymakers, researchers, journalists, and others. First, it will typically be useful and important to put teacher shortage data into a specific

schooling context, which can take numerous forms. One good generally strategy is to put teacher numbers into the context of the size of the relevant school system. For instance, rather than attempting to interpret just the raw number of vacant teaching positions, it may be helpful to also express that number as a rate, such as the number of vacancies per 10,000 students (as we do above), or as a percentage of total teaching positions (see Appendix Table 2). As we show above, the apparent severity of teacher shortages can vary considerably depending on whether numbers are expressed as raw counts or relative to the size of the school system.

Additionally, it will also be useful to compare the resulting figures in the context of current staffing levels, like the current student-to-teacher ratio. As we note above, estimates of “true” vacancies are often sensitive to assumptions about the “right” student-to-teacher ratio. Yet even when the true vacancy rate is known, the severity of the vacancy problem may depend on how well-staffed the district already is. For example, the marginal value of an additional teacher—and thus the seriousness of a vacant position—may be greater when current student-to-teacher ratios are high. Conversely, a vacant position may be less of a problem when the student-to-teacher ratio is already low. Additionally, a practical challenge for interpreting vacancy rates is that the number of teaching positions that exist may itself be determined by the quantity and quality of the teacher supply (e.g., because administrators decide it is not worth even posting a position that is unlikely to be filled). These issues have meaningful implications for the importance of a given teaching vacancy but are hard to understand without information on current staffing levels and how they have changed over time.

Second, we recommend discussions of teacher shortages be as precise as possible about how “shortages” are being defined and measured. As we document above, even the question of whether a teaching position is “unfilled” can be ambiguous because it could refer either to a

vacant position or a position filled by someone lacking some qualification. Similarly, some parties (e.g., economists) might use the term “shortage” to refer to a situation where the number of applicant teachers is insufficient to fill available positions, while others (e.g., school administrators) might use “shortage” to refer to situations where they wish there were more or better applicants. Similarly, ambiguity can plague discussions about what we refer to broadly as “underqualified” teachers, another common indicator of teacher shortages. Not only is a vacant position potentially a different problem than hiring an underqualified teacher, different types of underqualification might matter to different degrees. For instance, whether a position is filled by a teacher earning an alternative certification or one with an emergency waiver might have implications for students, though both might be considered “underqualified”. Indeed, given generally weak or counterintuitive relationships between teachers’ observable qualifications (e.g., credentials) and their effectiveness (e.g., An & Koedel, 2021; Chingos & Peterson, 2011; Rockoff et al., 2011), it is important to differentiate qualifications and effectiveness. Precision in discussions of teacher shortages might also facilitate comparisons across states—or make it clearer when such comparisons should not be made—by drawing attention to the specific implications of shortages for teachers and schools and to specific regulatory differences across jurisdictions.

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Tables

Table 1. Teacher vacancy and underqualification by state

State/Jurisdiction	Vacancy #	Underqualified #	School year	Primary source
Group 1: States with clear vacancy (11 states)				
Arizona	1,699	3,634	2021-2022	Institution Document
Colorado	235	893	2020-2021	DOE/BOE Document
Connecticut	242	518	2014-2015	DOE/BOE Document
Florida	3,911	16,585	2021-2022	DOE/BOE Document
Illinois	1,703	337	2021-2022	DOE/BOE Information
Minnesota	101	4,505	2019-2020	DOE/BOE Document
Missouri	38	3,547	2020-2021	DOE/BOE Document
Nebraska	42	175	2020-2021	DOE/BOE Document
Oklahoma	494	1,237	2018-2019	News Report
Pennsylvania	343	1,085	2017-2018	DOE/BOE Information
Utah	37	3,966	2021-2022	DOE/BOE Document
Group 2: States with less clear vacancy (26 states plus D.C.)				
Alabama	3,000+	^5,046	2021-2022	News Report
Delaware	205	^284	2020-2021	News Report
D.C.	160	^2130	2021-2022	News Report
Hawaii	364	^718	2020-2021	News Report
Idaho	470	^476	2017-2018	DOE/BOE Document
Indiana	980	^952	2020-2021	News Report
Kansas	1,200	^746	2021-2022	News Report
Kentucky	806	^245	2020-2021	Institution Document
Maine	689	^485	2017-2018	Institution Document
Maryland	~1,000	3,658	2021-2022	News Report
Michigan	527	^885	2019-2020	News Report
Mississippi	3,036	^1521	2021-2022	DOE/BOE Information
Montana	328	^88	2016-2017	DOE/BOE Document
Nevada	837	^1,092	2018-2019	Institution Document
New Jersey	148+	9,455	2021-2022	News Report
New Mexico	1,048	^726	2021-2022	Institution Document
North Carolina	1,698	^14,822	2020-2021	News Report
North Dakota	145	^50	2018-2019	News Report
Rhode Island	93+	^180	2021-2022	News Report
South Carolina	938	^632	2021-2022	Institution Document
South Dakota	120	^71	2021-2022	News Report
Tennessee	1,200	^1,483	2020-2021	News Report
Texas	570+	^8,697	2021-2022	News Report
Virginia	1,420	^3,756	2020-2021	News Report

West Virginia	1,000	^458	2021-2022 News Report
Wisconsin	2,565-	^1,346	2021-2022 Institution Document
Alabama	3,000+	^5,046	2021-2022 News Report
Group 3: States with unknown vacancy (13 states)			
Alaska	unknown	^53	2021-2022 DOE/BOE Information
Arkansas	unknown	1,528	2017-2018 DOE/BOE Document
California	unknown	24,029	2018-2019 DOE/BOE Information
Iowa	unknown	60	2017-2018 DOE/BOE Information
Louisiana	unknown	10,560	2019-2020 DOE/BOE Document
Massachusetts	unknown	7,407	2020-2021 DOE Correspondence
New Hampshire	unknown	5,878	2020-2021 News Report
New York	unknown	5,328	2017-2018 DOE/BOE Information
Ohio	unknown	542	2017-2018 DOE/BOE Information
Oregon	unknown	381	2017-2018 DOE/BOE Information
Vermont	unknown	^98	2021-2022 News Report
Washington	unknown	5,902	2019-2020 DOE/BOE Information
Wyoming	unknown	181	2020-2021 DOE/BOE Information

Note: * denotes primary reference for multiple-source information. + denotes a subtotal of the state's total teacher vacancies. - denotes the number of teacher openings instead of teacher vacancies. ~ denotes a rough estimate of the state's teacher vacancies. ^ denotes estimated underqualification counts retrieved from the Civil Rights Data Collection (2018) and Common Core Data. For more information, see Appendix 1.

