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Why Are Student-Teacher Linkages Important?

An Introduction to Data Quality Concerns and Solutions in the Context of Classroom-Level Performance Measures

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Introduction

In order to perform data-driven teacher evaluation, schools must first link teachers to their students in a data system. Yet these student-teacher linkages (the data that connect teachers to their students within a specific content area) are rarely adequate in existing school data structures. While many school, district, and state data systems already have the capacity to make these linkages in some form, the data are not nearly as complete as is required for effective analysis.

These linkages are complex to set up and maintain. In order to produce a reliable measure of classroom effectiveness, the data must capture (a) student and teacher mobility (both within- and between-schools), (b) courses that incorporate multiple subject areas, (c) team teaching, (d) collaborative instruction, and (e) pull-outs for special education and English language learner (ELL) students. Any effective solution to these obstacles requires (a) school-level involvement, (b) the ability to capture longitudinal changes in the classroom, (c) the development of data systems, and (d) decisionmaking on the alignment of curricula with testing standards. While fulfilling this multi-faceted challenge is difficult, with adequate dedication of time and resources, it is achievable.

When implementing differentiated compensation initiatives under the Teacher Incentive Fund (TIF) program, grantees have recognized both the importance and challenge of linking students and teachers. "If you are going to do differentiated compensation, you have to have good data systems in place—we've had to scramble to develop them. *You don't know what you need until you start doing this*," one grantee reported in a telephone interview.

Beyond differentiated compensation, student-teacher linkages are essential in any assessment intended to measure teacher and program effectiveness, target professional development, or distribute critical resources. Yet few districts have the capacity to produce data with the quality sufficient to perform reliable analysis. In most states and districts, this process is still in its infancy. According to the Data Quality Campaign's 2009–10 survey on the "10 Essential Elements of a State Longitudinal Data System," all 50 states have statewide student identifiers, student-level enrollment data, and student-level test data; however, only 24 states have statewide teacher identifiers that provide a teacher-student match (Data Quality Campaign, 2010). This number is up from just 13 states in 2005. However, most of the states capable of these matches can produce only "teacher of record" linkages. These superficial linkages between teachers and students fall short of capturing the complexity of real school environments to the extent necessary to accurately measure teacher performance. As teacher-level analyses begin to play a more prominent role in designing and implementing school reforms, development of systems that enable accurate student-teacher linkages is essential. The purpose of this paper is to shed light on some

of the complexities that accompany student-teacher linkages and to emphasize the importance of investing time and resources to improve data quality in this area.

Why are accurate student-teacher linkages important?

Evidence suggests that the impact of teacher quality on a child's education exceeds school environment, resources, and other factors (Data Quality Campaign, 2010; Rivkin, Hanushek, & Kain, 2005). Consequently, for school administrators conducting analysis on teacher quality, identifying both excelling and lagging instructors is a prerequisite for data-driven school improvement. Linking teachers with their students is a necessary step in any data-driven assessment of teachers, whether attainment, gain, growth, or value-added is the preferred performance measure. States can apply these assessments of teachers in various ways, such as for staff management, program evaluation, professional development targeting, resource allocation, high-stakes bonuses, and employment decisions.

In order to glean the most benefit from teacher assessments, accurate attribution of instruction is important, especially in the context of classroom-level performance measures. The margin of error for analysis diminishes as schools disaggregate measurements to the classroom level; this magnifies any inaccuracies in the data and can produce misleading results. Consider the following example: For researchers analyzing grade-level performance, the sample size could range up to several hundred students. The large sample size for these analyses ensures that an anomalous score or errant attribution of instruction will likely be lost in the margin of error. One student out of hundreds provides less than 1 percent of the data used for these analyses. On the other hand, if the analysis is at the classroom or teacher level, the sample size could be as small as 15 or 20. The inclusion of one erroneously assigned student generates 5 percent or more of the analysis at this level, leading to a potentially inaccurate result.

Inaccurate results carry dire potential consequences and are not limited to compensation issues. If based on poor data, decisions about high-stakes bonuses or employment could damage the credibility of administrators, challenge evaluation methods, or instigate conflict among faculty. Teachers and principals using performance measures to adjust instruction strategies or target professional development could make the wrong decisions. Erroneously low results for a teacher could dampen morale and induce feelings of helplessness, while inaccurately high results could give teachers a false sense of accomplishment and inhibit them from improving their practice. The greater the number and magnitude of decisions driven by poor data, the greater the potential for adverse consequences.

Generic logic model: How are students and teachers linked?

