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Student–Teacher Linkage Verification: Model Process and Recommendations

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Student–Teacher Linkage Verification: Model Process and Recommendations

INTRODUCTION

As momentum grows for tracking the role of individual educators in student performance, school districts across the country are implementing projects that involve linking teachers to their students. Federal programs like Race to the Top and the Teacher Incentive Fund (TIF) contribute to this trend by requiring participants to implement educator evaluation systems that use student performance as one of the main components. Programs that link teachers to student outcomes require a verification process for student–teacher linkages. Linkage verification improves accuracy by allowing educators to check for and correct student and course assignment errors. Without an effective verification process, data errors are much more likely to affect the validity of performance assessments, program evaluations, educational research, professional development decisions, and any other initiative that uses student–teacher data.

In order to accurately link students, teachers, and courses, district leaders must first determine what types of links they want to make and the extent to which their current data systems support such links. Typically, districts did not design their student data system to seamlessly and accurately link students, teachers, and courses; therefore, the systems may require substantial upgrades.[1] Once the student information system (SIS) generates preliminary links, often by combining data from multiple sources, educators must verify those links.

The culmination of an appropriately implemented design, collection, and verification process will produce highly accurate links, although other factors such as teacher absences or team teaching may still threaten the validity of those links.

This paper describes a model process for gathering and verifying student–teacher linkage data and offers recommendations at each stage. Appendix A contains use-case[2] specifications that correspond to the model verification process. The use-case specifications present more detailed steps that may be useful to readers interested in designing their own process or contracting for verification services.

The model verification process begins with a planning stage, followed by configuration and testing. Once these steps are complete, teachers and administrators can begin verifying data. During verification, administrators and teachers confirm or modify classroom assignments using computer software or a web-based application. Verification takes place in three main steps: an initial administrator review, a teacher review, and a final administrator check. In addition, users can enter additional data during verification, such as the percentage of instructional responsibility for team teachers. After teachers and administrators verify the data, districts should gather and report information about the linkage verification process. Districts should use this information to continuously improve the accuracy and quality of their student–teacher links.

1 Many of the necessary changes are encouraged by programs like Race to the Top.

2 A use-case document is a detailed diagram that depicts the process through which users of a system achieve a goal. For a more detailed explanation, see Appendix A.

I. PLANNING

Since student–teacher linkages should be as accurate as possible, careful planning and testing of any verification system should take place before full implementation. Otherwise, districts may not identify flaws in the verification process until after they have used inaccurate data in high-stakes decisions. In the case of a performance-based compensation system, for example, inaccurate data could result in unfair rewards or punishments for teachers, which in turn could erode support among educators and the broader public.

This section contains several recommendations that districts should consider when designing and planning an electronic student–teacher linkage verification system. As district managers determine what features the verification system must contain, they should engage the stakeholders who know the data best. Districts should train teachers and administrators on how to use the system and should provide readily accessible support to educators during the verification process itself.

Determine what the verification system must do

The first planning step is to determine what features the verification system must contain. For example, districts should decide which courses require linkage verification, when and how often verification should occur, and other features that depend on project details. After districts determine the verification system's required capabilities, programmers can begin designing software that meets those specifications.

Many verification system features, such as the stage where teachers certify that their class rosters are accurate, will be common to all verification systems. Other potential features will depend on the capabilities of district data systems. If a district wants to know something about classrooms that the SIS does not currently capture, the district may either upgrade the SIS or add the data during verification. For example, if an SIS does not contain detailed data on co-teachers, a district will have to choose between (1) adding co-teacher data to the SIS or (2) requiring teachers to enter those data ad hoc using verification software.

Engage stakeholders who know data systems best

Linking students and teachers often requires districts to integrate data from multiple information systems. However, because districts did not design their information systems to link among students, teachers, and courses, each district data system may present its own unique set of challenges. For example, in one school district's human resources data system, 25 percent of teachers had inaccurate data (such as employee identification numbers or incomplete names) before the district began to manage its data quality. Another common challenge is that districts often do not manage courses for elementary grades because those classrooms are considered self-contained.

Districts need to identify and overcome data limitations with the assistance of personnel who know the data best. District stakeholders such as departmental middle managers, technical staff, and other school-level clerical personnel who regularly use the data are likely to be familiar with data limitations and may also know of ways to mitigate those limitations. Districts should take advantage of this knowledge as they plan to integrate new tasks and new data quality requirements into their use of information systems.

Balance the desire for nuanced data against the need for stakeholder buy-in

Although districts should strive to obtain accurate and appropriately detailed student–teacher linkage data, they should also remember that user experiences affect opinions of the verification process. Districts must balance the desirability of collecting nuanced data against the need to maximize stakeholder buy-in and participation, as well as the need to control administrative costs.

Collecting the most detailed data possible is not always feasible because in many cases, doing so would make the verification process too great a burden for educators. For example, district leaders may wish to gather highly specific data on the percentage of instruction delivered by support specialists and resource teachers. However, if inputting these data makes the process too long and difficult, educators may become frustrated with verification and be less likely to participate. In a performance-based compensation system, drops in educator support and participation could jeopardize the whole initiative by increasing the likelihood of high-profile errors. Although it is important to collect nuanced data, districts have to balance that need against the need to win stakeholder support.

One way to add nuanced data while managing project complexity is to gradually increase the degree of detail collected during verification. After teachers have become familiar with the verification process and district managers have had a chance to work out other potential problems or inefficiencies, managers can establish procedures to collect more nuanced data. Such a strategy would mitigate the risk of overwhelming educators in the first few years, when inexperience with verification increases the risk of error and inefficiency.

District leaders should also be aware that the verification process will affect stakeholder buy-in. During the pilot verification and once the system is implemented, district staff should monitor educators' experiences. Districts should collect various pieces of information such as data on system responsiveness and the number of calls to the help desk and should take appropriate action to address stakeholder concerns.

Train, support, and communicate with educators

Teachers and administrators face many demands on their time, and linkage verification adds to that burden. The estimated time to complete for the model linkage process outlined below is 10 to 20 minutes for individual teachers and about five hours for principals at the elementary and middle school levels. As such, district leaders should clearly communicate with teachers and administrators regarding the purpose of the verification process and the importance of data quality for any high-stakes use. When teachers see that (1) the district uses the data to determine potentially high-stakes decisions, and (2) the district wants teacher input on data quality, teachers will be more likely to trust the program's outcomes measures. District leaders should communicate clear and consistent messages regarding the rationale for verification processes both early and often.

Before teachers and administrators begin to use a verification system, districts should train them on its use. Even if the verification process is relatively simple, educators should see a demonstration of the process and be informed of common difficulties. Training sessions should also include information about who needs to verify their student–teacher linkage data, when and how often verification should occur, and other logistical details. Districts should update training to reflect the results of pilot programs, educator surveys, and data collections that reveal common errors and trends. Without training, educators will be more likely to make errors and need support later. In addition, they may be more likely to feel burdened by a new and unfamiliar process.