Figures

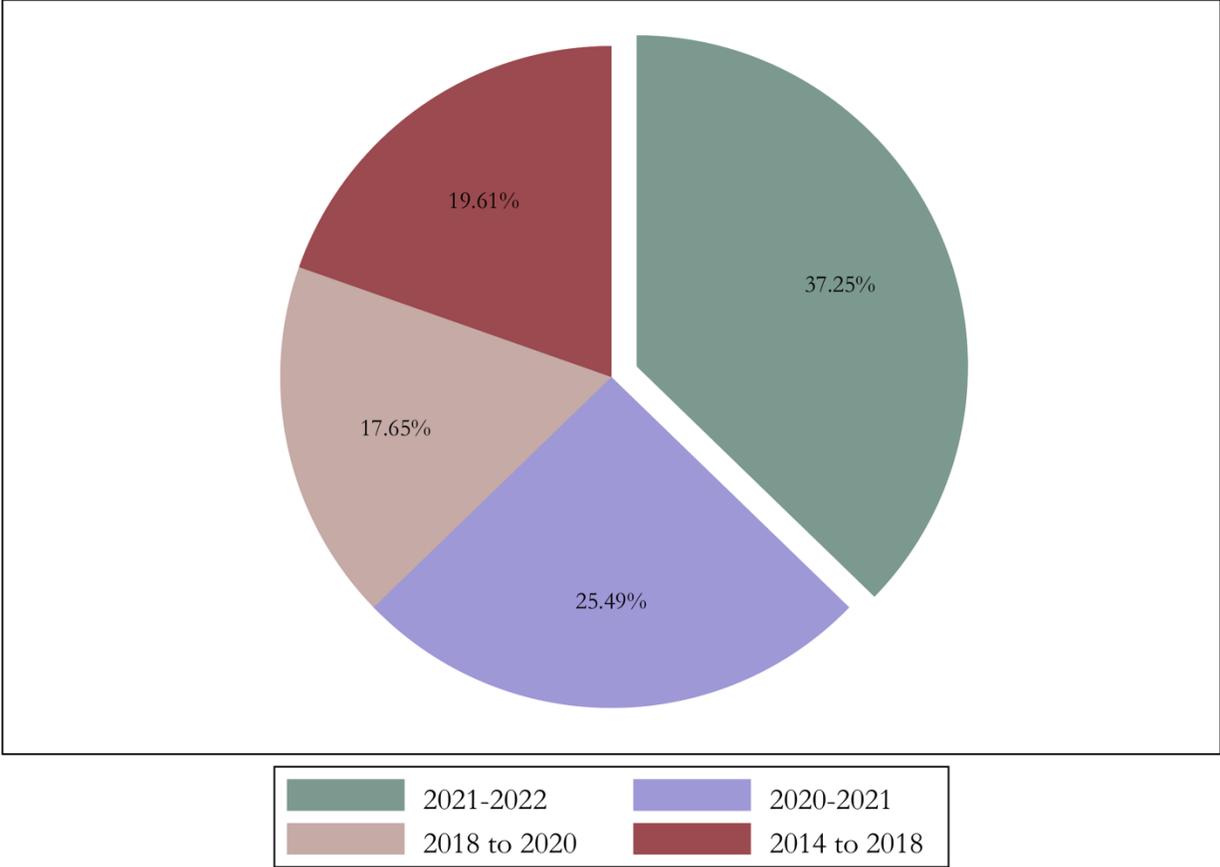


Figure 1. School years with vacancy information

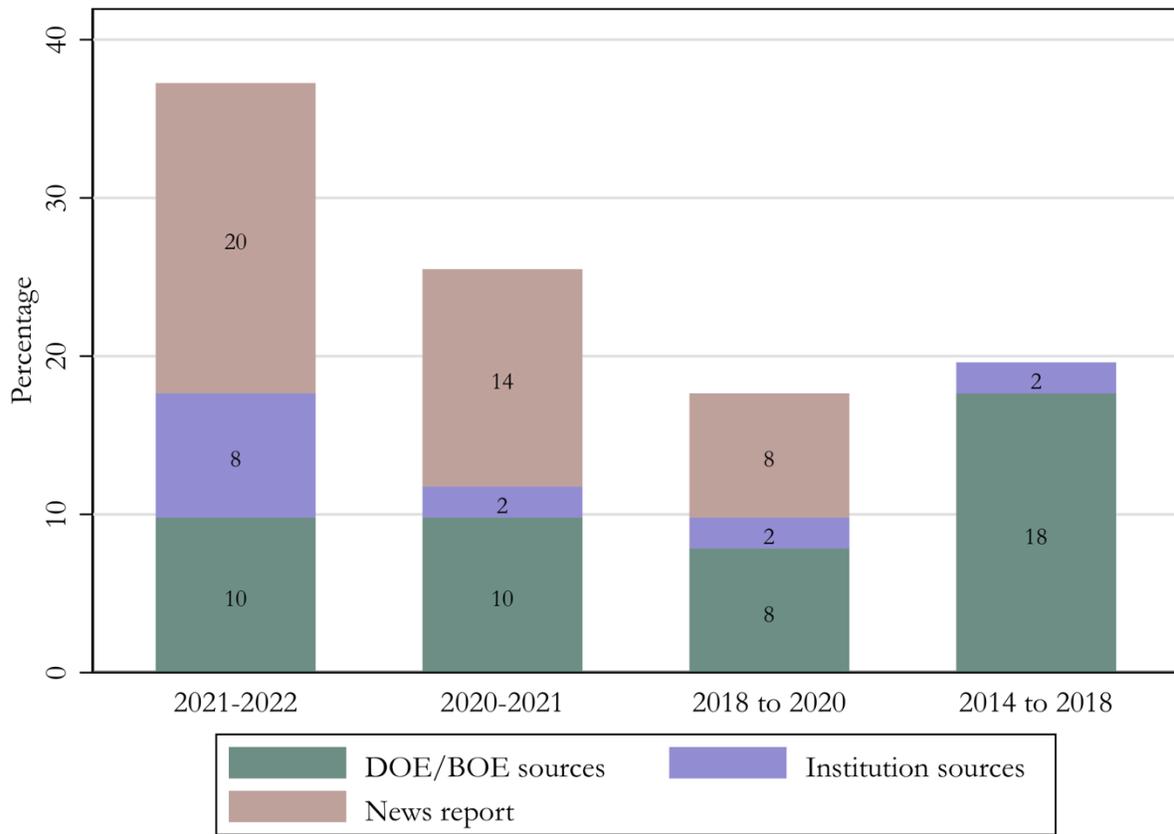


Figure 2. Primary source types by school year

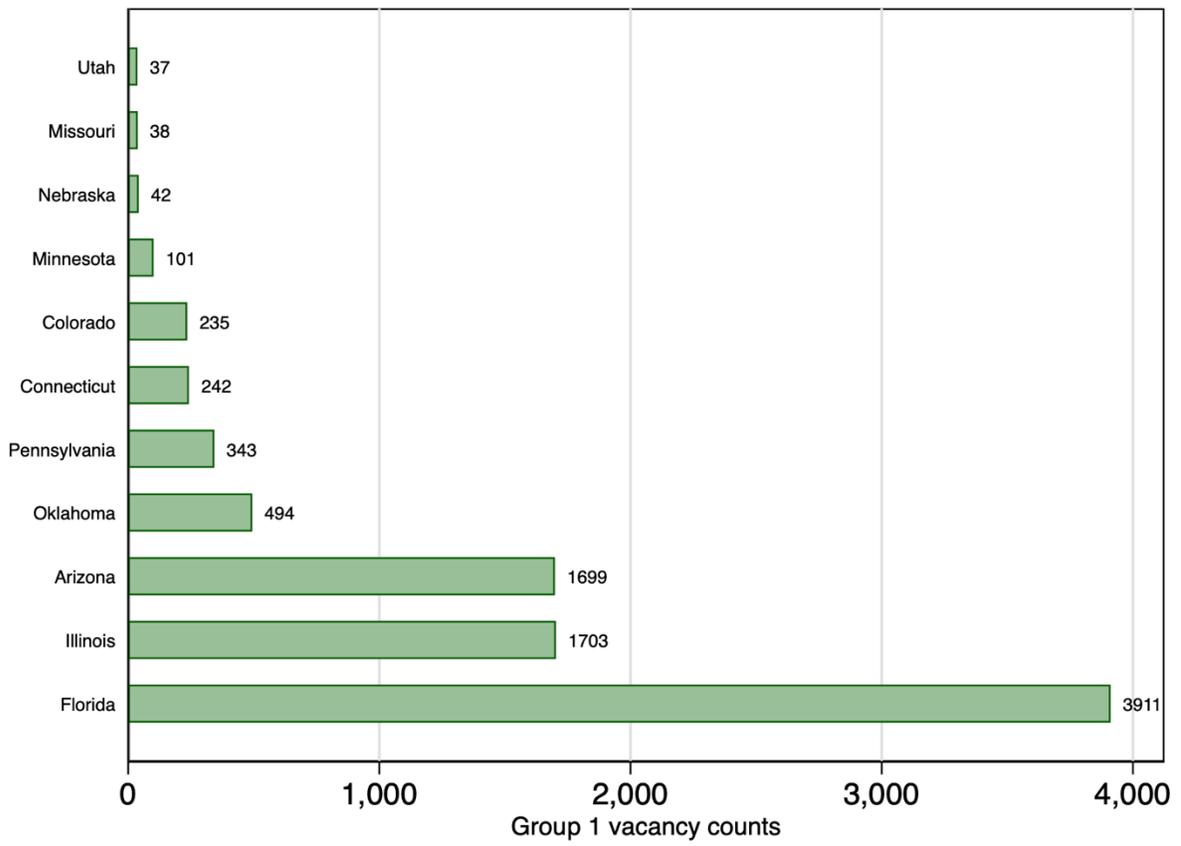


Figure 3. States with clear vacancy counts

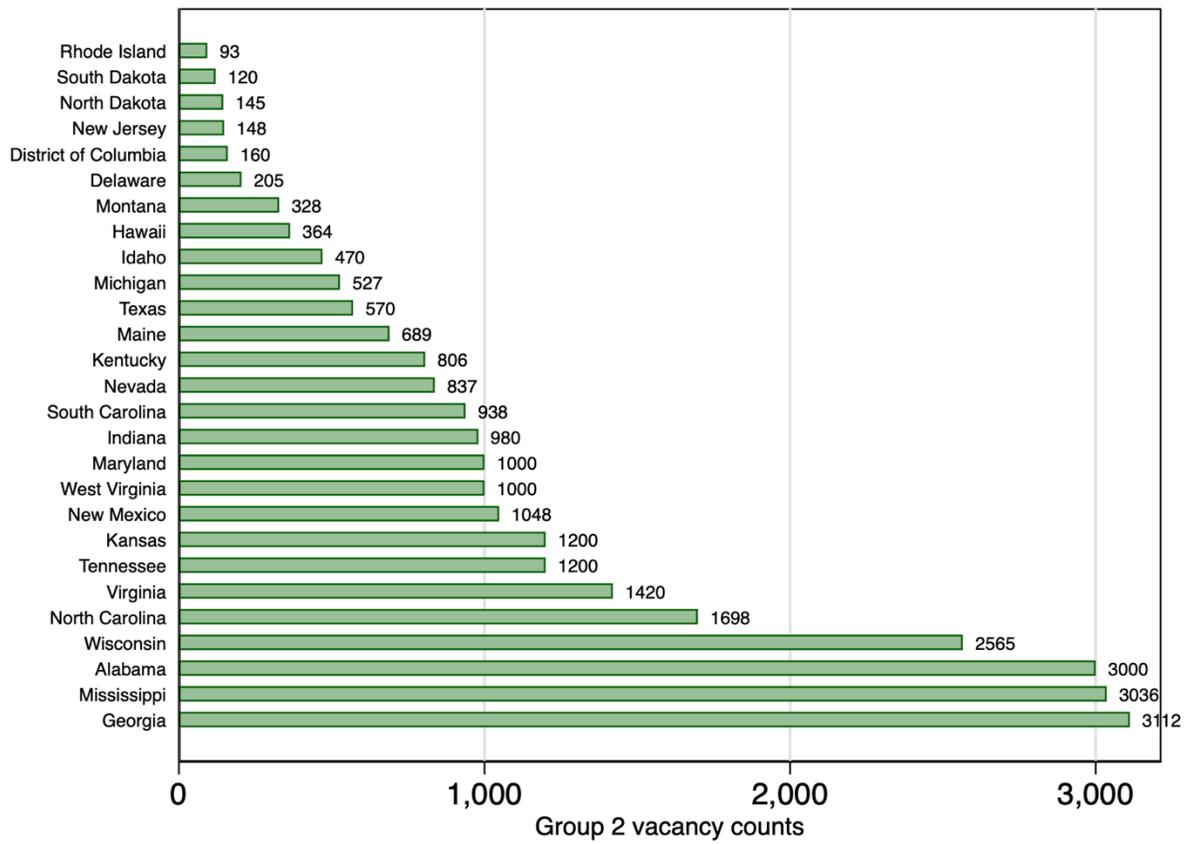
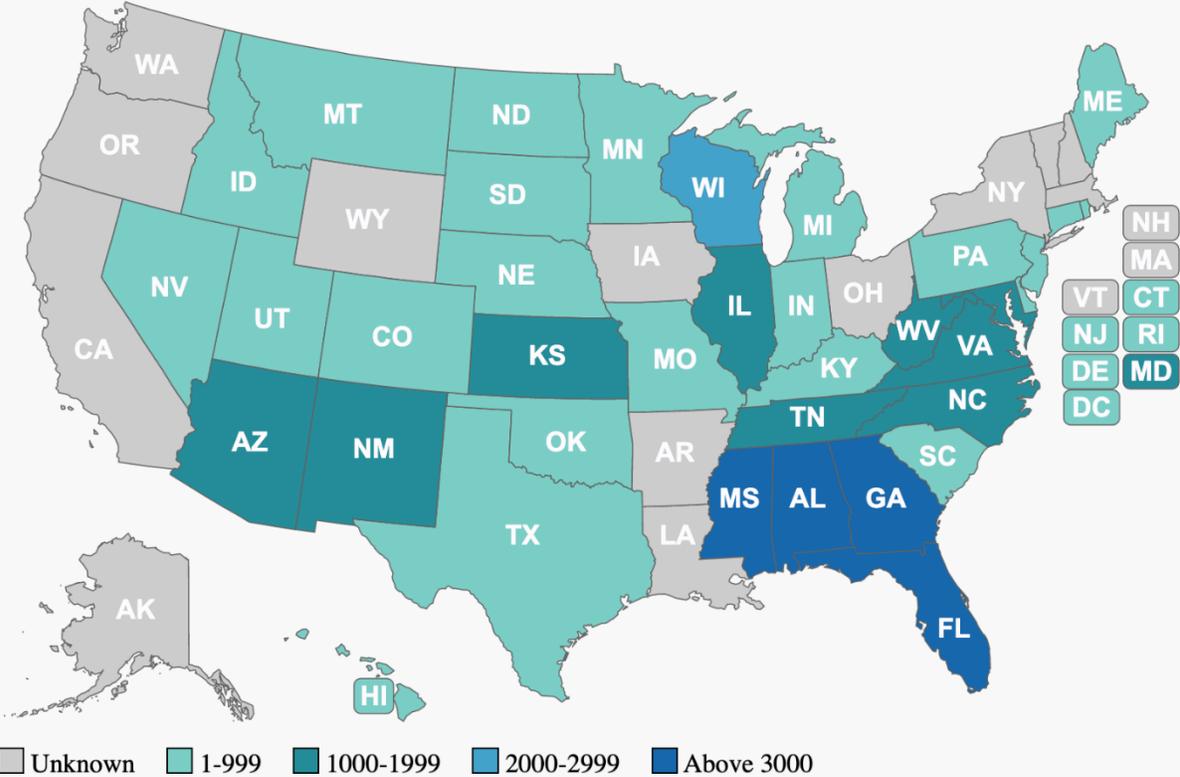


