Improving State Need Assessments of Secondary Science and Mathematics Teachers: A Summary of Basic Steps

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This document summarizes the basic steps involved in developing supply and demand estimates for secondary science and mathematics teachers that were suggested in the report *Improving State Need Assessments of Secondary Science and Mathematics Teachers: Challenges, Opportunities, and Recommendations.* That report, which can be viewed at http://state-needs.teacher-imperative.com, provides a more detailed explanation of the basic steps and of the conceptual, practical, and methodological issues that surround teacher supply and demand projections. The report also includes separate discussions of teacher data, teacher quality, and teacher licensure, which are not summarized here. And it includes, as a supplement, a downloadable technical review of the relevant methodological literature written by Steven Raphael.

Developing a Current Need Estimate

The starting point for states' efforts to identify their need for teachers in science and mathematics – i.e., the shortfall or surplus of teachers that results from the interaction of teacher supply and demand – is their analysis of their *current* need situation. The sort of current need estimate proposed here is fundamentally descriptive and employs present-time data to determine whether there is a sufficient number of teachers to cover the demand for classes. The approach focuses on the extent to which teacher supply has not met demand as manifest in immediate identifiable needs for teachers at the local level. These local needs are defined by two factors:

1. Classes that had to be cancelled because no teacher could be found to staff them (including, ideally, classes not even offered in the belief that no teacher would be found)

2. Classes taught by individuals whose qualifications are questionable.

Data Checklist

To develop an estimate of a state's current need for science and mathematics teachers, the state should ideally have the following information at its disposal, both for individual districts and for the state as a whole. The "Basic Data" are the minimum kinds of data required to develop a reliable first-order estimate of the state's current unfilled need for teachers. The "Bonus Data," if available, will enable states to refine that first-order estimate. Clearly, states and districts ultimately must make a need determination with the best data available, even if it does not meet the ideal for quality or scope:

Basic Data:

- ☐ The number of classes in science and mathematics not currently staffed by adequately qualified teachers
- ☐ The number of classes in science and mathematics that had to be cancelled because schools and districts could not find adequately qualified individuals to teach them
- ☐ The years of experience of science and mathematics teachers in each school – in order to determine whether some schools have a disproportionately inexperienced faculty that could indicate difficulty in recruiting or retaining good teachers

Bonus Data:

- ☐ The average rates of student and teacher attrition in science and mathematics during the school year – in order to account for any additional need for teachers during the year that might arise after the current need assessment is made
- ☐ The relative difficulty local district administrators had in filling positions during the current and previous few years in science and mathematics (ideally expressed as the number of applicants per position, compared with the number of applicants for similar positions in other districts and subjects)

Three Basic Steps

There are three basic steps for developing a thorough and reliable assessment of a state's current need for teachers. Depending upon the accuracy of the data, the first two steps can provide a

credible approximation of the current unmet need for teachers and a rough indication of the relative quality of teachers in the various districts around the state. The data for the third step are inherently less reliable, but they nevertheless can provide a basis for concluding that the state's need for additional teachers may be somewhat greater than indicated in estimates based only on steps 1 and 2:

1. Gather the most reliable data possible, by school and district, on the number of science and mathematics classes in specific subjects that are staffed either by teachers who lack the state-defined normative qualifications or by long-term substitutes. This includes teachers who are teaching out-of-field or on emergency credentials.

2. Gather data, by school, on the years of experience of the science and mathematics faculty

3. To the extent possible, supplement these basic data with the following additional data:
    a. The number of classes that had to be cancelled or could not be offered because adequately qualified teachers were not available to teach them
    b. The degree to which hiring science or mathematics teachers was comparatively difficult – even if successful – in the various schools and districts and whether these difficulties are common statewide or limited to specific schools and districts.

Developing a Future Need Projection

Although the starting point for states' estimates of their need for science and mathematics teachers should be the assessment of *current* need, it is the projection of their need for the *future* that is most important in shaping related policies and practices. At their best, however, such projections cannot be as confident as estimates of current need. The inherent uncertainty of the future, the reliance on statistical methods that make reasonable but not ironclad assumptions about human behavior, and the increased need for data that may be inaccurate or incomplete all compromise the validity of future need projections. Nevertheless, we attempt here to provide guidelines for generating estimates of future teacher supply and demand that are as reliable as possible. These include guidelines for projecting future supply and future demand independently, and then for the reconciliation of these two estimates.

Data Checklist

1. To Determine Teacher *Demand*:

   Basic Data:

   - ☐ A *current* need estimate for science and mathematics teachers to provide a basis for identifying and addressing specific local needs
   - ☐ Historical data (at least 5 years back) on teacher demand in science and mathematics
   - ☐ Current and historical student enrollment data, including the total number of students and the percentage taking secondary science and mathematics courses (by specific subject, if possible)
   - ☐ Student enrollment projections that match the desired timeline for the teacher need forecast (likely 5-10 years)
   - ☐ Target class size limit for science and mathematics courses – district-by-district if this is locally determined

   Bonus Data:

   - ☐ Anticipated course enrollment impact of any changes in high school graduation requirements or curricular changes (e.g., in the sequence or scope of biology, chemistry, and physics courses) in science or mathematics
   - ☐ Differences in course taking patterns in science and mathematics among the various ethnic and socioeconomic groups

2. To Determine Teacher *Supply*:

   Basic Data:

   - ☐ Baseline data on the teachers who are currently teaching science and mathematics courses throughout the state: their number, licensure or certification status, age, gender, ethnicity, and years of teaching experience
   - ☐ Historical rates of teacher attrition and retirement in the state over the last 5-10 years – by age, gender, ethnicity, and years of experience and specifically for teachers in the sciences and mathematics if possible