One option for district leaders to consider is to designate a common time for teachers and administrators to complete their linkage verification. If a school's educators complete verification at the same time in a centralized location, technical staff could be available to provide real-time, in-person assistance. Technical staff could also include training within the same session. Although live assistance may not be the most cost-effective way to provide support to educators, concerns such as stakeholder buy-in and educators' time should factor into the decision. This option may be especially beneficial in the first years of implementation, when the verification system is new to educators and district staff.

II. CONFIGURATION AND TESTING

Even after extensive planning, testing should take place before districts use verification systems to confirm student–teacher links that will inform high-stakes decisions, research, or program evaluations. Testing through a pilot program permits districts to identify common errors and gather stakeholder feedback in order to improve the verification process before full implementation. In addition, testing provides an opportunity to ensure that educators' computers have the proper configuration to run the verification software or web-based application.

Ensure that educators' computers can run the software

In order to make the verification process as smooth and efficient as possible, districts should ensure that educators' computers can run the verification software before problems arise. Otherwise, compatibility issues could delay or disrupt the linkage verification process. Most likely, teachers will complete verification via a web-based application. While computers and Internet access are nearly ubiquitous in schools today, the web browsers installed on those computers may be significantly out of date. Programmers should be clear as to what Internet browsers or other features schools need to support the verification system, and these conversations should begin as early as possible.

Ensuring software compatibility requires districts and programmers to communicate effectively. Districts should gather and share information about relevant computer characteristics, including hardware, operating systems, web browsers, and pre-installed plug-ins and drivers. Programmers should communicate with districts regarding the information they need. In cases where a potential feature of the software would require a computer upgrade, district leaders and programmers should collaboratively weigh possible solutions. Sometimes, a valuable feature of verification software may require a simple and cost-effective upgrade; other times, a slight improvement to the verification system may not justify the cost of the required computer upgrade.

Pilot and improve the system

Before districts use a new student–teacher linkage verification system for high-stakes decisions, they should administer a pilot program to test and revise the system. To the extent possible, districts should run the pilot as though it were an actual verification. Pilot programs allow districts to identify errors, complications, and inefficiencies ahead of time. Districts that forego pilot programs for the sake of expediency may regret that decision if unexpected complications occur.

If possible, districts should consider piloting the verification process alongside pilots of other related programs. For example, if a district plans to provide student growth scores to teachers in preparation for a new evaluation system, the district could use the pilot verification to check the accuracy of those links.

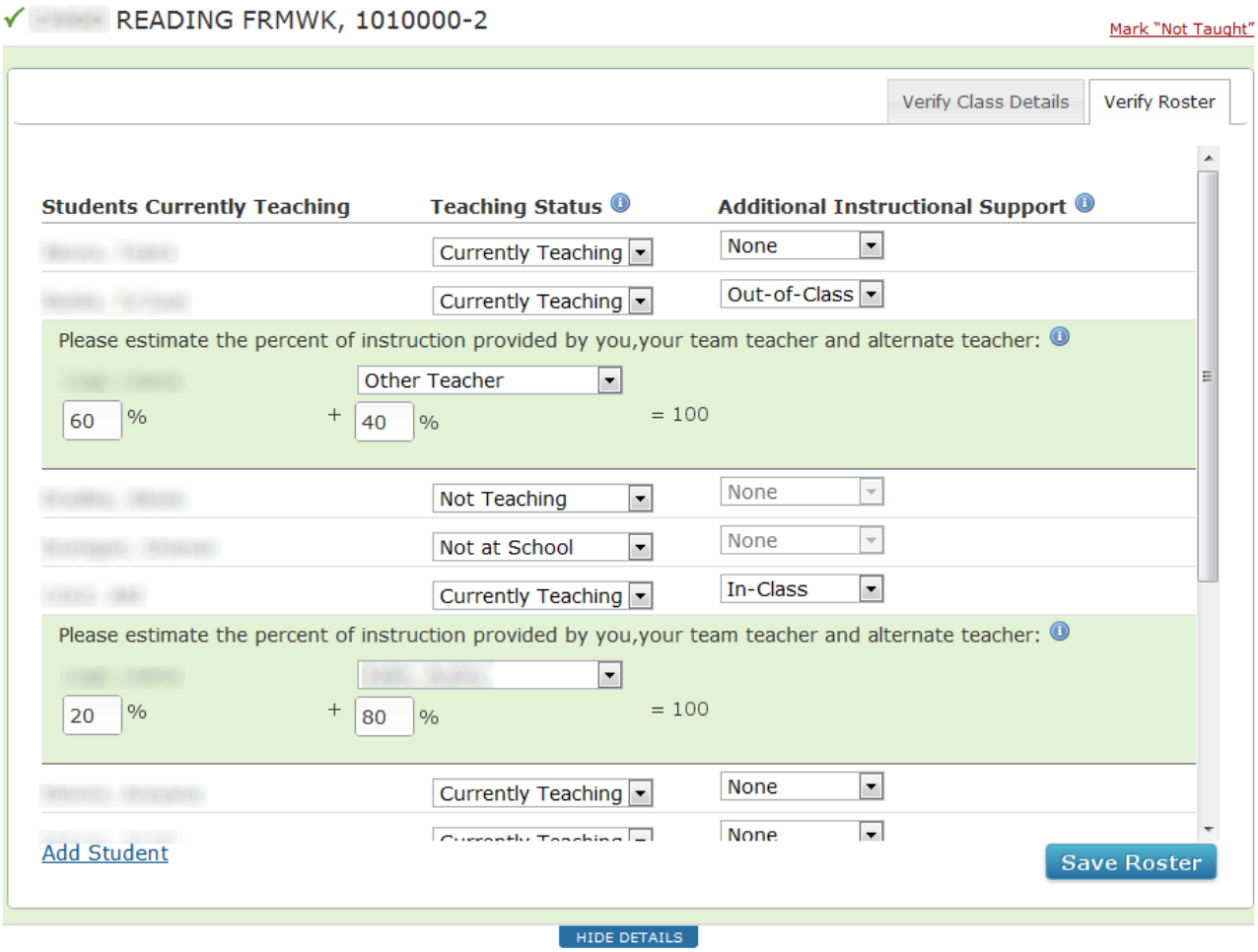
To maximize a pilot program's value, district managers should gather a great deal of information and feedback. The *Reporting and Quality Control* section below includes recommendations on what information to gather and how to use it.

III. LINKAGE VERIFICATION

Once districts have created a verification process and extracted initial linkage data from the data system, they can initiate the verification process itself. In the model process presented in this section, building administrators and classroom teachers correct and verify student–teacher linkages using computer software. An administrator performs an initial check for major errors, and then teachers conduct a review where they can edit their class rosters and adjust other information as needed. Finally, administrators check that the teachers' changes were correct, including confirmation that all students have an assigned teacher. (Figure 1 is a sample screenshot of a linkage verification web application.)

Based on the experiences of districts that have verified student–teacher linkage data, the verification process modeled in this section takes approximately two to three weeks. The process uses an estimated five hours of a principal or administrator's time and 10 to 20 minutes of each teacher's time. The time required of building staff varies with data quality—if few errors exist in the data, educators do not need to spend as much time correcting them.