Figure 4. States with less clear vacancy counts

Raw Counts of Reported Teacher Vacancy By State



Note: Lastest school year with information in parentheses.

Figure 5. Teacher vacancies in the U.S. by state

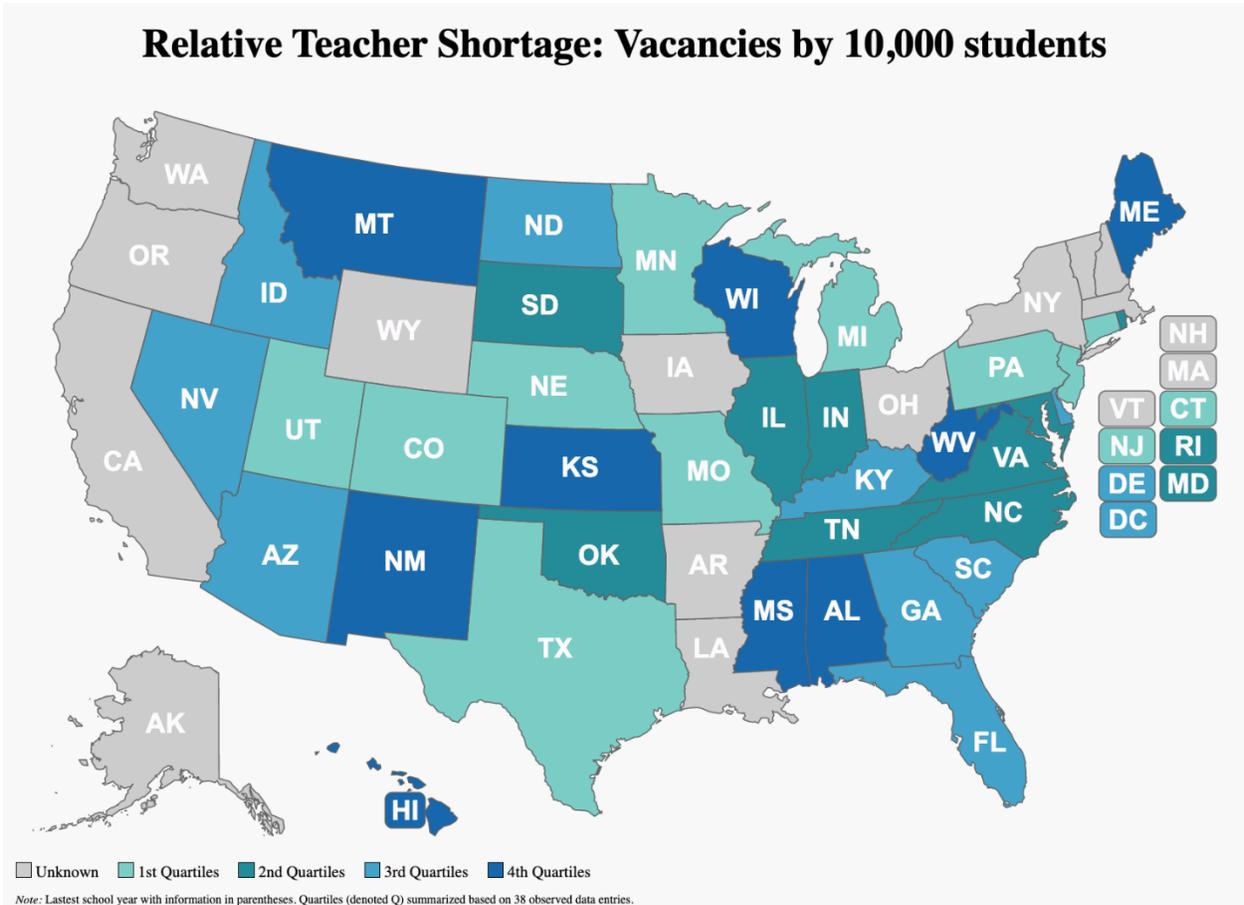


Figure 6. Teacher vacancies by 10,000 students by state
 Note: Quartiles based on 38 observed data points. Min=0.43, Q1=4.47, Q2=12.21, Q3=17.80, Max=68.59.

