

Murky Pools: Describing the supply of teachers and staff to schools

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ABSTRACT

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1. How does the number of applications per position vary by teaching position, both overall and only for those applications from teachers with appropriate certifications?
2. How does the number of candidates vary across position? More specifically, are the number of applications a good proxy for number of available candidates or do candidates respond to supply by applying to more positions when there are fewer spots available per candidate?
3. How does the number of applications per non-teaching staff position, the number of candidates per position, and the number of applications per candidate vary across positions.
4. Are the patterns evident in a state with complete data similarly evident in the incomplete data from other states?

These questions are addressed using a novel dataset. Information is drawn from a 2010 data extract from Schoolspring.com, the country's largest online jobs clearinghouse for education positions at the K-12 level. This paper utilizes job postings, job applicant information and employer information from New England States, with a particular emphasis on findings from the State of Vermont where the data exist for every district in the State.

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Murky Pools: Describing the supply of teachers and staff to schools

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Introduction

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This paper is the first that we know of to examine the applicant pool across teaching areas and among non-teaching school staff positions. In particular, we ask the following four research questions:

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These questions are addressed using a novel dataset. Information is drawn from a 2010 data extract from Schoolspring.com, the country's largest online jobs clearinghouse for education positions at the K-12 level. This paper utilizes job postings, job applicant information and employer information from New England States, with a particular emphasis on findings from the State of Vermont where the data exist for every district in the State.

The findings point to a new observation among those that question how teacher sorting occurs. These findings will demonstrate that applications for teaching positions vary in both their overall count, but also in key aspects of the qualifications of applicants BY TYPE OF TEACHING

POSITION. The same is true for non-education staff positions like administrators and school support staff. We observe substantial variation, but also a degree of murkiness in the qualifications of applicants. The percentage of applicants that are actually certified for the position that they have applied for, varies considerably by the type of teaching position. This means that for some teaching positions, administrators and hiring officers are more challenged to identify legitimate candidates.

Background

Research about the importance of hiring high quality educators has, over the past decade, increased attention on the moment of hiring. Whereas a prior research stressed the characteristics of teachers entering the profession, or the tendency of new teachers to work close to home, more recent work has focused squarely upon illuminating how hiring officers (e.g. superintendents, principals and HR directors) actually recruit and retain teaching staff (Boyd, Lankford, Loeb, Ronfeldt, & Wyckoff, 2011; Boyd, et al., 2005b; Cannata, 2010; Hanushek, Rivkin, Rothstein, & Pordgursky, 2004; Harris, Rutledge, Ingle, & Thompson, 2010; Ingle & Rutledge, 2010; Liu & Johnson, 2006; Maier & Youngs, 2009; Rutledge, et al., 2008).

In what follows we summarize some of the literature about teacher labor markets, including scholarship on the hiring process for teachers and the role of school location and social networks in the teacher hiring and job seeking process.

Applicant Preferences: Student, School, and Location Characteristics

A great deal of research has answered the question of why teachers sort themselves towards certain schools as a function of the balance between their own characteristics and their preferences for the job setting. For example, teachers with stronger overall qualifications are

found to sort towards better performing schools, with high performing students and high salaries (Lankford, Loeb, & Wyckoff, 2002, p. 238). Some research has argued that the absence of high quality teachers in lower performing and less desirable locations, is mainly a function of the tastes and preferences of higher performing teachers (Hanushek & Rivkin, 2007; Lankford, et al., 2002; Murnane & Steele, 2007). Of course, another large theme in this research literature is the observation that the sorting of teachers is governed by their preferences to work in close proximity to where they were raised. Called the draw to home thesis, Boyd et al (Boyd, et al., 2005b) found that teachers work in close proximity to home, and likely do so more than other similar occupations (Reininger, XXXX).

Teachers appear to favor local jobs over those requiring larger moves, but characteristics of the school community also matter. Cannata (2010) has found that teachers considered how supportive the principal seemed to be, whether mentoring and instructional materials were provided (Cannata, 2010). Teachers tend to apply to positions in which the district demographic characteristics are similar or match their own (Cannata, 2012)

Several scholars have addressed the role community amenities play in the attractiveness of a setting for teacher applicants. Both school location and neighborhood characteristics matter to teachers. Boyd et al (2011) found that teachers seem to favor higher median income settings that have rich community amenities, at least when considering whether to transfer jobs or not.

Recently Miller (2011) identified which community amenities seemed to influence teacher application and job taking. Miller examined factors like geographic isolation, access to hospitals, shopping and housing, and found that teachers that were originally from rural areas tend to work further away from their home environments than those in urban communities. In general teachers with higher overall qualifications like degrees from better college or university programs, or

even those teachers with stronger SAT performance scores were less likely to stay in rural school settings.

Teacher and employer characteristics and preferences revealed through recruitment and hiring processes

A more recent, though notably smaller body of research has addressed questions about how principals and other hiring officers both recruit and hire teachers in schools. The moment of hiring is complex, but fundamentally necessary in the attraction and retention of teachers (Rutledge et al., 2008). Unfortunately, employers are often working with limited information about the candidates. Harris et al, in their surveys of principals, found that principals favored teachers with content knowledge, as well as strong personality skills and high intelligence. Harris also found that some teachers with impressive content knowledge and intelligence, also had a strained relationships with students and difficulty reaching all students—Dull personalities often do not motivate students and principals were aware of these issues while hiring (Harris et al. 2010) . In all principals, and the officers that hire teachers, assume a great deal of competency among teachers, with respect to content and general abilities, largely because of limited information about the job candidate (Harris et al., 2010; Rutledge et al., 2008).

Summary

For the most part, the literature on where teachers teach has identified the persistent sorting of teacher quality across urban, suburban and rural areas; This literature tends to stress how the discrete qualities of the local job site(e.g. district size, location, amenities) interact with candidate preferences (e.g. expressed by teacher characteristics). Yet, there is very little information in the literature that speaks to how employer preferences for candidates may

influence teacher sorting. Further, there is no real information about how the matching process of candidates to jobs varies by important factors like the hiring season or the job itself. The literature is largely quiet for example on whether job candidate preferences and characteristics for jobs varies by type of job (e.g. English subject area vs. a special education generalist position), OR whether such preferences and characteristics vary depending on the time of the hiring season. The literature is completely silent on non-education staff positions.