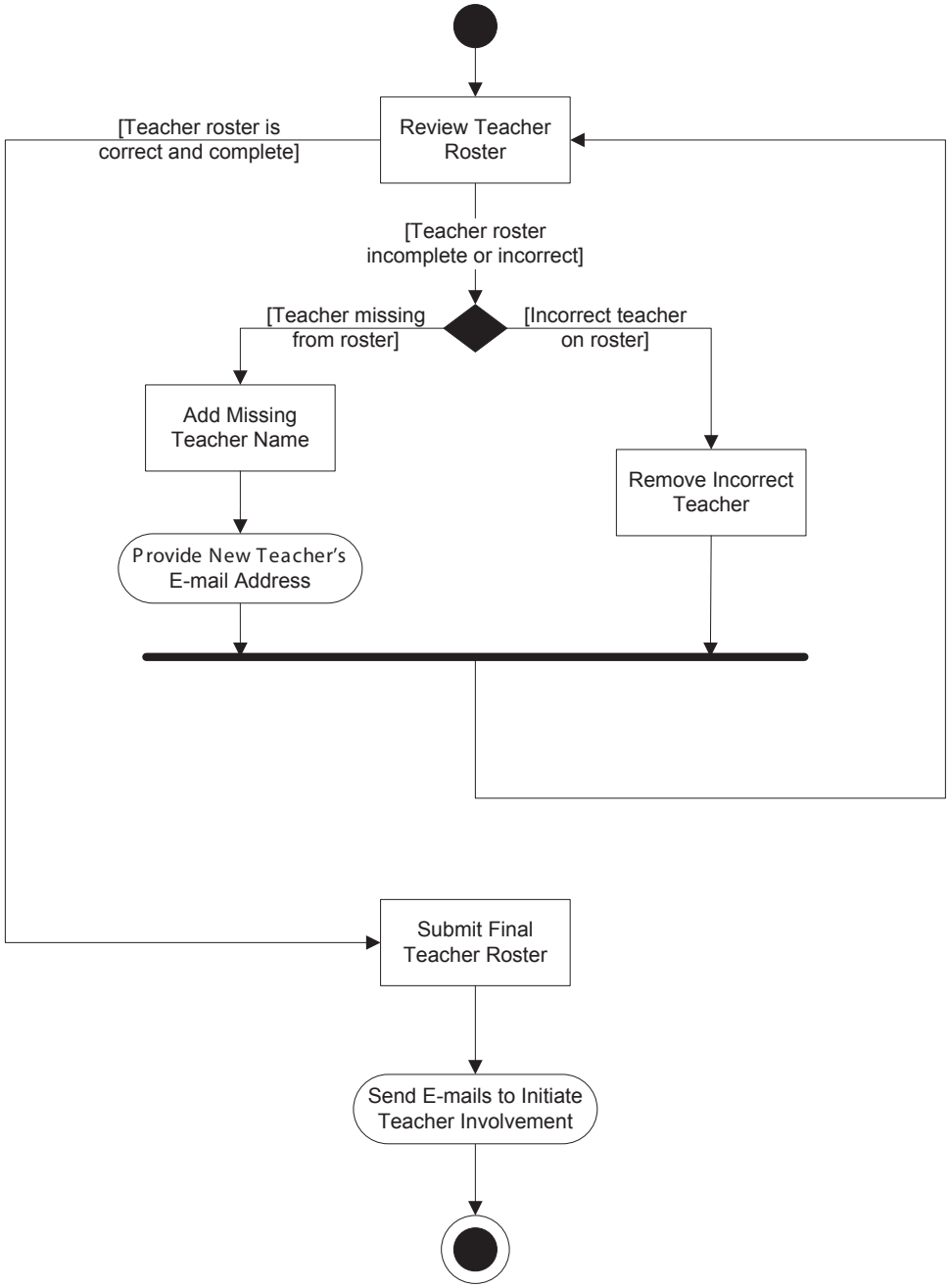
Figure 1. Screenshot from a student–teacher linkage



Step 1: *Administrator reviews teacher rosters*

After a district pulls linkage data from its data system and distributes the data to schools, school principals or other building administrators conduct an initial review of the student–teacher–course linkages. At this stage, the administrator mainly looks for course-level discrepancies. For example, a teacher may not have any assigned students; a large group of students may not have any assigned teacher; or a teacher may be missing from the data entirely. (Figure 2 illustrates this step.)

Figure 2. Initial administrator review of the links pulled from data systems



The length of the verification process depends on the district's initial data quality. The rate of course-level errors may vary significantly between schools, and some schools may not have any course-level errors at all. The example below illustrates this:

Field example: The frequency of data errors may vary significantly between schools, as illustrated by one large urban district. The district links teachers to students by merging teacher–course links from its human resources system with student–course links from its student information system. In a six-school pilot study, three schools' data contained course–teacher discrepancies, while the other three did not. Even among just three schools, course-level error rates varied from 0.1 percent of records to nearly 7 percent. In this district, course-level errors did not affect the elementary grades included in the pilot (3–5), but affected each of the secondary grades (6–8).

Step 2: *Teachers review class rosters*

When teachers review their class rosters, the first step is to verify that their course assignments are correct. After teachers confirm course assignments, they review the content area in which their course is classified, the length of the course, and applicable team teacher assignments. Note that the term "course" explicitly denotes the subject-specific instruction in a tested subject. While secondary schools commonly use the terms "course" and "section" (for courses taught more than once per day like Algebra I or English Literature), this paper also uses these terms for primary and elementary instruction in order to explicitly capture the differences in how instruction is provided to students by subject.