Relative Teacher Shortage: Underqualified hires by 10,000 students

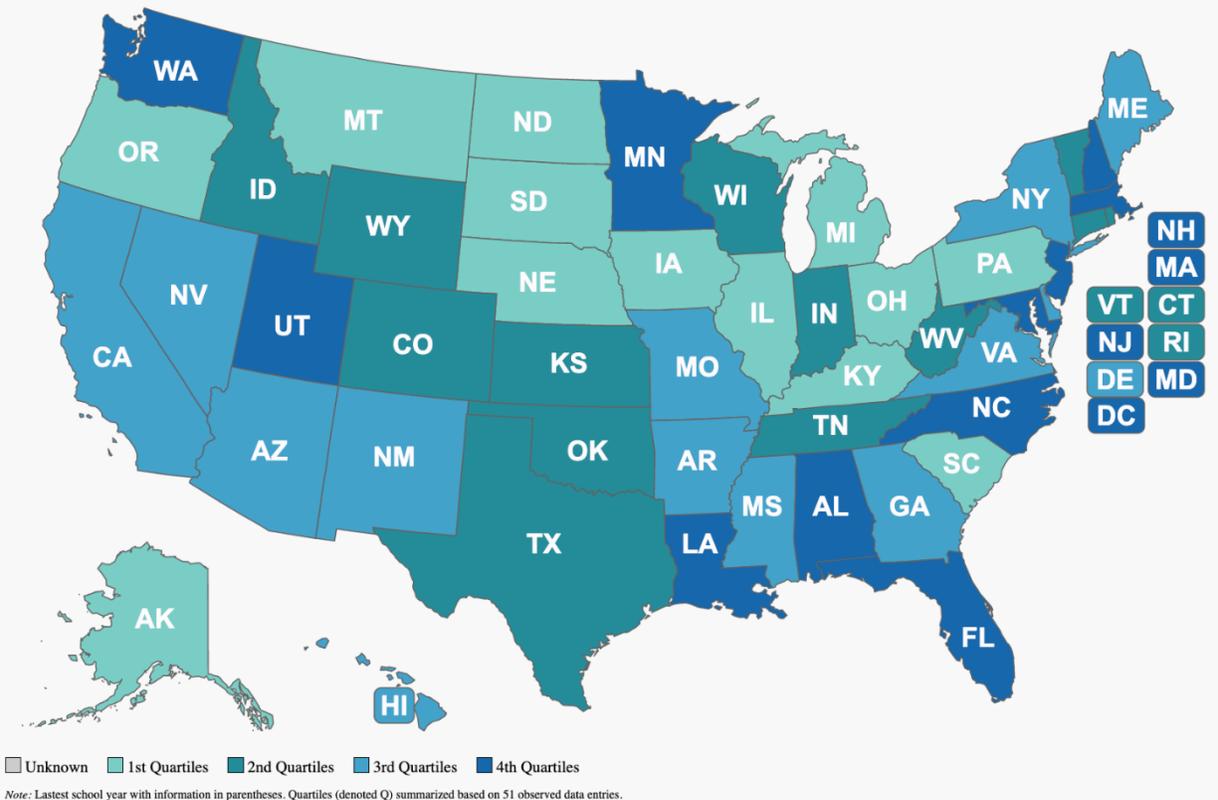


Figure 7. Underqualified hires by 10,000 students by state

Note: Quartiles based on 51 observed data points. Min=1.17, Q1=8.24, Q2=19.45, Q3=40.69, Max=348.79.

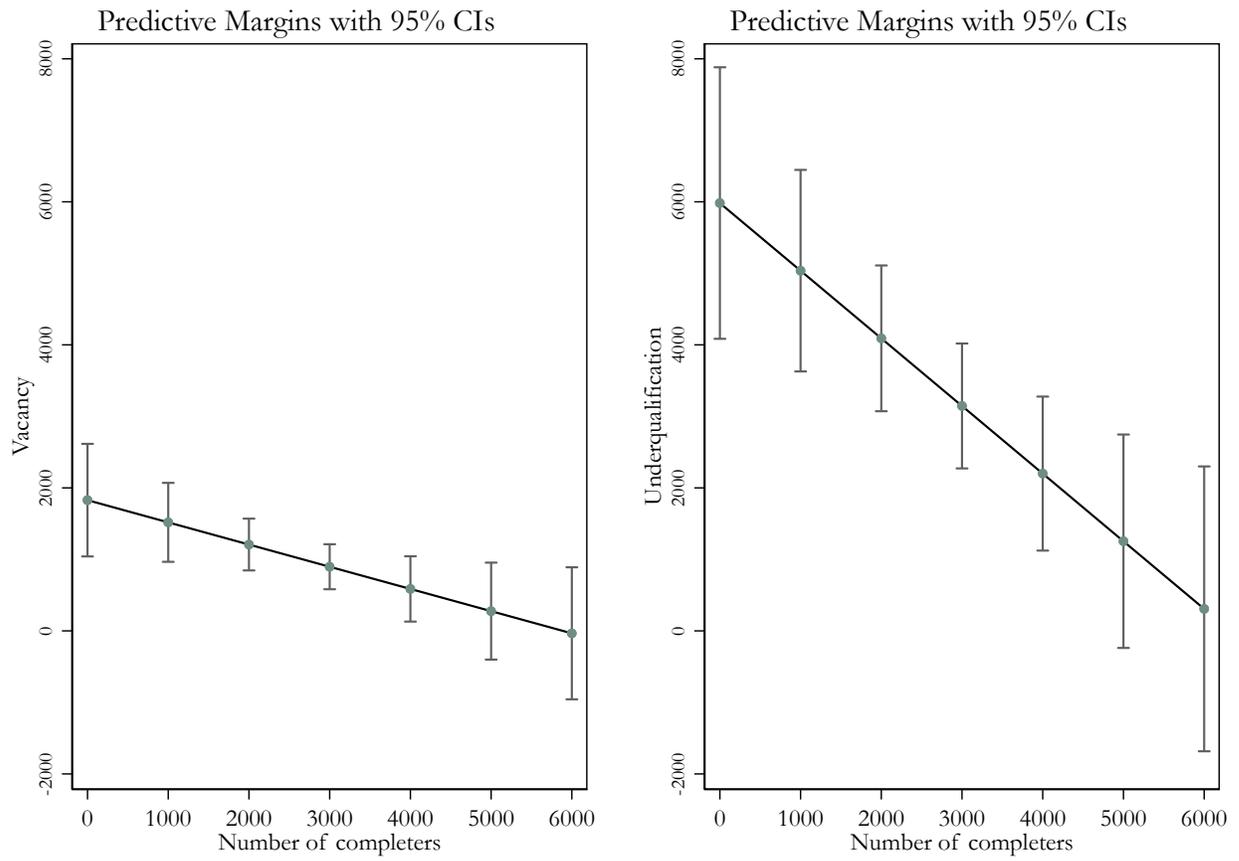


Figure 8. Relationship between the number of completers and vacant positions as well as underqualification, accounting for the number of students in the state.

Supplementary Materials

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Appendix 1. Full search results with descriptions

State/Juris	Vacancy	Underqualified	School year	Primary source	Reference(s)	Notes
Alabama	3,000+	^5,046	2021-2022	News report	Alabama Political Reporter (2021)	Alabama was estimated to have 3,000 unfilled secondary math and science teacher positions across the state (Alabama Political Reporter Staff, 2021). The total number of teacher positions being vacant in the state by the time of the report is likely to be larger.
Alaska	Unknown	^53	2021-2022	DOE/BOE information	State of Alaska Office of the Governor (2022)	<p>The latest press release by the Alaska Governor Office that addresses teacher shortages states: When Alaska was faced with the national teacher shortage due to the pandemic, many school districts in Alaska were scrambling to fill the gaps in the middle of the COVID-19 pandemic. Over 100 Filipino teachers arrived in Alaska to fill those roles in our state’s school district. (State of Alaska Office of the Governor, 2022)</p> <p>It is therefore likely that Alaska’s teacher positions for the most recent school year been fully filled. Nevertheless, the evidence is not sufficient to state that the state currently has no teacher vacancy. Other relevant sources, though being dated, include a report from the University of Alaska Anchorage, which provides about 230 teacher vacancies for Alaska in 2015-2016 (Hirshberg et al., 2015), and the Civil Rights Data Collection (2018), where 53 underqualified hires are listed for the state in 2017-2018.</p>
Arizona	1,699	3,634	2021-2022	Institution document	Arizona School Personnel Administrators Association (2021)	The Arizona School Personnel Administrators Association (2021) reports, as of September 2021, the state still had 1,698.67 teacher positions remain unfilled, while 3,633.50 teacher

Arkansas	Unknown	1,528	2017-2018	DOE/BOE document	Arkansas Department of Education (2018)	positions were being filled by individuals “not meeting standard teacher requirements” (p. 2). The report by the Arkansas Department of Education provides detailed information regarding the state’s teaching force of the 2017-2018 school year, signifying shortages with 4.6 percent of its 33,228 teachers teaching without being certified or certified but not in their assigned subject areas (Arkansas Department of Education, 2018). The document did not indicate the state had any unfilled teacher position.
California	Unknown	24,029	2018-2019	DOE/BOE information	California Department of Education (2019)	We retrieve staff data files downloaded from the California Department of Education website (2019). Similar to the Learning Policy Institute (2017) we define underqualified teachers as those holding at least one of: an intern credential; a waiver or emergency credential; a limited assignment teaching permit; or a provisional or short-term permit. In some applications, the Learning Policy Institute limits this count to newly-hired teachers (i.e., those in their first year in the district; e.g., Learning Policy Institute, 2019). If we take a similar approach, our count of underqualified teachers in California falls to 11,114. These files do not include vacancy data.
Colorado	235	893	2020-2021	DOE/BOE document	Colorado Department of Education (2021)	The Colorado Department of Education has been collecting data on their teacher shortages over the past two years, with latest results showing the state had 235 vacant teacher positions, and 893 teachers had been hired via a shortage mechanism for the school year 2020-2021 (Colorado Department of Education, 2021). Of note, this shortage mechanism is explained as “hiring long-term substitutes, retired educators,

Connecticut	242	518	2014-2015 DOE/BOE document	*Connecticut State Department of Education (2015); Gais et al. (2019)	alternative licensure program candidates and emergency authorizations holders.” The latest data bulletin from the Connecticut State Department of Education was released in 2015, providing that the state’s local education agencies had sought to fill a total of 5,409 teacher positions for the school year 2014-2015, where 318 remained vacant as of October 1, 2014, and 242 among which were positions involving instructional duties (calculated from Table 6, Connecticut State Department of Education, 2015). In addition, the document provides the state had a total of 518, specifically 102 and 416 positions involving teaching, respectively filled under durational shortage area permits and minimal qualifications (calculated from Table 6). In recent years, a report released by the Rockefeller Institute of Government, examining educational trends and statistics in Connecticut over the past decade, remarks that there has been little evidence of a statewide teacher shortage, but warns about growing imbalances between the state’s teacher supply and demand with respect to subject areas, geographic locations, and students’ socioeconomic backgrounds (Gais et al., 2019).
Delaware	205	^284	2020-2021 News report	Alamdari (2020)	The latest information regarding Delaware’s teacher vacancy came from Delaware Online (Alamdari, 2020). Citing “a poll of human resources directors for the 19 school districts,” the news article reports the state had a total of 205 teacher vacancies for the school year 2020-2021.
District of Columbia	160	^2130	2021-2022 News report	Collins (2021)	The Washington Informer, citing D.C. State Board of Education, reports the jurisdiction had