- ☐ Historical numbers of newly licensed science and mathematics teachers produced each year by the various teacher preparation programs in the state (including alternate route programs)
- ☐ Numbers of science and mathematics teachers over the last 5 years who have received new licenses each year as transfers from out of state
- ☐ Data on other potential sources of science and mathematics teachers who may be enticed into active teaching positions by appropriate policies and incentives, e.g., the total number of licensed science and mathematics teachers in the state, including retirees

Bonus Data:

- ☐ Data on the delayed entry and re-entry rates of individuals either who take time out after licensure prior to their initial entry into teaching or who take a break between their initial entry and their subsequent return. Ideally, these data would be calculated specifically for science and mathematics teachers
- ☐ The total number of individuals who applied during the current year and the past several years for the science and mathematics positions available in each district
- ☐ The number of individuals who applied for science and mathematics teaching positions in the state and districts during each of the past several years and were not hired by any school or district
- ☐ District-level data that include the number and preparation programs of all newly hired science and mathematics teachers in each district
- ☐ Data from the largest teacher preparation programs in the state that tracks the placement of their graduates over the last 5 years
- ☐ Data on the impact of compensation and other incentives – and of any other labor market considerations – on science and mathematics teacher recruitment and attrition in the state and for specific schools and districts

<u>Early Warning Data</u>

In addition to the data related to developing rigorous forecasts of teacher supply and demand, a good analysis of a state's currently employed teacher workforce can provide a few key data points that offer a preliminary indication (an "early warning") of any emerging need for science

and mathematics teachers that is likely to be particularly acute either across the state or in particular districts. One important caveat, however, is that data on a single year may be aberrant and not necessarily a sign of a trend.

- ☐ Proportion of science and mathematics teaching slots that were filled during the current year by new hires

  If a high proportion of teaching slots are filled with new hires, this may be an indication of a serious turnover problem. This indicator is especially useful when comparing districts to one another or individual schools within a district

- ☐ Proportion of employed teachers in a given science or mathematics subject area who are novice, under-certified, or teaching out-of-field

  This is a proxy measure of the quality of the teacher workforce

- ☐ Proportion of employed science and mathematics teachers who are within 5-10 years of the average teacher retirement age in the state or district or have passed it

  The more teachers nearing retirement, the greater the likelihood that teachers will need to be recruited and developed to fill the impending departures.

Developing a Projection of Future Teacher *Demand*

The projection of a state's need for science and mathematics teachers, whether short-term or long-term, requires independent projections of teacher supply and teacher demand. The guidelines offered here for developing a basic projection of teacher demand consist of five suggested steps:

1. Gather current and, if possible, historical data (preferably for at least the last 5 years) on the identified statewide *need* each year for secondary science and mathematics teachers

2. Determine current statewide student enrollment by specific subject (e.g., Algebra, Physics, and Biology) and course difficulty level (basic, college preparatory, Advanced Placement) in secondary science and mathematics courses, and track historical enrollments over at least the past 5 years if possible

3. Project future statewide student enrollment over the next 5-10 years for secondary science and mathematics

4. Derive a *first-order projection* of teacher demand for each science and mathematics subject over the next five years by multiplying the target class size in science and mathematics subjects by the projected student enrollments in the subjects for the next five years.

   This will actually yield a projection of the number of *classes* that must be covered in the various science and mathematics subjects. To project the number of *teachers* required, further divide the number of classes to be covered by the average teacher course load

5. Refine the first-order projection of teacher demand
   - Adjust student enrollment projections in light of any impending new high school graduation requirements or curricular changes (statewide and district-specific) that are likely to have an impact on the number or kinds of courses students will take
   - To the extent possible, develop district-by-district projections for the entire state. These should be adjusted to reflect <u>total</u> demand – i.e., the addition of science and mathematics classes schools may have not been able to offer historically because of their inability to find suitable teachers.

<u>Developing a Projection of Future Teacher *Supply*</u>

1. Gather baseline data on the teachers who are currently teaching science and mathematics courses throughout the state
   - Number of teachers
   - Their gender and ethnicity
   - Their licensure or certification status – whether they are fully licensed, their licensure stage (provisional, permanent, advanced, etc.), and the specific subjects and/or courses their license, certificate, or endorsement permits them to teach
   - Their age and years of experience in full-time teaching

2. Project the number of currently employed teachers in each mathematics and science discipline who are likely still to be teaching in the state in each of the next 5-10 years

3. Project the number of new science and mathematics teachers who are likely to be licensed and available to teach in each of the next 5-10 years

4. Construct a *first-order* projection of the available supply of science and mathematics teachers statewide by adding the number of teachers estimated to be available over each of the next five years from the various sources and subtracting the number of teachers anticipated to be lost through attrition each year

5. Refine the first-order projection of teacher supply
    - To the number of science and mathematics teachers who are currently employed, add the number of licensed science and mathematics teachers who applied for teaching positions in the current year (or year the data were collected) but were not hired
    - Calculate and subtract from the first-order supply projection the number of teachers who are currently teaching secondary science and mathematics courses but lack the appropriate state credentials
    - To the extent possible, develop district-by-district supply projections

<u>Weighing Projected Supply against Projected Demand</u>

1. Determine the extent to which the projected statewide supply of teachers for the next 5-10 years matches the projected statewide demand for that same period
    - This can be carried out using either the first-order estimates or the more refined estimates suggested in the guidelines for developing supply and demand projections
    - If projections of district-specific supply and demand have been developed, the resulting need can be projected for specific districts, as well

2. To the extent possible, reconcile statewide and district-specific projections

3. It is valuable to attempt to factor into the need projections the desire to have a surplus of applicants for science and mathematics teaching positions. This allows for greater selectivity in hiring and thus increases the likelihood of hiring better quality teachers.

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