Data and Methods

Data and Data Management

The primary data source for this study comes from an online education jobs clearinghouse, *SchoolSpring.com* (now part of *Nechemia, LLC*), which is active in multiple states. SchoolSpring is the country's largest online jobs clearinghouse focused on education professionals with upwards of 40,000 unique visitors per day. SchoolSpring has contracts with all school districts in Vermont and covers all job postings for the state of Vermont; this allows us to study the entire Vermont public school teacher and staff labor market.

SchoolSpring posts employment opportunities for a wide variety of school and district positions. These include, but are not limited to teaching positions for math, science, history, ELA, elementary school, special ed, art and music, and physical education; staff positions are even more varied, and include superintendent, principal, computer systems experts, mental and physical health staff, cooks, custodial roles, and even bus drivers.

To these job postings, candidates submit an application through the SchoolSpring system. Candidates complete a common application, which gathers information about candidates'

education credentials (i.e., college transcripts and test scores), prior work experiences, and professional references. Candidates can use the common application to apply to multiple jobs postings on SchoolSpring simultaneously. In addition, teacher and staff candidates have the opportunity to tailor their applications by answering specific questions posed by employers.

The data School Spring provided to us include detailed records on teacher and staff job postings by schools and districts. The SchoolSpring system records information on all jobs posted through its system, as well as the employers that post the positions. This information includes number of positions available, job start date, job status (i.e., filled or not), job type (i.e., full time, part time), posting date, level of education preferred, position type (i.e., new, retirement), salary, prior experience required, grade level, benefits, number of references required, school location, type of school (e.g. public, charter, private), job title, employer's address, job requirements, and the job description. Table XX provides descriptive statistics of employer fields used in analyses. For example...

Application details and data from job candidates are also tracked, and linked to relevant job postings. SchoolSpring data on candidates include a range of information not typically available in large-scale studies of teachers' career paths. This information includes prior teaching experience, non-teaching professional experience, current salary, date available to begin work, gender, race, birth year, highest level of education, highest degree earned, gpa from bachelors' program, gpa from masters' program, major(s) from BA program, major(s) from MA programs, teaching examination scores, certification status, certification area, proficiency in another language, veteran status, and address. Of importance for our analysis is the candidates' certification status, which we use to better understand how qualified the applicant pool is for given jobs in Vermont.

To the SchoolSpring data, we link data from the National Center for Education Statistics Common Core of Data (CCD), an annual dataset that includes fiscal and non-fiscal data about all public districts in the United States.

Our initial sample from the academic years 2006-07 to 2008-09 consists of approximately 9,700 jobs and 146,132 applications for teacher or staff positions. These data allow us to describe the teacher and staff labor market in Vermont.

Sorting Job Posts

We are interested in sorting the job posting data into specific teacher and staff *job categories*.

We want to know, for example, how many jobs were posted in the category of mathematics, science, history, or elementary teacher, or vice principal, bus driver, administrative assistant, to name a few job categories. The specific teaching categories of interest can be broken down into two types: grade level or school division teachers, and subject area teachers. The grade-level or school division teachers are elementary, middle, or high school, and non-grade or non-division general educators. The teaching subjects of interest are math, science, technology, history, ELA, foreign language, art and music, physical education, limited English proficiency (LEP), special education, substitute, title 1 teachers, and other. If a position is flagged as a specific subject, such as ELA, then it is not considered a grade-level or division teaching position. For example, 9th-grade ELA positions are counted as ELA teachers, not 9th grade teachers. The staff categories we identify are: superintendent, principal, vice-principal, academic leaders, academic coach, sports coach, media, management, health staff, paraeducators, temp-positions, after-school staff, administrative staff, childcare, tutors, drivers, custodial, and food staff. A staff position cannot be counted as a teaching position.

To identify job postings in these particular areas, we start by conducting a keyword search of the *job title* data field (see appendix XX for the specific keywords used in each search). Although other fields in the data contain more complete descriptions of each job posting, the brevity of *job title* field limits the potential for false positive hits. As we rely on keywords to sort job posting, the more words a searched field contains, the more potential there is for miscategorizing a posting.

The keyword lists used in this sorting process were developed iteratively. After an initial list was constructed and the data sorted, results were examined for coverage and accuracy. Coverage, in this case, means that most job postings were sorted into a specific teacher or staff category. Accuracy here is understood to mean that jobs are sorted into the category to which they belong; this was assessed by visually inspecting randomly selected job postings. Keyword lists were then updated, job posting were resorted, and results were again reviewed for coverage and accuracy. This process repeated until over 90% of job postings were sorted to a job category, and [not sure what to say, this process hasn't actually ended yet...].

In constructing keyword lists, it became clear that certain words ought to exclude a posting from being sorted into certain categories. For example, we did not want to sort “assistant to the superintendent” into the superintendent category just because the word “superintendent” was present in the job title. Nor would we want to sort “English as a second language” into the ELA category. To avoid problems like this, we generated keyword exclusion lists. Words on these lists acted to stop a job posting from being sorted into certain categories. These lists, too, were updated iteratively (and are listed in appendix XX).

Some of the statistics we present below are based on the number of total teaching positions posted to the SchoolSpring website. To calculate such statistics, it was necessary to put a “staff” or “teacher” label on each job posting. The categories already described provided a natural division for each position. If a job post was categorized as a grade-level, division, or subject specific position, it was counted in the “teacher” category. This category was supplemented with a keyword search on the uncategorized job postings. Generic words in the job title, such as “teacher”, would result in an uncategorized post being sorted to the “teacher” category. A job posting was sorted to the “staff” bin if the posting fell into one of the staff categories listed above.

The staff categories used proved to be too many for easy graphical representation. To address this issue, we combined a number of positions into more general staff categories. Listed below are the super-categories for the staff positions:

- *School Leadership* combines management, superintendent, principal, vice principal, and academic leader staff positions;
- *Instructional Support* combines media, tutors, and academic coaches positions;
- *Assistants and Operations* combines school administration, food service, custodial, and driver staff positions;
- *Afterschool and Childcare* combines afterschool and childcare positions.