Florida	3,911	16,585	2021-2022	DOE/BOE document	Florida Department of Education (2022)	160 teacher vacancies, as of September, 2021 (Collins, 2021). The latest document from the Florida Department of Education provides the state had a total of 4,489 educator vacancies actually reported by school districts statewide, of which 3,911 were teacher positions (i.e., excluding such positions as school guidance/counselors, pathologists, specialists, etc.) (Exhibit 4, pp. 5-6). Additionally, about ten percent of the state's total number of courses were taught by teachers not certified in appropriated field (Exhibit 43, pp. 5-6). Given the total number of the state's teachers (per latest Common Core Data), this implies an approximate number of about 16,585 not-fully-certified teachers holding positions in the respective school year.
Georgia	3,112	^5220	2019-2020	News report	Williams (2020)	In March, 2020, the Georgia Recorder, citing state representative Dave Belton, reported the state had 3,112 teacher positions from the year before that could not be filled (Williams, 2020).
Hawaii	364	^718	2020-2021	News report	Lee (2021)	The Honolulu Civil Beat, citing the Hawaii Department of Education's Office of Talent Management, reports 364 vacancies across the state by the end of the first semester of the 2020-2021 school year (Lee, 2021).
Idaho	470	^476	2017-2018	DOE/BOE document	Associated Press (2021); Davis (2022); Dibb (2021); *Linder & McHugh (2018); U.S. Department of Education (2022)	It has been widely recognized that Idaho is in short of teachers, especially after recent school closures and increasing teacher attrition (e.g., Associated Press, 2021b; Davis, 2022; Dibb, 2021). The state has also been reporting teacher shortage areas to the U.S. Department of Education for several years (U.S. Department of Education, 2022). Nevertheless, there has not been any number specified regarding the state's

Illinois	1,703	337	2021-2022	DOE/BOE information	*Illinois State Board of Education (2021); Illinois Association of Regional Superintendents of Schools (2021)	vacant teacher positions. The latest document from the DOE about the state's teaching force was released in 2018, providing an annual teacher demand estimate of 1,750, and that only 65% of the state's 1,969 newly-minted teachers would serve in its schools (Linder & McHugh, 2018). This implies the state was likely to have a shortage of 470.15 teachers at the reporting time. The Illinois Association of Regional Superintendents of Schools (2021), using data from their 2021 superintendent survey, reports a total of 2,040 teacher positions either vacant or filled by underqualified teachers as of October, 2021. The state DOE also indicates 1,703.6 teacher positions remained unfilled at the same time (Illinois State Board of Education, 2021), implying 337 of the aforementioned 2,040 positions had been underqualified fill.
Indiana	980	^952	2020-2021	News report	Bastide (2020)	A news article from the Herald Bulletin, citing political candidate Woody Myers, reports 980 teacher vacancies for Indiana as of October 2020 (Bastide, 2020).
Iowa	Unknown	60	2017-2018	DOE/BOE information	*Civil Rights Data Collection (2018); Iowa Department of Education (2016); Iowa Department of Education (2021); Rushing (2021); Stein (2021); Stratton (2021); U.S. Department of Education (2022)	A recent news article from KCCI Des Moines in January, 2022, reported about 1,000 classroom and sped-ed teacher positions had been vacant across Iowa, while 3,000 other education jobs being open on the state's employment board website (Stratton, 2022). In this vein, the issue of teacher shortages in Iowa has been circulated in the news since the fall semester of 2021 (e.g., Rushing, 2021; Stein, 2021). The state DOE has however not released any information on teacher vacancies, while continuously reported shortage areas to the U.S. Department of Education (2022). In addition, latest data from the Office

Kansas	1,200	^746	2021-2022 News report	Bisaha (2020); *The Kansas City Star Editorial Board (2021); Kansas State Department of Education (2019); Kansas State Department of Education (2016)	<p>for Civil Rights, 2017-2018, indicate only 60 teacher positions in the whole state being filled by under-certified teachers (Civil Rights Data Collection, 2018). Relatedly, the state DOE’s annual report Condition of Education (Iowa Department of Education, 2021), of which the latest update is released in 2021 where the DOE reported the teaching force had grown from 33,610 teachers in 2000-2001 to 38,022 teachers in 2020-2021, while K-12 pupil-teacher ratio dropping from 15.8 in 2001 to 13.1 in 2021. Meanwhile, the state’s NCLB report card (Iowa Department of Education, 2016) in its latest update (2015-20216) reports only 16 out of all the state’s 149,349 schools having sessions not taught by highly-qualified teachers (identified by matching the assignment and endorsement areas), and an absolutely zero percent of teachers working under emergency/provisional licensure. Putting together, it is possible to hope for a “positive” picture of the teaching force in Iowa, but the evidence so far is not sufficient to claim that the state has no teacher vacancy, nor to make an assertion on the extent of its teacher shortages.</p> <p>The latest news regarding Kansas’ teaching force came from the Kansas City Star, which reported the state had more than 1,200 teacher vacancies in the fall of 2021 (The Kansas City Star Editorial Board, 2021). The news report, however, does not provide any source for its information. Another news article from the U.S. News, citing the Kansas State Department of Education, reported the state had 771 teacher vacancies in the 2020-2021 school year (Bisaha, 2020). Its references are not provided either. Official documents from the KSDE indeed dated</p>
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Kentucky	806	^245	2020-2021	Institution document	Kentucky Council on Postsecondary Education (2021)	back to three years ago where respectively 815, 642, 523, and 227 teacher vacancies being reported for school years of 2019-2020, 2018-2019, 2017-2018, and 2015-2016 (Kansas State Department of Education, 2016, 2019). The latest information regarding Kentucky's educational workforce comes from the 2021 report by the state's Council on Postsecondary Education. The report provides estimates of the state's supply and demand by occupation in the education workforce (Table 5.1, Kentucky Council on Postsecondary Education, 2021), specifically summing up to a total shortage of 806 PK-12 and special education teachers. It is important to note this figure is calculated by overall supply-and-demand gaps instead of disaggregated data per assignment area. In other words, the state's office might have included surpluses into shortages and/or counted non-instructional vacancies toward teachers'.
Louisiana	Unknown	10,560	2019-2020	DOE/BOE document	Louisiana Department of Education (2021)	The latest information from the Louisiana Department of Education (2021) does not provide any information on vacancy, but a total of about 10,560 teacher positions (24% of 44,000) in the 2019-2020 school year being filled with underqualified candidates.
Maine	689	^485	2017-2018	Institution document	Kimball et al. (2019)	The most recent data on Maine's teacher force comes from the 2019 report by the University of Maine System Board of Trustees. The report provides a difference of 599 between the state's total teacher demand, counted by 2017 job openings, and that of supply, counted by undergraduate education degrees awarded (Kimball et al., 2019). However, by this method, the surplus in one area is counted toward

Maryland	~1,000	3,658	2021-2022 News report	Fontelieu (2022); *Hall (2021); Sesay (2022); U.S. Department of Education (2022)	<p>another's shortage as supply exceeds demand in certain categories (e.g., secondary education with 72 in supply and 21 in demand, Table 7, Kimball et al., 2019). Using data from the report, excluding surpluses and non-instructional shortages, we arrive at a 689 teacher vacancy estimate for the state in 2017-2018.</p> <p>Although Maryland consistently reports teacher shortage areas to the U.S. Department of Education (U.S. Department of Education, 2022), and there are news reports on teacher shortages in many parts of the state (e.g., Fontelieu, 2022; Sesay, 2022), little is found on the extent of their teacher vacancy. The most recent news about the state's teacher vacancy comes from the WUSA9, where over 1000 teacher openings, as of August 2021, are reported for the state's largest school district: the Montgomery County Public Schools (Hall, 2021). In correspondence with our research team in the summer of 2021, the Maryland Department of Education (MSDE) stated they had not recorded headcounts on teacher vacancy, while fortunately provided their latest count of underqualified hires, specifically a total of 3,658 teacher positions.</p>
Massachusetts	Unknown	7,407	2020-2021 DOE correspondence	<i>Is There a Teacher Shortage in Massachusetts?</i> (n.d.); Jung (2020); Levin et al. (2015); U.S. Department of Education (2022)	<p>Massachusetts has been reported with teacher shortages (e.g., <i>Is There a Teacher Shortage in Massachusetts?</i>, n.d.; Jung, 2020; Levin et al., 2015; U.S. Department of Education, 2022) but so far no information is found on the extent of their vacancy or whether there is one. The Massachusetts Department of Elementary and Secondary Education's Public Records Center responded to our correspondence that they had not collected data on teacher vacancy. The Center however provided their latest counts, as</p>