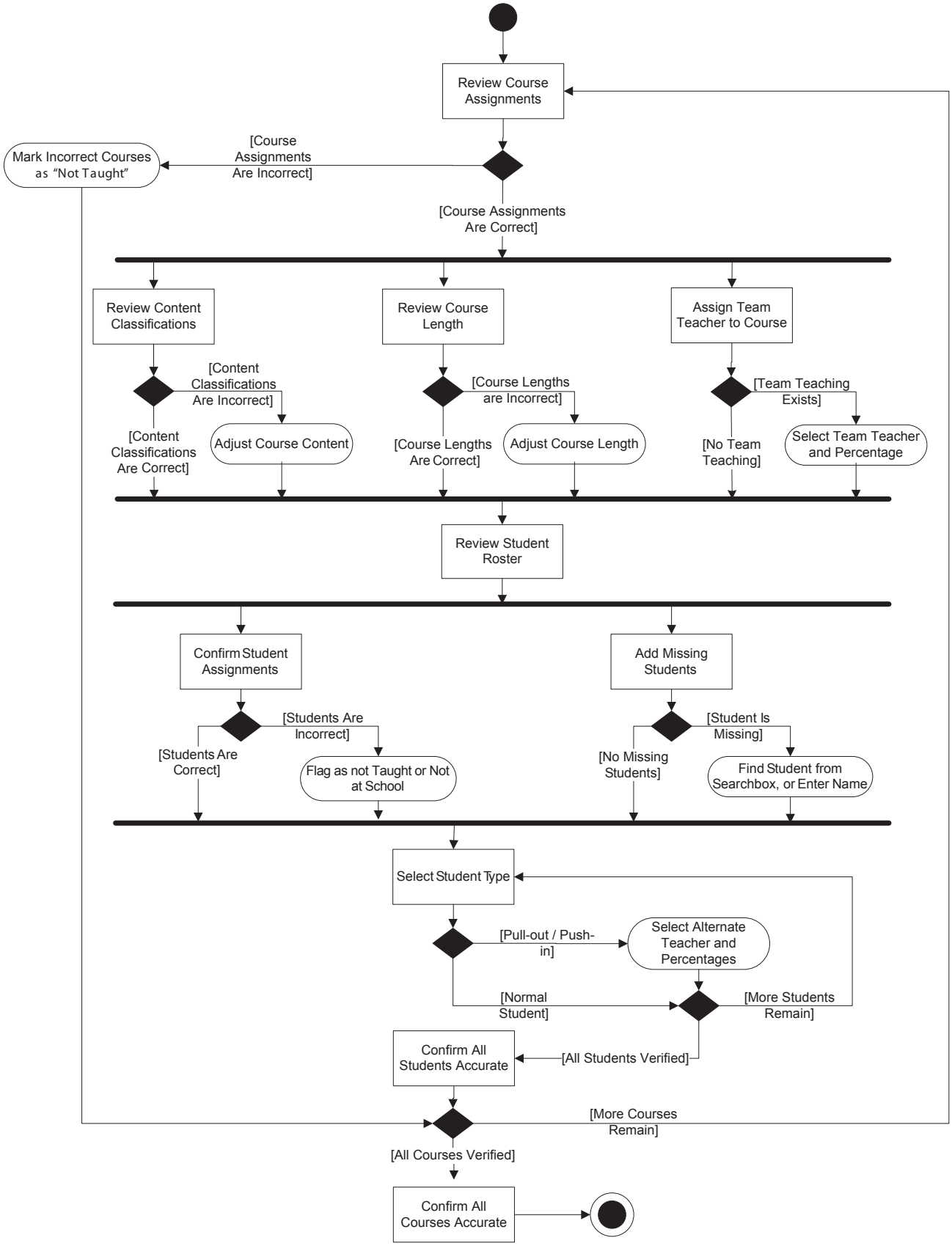
Once teachers verify course data, they move on to the student rosters themselves. At this stage, teachers confirm correct student assignments, flag erroneous student assignments, and add missing students. Next, teachers enter or verify student types, specifically whether or not the student is an exceptional student who receives pull-out or push-in instruction from a specialist. Some teachers may spend considerable time correcting errors, while others will need to spend very little. This is because errors can vary a great deal among teachers, as illustrated by the field example below:

Field example: In the same example school district described in Step One above, student-level discrepancies[3] affected all six schools and grade levels. However, the distribution of student-level discrepancies varied greatly among teachers, ranging from 0 percent to over 95 percent. Forty-six percent of teachers had no errors in their student data, and 32 percent had discrepancies on between 0.01 and 10 percent of their student records. Seven percent of teachers had errors on between 10.01 and 30 percent of their student records, and the same portion had errors on between 30.01 and 50 percent. Five percent of teachers had errors on more than 50 percent of their student records.

After confirming that all students and courses are accurate, the teachers submit their changes for a final administrator review. (Figure 3 illustrates this step.) Logging all administrator and teacher changes to courses and rosters is very important. Logging permits administrators and their supervisors to review changes and helps safeguard against intentional manipulation.

3 Student-level discrepancies are instances where a student is assigned to the wrong teacher.

Figure 3: Teacher review of linkage data



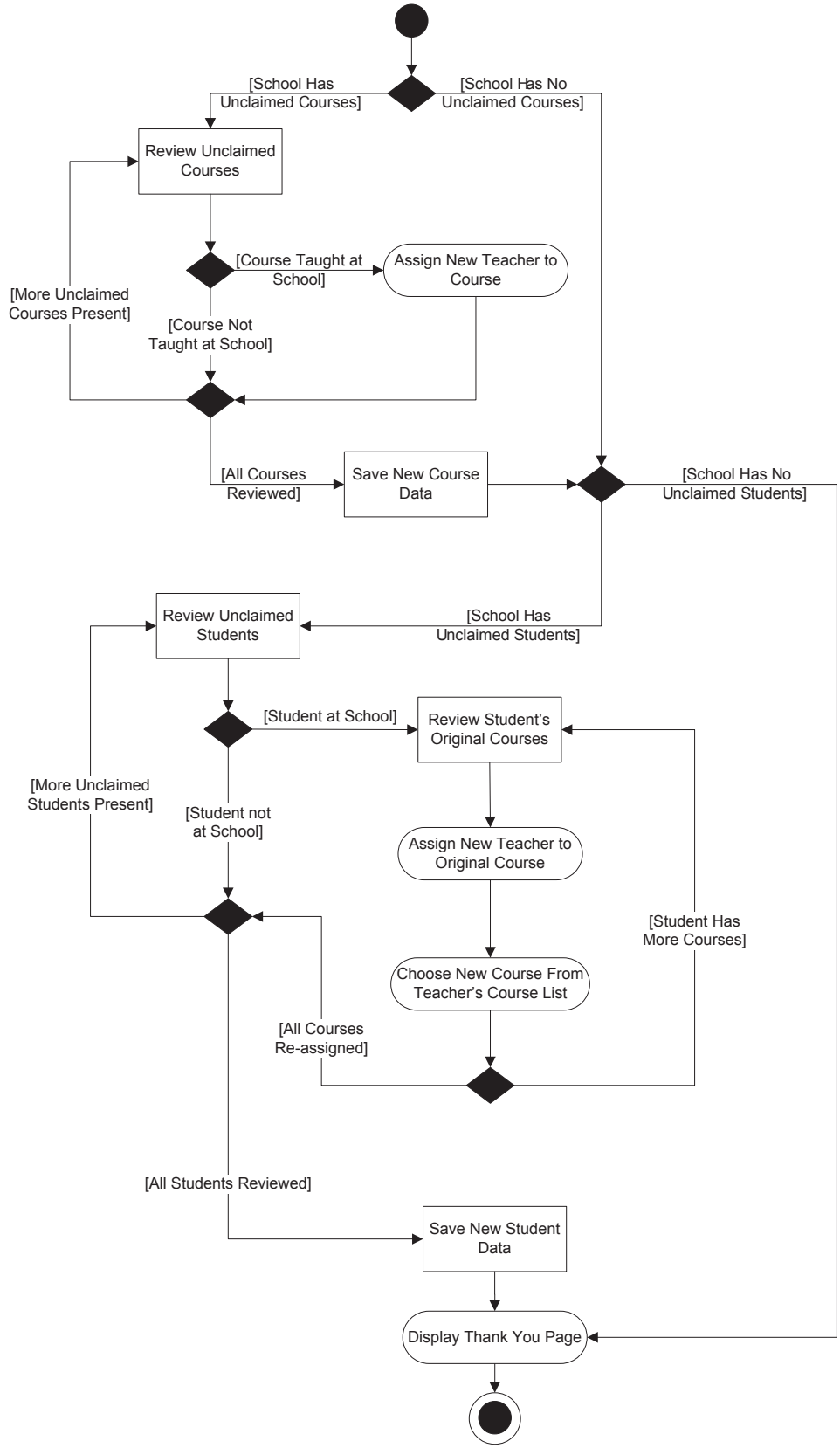
During the course of field studies and work with TIF grantees, wide variation emerged in two critical elements that contribute to data quality. First is the level of informal team teaching. Informal teams can use a range of different organizational forms of instruction, including ability grouping, reading groups, and project-based-learning teams. The reason for team teaching often varies dramatically by school. Even among schools with similar populations in the same district, it is common for some to practice no informal team teaching even as others use a considerable amount. Depending on whether the student data system contains team teaching data, the data system may or may not reflect such differences.

