Visualizing Student Achievement Data

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ABSTRACT
UPDATED—29 December 2017. Student assessment data is not often readily available to teachers, instructional coaches, and administrators. Student informations systems are playing a larger role in helping schools, districts, and states, track student progress and growth as an accountability measure, and, more importantly, so that schools can modify and tailor instruction for students. In collaboration with Leadership Public Schools (LPS), a charter network consisting of three schools in the San Francisco Bay Area, I created a data visualization tool to make achievement data readily available. The dashboard shows individual student achievements, aggregate data for courses — including learning targets which may be made up of of one or more assignments — and individual assignments. The dashboard was built with simplicity as the guiding design principal to allow teachers, instructional coaches, and administrators to quickly perceive quantitative values and comparisons from the data.

Author Keywords
Data Driven Instruction; Student Achievement; Data Driven Schools; School Accountability; Student Data Tracking and Reporting; Data Visualization; Standards Based Grading (SBG); Culture of Data; Data Literacy; Assessment Data; Education; Dashboard Design; Student Information Systems (SIS); D3.js; React; Heroku.

ACM Classification Keywords
H.5.2 Information Interfaces and Presentation (e.g., HCI): User Interfaces, User-centered design
H.5.m Information Interfaces and Presentation (e.g. HCI): Miscellaneous, Data Visualization

INTRODUCTION
Having taught high school mathematics in Oakland, California, I understand some of the struggles that teachers face when it comes to understanding student achievement and designing curriculum. One of the struggles I faced as a teacher was understanding each of my students' academic achievement in mathematics and reading. I needed to know each student's literacy level to determine if they could read and comprehend the math textbook, and I needed to know what gaps in knowledge each student possessed in mathematics so students could achieve more than one year of growth in my classroom. I received aggregate data for student performance on Algebra 1 standards from the Standardized and Reporting (STAR) program, but I didn't have any other data to understand the knowledge and skills that students possessed.

Many teachers face a similar problem in California as they have limited data on student achievement. Student data can also be siloed within school sites or restricted to "data islands" within school districts [2].

Standardized testing begins at the third grade level in California. The lack of early grade level achievement data creates a problem of understanding student readiness in the third grade. One of my friend's Richard Pelayo, who served as Managing Director for Go Oakland Public Schools, indicated that achievement data is lacking. In one of his consulting projects, he noted that there's a gap between understanding student achievement from pre-K to third grade because the data simply does not exist This creates a problem of understanding student achievement and student preparedness prior to the third grade. Essentially, students may already be behind academically by the time they reach third grade, and it may be too late for reading intervention or other forms of academic intervention to take place before standardized testing or any other form of assessment measures reporting takes place when students reach the third grade. Standardized testing is a form of measuring learning outcomes but should not be the only piece of data that teachers should use to inform instruction. In fact, much of the research I consulted recommended that teachers be the interpreters of data and curriculum design as they can determine curriculum alignment to standardized tests and make any needed changes in the curriculum.

While the development project does not focus on the lack of assessment data for K-3 students, I do have recommendations for the type of data that could be collected. One such test is a transitional Kindergarten (TK) and Kindergarten readiness assessment aligned to the Common Core Standards [16]. Another piece of data would be the California English Language Development Test (CELDT), which is used to measure English proficiency and can be tracked over time from K-12 grade levels. The exam is required by law to be given to students whose home language, that is the primary language spoken in the household, is not English [3]. Another norm-referenced test which might be beneficial to track would be the Brigance test. Not all schools use the test, and it is usually up to the administrators and instructional staff to test students in pre-Kindergarten, Kindergarten, and First Grade [1]. Finally, the last test which could be tracked is the Developmental Reading Assessment. "The Developmental Reading Assessment (DRA2)™ is an interim benchmark assessment that is designed for students in Kindergarten through third grades. It allows teachers to systematically observe, record, and evaluate change in a student's reading performance over

time." A similar test to to be used instead of the DRA is called Fountas & Pinnell. All of these tests could be stored in a data warehouse so administrators, data analyst, researchers and teachers can leverage the data for school wide patterns of achievement, school site and district level reports, education policy, and curriculum planning and student intervention.