Michigan	527	^885	2019-2020 News report	French (2019)	<p>of July, 2021, of underqualification, specifically 5,027 teachers working with a provisional license, 2,100 teachers working with an emergency license, and 280 teachers working under a waiver. This totals 7,407 underqualified hires in the state for the 2020-2021 school year.</p> <p>A news article on Bridge Michigan, citing a survey conducted by the Michigan Associate of Superintendents and Administrators in the second week of September, 2019, reports 216 openings in special education in 2019-2020, accounting for 41 percent of the state’s total openings (French, 2019). This implied about 527 total openings across the state after the start of the 2019-2020 school year. Per our definition of a vacant position: a position that is left vacant or unfilled after the start of a school year, this figure is the closest estimate for the state’s teacher vacancy in 2019-2020.</p>
Minnesota	101	4,505	2019-2020 DOE/BOE document	*Minnesota Professional Educator Licensing and Standards Board (2021); “Tiered licensure in Minnesota” (n.d.)	<p>The 2021 Biennial document by the Minnesota Professional Educator Licensing and Standards Board (2021) reports, by October, 2019, the state had been employing a total of 4,505 teachers teaching under substandard licensing (Table 2), including tier 1, tier 2, out-of-field (OFP), and innovative-program permission (IPP) (see <i>Tiered Licensure in Minnesota</i>, n.d., for details), and 101 teacher positions that could not be filled “even with tier 1, tier 2, and permissions” (p. 43).</p>
Mississippi	3,036	^1521	2021-2022 DOE/BOE information	James (2021)	<p>A news article from Mississippi Today, citing the Mississippi Department of Education’s one-hundred-percent response-rate superintendent survey fielded in September, 2021, reports a state total of 3,036 certified teacher vacancies—the figure that includes completely unfilled teacher</p>

Missouri	38	3,547	2020-2021 DOE/BOE document	Missouri Department of Elementary & Secondary Education (2021a); *Missouri Department of Elementary & Secondary Education (2021b)	positions and positions filled by less-than-fully certified teachers—for the 2021-2022 school year (James, 2021). We cannot disaggregate this number to exclusively count vacancy due to the lack of details provided in the original source. In June, 2021, the Missouri Department of Elementary & Secondary Education (2021a) released an official document indicating that its schools had sought to fill roughly 5,000 educator vacancies for the 2020-2021 school year. A later report, being released in December 2021, provides a total of 3,585 teacher FTEs either being vacant or filled by less-than-fully certified teachers, where 3546.86 FTEs belonged to the latter category (calculated from Table VI, Missouri Department of Elementary & Secondary Education, 2021b).
Montana	328	^88	2016-2017 DOE/BOE document	Harris (2021); *Mohr & Furois (2017); Morton (2021); Szpaller (2021)	The latest official report on Montana’s teaching force came out in the late 2017 by the state’s Office of Public Instruction, providing a shortage measure for the 2016-2017 school year of 638 educator FTEs, including teachers, school staff, and counselors (Mohr & Furois, 2017). Diving deeper, 554 of these positions were instructional positions (i.e., school counselor and staff excluded) that Montana schools had sought to fill, and 328.27 remained “difficult or very hard to fill” (p. 6). More recent information provided by new reports suggest teacher shortages have continued in Montana with indicators such as the 2021-2022 request by school districts for emergency authorization of 120 teacher positions (Harris, 2021; Szpaller, 2021), or that the state has hired over 400 less-than-fully certified teachers over the past three year (Morton, 2021).

Nebraska	42	175	2020-2021	DOE/BOE document	Nebraska Department of Education (2020)	The Nebraska Department of Education (2020), employing data from a statewide survey on districts/school systems (including public and non-public) in October, 2020, provided a state total of 216.60 public-school teacher positions either being unfilled by the time of the survey or filled with candidates without full qualification (Table 3b). Diving deeper, 44 of these positions were teacher vacancies—positions that were not filled at all—while the rest (174.60) were filled by underqualified teachers (Nebraska Department of Education, 2020). Of note, the survey’s response rate was only 37%, suggesting these figures likely underestimate the state’s shortages.
Nevada	837	^1,092	2018-2019	Institution document	*Hays et al. (2018); Data Insight Partners (2021)	The most recent information on Nevada’s teacher shortages comes from a study by a research team at the University of Nevada in 2018, with statewide survey data, suggesting a total over 900 educator vacancies for the school year 2018-2019, of which 837 positions are classroom teachers (Hays et al., 2018). This figure however likely underestimates the state’s teacher shortages. A state’s partnered agency, the Data Insight Partners (2021), using historical data as of October 1, 2019, projected the state would need an addition of 3,063 teachers to meet their current staffing level in coming school years, while reaching the national average student-teacher ratio would put the state in short of nearly 10,000 teachers. From the conservative perspective of our study, we report the actual count of 837 teacher vacancies for Nevada in 2018-2019, while awaiting for more timely shortage measures from the state’s offices.

New Hampshire	Unknown	5,878	2020-2021	News report	*Albertson-Grove (2020); Green (2022); The Teaching Project (n.d.); U.S. Department of Education (2022)	Although New Hampshire has been recently reported with teacher shortages in the news and elsewhere (e.g., Green, 2022; The Teaching Project, n.d.), no information is provided on the extent of their teacher vacancy. The state DOE has not provided any figure on the extent of teacher shortages, and has stopped listing shortage areas on the U.S. Department of Education since 2019 (U.S. Department of Education, 2022). A more dated source of information, the New Hampshire Union Leader (Albertson-Grove, 2020), reports about 40 percent of the state’s teachers in the school year 2020-2021 were either not fully certified or certified out-of-field. Per latest Common Core Data, the state had about 14,694 teachers by the end of the 2019-2020 school year, suggesting that about 5,878 teacher positions (40%) had been filled by underqualified individuals.
New Jersey	148+	9,455	2021-2022	News report	Clark (2021); Kennedy (2020); *Lahoud (2022); Symons (2020); The New Jersey Campaign for Achievement Now (2020); U.S. Department of Education (2022); *Wall (2021)	New Jersey has been reported with teacher shortages for years (e.g., A. Clark, 2021; Kennedy, 2020; Symons, 2020) and has been reporting shortage areas for the U.S. Department of Education (U.S. Department of Education, 2022). However, there has not been a total count of the state’s teacher vacancies. The New Jersey Department of Education responded to our correspondence that they had not been collecting data on vacancy counts, yet provided a total of 9,455 underqualified hires by the end of 2020-2021. Information from other sources provides 120 vacant teacher positions in Newark Public Schools by September, 2021 (Wall, 2021), and Camden City School District with 28 positions by January, 2022 (Lahoud, 2022). Relatedly, these two school districts reported 134 teacher

New Mexico	1,048	^726	2021-2022	Institution document	*Boren (2021); Boren (2020)	vacancies in the year before (The New Jersey Campaign for Achievement Now, 2020). The latest shortage information for New Mexico comes from the 2021 educator vacancy report by the Southwest Outreach Academic Research (SOAR) at New Mexico State University (Boren, 2021). Accordingly, as of September 10, 2021, the state had a total of 1,727 educator vacancies, of which 1,048 were teacher positions (Boren, 2021). The authors noted this was a 84-percent up from the state's vacancy count of 571 positions the year before (Boren, 2020, 2021).
New York	Unknown	5,328	2017-2018	DOE/BOE information	Chacko (2021); *Civil Rights Data Collection (2018); New York State Department of Education (2019); Rivas (2021); The Sun News Report (2020)	Although New York has recently been reported with teacher shortages in the news and elsewhere, no data have been released on the extent of the state's teacher vacancy, while the evidence cited centering around shortage indicators such as decreasing enrollment in teacher preparation programs, increasing teacher attrition due to retirement, or low levels of incentives for teaching (e.g., Chacko, 2021; Rivas, 2021; The Sun News Report, 2020). Meanwhile, the New York State Education Department in an official report (2019), per data as of January, 2019, remarks that the state's teachers' age distribution has not suggested an impending shortage due to retirements, and its current challenges have been about staffing teachers of colors and teachers of perennially hard-to-staff disciplines including mathematics, sciences and special education instead a statewide shortage. The only available data on the state's teaching force dated back to 2017-2018 with data from the Civil Rights Data Collection (2018), where 5,328 teacher positions

North Carolina	1,698	^14,822	2020-2021 News report	North Carolina Teachers of Tomorrow (2020)	are reported to be filled with underqualified candidates. A news article from the North Carolina Teachers of Tomorrow (2020) reports 3,107 teaching job openings across the state at the beginning of the school year 2020-2021, of which 1,698 had remained vacant by the 40 th day of school. By our definition of a vacant teacher position: a position that is left vacant/unfilled into the school year, this measure is considered vacancy count for the state in 2020-2021.
North Dakota	145	^50	2018-2019 News report	Emerson (2019)	The latest shortage information for North Dakota comes from a news article on the Bismarck Tribune. Citing the North Dakota Department of Public Instruction, the article reports 145 teacher vacancies for the school year 2018-2019, which is less than two percent of the state's 11,200 teacher positions (Emerson, 2019). We could not find any information on whether the state was employing underqualified teachers within that time period. Such information is retrieved from a dated source, which provides a state total of 50 underqualified hires for the 2017-2018 school year (Civil Rights Data Collection, 2018).
Ohio	Unknown	542	2017-2018 DOE/BOE information	*Civil Rights Data Collection (2018); Hawk (2022); Jarvis (2022); Ohio Department of Education (2021, 2022); U.S. Department of Education (2022)	Although Ohio's teacher shortages continue to be reported in the news (e.g., Hawk, 2022; Jarvis, 2022; Poiner, 2021), no number has been provided on the extent of teacher vacancy, while the cited evidence only referring to increasing teacher resignation, shrinking applicant pool for teaching jobs, and decreasing number of students enrolling in teacher preparation programs. The Ohio Department of Education, while continuing listing teacher shortage areas (U.S. Department of Education, 2022) and addressing staffing