The second element is the extent to which building leadership uses the SIS to capture the complexity of instructional service delivery by teachers, support staff, and others. A poorly designed SIS interface that does not seem to support the day-to-day operation of the school could result in building staff not keeping records up to date. In such cases, paper grade books and lesson planners that teachers can update with a pencil and move from room to room with them may be a better technological fit for the problem of managing informal teaming. Recognizing this potential source of error can help district leaders plan solutions that account for data inadequacies. For example, they may choose to provide targeted verification system features and professional development for schools that are likely to encounter these issues.

Step 3: *Administrators review changes, resolve conflicts, and account for unassigned students*

In the final stage, administrators verify that all student–teacher-course linkages at the school are correct. First, administrators review any courses that do not have a teacher assigned. After determining whether the school teaches the course, the administrator either assigns it to the correct teacher or removes it. Next, administrators review all students without a course. If an unclaimed student does not attend the school, the administrator removes that student; otherwise, the administrator investigates that student's course assignments and assigns him or her appropriately. (Figure 4 illustrates this step.)

Figure 4: Second administrator review



As in the previous two steps, the length of the verification process depends significantly on the initial accuracy of the data. In schools where many teachers have a high rate of errors in their student records, administrators will likely have more unassigned students to deal with after teachers complete their roster verification. Once all issues at this stage are resolved, the linkage data should be accurate and ready to use.

Battelle for Kids' Student–Teacher-Linkage Process

Battelle for Kids has worked extensively with school districts to improve the quality of their teacher–student linkages. The organization recommends several steps to ensure accuracy (Battelle for Kids, 2009).

Collect high-quality data. School districts must ensure that the data they collect are sufficient to measure what the district intends to measure. Most states link students to a "teacher of record" for each class or class period, as determined by a "snapshot" taken once or twice per year. Although this approach works for funding purposes, assigning students to one teacher based on one or two moments in time makes it impossible to capture data that accurately describe a wide variety of situations. For example, when teachers share responsibility for a student's instruction through flexible grouping or co-teaching, data systems must be able to assign multiple teachers to that student and accurately reflect the portion of instruction that the student receives from each teacher. When students move between schools, data systems that only take one or two annual snapshots will assign full responsibility to the teacher of record at that moment, and no responsibility to other instructors who taught that student. District staff and others should ensure that their data systems actually collect the data they hope to use in a performance evaluation.

Assign accurate and aligned identifiers to educators, students, and courses. In order to accurately link teachers, students, courses, and test data, it is imperative that data systems include a unique identifier for each data element (i.e., teacher, student, and course). If these identifiers are inaccurate for any reason, the educator performance assessment will be inaccurate as well. District course codes are typically not the same as state course codes, and Battelle for Kids has identified cases where mismatches between district and state codes resulted in several years of inaccurate data reporting. To ensure accuracy, state and district codes should align, and states and districts should take steps to guarantee that each district reflects updates on the state's end. Similarly, inaccurate or duplicative teacher and student identification numbers can cause the wrong teachers to be assigned to the wrong students, which can result in undue punishments or rewards for the affected teachers.

Create a secure process to verify the information. Regardless of how well a data system is set up, there is always a risk that errors will persist. It is important to create a process for identifying and fixing these errors. Battelle for Kids recommends a three-stage verification process:

- First, a principal or administrative designee should be able to review teaching assignments as they exist in the data system and enter additional information or make changes based on visible errors—for instance, if a teacher does not have any students.
- Second, teachers must have the opportunity to review and modify the data. This stage includes modifying course rosters, indicating the dates of class membership for mobile students, and setting the percentage of a student's instructional time for which the teacher was responsible. Logging all changes at this stage guards against errors or falsification.
- Third, administrators should review the data again, checking for errors, omissions, and other inconsistencies. For example, if the percentage of responsibility for a student claimed by that student's co-teachers adds up to more or less than 100, the administrator would work with those teachers to adjudicate the error.

At all stages, access to student and teacher data should be secure. When payouts or other high-stakes consequences depend on accurate teacher–student linkages, there is a risk that someone will attempt to manipulate the data to their advantage.

Train and support educators. Appropriate training and support help ensure that educators understand how to use the systems and can also facilitate stakeholder buy-in by increasing understanding and acceptance of the verification process. Professional development sessions should establish why the data are important and clearly explain their uses. Teachers and administrators should have access to technical support by phone or other means and monitor and profile data for common errors.

For more resources on student–teacher linkage, see the "Further Reading" box.

IV. REPORTING AND QUALITY CONTROL

If districts hope to maximize the effectiveness of their linkage verification process, they should collect information about the process each time it occurs and build quality-control structures to improve it. Taking these steps can help districts identify common errors and potential areas for improvement.

Use data and educator feedback to improve the verification process

Data collection and analysis of error types is a critical component of monitoring and improving a verification process. If districts collect appropriate data, they can use the data to identify inefficiencies, common errors, and trends. Such data can inform future improvements to the verification system. The data should be detailed enough to be informative. For example, knowing that a district has a 5 percent error rate is helpful, but it is much more helpful to know which schools and classrooms had the most errors, what types of errors those were, and what common characteristics those classrooms share. District managers should consider collecting and analyzing the following types of data regarding their verification process:

- The number of records that are correct or incorrect before the verification process;
- The types of errors that exist before the verification process;
- The types of changes that teachers and administrators make;
- Error and participation data that can be disaggregated by factors that include teacher, grade, course, school, and completion of relevant training;
- The characteristics of situations in which errors are difficult to resolve (e.g., when educators must spend a great deal of time resolving a discrepancy); and
- The number of teachers who complete, partially complete, and never begin the verification process.

Teachers, administrators, and anyone else who participates in the verification process should have an opportunity to describe their experience and provide feedback. As with data collection, district managers can use this information to improve the verification process. In addition, stakeholders may have ideas about how to improve the verification software or process that district leaders have not considered.

To maximize the quality of the information collected from surveys, districts should ensure teachers and others that their answers will be confidential and that the purpose of the survey is to identify potential areas of improvement. Ideally, surveys should link to the data described above, so that districts can identify relationships between educator attitudes and characteristics. Managers should consider gathering the following types of information through surveys:

- The length of time spent on the verification process;
- Attitudes regarding all aspects of the verification process, including training, supports, communication, user interface, and experiences resolving data discrepancies;
- Suggestions as to how to make the process more efficient or effective; and
- Characteristics of the respondent, to identify trends.