The process of linking students to teachers is complex. Data systems rarely capture student-teacher linkages directly; the connection more often resembles something like student→ course→ period→ teacher (Watson, Kraemer, & Thorn, 2009). This generic logic model used to link students and teachers typically merges student information systems (SIS) data for student schedules with teacher assignments (often from a separate data location, such as Human Resources). Typically, states did not design these databases with the capacity to capture the level of detail necessary for high-stakes decisionmaking. Simply linking two existing datasets to create "teacher of record" linkages fails to capture the nuances and collaborations that exist in real school environments and introduces a number of problematic assumptions.

Real-life complexities: Why student-teacher linkages are not as simple as they seem

At the end of the 2009–10 school year, two urban districts contracted with researchers from the Value-Added Research Center at the Wisconsin Center for Education Research to validate student-teacher linkage data. The researchers visited schools in these districts and interviewed staff and school administrators. We drew all of the following vignettes from one-on-one interviews performed with school teachers. The vignettes serve to demonstrate the challenging, multi-faceted requirements inherent in classroom-level analysis.

Classifying Course Content

While interviews were limited to third- through eighth-grade teachers responsible for mathematics or English language arts (ELA) content, they were not restricted to only those teachers who officially taught these subjects. Many teachers from other subjects, most commonly science and social studies, integrated math or ELA content into their courses. Students commonly received measurement and conversion lessons in science classes and reading comprehension and essay outlining instruction in social studies. If the goal is to hold one teacher accountable for a student's growth in a subject area, districts must decide how they want to disentangle cross-content instruction.

Districts can take several approaches to address this issue. One strategy treats the classroom as a "black box," a simple input-output system that does not concern itself with what goes on inside the classroom (i.e., teaching methods, curricula, classroom support staff, etc.). The "black box" approach looks only at the students coming into the class and leaving the class, without accounting for cross-content instruction or other challenges. This more hands-off approach accepts imperfect information and embraces the notion that the teacher is responsible for everything that goes on in the classroom, including the curriculum. Less a solution, and more a way to sidestep the problem at hand, this philosophy can be unfair in some instances, particularly when the curriculum and classroom supports are out of the teachers' control. However, it is one way to address the attribution problem, and it is accurate to the extent that, in self-contained classrooms, one teacher is responsible for teaching a group of students in all subject areas.

Another potential approach that can be adopted by district administrators involves standardizing the curriculum, aligning the course content with test standards, and assessing the teacher based on his or her students' test scores in that content area. This more thorough, systematic approach to classifying course content produces more transparent and reliable testing standards. These standards help align course content and assessment content in a way that makes the award system more transparent and bolsters stakeholder support.

Understanding the differences between the performance measures that these two linkage methods produce is also important. The "black box," "teacher of record" method will produce a measure of classroom-level value-added (the total value-added by the entire classroom). The second approach begins to work toward a genuine measure of teacher-level value-added, controlling for the intrinsic properties of the classroom that are out of the teacher's control. Classroom performance measures can serve several useful purposes; however, it is important to note that classroom performance is not the same as teacher performance. States can use classroom measures effectively to target professional development or identify struggling classes. In addition, states can

better serve and more fairly distribute high-stakes bonuses using measures that isolate the impact of the teacher from the impact of the classroom as a whole. This requires taking into account the curriculum, peer effects (the impact of other students in the class), and the effects of other teachers on the classroom (discussed in more detail below), among other factors in producing performance measures. Accounting for these factors requires significant investment in student-teacher linkage data quality and requires aligning assessment standards with course expectations.

Student Mobility and Re-grouping

While self-contained classrooms mitigate many common challenges in student-teacher linkages, these classrooms are not immune to other sources of data inaccuracy. One of these sources of data inaccuracy is student mobility. Capturing student mobility, both between and within schools, presents a considerable challenge for student-teacher linkage systems. In one elementary school we visited, all classrooms were self-contained, and teachers saw the same students for every subject area with one exception. In order to tailor the curriculum to better fit each student, the school regrouped students by ability for reading. The school periodically regrouped classes at the discretion of the teachers' collective assessments; students moved up or down levels every 6 to 8 weeks based on their needs. Instead of updating rosters every time the classes regrouped, the school simply left students on the roster of their core teacher, who entered the grades students received from the teacher responsible for the reading instruction.

This kind of nontraditional organization presents a serious challenge to linking teachers to students. If the goal was to evaluate the value-added by a student's reading instructor and the school matched the data using the "teacher of record" method, it would have linked the majority of these students to the wrong instructor. Analysts relying on these data would have produced an inaccurate and misleading performance measure. If the district attempted to implement high-stakes testing, analyses relying on these data linking students to their reading teachers would have rendered results that were at best irrelevant and more likely severely distorted.