Oklahoma	494	1,237	2018-2019 News report	*Eger (2018); Raache (2022)	<p>issues in recent media releases (e.g., Lovett, 2016; 2021, 2022), has neither provided data on teacher vacancy nor underqualified hires. So far the only information source for Ohio is the Civil Rights Data Collection (2018), which lists the state with 542 teacher positions filled by underqualified candidates in the 2017-2018 school year.</p> <p>A news article on the Tulsa World, citing results from a 2018 statewide, 78-percent response rate, superintendent survey, reports 494 vacant teacher positions for Oklahoma in 2018-2019 (Eger, 2018). The news in addition reports, within two months of the fiscal year 2019, the Oklahoma State Board of Education approved 1,237 emergency teacher certifications, which was noticeably high given the whole fiscal year 2018 only saw 1,975 such approvals in total (Eger, 2018). More recent sources, though not providing vacancy counts, suggest teacher shortages in Oklahoma have been more serious as 3,600 emergency certifications have newly been issued for the 2021-2022 school year, and over 400 adjunct teachers are currently employed to cover the state’s classrooms (Raache, 2022).</p>
Oregon	Unknown	381	2017-2018 DOE/BOE information	Baumhart (2021, 2022); *Civil Rights Data Collection (2018); Lovett (2016); Simon & Maxouris (2021)	<p>The State of Oregon has recently been reported with “emergency” teacher shortages (Baumhardt, 2021, 2022), and its schools have been recorded to have a “staffing crisis” (Simon & Maxouris, 2021), but little can be found on the extent of the issue. The latest, relevant information from the state DOE was released seven years ago, reporting a total of 832 teachers being employed across the state under provisional licensure, while providing no vacancy count (Lovett, 2016). A federal data source, dated but more</p>

Pennsylvania	343	1,085	2017-2018 DOE/BOE information	Pennsylvania Department of Education (2018)	<p>recent than the state's, reports a lower sum of 381 teacher positions for the state in 2017-2018 that were filled by candidates without fully meeting the state's licensing/certification requirements (Civil Rights Data Collection, 2018). With this little information available, no assertion can be made on the current condition of the state's teacher shortages, let alone the extent of their teacher vacancy or underqualification.</p> <p>The Pennsylvania Department of Education presented in April, 2018, that there were in total 1,428 teacher positions across the state not being filled with qualified candidates (Pennsylvania Department of Education, 2018). Diving deeper, 343 teacher positions were classified as supply shortage, 434 were classified as emergency-type shortage (i.e., positions filled by teachers with emergency permits), and 651 were classified as both supply and emergency shortage type (calculated from slide 13, Pennsylvania Department of Education, 2018). We report this 343 supply-type shortage positions as vacancy, as they were positions that the state could not fill, and the sum of the two latter shortage categories: 1,085 positions, for underqualified hires.</p>
Rhode Island	93+	^180	2021-2022 News report	Machado (2021)	<p>In December, 2021, the WPRI 12 News reported 134 educator vacancies for Providence School District, the largest school district in Rhode Island, of which 93 were classroom teacher positions (Machado, 2021). Noticeably, the district originally had 124 educator vacancies at the beginning of the school year, and despite its active, continuous recruitment efforts, vacancies have continued to increase due to mid-year teacher attrition (Machado, 2021).</p>

South Carolina	938	^632	2021-2022	Institution document	*Garrett (2021); Center for Educator Recruitment, Retention, & Advancement (2022)	The latest educator supply and demand report from a South Carolina-based institution, the Center for Educator Recruitment, Retention, & Advancement (CERRA), provides the state had a total of 1,062.79 educator positions being vacant after the 2021-2022 school year had started, of which 937.79 were teacher positions (Garrett, 2021). A February update by the Center indicates the state's total educator vacancy has gone up to 1,121 positions, including teachers and educators who provide instruction/support to students in school (e.g., counselors, librarians, etc.), largely due to mid-year teacher attrition (Center for Educator Recruitment, Retention, & Advancement, 2022). The update is not yet fully documented, thus does not provide details on the data that allow us to disaggregate the numbers and exclusively account for teacher vacancy. We report the most recent, official record of teacher vacancy of 938 for the South Carolina, while awaiting for new updates from the institution.
South Dakota	120	^71	2021-2022	News report	Associated Press (2021).	In August, 2021, the Associated Press (2021a) reported the South Dakota State's Education Secretary Tiffany Sanderson's prediction that there were likely 120 vacant teacher positions for the state's classrooms in the 2021-2022 school year. Sanderson's prediction was based on the number of teacher positions remaining open at the time, and the weeks away from the school year were too short to staff them due to increasing difficulties created by the Covid-19 pandemic (Associated Press, 2021a).
Tennessee	1,200	^1,483	2020-2021	News report	*Denis (2020); Tennessee Department of Education (n.d.); Tennessee State	A recent news article from the Wicked Karma Radio Network (WKRN), citing Amanda Kail, the president of the Metropolitan Nashville Education Association, reported Tennessee had

				Collaborative on Reforming Education (2020)	more than 1,200 teacher vacancies for the 2020-2021 school year (Denis, 2020). The figure is somewhat consistent with a policy memo released in the spring of 2020 by the Tennessee State Collaborative on Reforming Education (SCORE) (2020), which indicates many school districts of the state were having over 100 teaching vacancies, roughly translating to about 1,470 vacancies for the state's 147 districts in total (Tennessee Department of Education, n.d.).
Texas	570+	^8,697	2021-2022 News report	Fikes (2019); *Lopez (2021); Martin (2021)	In September, 2021, the Texas Tribune reported 300 vacant teacher positions for Houston Independent School District (ISD), which had been left over from 700 openings in the summer (Lopez, 2021). The news also provided that Killen ISD and Waco ISD together had 470 teacher openings for this school year, of which only 200 were filled, and at least 45 smaller school districts across the state had temporarily cancelled their face-to-face classes due to staffing difficulties (Lopez, 2021). These figures suggest Texas had at least 570 teacher vacancies for 2021-2022. A state-total vacancy count is however not available despite the news' continuous mentions of the state's teacher shortages (e.g., Fikes, 2019; Martin, 2021).
Utah	37	3,966	2021-2022 DOE/BOE document	*State of Utah Office of the Legislative Auditor General (2021a, 2021b); Utah State Board of Education (n.d.)	Latest data from the state's Office of the Legislative Auditor General provide that Utah has retained a strong teaching force with low levels of teacher turnover compared to the national average and the state itself in years past (State of Utah Office of the Legislative Auditor General, 2021b). We retrieve from the Office's district-level data a total of 37 teacher positions being vacant on the first day of the 2021-2022 school year (State of Utah Office of the

Vermont	Unknown	^98	2021-2022 News report	Barton (2020); U.S. Department of Education (2022); *Vermont Daily Chronicle (2022)	<p>Legislative Auditor General, 2021a). We also find about ten percent of the state's teachers having working under non-professional licensure, as of October 2021, and per the state's latest district-level licensure data (Utah State Board of Education, n.d.), we estimate a total of 3,966 underqualified teachers teaching in the state for the school year of 2021-2022.</p> <p>Although Vermont has been reporting teacher shortage areas to the U.S. Department of Education for at least three years (U.S. Department of Education, 2022), there has not been information provided on the extent of their teacher vacancy. Meanwhile, during the Covid-19 peak, school districts in Vermont were still open, and staffing difficulties were on support personnel and substitute teachers rather classroom teachers (Barton, 2020). A recent newsletter from the Vermont Daily Chronicle (2022) also indicates staffing issues in the state were trending in the opposite direction relative to the national average, specifically with decreasing numbers of job openings for both classroom teachers and substitutes. Putting together, it seems that the teaching force in Vermont has remained strong even coping with Covid-19, yet the evidence so far is not sufficient to make an assertion that the state has no teacher vacancy or to be informed about their underqualified hires.</p>
Virginia	1,420	^3,756	2020-2021 News report	Masters (2021)	<p>The Virginia Mercury, citing the Virginia Department of Education, reports the state had 1,420 unfilled teacher positions in the 2020-2021 school year, up nearly 62 percent from 877 vacancies in 2018-2019 (Masters, 2021).</p>

Washington	Unknown	5,902	2019-2020	DOE/BOE information	Washington State Professional Educator Standards Board (2021); *Washington Office of Superintendent of Public Instruction (2022)	The latest information regarding Washington's teaching force comes from the 2021 report by the Washington State Professional Educator Standards Board (2022). The report addresses Washington's teacher shortages using indicators such as increasing amount of teachers teaching under limited or conditional permissions instead of numbers of vacant teacher positions, yet provides no information on the extent of shortages. Meanwhile, latest data from the state's Office of Superintendent of Public Instruction (2022), the state's average class size was 18.0 in 2019-2020, while student-teacher ratio was 16.6:1, and 8.7% of its 67,841 teachers, or 5902.167, were teaching under substandard qualifications.
West Virginia	1,000	^458	2021-2022	News report	*McCormick (2021); West Virginia Department of Education (2021)	A West Virginia Department of Education official, Carla Warren, spoke on the West Virginia Public Broadcasting (McCormick, 2021) that the state had about 1,000 teacher vacancies for the 2021-2022 school year. It is important to noted, according to Warren, the figure includes both vacant positions and positions filled by less-qualified teachers or held temporarily by substitute teachers and district and school personnel. There is no detail in the information source that allows disaggregation of data to exclusively account for teacher vacancy. Latest document from the DOE also indicates the state has not has not kept track of their vacancy headcount (West Virginia Department of Education, 2021), suggesting an exact number of the state's total vacancy is currently unavailable.
Wisconsin	2,565-	^1,346	2021-2022	Institution document	Fox (2021); Gunn (2021); *Wisconsin Policy Forum (2021);	There has been no data on the extent of teacher vacancy in Wisconsin. The latest information comes from the Wisconsin Policy Forum (2021),