Field Example: Tables 1 and 2 below are an example of the types of data that are useful to improving a linkage verification system. These tables describe errors in the data that existed before the verification process. The data in Table 1 reveal that two schools, B and C, were especially prone to having errors in their data. While school B struggled only with student–course discrepancies, school C also had some teachers with wrong course assignments. Table 2 shows that student–course discrepancies were most likely to occur in grades 3, 4, and 5 and that course–teacher discrepancies occurred only in the middle grades. The data also reinforce that errors exist at every grade level and in every school.

Table 1. Number of participating teachers (N), counts, and percentage of records validated as correct, course-level discrepancy, and student-level discrepancy by school

School	N	Validated as Correct		Course–Teacher Discrepancy		Student–Course Discrepancy	
A	4	312	96.59%	0	0.00%	11	3.41%
B	7	452	87.77%	0	0.00%	63	12.23%
C	8	392	63.95%	53	8.65%	168	27.41%
D	11	2,812	97.27%	3	0.10%	76	2.63%
E	12	915	97.34%	0	0.00%	25	2.66%
F	14	938	94.46%	9	0.91%	46	4.63%
G	20	1,712	95.16%	43	2.39%	44	2.45%
Total	76	7,533	93.30%	108	1.34%	433	5.36%

Table 2. Number of participating teachers (N), counts, and percentage of records validated as correct, course-level discrepancy, and student-level discrepancy by grade level

Grade	N*	Validated as Correct		Course–Teacher Discrepancy		Student–Course Discrepancy	
3	4	356	88.12%	0	0.00%	48	11.88%
4	10	945	90.43%	0	0.00%	100	9.57%
5	23	1303	90.49%	0	0.00%	137	9.51%
6	11	1175	95.76%	23	1.87%	29	2.36%
7	12	1324	94.03%	62	4.40%	22	1.56%
8	14	938	95.42%	9	0.92%	36	3.66%
9	16	1492	95.46%	13	1.32%	36	3.65%
Total	90	7533	93.35%	108	1.34%	433	5.36%

* Some teachers taught students in more than one grade.

Integrate quality control into district plans and staffing

Districts should build structures that result in continuous monitoring of the verification process for quality and potential areas of improvement. Collecting data and feedback about the verification process is a critical piece of quality control, but prioritizing the analysis and use of that information is equally important. Districts should assign responsibility for monitoring and maintaining the quality of student–teacher linkages to specific people or organizational units and should allocate sufficient resources and time to perform a thorough analysis. In addition, districts should include a focus on the quality of student–teacher linkages in strategic plans or other goal-setting documents.

CONCLUSION

Linkage verification plays a pivotal role in any initiative that requires linking teachers to student performance, including educator performance assessments, educational research, and program evaluations. Without verification, districts practically guarantee that errors will persist in classroom assignment data. Such errors damage the accuracy of data analysis, which could result in erroneous research or unjust consequences for educators.

The verification process presented in this paper provides a model for districts that intend to improve the quality of student–teacher linkage data. Careful planning and testing are essential steps to ensure that the verification process itself runs smoothly and catches as many errors as possible. After teachers and administrators review the data, districts should collect information about the process and improve it for future years. An effective verification system will improve any program that uses links between students and their teachers.

FURTHER READING

Other CECR Resources

Watson, J. G., Kraemer, S. B., & Thorn, C. A. (2009). *Data quality essentials: Guide to implementation: Resources for applied practice*. Center for Educator Compensation Reform. http://cecr.ed.gov/ pdfs/guide/ dataQuality.pdf

Watson, J. G., Withham, P., & St. Louis, T. (2010). *Evaluating student–teacher linkage data in Teacher Incentive Fund (TIF) sites: Acquisition, verification, and system development*. Center for Educator Compensation Reform. http://cecr.ed.gov/pdfs/CECR_HarvestingPaper2.pdf

Kluender, R., Thorn, C. A., & Watson, J. G. (2011). *Why are student–teacher linkages important? An introduction to data quality concerns and solutions in the context of classroom-level performance measures*. Center for Educator Compensation Reform. http://cecr.ed.gov/pdfs/CECR_HRA_Linkages.pdf

Other Non-CECR Resources

Battelle for Kids (2009). *The importance of accurately linking instruction to students to determine teacher effectiveness*. Battelle for Kids. http://static.battelleforkids.org/images/BFK/ Link_whitepagesApril2010web.pdf

Bergner, T., Steiny, J., & Armstrong, J. (2007). *Benefits of and lessons learned from linking teacher and student data*. Data Quality Campaign. http://www.dataqualitycampaign.org/files/publications-benefits_of_and_lessons_learned_from_linking_teacher_and_student_data-120607.pdf

Data Quality Campaign. (2010). *Effectively linking teachers and students*. Data Quality Campaign. http://www.dataqualitycampaign.org/files/DQC7_14.pdf

APPENDIX A: USE-CASES FOR LINKAGE VERIFICATION

This appendix contains a set of design documents called use-case specifications. These use-case specifications support district and state leaders who are preparing to implement student–teacher linkage data verification projects. They are a detailed supplement to the diagrams of the process described in the *Linkage Verification* section above. The use-case specifications show the precise steps used to complete this model linkage verification process down to the mouse click.

A use-case specification is a detailed diagram that depicts the process through which users of a system achieve a goal. Use-case specifications detail each possible user action and the system's response to that action. The use-case documents in this appendix break the steps into two paths: the main or most straightforward path and alternate or exception paths. The main path is the smoothest possible path through the system: for example, when a teacher attempts to log in to the system, the main path is for the login to work. However, alternate paths are possible: the teacher may enter an incorrect password and receive an error message. At each step on the main path where an alternate path is also possible, the diagram indicates those alternate paths. Thus, the use-case documents provide a detailed, step-by-step look at all of the possible paths that teachers and administrators can take during linkage verification.

Actor/Goal Table (Use-Case Index)

ID	Actor	Use-Case Name	Business Goal	Complexity	Priority	Page #
UC1	Teacher	Teacher Login	Allow teacher to use STVS.	Low	I	X
UC2	Teacher	Teacher Screening	Allow STVS to filter teacher participation.	Low	I	X
UC3	Teacher	Verify Class Information	Allow teacher to review and confirm class assignments.	High	I	X
UC4	Teacher	Verify Class Roster	Allow teacher to review and confirm student assignments.	High	I	X
UC5	Principal	Principal Login	Allow principal to use STVS.	Low	I	X
UC6	Principal	Unclaimed Course Resolution	Allow principal to assign unclaimed courses to teachers.	Low	I	X
UC7	Principal	Unclaimed Student Resolution	Allow principal to assign unclaimed students to teachers and courses.	High	I	X

Teacher Login			
Use-case Number	UC1		
Scope	STVS Web Application		
Level	Primary Task		
Description/ Purpose	Teachers must login to STVS in order to gain access to teacher interface.		
Primary Actor	Teacher		
Precondition	Web server is functional.		
Trigger	Teacher elects to login.		
Success Guarantees	Teacher authenticates and is able to access STVS.		
Main Path	**Step**	**Action**	**A./E. P.**
	1	Teacher enters login credentials.	
	2	Teacher submits login credentials.	
	3	STVS checks credentials.	1a
	4	STVS checks account is enabled.	2a
	5	STVS displays screening page if teacher's first logon, or class list for any subsequent logons.	3a
Alternate/ Exception Path(s)	**Step**	**Action**	**A./E. P.**
	1a	User submits incorrect credentials.	
	1b	STVS displays login error message.	
	2a	User attempts to login with disabled account.	
	2b	STVS displays login error message.	
	3a	Window for teacher participation has passed.	
	3b	STVS displays page explaining when the teachers were locked out and providing contact information for any questions or concerns.	