Students moving between schools within the district can also be a source of error. At one secondary school we visited in June, many teachers could not recognize a significant number of names from their first-quarter student rosters. Truancies, suspensions, expulsions, and high student mobility all led to constant changeover in these classrooms. More comprehensive analysis from Battelle for Kids, a not-for-profit organization that helps districts with student-teacher linkage data, corroborates this anecdotal evidence. Battelle found, based on data verified by principals and teachers, that the percentage of students linked to more than one teacher in a subject ranges from 11 percent in small schools to more than 33 percent in larger urban schools (Battelle for Kids, 2009). Based upon these findings, the "teacher of record" process outlined above would fail to accurately capture teacher links for more than 33 percent of urban students.

Teacher Mobility

Students are not the only mobility concern; teachers also change schools, take leave, or are reassigned to different classrooms. In one relatively large primary school with multiple team-taught classrooms, two teachers left on maternity leave in early spring.

The school simply replaced one of the teachers with a long-term substitute teacher; the other's classroom transition was slightly more complex. When she left for maternity leave, school administration decided that the most effective strategy would be to transfer a team teacher from another classroom to take over the class. The team teacher took over the full class for the teacher who left on leave, and the school brought in a substitute to continue her role in the team-taught classroom. The SIS did not capture any of these teacher transitions. This district has made concerted efforts to improve data quality in student-teacher linkages, but in this case, the data system still fell far short of capturing reality. While districts can make individual decisions about how to handle evaluations in these situations, this kind of complexity elucidates the need for school-level participation and longitudinal data collection.

Ability to Capture Longitudinal Changes

Currently, student-teacher linkages often use data from a single point in time to represent the entire school year. This approach is profoundly inadequate in its capacity to capture continuous changes that occur. Failing to document teacher mobility, as in the example above, is not the only shortfall. Relying on a single snapshot in time also fails to account for (a) student mobility, both between classes and between schools; (b) accommodations made for special education and ELL students; and (c) attendance information. A system capable of capturing longitudinal changes in school rosters is a requirement for any successful student-teacher matching endeavor. While it is important to avoid overburdening school teachers and administrators with time-consuming data entry, school-level involvement is essential to data quality in student-teacher linkages. Those developing systems to capture student-teacher linkages should actively seek faculty input on how to find a balance between keeping requirements for teacher participation reasonable and capturing the necessary level of detail. A single period of data collection can be sufficient provided that this single period can document the longitudinal changes that occurred over the year.

Team Teaching

Team teaching presents a serious challenge to relying on "teacher of record" linkages and can obstruct capturing classroom realities. In the school described above, for example, other team-taught classrooms had two teachers for each class of roughly 30 students. All of the teachers from these classrooms with whom we spoke were very content with the program and the ability to play off the strengths of their co-teacher in order to best serve their students. However, in interviewing them we discovered that the data system entirely misrepresented their student-teacher linkages. According to the data in the system, one of the co-teachers taught students with last names beginning with A through K, and the other taught L through Z. In reality, however, both teachers asserted they shared equal responsibility for all of the students. Implications for connecting these students with their "teacher of record" and measuring performance are obvious. Based on the data configuration, the school would base each teacher's analysis on an arbitrary half of their students, inevitably generating distorted performance measures.

While this type of team teaching may not be pervasive in all school districts, it is relatively common for one instructor to help another instructor teach a class. In one of the districts where we performed interviews, 15.7 percent of student records we sampled were associated with unrecorded team teaching (in any form) and instructional support information. In many cases, instructors assigned to special education or ELL students provided reinforcement and occasional lessons for other students in the class. The SISs almost never documented this instruction because, in most instances, the system lacks the capacity to record multiple teachers for the same students for a particular course.

ELL and special education students also provide considerable challenges for student-teacher linkage systems. Many of these students are in mainstream classes, but receive pull-out services several times a week. The implication is that the student receives instruction from more than one teacher (which systems rarely document in a way conducive to data analysis) and thus, schools will need to decide the percentage attribution for each teacher for the student in question. Self-contained special education or ELL classrooms also face this dilemma. The presence and role of paraprofessionals in these classes frequently inspired contemplation when we interviewed teachers on their role in a particular student's education. Between-classroom mobility is typically higher for these students as well, providing another example of the need to capture longitudinal data.

Other Organizational Deviations

Other common organizational structures like family clustering (described below), block scheduling, or project-based curricula all deviate from the traditional one teacher–one student model. Each of these structures has the potential to complicate classroom-level measurements. Family clustering can involve extensive team teaching and sharing of students, and block scheduling can alter instructional times. Project-based curricula often involve collaboration between teachers and can tilt appropriation of resources, such as changes in class size or allocation of professional development resources, creating an unfair playing field. Where they occur, schools need to account for all of the factors mentioned above, or at the very least considered, throughout the student-teacher linkage process. It is clear that blindly relying on the accuracy of data matched from SIS databases to create "teacher of record" linkages is inadequate.