					Wisconsin Public Radio (2021)	which is has recently been widely discussed in the news (e.g., Fox, 2021; Gunn, 2021; Wisconsin Public Radio, 2021). The Forum’s document (Wisconsin Policy Forum, 2021), citing the state’s Department of Workforce Development, reports a projection of 2,565 preschool and K-12 teacher openings in the state in each of the coming years.
Wyoming	Unknown	181	2020-2021	DOE/BOE information	*2020-21 Report Card (n.d.); Hughes (2020); McFarland (2022); Morton (2021); U.S. Department of Education (2022)	Although Wyoming is said to have “a teacher shortage for years” (McFarland, 2022), there has not been a figure of its teacher vacancies reported so far. According to the state’s official data for the school year 2020-2021 (2020-21 Report Card, n.d.), it had a total of 7,445.55 teacher FTEs, of which 180.81 were teachers teaching under emergency or provisional permission, and absolutely zero percent out-of-field teachers. The state did, however, have a short-term crisis of substitute teacher in 2020 when Covid-19 reached its peak (Hughes, 2020), and has been having staffing difficulties to some extent (McFarland, 2022). It has also been reporting teacher shortage areas to the U.S. Department of Education (2022) since at least 2015. In general, Wyoming’s teacher shortages seem not as severe as neighboring regions, and that the state is likely not experiencing teacher vacancy (Morton, 2021). However, the evidence so far is neither sufficient to state that they have no vacancy nor to provide the extent of their shortages.

Note: * denotes primary reference for multiple-source information. + denotes a subtotal of the state’s total teacher vacancies. - denotes the number of teacher openings instead of teacher vacancies. ~ denotes a rough estimate of the state’s teacher vacancies. ^ denotes underqualification counts retrieved from the Civil Rights Data Collection (2018) in supplement to data unavailability in the primary searched results.

Variable description:

- Vacancy: Number of vacant/unfilled teacher positions reported by or retrieved from the information source(s)

- Underqualified: Number of underqualified hires reported by or retrieved from the information source(s)
- School year: School year associated with the vacancy information
- Prime source: Type of the information source primarily used to determine vacancy count (and underqualification if provided)
 - DOE correspondence: Information comes from correspondence between the research team and state boards/departments of education
 - DOE/BOE document: Information comes from official documents by state departments of education or board of education
 - DOE/BOE information: Information comes from state boards/department of education but not officially documented (e.g., websites, presentations, officials' statement, etc.)
 - Institution document: Information comes from official documents by independent agencies or institutions
 - Institution info: Information comes from independent agencies or institutions but not officially documented (e.g., websites, presentations, officials' statement, etc.)
 - News report: Information comes from news reports, briefs, or other forms of media releases

Appendix 2. Teacher vacancies per teacher and student population

State/Jurisdiction	# Teachers	# Students	Vcy/100 tchs	Vcy/10K stds	Unq/100 tchs	Unq/10K stds
Alabama	42,022	734,559	7.14	40.84	12.01	68.69
Alaska	7,484	129,872	N/A	N/A	0.71	4.08
Arizona	48,912	1,116,034	3.47	15.22	7.43	32.56
Arkansas	35,800	496,085	N/A	N/A	4.27	30.80
California	266,149	6,180,188	N/A	N/A	9.03	38.88
Colorado	53,900	883,199	0.44	2.66	1.66	10.11
Connecticut	41,864	541,074	0.58	4.47	1.24	9.57
Delaware	9,747	138,092	2.10	14.85	2.91	20.57
District of Columbia	7,409	89,883	2.16	17.80	28.75	236.97
Florida	165,929	2,789,892	2.36	14.02	10.00	59.45
Georgia	117,837	1,769,657	2.64	17.59	4.43	29.50
Hawaii	12,221	176,441	2.98	20.63	5.88	40.69
Idaho	16,592	301,186	2.83	15.60	2.87	15.80
Illinois	132,802	1,943,117	1.28	8.76	0.25	1.73
Indiana	61,226	1,033,964	1.60	9.48	1.55	9.21
Iowa	35,553	511,850	N/A	N/A	0.17	1.17
Kansas	36,603	481,750	3.28	24.91	2.04	15.49
Kentucky	42,223	658,668	1.91	12.24	0.58	3.72
Louisiana	38,589	710,439	N/A	N/A	27.37	148.64
Maine	14,760	180,204	4.67	38.23	3.29	26.91
Maryland	61,485	882,527	1.63	11.33	5.95	41.45
Massachusetts	75,131	911,465	N/A	N/A	9.86	81.26
Michigan	84,768	1,495,924	0.62	3.52	1.04	5.92
Minnesota	54,387	893,203	0.19	1.13	8.28	50.44
Mississippi	31,578	442,627	9.61	68.59	4.82	34.36
Missouri	69,145	882,388	0.05	0.43	5.13	40.20
Montana	10,555	146,375	3.11	22.41	0.83	6.01
Nebraska	24,028	324,697	0.17	1.29	0.73	5.39
Nevada	23,240	492,640	3.60	16.99	4.70	22.17
New Hampshire	14,695	168,526	N/A	N/A	40.00	348.79
New Jersey	117,060	1,373,948	0.13	1.08	8.08	68.82
New Mexico	21,850	316,840	4.80	33.08	3.32	22.91
New York	213,159	2,724,663	N/A	N/A	2.50	19.55
North Carolina	100,777	1,513,677	1.68	11.22	14.71	97.92

North Dakota	9,470	113,845	1.53	12.74	0.53	4.39
Ohio	98,912	1,704,399	N/A	N/A	0.55	3.18
Oklahoma	42,448	698,891	1.16	7.07	2.91	17.70
Oregon	29,823	580,645	N/A	N/A	1.28	6.56
Pennsylvania	121,918	1,726,809	0.28	1.99	0.89	6.28
Rhode Island	10,693	139,184	0.87	6.68	1.68	12.93
South Carolina	53,556	766,819	1.75	12.23	1.18	8.24
South Dakota	9,930	139,318	1.21	8.61	0.72	5.10
Tennessee	64,784	985,207	1.85	12.18	2.29	15.05
Texas	364,478	5,372,806	0.16	1.06	2.39	16.19
Utah	30,256	680,659	0.12	0.54	13.11	58.27
Vermont	8,042	82,401	N/A	N/A	1.22	11.89
Virginia	87,220	1,250,713	1.63	11.35	4.31	30.03
Washington	62,209	1,142,073	N/A	N/A	9.49	51.68
West Virginia	18,854	253,447	5.30	39.46	2.43	18.07
Wisconsin	59,801	830,066	4.29	30.90	2.25	16.22
Wyoming	7,391	93,037	N/A	N/A	2.45	19.45

Note. Variable description: Teachers: State's total teacher FTEs (full-time equivalent), by Common Core of Data², as of the school year associated with shortage information. Students: State's total number of students, by Common Core of Data, as of the school year associated with shortage information. Vcy/100 tchs: Teacher vacancies per 100 teachers. Vcy/10K studs: Teacher vacancies per 10,000 students. Unq/100 tchs: Underqualified hires per 100 teachers. Unq/100 studs: Underqualified hires per 10,000 students.

² The Common Core of Data were used to determine relative teacher shortage measures instead of the states' numbers for consistency of comparison and interpretation.

Appendix Table 3. Teacher vacancy counts by U.S. Census region and division

Region 1 Northeast: 1,515	Region 2 Midwest: 7,421
• New England: 1,024	• East North Central: 5,775
• Mid-Atlantic: 491	• West North Central: 1,646
Region 3 South: 22,550	Region 4 West: 5,018
• South Atlantic: 13,444	• Mountain: 4,654
• East South Central: 8,042	• Pacific: 364
• West South Central: 1,064	
National total: 36,504	

Note: Estimated national teacher vacancy is a rough estimate by summing all known vacant positions. Division 1: New England (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont). Division 2: Mid-Atlantic (New Jersey, New York, and Pennsylvania). Division 3: East North Central (Illinois, Indiana, Michigan, Ohio, and Wisconsin). Division 4: West North Central (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota). Division 5: South Atlantic (Delaware; Florida; Georgia; Maryland; North Carolina; South Carolina; Virginia; Washington, D.C. and West Virginia). Division 6: East South Central (Alabama, Kentucky, Mississippi, and Tennessee). Division 7: West South Central (Arkansas, Louisiana, Oklahoma, and Texas). Division 8: Mountain (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming). Division 9: Pacific (Alaska, California, Hawaii, Oregon, and Washington)

Appendix Table 4. The relationship between number of completers, vacancy, and underqualification

	(1)	(2)
	Vacancy	Underqualification
Number of completers	-0.310*	-0.946**
	(0.131)	(0.288)
Students	0.001**	0.006**
	(0.000)	(0.001)
Constant	647.376**	276.757
	(212.790)	(570.842)
Observations	37	50

Note. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$