Teacher Screening			
Use-case Number	UC2		
Scope	STVS Web Application		
Level	Primary Task		
Description/ Purpose	Isolate teachers in the grade levels (and content areas) of data collection.		
Primary Actor	Teacher		
Precondition	Web server is functional, teacher can log in.		
Trigger	Teacher has logged in for the first time.		
Success Guarantees	Teacher is allowed to participate in the study and proceeds to UC3.		
Main Path	**Step**	**Action**	**A./E. P.**
	1	Teacher logs in for the first time.	
	2	STVS displays initial screen asking whether the teacher currently teaches in the district and, if so, which grade levels/subject areas.	
	3	Teacher selects whether he/she teaches in the district.	1a
	4	Teacher selects grade levels and subjects he/she teaches and submits the form.	
	5	STVS saves grade level and subject area information.	
	6	STVS displays the class verification page.	2a, 3a
Alternate/ Exception Path(s)	**Step**	**Action**	**A./E. P.**
	1a	Teacher says he/she does not teach in the district.	
	1b	STVS displays confirmation dialogue explaining that if the teacher does not teach in the district, no further action is required.	1.1a
	1c	Teacher confirms that he/she does not teach in the district.	
	1d	STVS displays page thanking teacher for participation.	
	1.1a	Teacher selects to cancel selection saying he/she does not teach in the district (i.e., teacher does teach in the district and selected no by mistake).	
	1.1b	STVS closes dialogue and returns to the grade-level/subject selection stage.	
	2a	Teacher does not select any grade levels or subjects within the scope of data collection.	
	2b	STVS thanks teacher for his/her time and indicates that his/her participation is complete.	
	3a	Teacher does not have any classes associated with him-/herself that need to be verified.	
	3b	STVS displays a page explaining that the teacher has no classes associated with him-/herself and allows the teacher to enter any missing classes.	

Verify Class Information			
Use-case Number	UC3		
Scope	STVS Web Application		
Level	Primary Task		
Description/ Purpose	Teachers need to confirm the class information loaded into the STVS.		
Primary Actor	Teacher		
Precondition	Teacher user is logged in. Teacher is at Verify Classes screen.		
Trigger	Teacher elects to confirm class information.		
Success Guarantees	Teacher enters information to verify class details.		
Main Path	**Step**	**Action**	**A./E. P.**
	1	STVS displays a list of classes the teacher teaches.	1a
	2	Teacher reviews a row containing the class information.	2a
	3	Teacher expands details of the class.	
	4	Teacher adjusts content classification if needed.	
	5	Teacher indicates whether he/she taught the class all year.	
	6	Teacher adjusts team teacher if one exists.	3a
	7	Teacher selects to save class information.	4a, 5a
	8	STVS saves class information.	
	9	STVS displays the classes with the updated information as well as a message asking the teacher to move to the roster tab. (UC4)	
	10	STVS displays completion message once all classes and student rosters are verified.	
Alternate/ Exception Path(s)	**Step**	**Action**	**A./E. P.**
	1a	Teacher notices a missing class which he/she teaches but is not in the list.	
	1b	Teacher clicks "[Missing a Class?]" link.	
	1c	STVS displays textbox for teacher to enter list of missing class(es).	
	1d	Teacher enters missing class(es) and clicks "Save."	
	1e	STVS saves missing class information and closes dialogue, again showing class list (note: missing classes will not be added to the visible class list).	
	2a	Teacher indicates the class as "Not Taught."	
	2b	STVS displays a confirmation dialogue asking the teacher to confirm that he/she does not teach the class (this dialogue also displays the class roster).	2.1a
	2c	Teacher confirms that he/she does not teach the class.	
	2d	STVS moves class indicated as "Not Taught" to bottom of page, separately from those whose details still need to be verified.	
	2.1a	Teacher realizes that he/she does teach the class and clicks "cancel."	
	2.1b	STVS closes dialogue and returns to class list. No changes are made.	
	3a	STVS displays percentage boxes for teaching distribution.	
	3b	Teacher enters percentages for his/her and team teacher's contributions.	
	4a	Teacher leaves any questions within class details unanswered.	
	4b	STVS displays error message indicating the missing data and does not save.	
	5a	Teacher indicates a team teacher, but percentage boxes do not add to 100.	
	5b	STVS displays error telling teacher the percentages must equal 100 and does not save.	

Verify Class Roster			
Use-case Number	UC4		
Scope	STVS Web Application		
Level	Primary Task		
Description/ Purpose	Teachers need to confirm the student list loaded into STVS.		
Primary Actor	Teacher		
Precondition	Teacher user is logged in. Teacher is at class list screen.		
Trigger	Teacher elects to confirm a class roster.		
Success Guarantees	Teacher enters information to confirm roster data for a given class.		
Main Path	**Step**	**Action**	**A./E. P.**
	1	Teacher clicks "Verify Roster" tab for a confirmed class.	
	2	STVS displays a list of students enrolled in the class.	
	3	Teacher reviews roster for completeness.	1a
	4	Teacher reviews each row containing student information.	
	5	Teacher adjusts the student's status.	
	6	Teacher indicates if any student(s) receive additional instructional support.	2a
	7	Teacher selects to save student roster.	
	8	STVS saves student information.	3a, 4a
	9	STVS displays the class roster with the updated information.	
	10	After roster and class details are completed and successfully saved, STVS marks the class as "completed."	
Alternate/ Exception Path(s)	**Step**	**Action**	**A./E. P.**
	1a	Teacher realizes there is a missing student.	
	1b	Teacher adds student (UC4a).	
	2a	STVS displays drop down to allow teacher to select which teacher provided the individual support, as well as percentage boxes for the teacher, team teacher (if indicated), and the additional support teacher.	
	2b	Teacher selects who provided the additional support.	
	2c	Teacher fills in percentage boxes to indicate each relevant teacher's contribution to that student.	
	3a	Teacher navigates away from screen without saving.	
	3b	Any changes the teacher made are lost.	
	4a	Roster contains students with unanswered questions or with percentage boxes not totaling 100.	
	4b	STVS displays message at top of roster indicating the number of students with errors.	
	4c	Students with errors are highlighted in red.	
	4d	Teacher must correct all errors before STVS will allow the roster to be saved.	