The original goal of my development project was to make a variety of assessment data available to teachers, instructional coaches, and administrators. Many teachers use student assessment data to understand where students are at the start of the year and can group students into appropriate skill groups to differentiate instruction. For California and specifically Oakland Unified School District (OUSD), some of the data that I would include on such a dashboard would include a transitional Kindergarten (TK) and Kindergarten readiness assessment aligned to the Common Core Standards [10], California English Language Development Test (CELDT), Fountas & Pinnell test (K-8), Scholastic Reading Inventory or SRI (K-12), Smarter Balanced Assessment Consortium or SBAC English Assessments, Scholastic Mathematics Inventory or SMI (K-12), District Benchmark Tests, SBAC Mathematics Assessments, and California Standard Tests in Science for fifth graders, eighth graders, and tenth graders. Due to time restrictions and the complexity of integrating with other data sources, I restricted the dashboard to one set of data within LPS after meeting with Amy Epstein, Executive Officer of Data, Assessment, and Tiered Support. The data set was obtained from JumpRope at the Richmond school site. Jump Rope is a standards-based, electronic gradebook [10]. This project was not originally intended to focus on standards-based grading. I have included additional resources for learning about standards-based grading and teacher practices in the README of the development project.

DATA-DRIVEN SCHOOL IMPROVEMENT

No Child Left Behind (NCLB) was a standards-based education reform based on the premise that setting high standards and establishing measurable goals could improve individual outcomes in education. States were given the choice to implement their own assessments of basic skills or use national ones and were required to give those assessments to all students across all grades. Schools received federal funding for meeting requirements and reporting on assessments and annual progress. Education literature reports that the increased focused on school accountability and the federal policy of NCLB had a clear positive impact on student achievement [7]. However, the achievement gap across African American students and their white peers did not narrow.

Even though the achievement gap did not narrow for some racial groups, the use of data in school accountability and instruction holds promise. Research has shown that using data in instructional decisions can lead to improved student performance [18, 19, 20]. Additionally, research on school improvement and student outcomes suggests data use is central to a school's improvement process [6]. However, the availability of data does not equate to great schools. Lack of data literacy skills, especially for novice teachers, can leave teachers feeling overwhelmed and intimidated [5]. The combination of teacher training in data literacy and continued collaboration and reflection on teaching will best serve schools and students.

The evidence surrounding a vision or school culture of data was weak overall, and I found no studies with a casual design linking a vision of data to student achievement. Much of the literature is focused on how school sites can leverage data, including standardized test scores, state assessment data, benchmark assessment data, formative assessments, and attendance data, to improve instruction. One researcher, Copland, advocates for a distributed leadership framework to be created for teachers and administrators so that responsibility for inquiry into teaching and learning is shared [4]. One panel of experts put together a comprehensive guide for using student achievement data in instructional decisions and planning [7]. They also established best practices for creating a culture of data and implementing a data system at the district level. Murmane, Sharkey, & Boudett reported on the use of data to improve instructional programs and students' skills across ten school sites and highlighted that many staffs do not possess expertise in learning from assessments results [15]. This is one of the fundamental problems in teacher training and preparedness. This also prevents teachers from being able to successfully analyze and act on student achievement data. Professional development or certification may need to be provided to teachers and administrators for analyzing data and making decisions from analyses [14]. Another solution supported by Symonds consists of "classroom coaches" supporting data use and inquiry in addition to larger level professional development [17]. Regardless of the strategies or frameworks used to create a culture of data in schools, most experts agree that the use of data in schools is positive and here to stay.

EXISTING SOLUTIONS

There are a number of existing solutions when it comes to collecting, reporting, and visualizing student achievement data. Some are free and basic while others are complex and costly. One solution that some teachers use to record and visualize student achievement is Excel, or a similar spreadsheet software program. The drawback of such programs like Excel is that they are labor intensive and demand expertise and time of the teacher. Many teachers may not be familiar with data visualization, cell formatting, formulas, or other methods unique to the software program to make sense of the data. Teachers can be provided with pre-formatted spreadsheets to enter data, but the data is often local to the teacher's computer, and the data is short-lived for a semester or year. Additionally, the data might not be portable if specified in a format that is unique to the software program (i.e. a .xls or .xlsx file) or readily shared if the recipient does not have the software program.