Job Applications and Candidates

Sorting job postings in the fashion described above allows us to quantify not only the number of job postings in a particular area (teaching or staff) and for a particular category (e.g. math teacher or vice principal), but also the number of applications received for each of these job postings. We

are then able to calculate the mean and standard deviation of applications submitted within a specific job category. Looking across job categories, we can also examine variation in the mean applications received by job category.

We are also interested in identifying the underlying number of job candidates that exist in a job category applicant pool. To measure this, we gather the pool of applications for a particular position category and identify the number of unique candidates within this pool. Consider, for example, job postings for elementary school teaching positions. In Vermont, there were 656 jobs posted for full-time elementary school teachers within the years 2006-2009. To these jobs, the SchoolSpring data show that 25,598 applications were submitted, for an average of over 39 applications per elementary school job posting. Some of these applications came from the same candidates – that is, any one candidate is likely to apply to more than one job, by either applying to multiple elementary school job postings at the same school, applying for elementary school jobs at different schools, or some combination of both of these behaviors. By determining how many unique candidates there are applying to a specific position type, we are able to calculate, among other statistics, the candidates per job posting. The 25,598 applications submitted to elementary teaching posts in Vermont were submitted by 4064 unique candidates.

The provided SchoolSpring data also contain job posting and candidate application data from many other states. Four other states, in particular, had reasonable coverage in terms of the percentage of schools in the state represented in the data. These states are Connecticut, Maine, Massachusetts, and New Hampshire. We provide limited statistics on these four states.

Table XX provides a listing with descriptive information on applications and candidates for job postings in the state of Vermont. [DESCRIBE TABLE]

Findings

How does the number of applications per position vary by teaching position, both overall and only for those applications from teachers with appropriate certifications? Figure 1 describes the number of applicants per position for common teaching positions in Vermont. *The first clear finding is that open teaching positions vary radically in the number of applications they receive.* Elementary education positions receive close to 40 applications, while foreign language positions receive less than eight, on average. Among subjects, History received the most, then English language arts, and then Art and Music. Science received quite a bit fewer and the Special Education, Math and Limited English Proficiency positions even fewer, at about 11.

The second finding is that quite a number of the applicants are not certified to teach at all and even more are not certified in the area to which they are applying. Figure 1 shows that for Elementary positions, of the approximately 40 applications per job, approximately 35 are certified and about 26 are certified in to teach elementary education. As shown in Figure 2, the proportion of applications with certification is especially small for special education for which only 40 percent are certified.

How does the number of candidate vary across position? More specifically, are the number of applications a good proxy for number of available candidates or do candidates respond to supply by applying to more positions when there are fewer spots available per candidate? While postings for jobs receive different numbers of applications, the applications per position may not reflect true supply differences across teaching areas since candidates may systematically apply to different numbers of jobs. Figure 3 summarizes the total number of candidates per opening by teaching field. The differences have some similarity to those for the number of applications per

position but there are also some differences. In particular, History teaching shows the greatest supply, with elementary positions a relatively close second. Special education sees the fewest applicants with appropriate certification, followed by foreign language, and then by mathematics, limited English proficiency and science, which all have approximately the same supply.

A comparison of Figures 1 and 3 provides evidence that candidates in different fields apply to different numbers of jobs. Figure 4 illustrates this difference more directly. Elementary teaching candidates apply to far more positions than do most other groups of teachers. Teachers for Limited English Proficiency positions apply to fewer positions than do other teachers. All other positions apply to approximately the same number of open positions, on average. This variation could be due to labor substitution effects where elementary level certified teachers may opt to teach in a larger variety of positions than teachers with more narrow certifications.

Two findings are clear from these analyses. First, there is substantial difference in supply across fields with Elementary positions as well as History and English positions seeing meaningfully greater supply than Math, Science and Limited English Proficiency positions, and with Special Education positions seeing the lowest supply. Second, the number of applications per position is not an accurate measure of supply as candidates for different fields apply systematically to different numbers of open positions.

How does the number of applications per non-teaching staff position, the number of candidates per position, and the number of applications per candidate vary across positions. Figure 5 gives similar results for non-teaching positions in schools. Since most of these positions do not require certification, we do not include the certification analysis. As described above, we group jobs for this analysis into eight types of positions: temporary

positions, para-educators, school leadership, instructional support, sports coach, health staff, assistants and operations, and afterschool and childcare.

The number of applications and candidates per position is approximately the same for most non-teaching jobs as it is for most teaching jobs. Temporary positions, on average, receive the most number of applications and we see the highest number of candidates per available position for these jobs. There are more candidates for these positions than for teaching positions. Para-educator also receive a relatively large number of applications per position but these candidates apply to more positions than other candidates and the total supply (candidates per open position) is low, about the same as sports coach and health staff positions which have the lowest supply.

Figure 6 confirms the comparisons evident between applications and candidates in Figure 5.

Para-educators apply to the most positions, followed by sports coaches, health staff and school leadership. Afterschool and childcare workers, instructional supporters and health staff apply to the fewest.

Are the patterns evident in state with complete data similarly evident in the incomplete data from other states? Vermont is a particularly appropriate state for this analysis because SchoolSpring data covers all districts in the state and all jobs in those districts. However, districts in other states also use SchoolSpring. While we do not know how these districts choose whether or not to participate, and thus do not know how representative they are of their state, we can examine whether the trends observed in Vermont are consistent in the other states as well.

Figure 7a describes the number of applications per position and Figure 7b describes the number of candidates per position for participating schools in Massachusetts, Rhode Island, Connecticut, and Maine. We see substantial variation in the average number of applications and candidates

between states. For example, Massachusetts sees over 100 applications (over 75 with certification) for elementary positions while Connecticut and Maine see half that number.