Add Student to Class			
Use-case Number	UC4a		
Scope	STVS Web Application		
Level	Subfunction		
Description/ Purpose	Teachers need to add a student who is in school roster but not shown in class roster.		
Primary Actor	Teacher		
Precondition	Teacher user is logged in. Teacher is at class roster screen.		
Trigger	Teacher elects to add a missing student.		
Success Guarantees	STVS adds student to class roster.		
Main Path	**Step**	**Action**	**A./E. P.**
	1	Teacher clicks on "Missing a student?" option.	
	2	STVS displays a popup dialogue containing a search box.	
	3	As teacher begins typing student's name, STVS dynamically displays a list of students matching the current search string.	
	4	Teacher selects student to add to the class roster.	1a
	5	STVS updates student roster.	
	6	STVS displays the class roster page (return to UC4).	
Alternate/ Exception Path(s)	**Step**	**Action**	**A./E. P.**
	1a	Teacher does not find the needed student in the list.	
	2a	Teacher selects the "Add New Student" option (UC4b).	

Add New Student			
Use-case Number	UC4b		
Scope	STVS Web Application		
Level	Subfunction		
Description/ Purpose	Teachers need to add a student not found in the school roster.		
Primary Actor	Teacher		
Precondition	Teacher user is logged in. Teacher is at "Missing Student" screen.		
Trigger	Teacher elects to add a missing student not found in the school roster.		
Success Guarantees	STVS adds student to school and class rosters.		
Main Path	**Step**	**Action**	**A./E. P.**
	1	Teacher selects the "Add Missing Student" option.	
	2	STVS displays the "Create Student" screen.	
	3	Teacher enters the student's name and clicks add.	1a
	4	STVS creates new student, then adds student to school and class rosters.	
	5	STVS displays the class roster page (return to UC4).	
Alternate/ Exception Path(s)	**Step**	**Action**	**A./E. P.**
	1a	Teacher navigates away from screen without saving.	
	2a	Data entered are lost.	

Principal Login			
Use-case Number	UC5		
Scope	STVS Web Application		
Level	Primary Task		
Description/ Purpose	Principals must login to STVS in order to gain access to principal interface.		
Primary Actor	Principal		
Precondition	Web server is functional.		
Trigger	Principal elects to login.		
Success Guarantees	Principal authenticates and is able to access STVS.		
Main Path	**Step**	**Action**	**A./E. P.**
	1	Principal enters login credentials.	
	2	Principal submits login credentials.	
	3	STVS checks credentials.	1a
	4	STVS checks account is enabled.	2a
	5	STVS displays Unclaimed Courses page (UC2).	3a, 4a
Alternate/ Exception Path(s)	**Step**	**Action**	**A./E. P.**
	1a	User submits incorrect credentials.	
	1b	STVS displays login error message.	
	2a	User attempts to login with disabled account.	
	2b	STVS displays login error message.	
	3a	Principal has no unclaimed courses associated with his/her school.	
	3b	STVS instead displays Unclaimed Students page (UC3).	4a
	4a	Principal has no unclaimed courses or students associated with his/her school.	
	4b	STVS displays a page thanking the principal for participation.	

Unclaimed Course Resolution			
Use-case Number	UC6		
Scope	STVS Web Application		
Level	Primary Task		
Description/ Purpose	Principals need to be required to resolve conflicts that arise from teachers marking courses as "Not Taught."		
Primary Actor	Principal		
Precondition	Principal user is logged in. Principal is at Unclaimed Courses screen. Teachers have completed their verifications and their access has been concluded. STVS can identify and display conflicts.		
Trigger	Principal elects to resolve conflicts.		
Main Path	**Step**	**Action**	**A./E. P.**
	1	STVS displays screen with orphaned courses associated with content areas the district is interested in (i.e., Courses of content the district has indicated an interest in which were marked "Not Taught" by a teacher).	
	2	For each course, if it is taught, the principal checks the box in the "Taught" column.	
	3	If a course is taught, the principal selects a teacher from a drop down list indicating which teacher to associate the course with.	1a, 2a
	4	Principal clicks "Save and Continue."	2a
	5	STVS saves the data and moves to the "Unclaimed Students" screen (UC3).	3a
Alternate/ Exception Path(s)	**Step**	**Action**	**A./E. P.**
	1a	The teacher who taught the class is not found in the dropdown menu.	
	1b	Principal selects "other teacher."	
	2a	Principal clicks "save" option.	
	2b	STVS saves the changes to the database, stays on current screen.	
	3a	Principal has no unclaimed students associated with his/her school.	
	3b	STVS displays a page thanking the principal for participation.	

Unclaimed Student Resolution			
Use-case Number	UC7		
Scope	STVS Web Application		
Level	Primary Task		
Description/ Purpose	Principals need to be required to resolve conflicts that arise from teachers marking students as "Not Taught" or "Not at School."		
Primary Actor	Principal		
Precondition	Principal user is logged in. Principal is at Unclaimed Students screen. Teachers have completed their verifications, and their access has been concluded. STVS can identify and display conflicts.		
Trigger	Principal elects to resolve conflicts.		
Main Path	**Step**	**Action**	**A./E. P.**
	1	STVS displays screen with students marked as "Not Taught" or "Not at School" by teachers during roster verification process.	
	2	For each student, the principal specifies whether the student is at the school (UC3a) or not at the school.	1a
	3	After each student has been marked as the correct status, Principal clicks "Save and Continue."	1a, 2a
	4	STVS displays a screen thanking principal for participation and instructs him/her to use the links at the top of the screen to go back to either previous screen if changes are required.	
Alternate/ Exception Path(s)	**Step**	**Action**	**A./E. P.**
	1a	The principal selects "Save" option.	
	1b	STVS saves any changes to the database, remains on current screen.	
	2a	Students are present who are marked as "At School" but a teacher and/or course has not been selected.	
	2b	STVS displays error message at the top of student list and places red asterisk next to each student with missing information.	
	2c	All errors must be resolved before a successful save and continue.	

Unclaimed Student Resolution			
Use-case Number	UC7a		
Scope	STVS Web Application		
Level	Subfunction		
Description/ Purpose	Principals need to enter additional information for unclaimed students marked as "At School."		
Primary Actor	Principal		
Precondition	Principal user in logged in. Principal is at Unclaimed Students screen. Teachers have completed their verifications, and their access has been concluded. STVS can identify and display conflicts.		
Trigger	Principal identifies an unclaimed student as being at his/her school.		
Main Path	**Step**	**Action**	**A./E. P.**
	1	Principal marks an unclaimed student as "At School."	
	2	STVS expands a list of courses that the student was originally associated with, including a teacher drop down for each course.	
	3	For each course present, principal must first select which teacher taught that course to the student.	1a
	4	STVS generates a new drop down with a list of all courses taught by the selected teacher.	
	5	Principal selects which course the student should be associated with.	2a
	6	Principal repeats (2-5) for each course shown under the student's name.	
Alternate/ Exception Path(s)	**Step**	**Action**	**A./E. P.**
	1a	The teacher who taught the student is not present in the list.	
	1b	Principal selects "Other Teacher."	
	2a	"Other Teacher" was selected.	
	2b	No course list is generated, and the student is not associated with any specific course.	

REFERENCE

Battelle for Kids (2009). The importance of accurately linking instruction to students to determine teacher effectiveness. *http://static.battelleforkids.org/images/ BFK/Link_whitepagesApril2010web.pdf*