Approaches to linking students and teachers

Several components are common to any effective solution to capturing student-teacher linkages; when you address one problem, you begin to address them all. The process flow for capturing student-teacher linkages comprises three main steps. The first is data acquisition—identifying the teachers' content area of instruction and populating these teachers' rosters with their students. This first guess at student-teacher linkages requires pulling the data from SIS databases to a format accessible to principals and teachers. This accessible format must be capable of capturing the complex relationships between teachers and students as outlined throughout this paper. The second step involves verifying the data. Teachers and principals responsible for the classrooms should do this at the school level. Principals can play a key role by assigning teachers to courses, managing participation, and resolving any issues that arise. The final step requires finalizing the data: providing final verification that the linkages adequately reflect reality and transferring the data into a format conducive to analysis.

Regardless of the approach taken to address each of the steps above, any successful solution requires common components. Table 1 outlines these components.

Table 1: Components of Effective Solutions
• **Teacher and school administrator participation**
• **Development of data systems capable of capturing complexities of a real school environment**
• **Alignment of course content with testing standards**
• **Establishing a process flow that ensures elusive details, including longitudinal changes, are documented**

Several districts have been successful in transforming their data systems and process flows in an effort to capture accurate student-teacher linkages. One particularly poignant example is Houston Independent School District's (HISD) ASPIRE system. In its first year of implementation, the district faced serious challenges. There was pushback from the union over perceived lack of transparency behind data and methods, upset teachers who did not receive bonuses, and computation errors that mistakenly awarded bonuses to 99 part-time teachers (who two months later had to return portions of the bonuses to HISD) (Behrstock & Akerstrom, 2008).

In the years following, the district implemented steps to improve the evaluation process, particularly in the realm of data quality. It hired an external vendor to help make the student-teacher linkages used for the analysis and created a detailed process flow to ensure data quality. This process begins by acquiring the initial data from the SIS from each school and exporting them to the vendor, who uploads the records to a new interface. Principals assign teachers to classes using this interface; teachers verify their students and content areas of instruction; and finally schools calculate an advanced linkage to assign an instruction time percentage monthly for each student. Principals receive verification alerts to ensure accuracy. The scheduling department meets annually with the ASPIRE Core Technical Team to review how courses align with testing standards and which courses should be considered in the calculations for bonuses. Additionally, the ASPIRE Award Advisory Committee, comprising teachers, school-based staff, principals, district administrators, and consultants, annually reviews the award model and recommends changes to more accurately reflect employee assignments and roles on campuses and how they align to the performance-pay system.

This is one example of a district that has successfully embedded data quality into its reform program by securing stakeholder support, in turn enabling analysis and paving the way for improvement. According to Battelle for Kids, since implementing the performance-pay program funded in part by its TIF grant, the district has experienced a 1,400% increase in the number of Exemplary Schools (from 6 to 84) and an increase in college readiness in ELA (from 26% to 53%) and math (from 36% to 60%). The district has also observed a significant reduction in the achievement gap between white and African American students, white and Hispanic students, and between non-economically disadvantaged students and children of poverty (Battelle for Kids, 2009). All of these gains first required investing time and resources to ensure high-quality student-teacher linkage data.

Conclusion

"Teacher of record" linkages fail to account for a significant number of factors that could affect the accuracy of analysis dependent on student-teacher linkages. Table 2 summarizes the challenges discussed in this paper.

Table 2: Challenges to Reliable Student-Teacher Linkages
• **Student attendance and mobility**
• **Teacher attendance and mobility**
• **Cross-subject course content**
• **Instructional supports and curriculum specialists**
• **Team teaching**
• **Special education and English language learner accommodations**
• **Other divergences from the standard isolated classroom model**

Despite the multi-faceted nature of the challenge, with adequate dedication of resources, schools can make reliable student-teacher linkages. Rigorous quantitative analysis of teacher quality is one of the most powerful tools available to improve schools; data-driven evaluation can play a central role in identifying successful teachers and programs, targeting professional development, and developing modernized compensation structures. Accurate student-teacher linkages are essential to any teacher or classroom-level analysis; percent proficient, attainment, growth, and value-added models all face the same challenges.

States and districts looking to implement programs that rely on data-driven teacher evaluations would do well to account for the challenges outlined in this paper and appropriate sufficient resources to designing systems to ensure data quality in student-teacher linkages.

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