While the magnitudes differ, many of the trends observed for Vermont are evident in these samples as well. First, Elementary, History and English Language Arts positions consistently have the largest number of applications per position and candidates per position. Second, Foreign Language, Limited English Proficiency, Math, Special Education, and Science consistently have the fewest applications and candidates, especially from applicants with appropriate certification. Third, the total number of applications and candidates isn't a good reflection of supply because so many applicants do not have the appropriate certifications. Fourth and finally, even the number of applications from candidates with certification is not a good measure of supply because candidates for different positions differ in the number of positions they apply to. In particular, Elementary and History candidates tend to apply to more positions, perhaps because the competition in those areas is greater.

Figure 8 similarly describes the supply of staff positions for Massachusetts, Rhode Island, Connecticut, and Maine. These results are more consistent in magnitude across states than for teaching positions but they are not as consistent internally or with Vermont as they are for teaching positions. Two consistent patterns do emerge. Temporary positions tend to have higher than average applications and candidates per position and Sport Coach positions tend to have lower than average applications and candidates per position. School leadership positions, perhaps the most important for school functioning of the non-teaching positions, receive 12 to 20 applications per position and have approximately ten candidates per available position.

Discussion and Conclusion

Figure 1

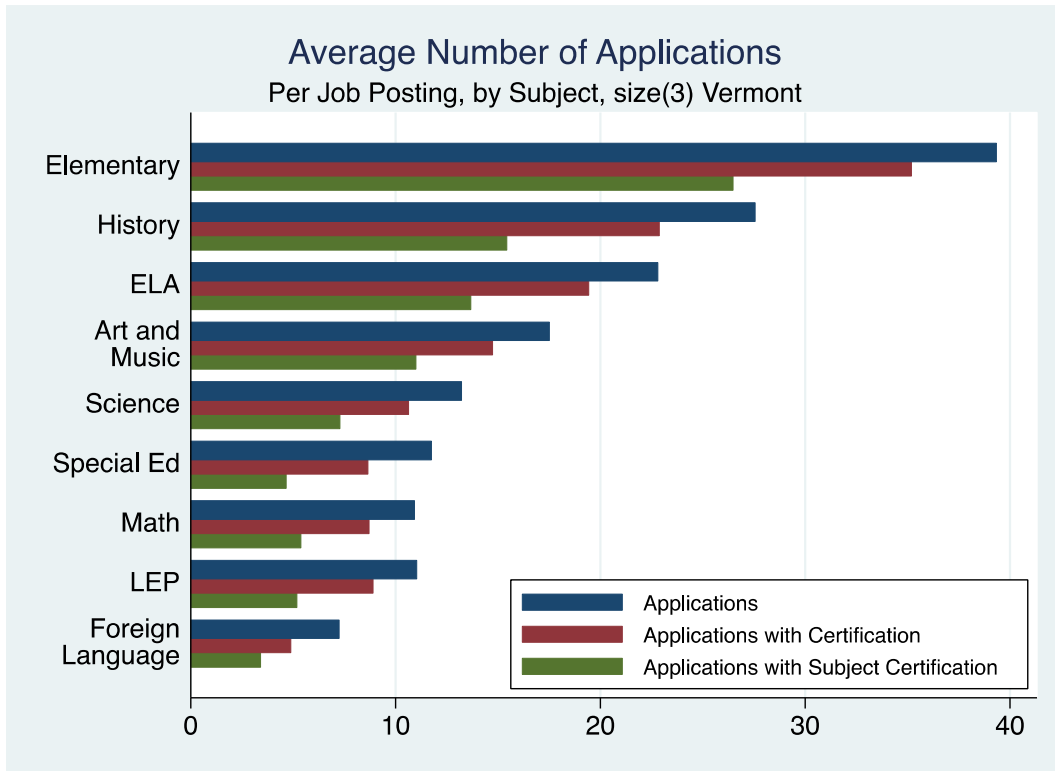


Figure 2

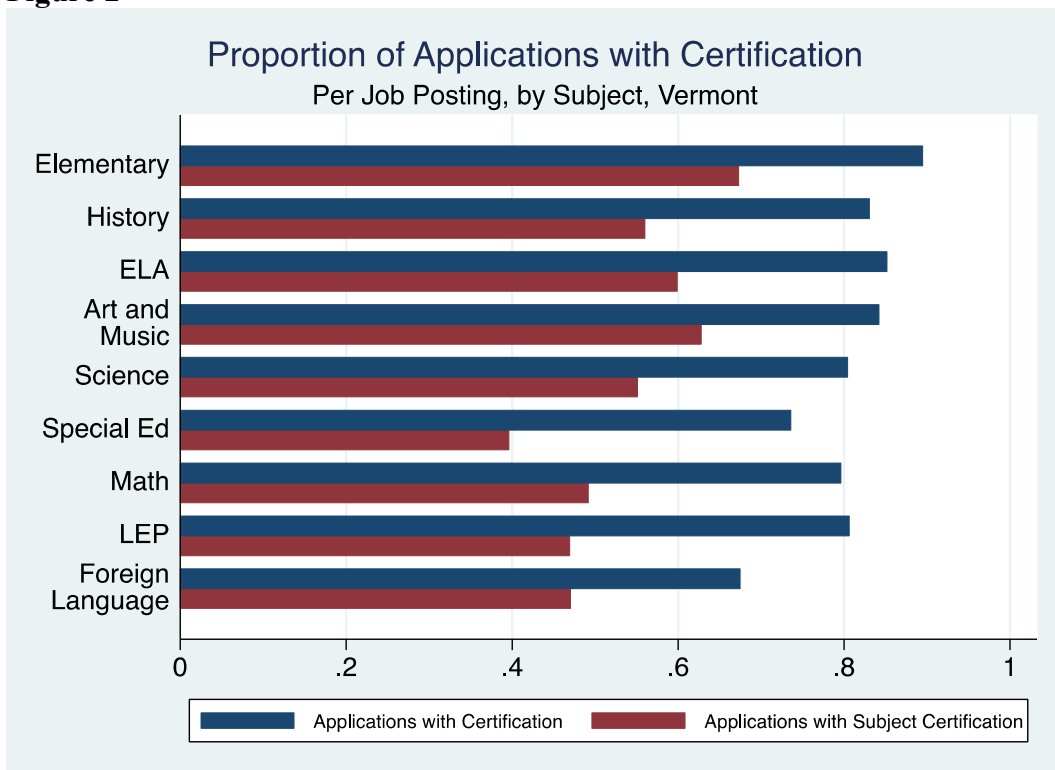


Figure 3

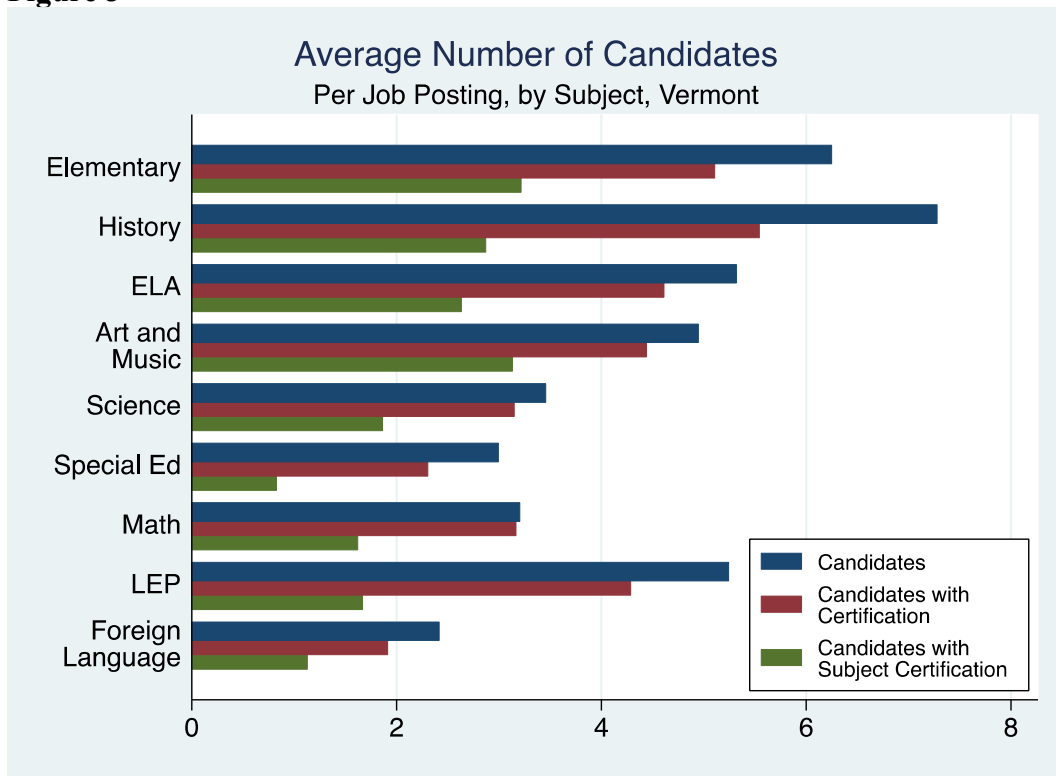


Figure 4

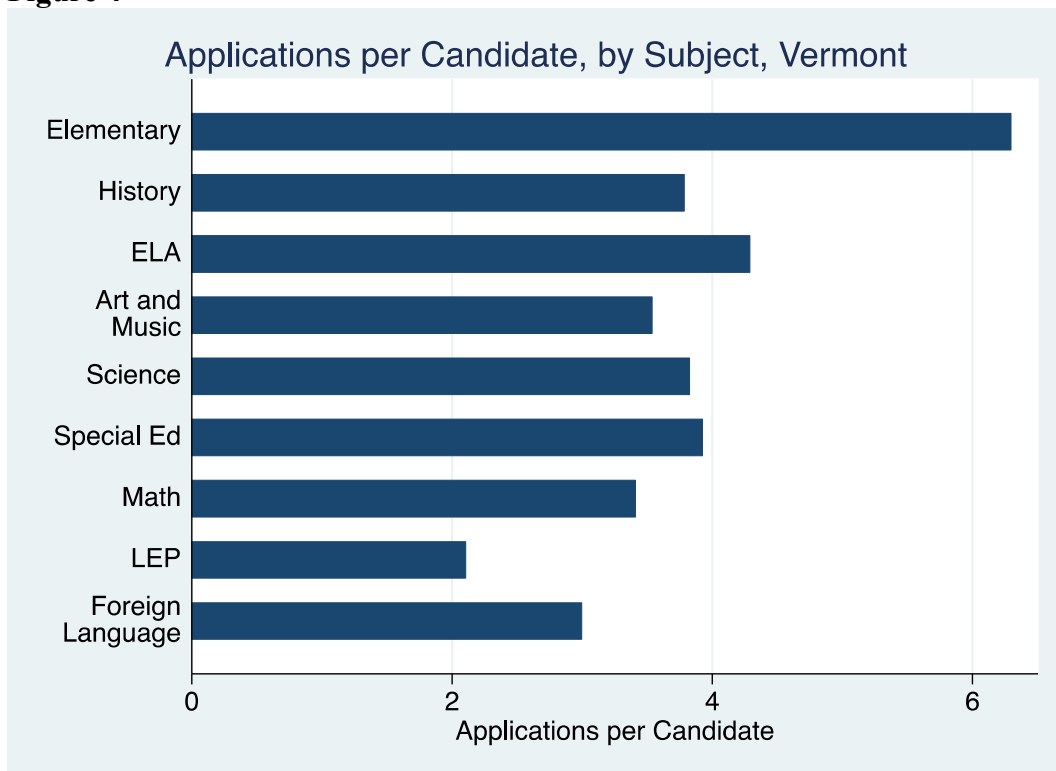


Figure 5

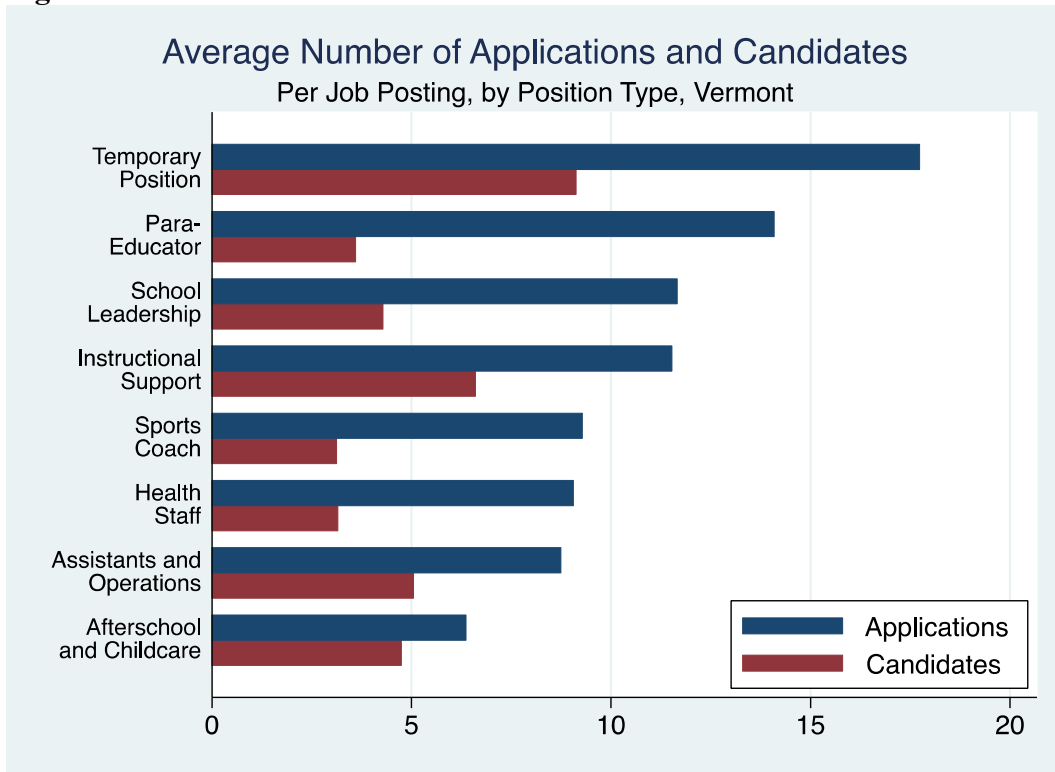


Figure 6

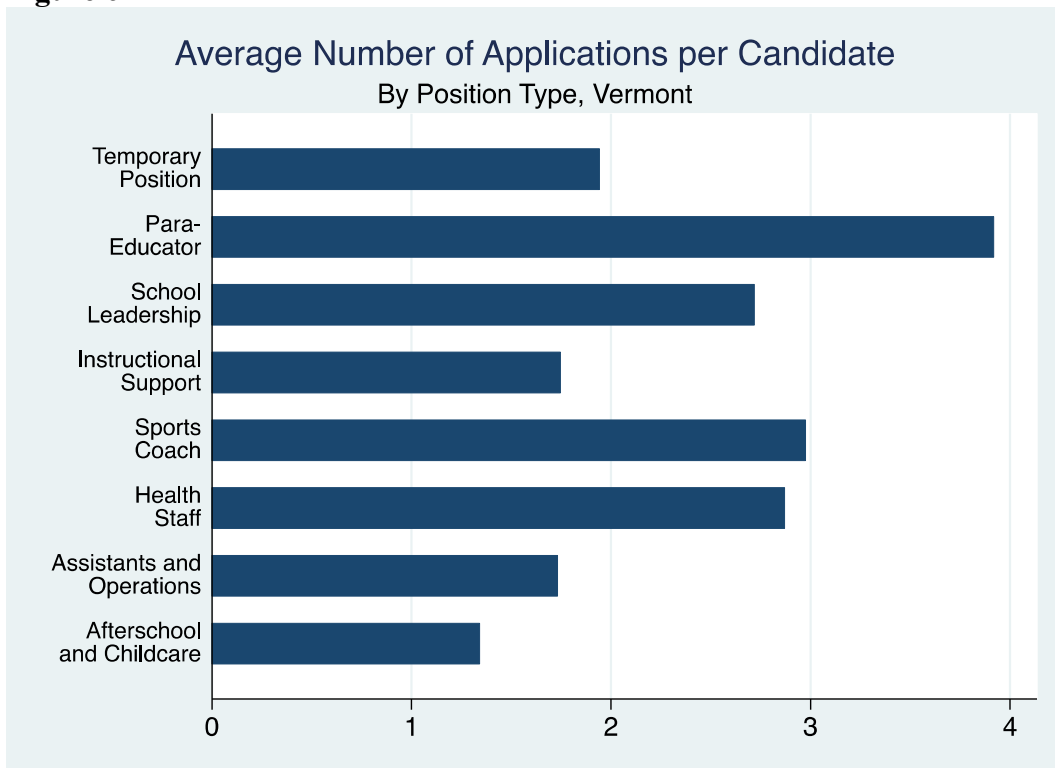


Figure 7a

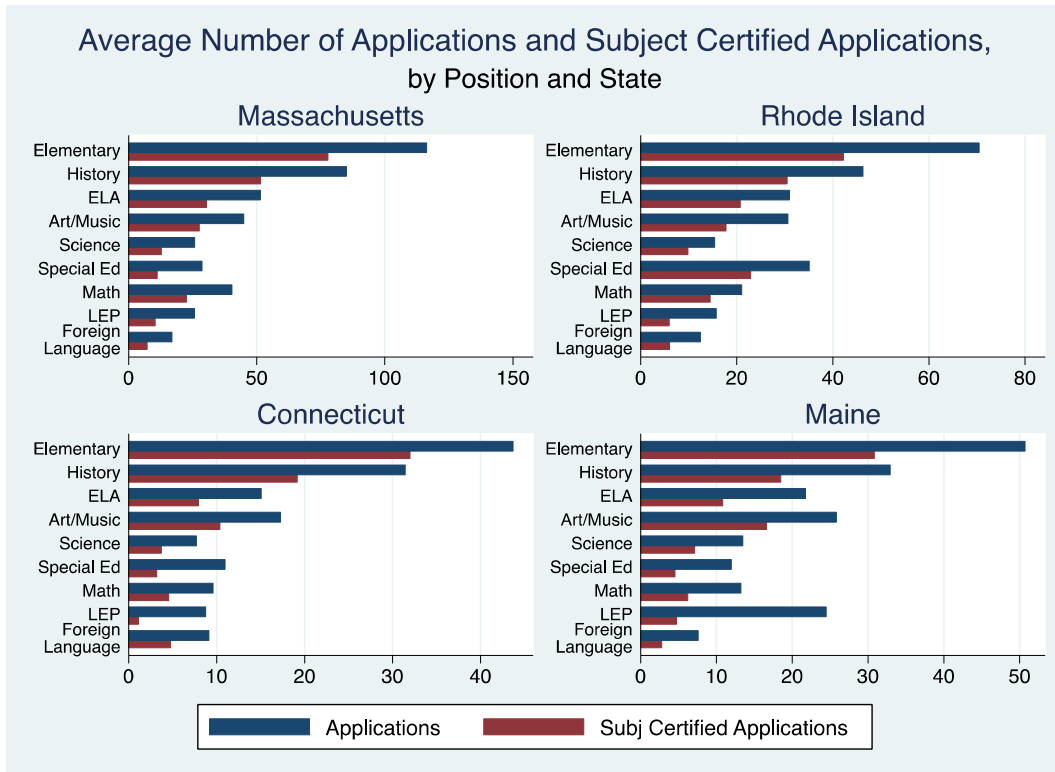


Figure 7b

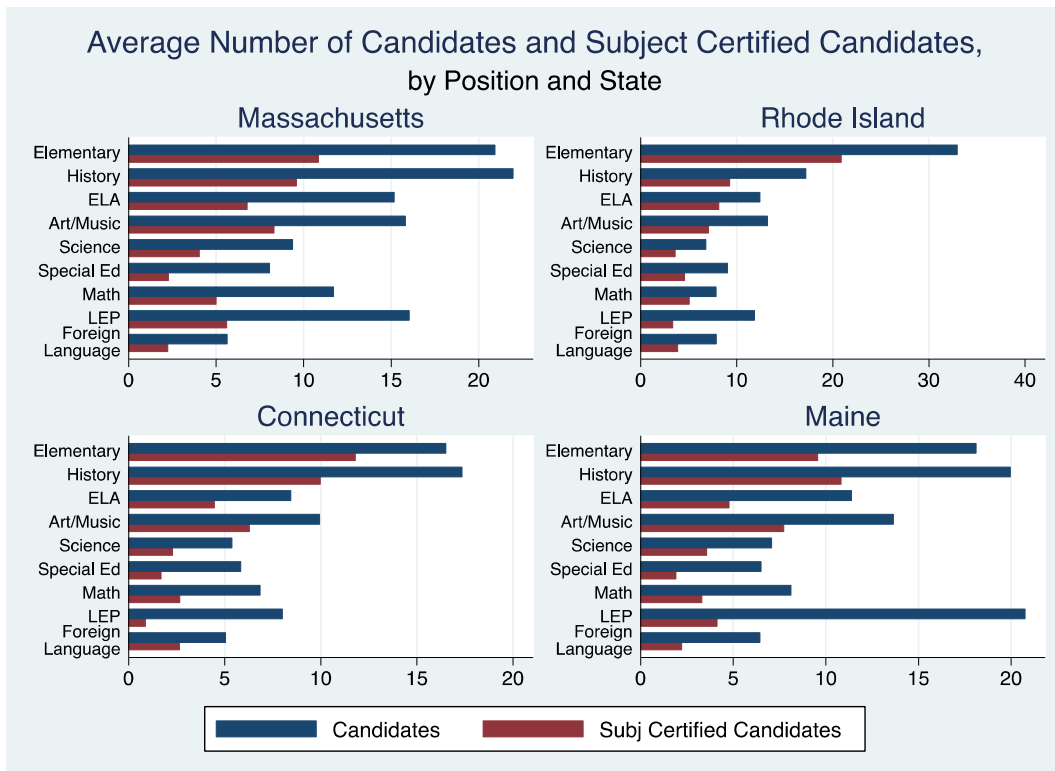
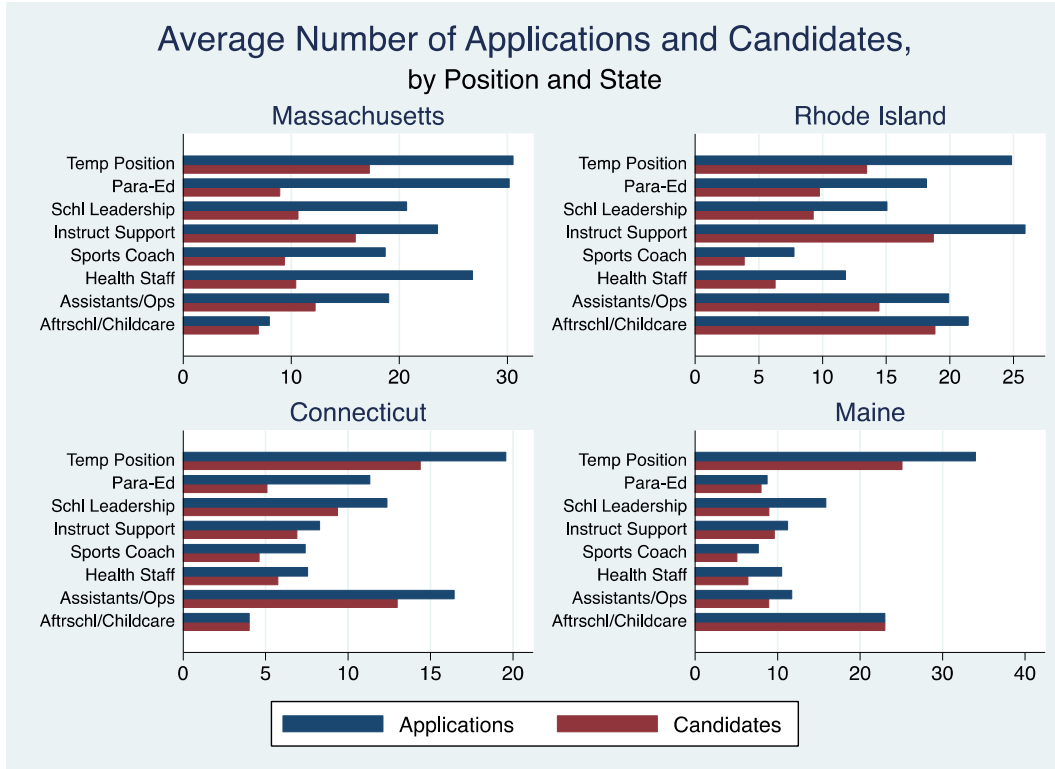