Another type of software solution is a Student Information Systems (SIS). These systems typically serve as both a warehouse of student data and a portal to report on and

view student data. One specific vendor is called Infinite Campus, and the software solution is sold to individual schools, districts, and states [8]. Infinite Campus is even a state-wide solution for six states in the United States. The software solution provides both standard and custom visualizations and reports for teachers, administrators, students, and parents. This is advantageous as users can see the data most pertinent to themselves. The drawbacks of such solutions are high monetary cost, integration costs — porting existing data into the system and integrating with current software or reporting mechanisms — and training for the users to use the software.

Another type of software solution which is focused on teachers, instructional coaches, and administrator is an education intelligence platform. This type of solution offers teachers the ability to create assessments and view results, allows data to be centralized in one place, and provides pre-built reports to inform data-driven decisions for instruction and support. One such vendor is called Illuminate Education, which has been purchased by OUSD and LPS [9]. Illuminate Education is effective for reports, that is tabular data, and it can generate custom reports. The software is consistent about using tables that allow dynamic sorting by clicking on column headers and filtering rows of data with custom search. A graphing utility exists that permits the user to attach one or more graphs to a custom report, but the creation of such graphs is time consuming. Casey Mirch, Data and Systems Administrator of LPS, clarified that some pre-built reports, such as ones for the Smarter Balanced Assessment Consortium (SBAC), have a consistent and sensible visual design. While the software does have many great features, it still has its limitations. For example, the software is not graphical. Schoolzilla and Tableau, two other visualization tools, are used predominantly by the data team at LPS to display data.

PROBLEM

LPS needed a solution to visualize aggregate and individual student progress by standards or learning targets. A "standard" defines the knowledge and skills students should possess at different points throughout their education. A "learning target" is considered to be a more granular piece of a standard which is often framed in the language "Students will be able to…" (SWBAT). The Richmond school site of LPS has elected to use standards based grading (SBG) for assessing student progress, and the charter network needed a way for teachers and coaches to quickly view student performance. The Richmond school site currently uses JumpRope, a software solution for collecting and reporting grades; however, the visualizations in the JumpRope program are limited. Currently, the software shows color coded bars as a measure of students success (see Figure 1). Red indicates the learner has not met the learning target. Yellow indicates the learner is close to meeting the learning target. Finally, green indicates the learner has met the learning target.

The visualization is problematic for a number for reasons. First, there is no way to see both aggregate data and individual student performance at the same time. Second, the user must click many times to view any given learning target within a course. This leads to a frustrating interface in which users spend more time finding data rather than making sense of student performance. Finally, the color-coded bars are not optimal for users who have red-green colorblindness. Some of these problems can be addressed easily while others require more effort.

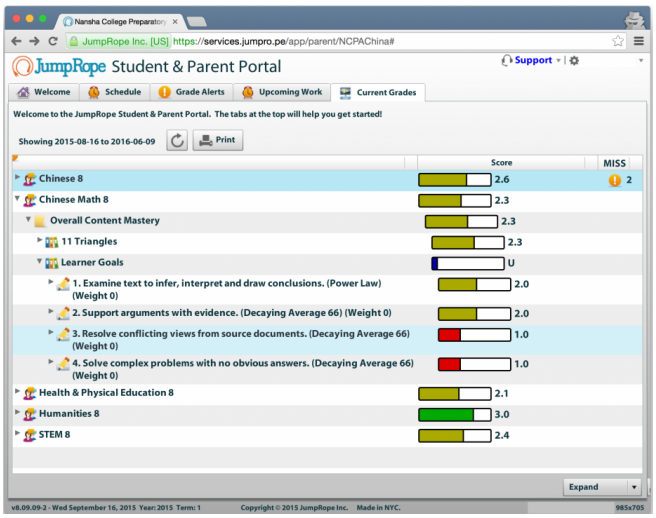


Figure 1. JumpRope interface shows aggregate performance across learning targets for a class.

PROJECT PROPOSAL

I decided to create a dashboard tool that allows teachers and administrators to visualize student achievement data. The project was separated into three phrases in order to deliver small chunks of work, collect feedback, and iterate. The three project phases were need-finding, design, and implementation. I met with administrators and teachers to determine the type of data that the stakeholders, that is the users of the dashboard, needed to perform their daily responsibilities — how these individuals typically access the data they need and how they report on or analyze data. The dashboard was designed to allow administrators and teachers to observe patterns in student achievement data so that they can explore patterns of performance in individual students and in cohorts of students (i.e. classes, grade levels).

The number one guiding design principle throughout the creation of the project was *simplicity*. Dashboards can have an overwhelming amount of information, be poorly designed for visual perception of quantitative attributes, and contain domain-specific data that aren't well known to the consumers of the data. I wanted to avoid these problems that often make visualizations and dashboards fall short so I focused on simplicity. Additionally, many teachers do not have data literacy skills or training in statistics, data visualization, or data analysis so I wanted to create a tool that was both easy to use and easy to analyze [5, 13].

WIREFRAMES

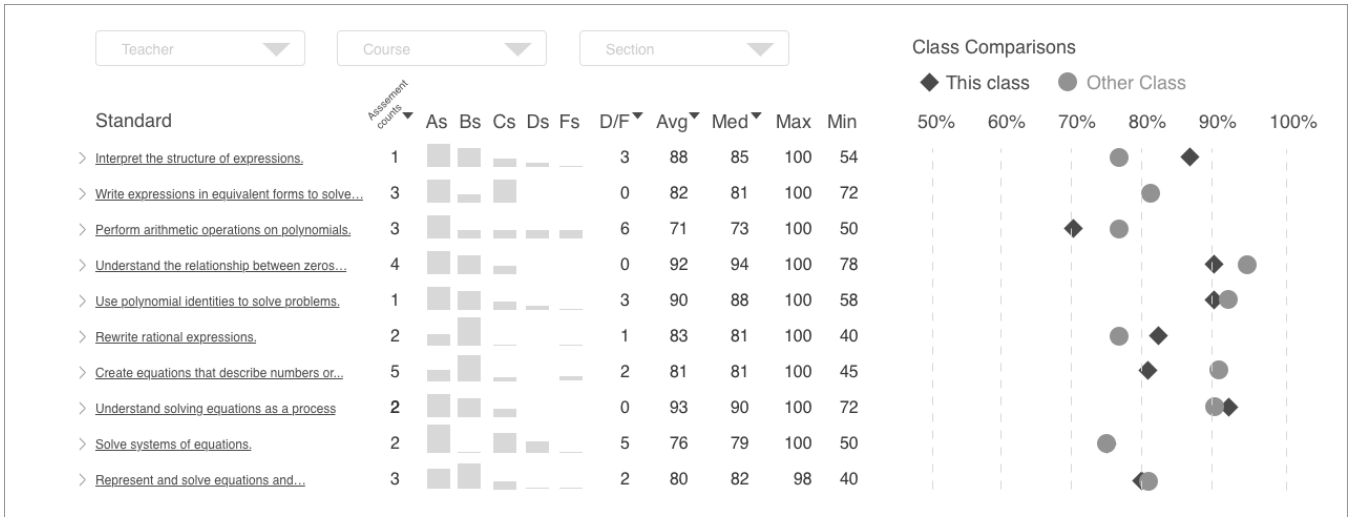


Figure 2. The standard view shows overall class progress on standards. Each standard (shown left) is clickable and when clicked shows a similar view of for all assessments that were used to assess the learning target. The class comparison (shown right) is used to view and compare class averages for learning targets. Multiple classes will be shown if two or more class periods are offered. The symbols can be toggled, limiting the number of classes visible at any one time, by clicking on the symbol or label in the legend above the dot plot.

Figure 3. The assessment view shows individual student scores on a given standard or any given assessment. By clicking on a Standard link or Assessment link, the class roster will appear at the right showing student scores. A benchmark (vertical line at 70) appears so teachers and can coaches can monitor when students reach basic proficiency of the standard or assessment.