Figure 8



Appendix 1: Sorting Teacher and Staff Job Postings

We use a keyword search on the *job title* field in the SchoolSpring data to sort job postings into specific categories. The first goal is to sort each job posting into a specific position category, such as elementary school teacher, science teacher, principal, or school librarian, to name a only a few. We then take these specific categories and divide them between two broader categories, *teaching* and *staff*. We use other fields in the data to confirm or identify the school level, e.g. elementary, middle, high, and if the position is full- or part-time.

Within the staff category, we combine certain staff positions for the sake of simpler graphical representation. Below is how various staff categories are combined:

- *School Leadership* combines management, superintendent, principal, vice principal, and academic leader staff positions;
- *Instructional Support* combines media, tutors, and academic coaches positions;
- *Assistants and Operations* combines school administration, food service, custodial, and driver staff positions;
- *Afterschool and Childcare* combines afterschool and childcare positions.

The keywords for each position type are provided below. In many cases, sorting a job posting into a position type is as much about finding the right key words as it is about excluding certain sets of words. The excluded word lists are also presented below.

Teaching position keywords:

elementary

"pre-kindergarten" "prekindergarten" "kindergarten" "grade 1" "grade 2" "grade 3" "grade 4"
 "grade 5" "first grade" "second grade" "third grade" "1st grade" "2nd grade" "3rd grade"
 "grades 1 & 2" "early" "grade one" "grade two" "grade three" "1/2" "1-2" "fourth grade"
 "fifth grade" "4th grade" "5th grade" "elementary" "grammar school" "primary school"
 "grade four" "grade five" "primary" "3/4" "5/6" "1/2" "1-2" "3-4 grade" "3-5 grade" "3rd gr"
 "5-6 grade" "grade k/1" "(k-2)" "5th teacher" "k-6" "4-6"

excluded words: "tutor"

middle

"grade 6" "grade 7" "grade 8" "sixth grade" "seventh grade" "eighth grade" "6th grade" "7th
 grade" "8th grade" "middle" "junior high" "grades 5-8" "grades 6-8" "grades 6-7" "grades 7-
 8" "grade six" "grade seven" "grade eight"

excluded words: "tutor"

high

"grade 9" "grade 10" "grade 11" "grade 12" "ninth grade" "tenth grade" "eleventh grade"
 "twelfth grade" "9th grade" "10th grade" "11th grade" "12th grade" "high school" "upper"
 "secondary" "9-12" "9-11" "9-10" "10-12" "10-11" "11-12" "grade nine" "grade ten" "grade
 eleven" "grade twelve"

excluded words: "tutor"

math

"math" "algebra"

excluded words: "tutor"

science

"science" "biology" "agriculture" "chemistry" "physics" "biological" "biochemistry"
 "horticulture" "science/ss" "physical sci"

excluded words: "family" "consumer" "tutor"

technology

"technology education" "tech educator" "computer technology teach" "computer technol"
 "technology teach" "computer teacher" "technology ed" "technical education" "computer
 science" "computer technology instructor" "computer technology education" "computer
 applications teacher"

excluded words: "family" "consumer" "tutor" "manager"

history

"social studies" "histo" "humanities" "religion" "english/soc" "language arts/social studie"
 "socia" "geography" "humanities" "information technology teacher" "ss/langua"
 "science/ss" "civics" "psychology" "public issues teacher" "social science"

excluded words: "tutor"

ela

"english language arts" "reading" "english position" "literacy" "english/soc" "hs eng"
 "language arts/social studie" "english teach" "english" "english (one year)" "english - long
 term maternity leave" "english / language arts" "english 9" "english and history" "literature"
 "english long term substitute teachers" "english teacher" "english-permanent part-time"
 "english/language arts" "english/social studies" "writing" "language arts teacher" "language
 art" "english substitute" "ss/langua" "english & lang" "long term substitute - english"
 "english pre-tech" "middle level english" "middle level language arts" "ms english long-term
 substitute" "ms language arts teacher" "combined w/lang art"

excluded words: "tutor"

foreign language

"foreign language" "frenc" "latin" "spanish" "spanis" "chinese" "german" "world
 language" "language teacher"

excluded words: "tutor"

art and music

"music" "art teacher" "art position" "orchestra" "dance" "vocal" "art" "arts" "choral" "chorus"
 "illustration" "drama" "strings teacher" "theater"

excluded words: "tutor" "guidance"

physical education

"pe teacher" "phys ed" "physical education teacher" "p.e." "health" "physical educ" "phys. ed." "elem. physical" "athletic" "activities" "trainer" "coach" "pysical"

excluded words: "athletic coach" "yoga" "tuto" "pathologist" "director" "coach" "coaches" "job trainer"

limited English proficiency

"ell teach" "esl teacher" "english as a second language" "english language learn" "alternative education" "ell instructor" "english second language" "esl" "bilingual" "esol"

excluded words: "tutor"

special education

"special" "sped/autism" "deaf" "blind" "intensive needs" "integration specialist" "mainstream" "resource room" "autism" "sped"

excluded words: "technical" "human resources" "case manager" "librarian" "media" "autism behavior interventionist"

substitute

"sub" "substitute" "substitute teachers"

excluded words: "tutor"

general education or teacher

"classroom" "consulting" "learning resource" "alternative education" "k-8" "certified" "intermediate" "teacher, main street academy"

excluded words: "tutor"

title I