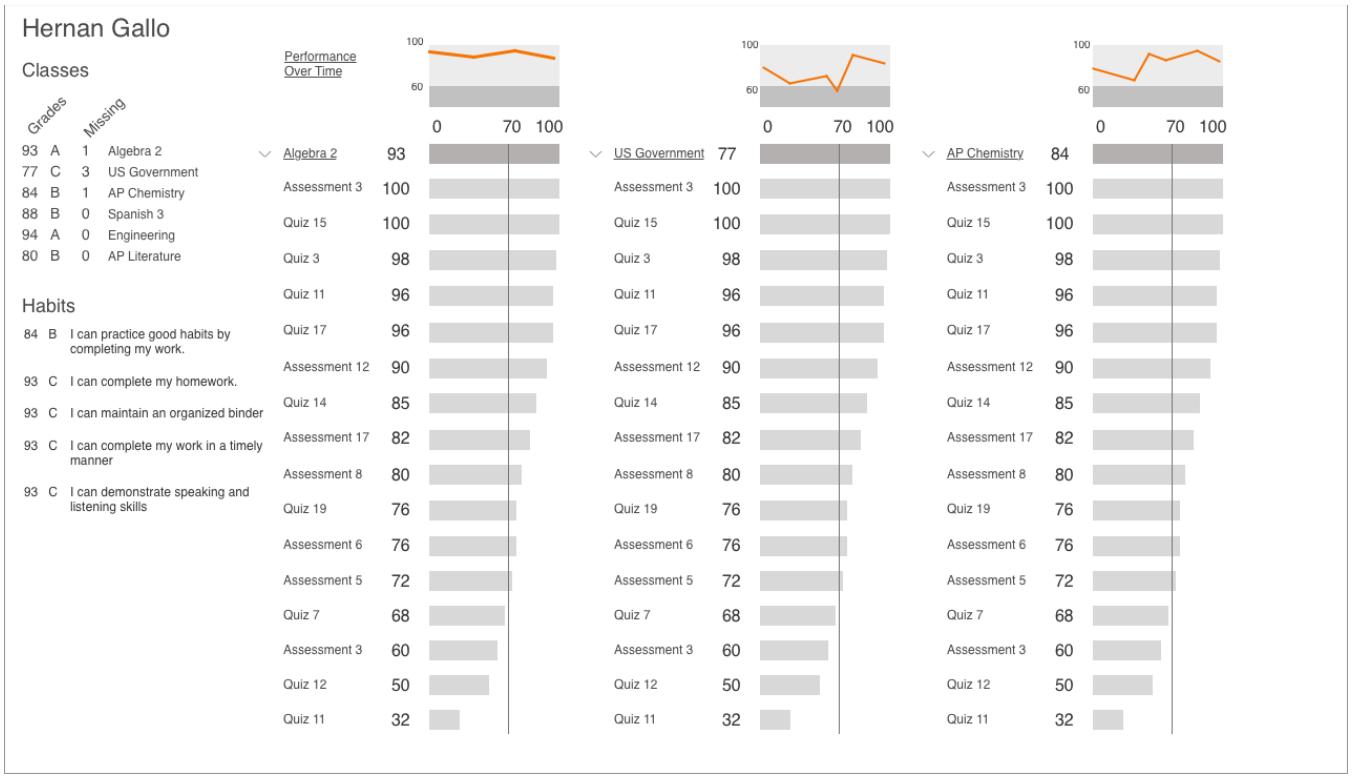


Figure 4. The student view shows individual student progress across all classes. Students can view their grades in each course as well as performance on individual assessments. A line chart if provided for each class to show the student's performance in each class over time. The bottom part of the line chart is shaded in a darker color so teachers and coaches know when the student scored a D/F.

FEEDBACK

I collected feedback from LPS staff, other educators and peers in the OMSCS 6460 Educational Technology course. I created an open response survey for peers to provide feedback on the wireframes. For each screen or view, I asked the respondent to answer two questions: "Are any elements on the view not clear?" and "Other feedback for the view?". There were 36 respondents, and I have included the most relevant and actionable feedback from that survey below.

Standard View (Figure 2)

"Are any elements on the view not clear?"

- How the names related to As, Bs, Cs, etc.
- I'm not sure what the percentages mean.
- One thing that confused me is that the grades go from highest to lowest (A-F) left to right. But then Class Comparison grades go from 50% (F) to 100% (A) left to right.
- The "D/F" column is not immediately obvious.

"Other feedback for the view?"

- Bigger font and color code different rows/columns?
- It might be nice rather than other classes to have a view of just past classes by year on the graph.
- Can add few other stats ex. Comparison with past data. Graphs.
- Font could be a little larger.
- I think it would be helpful to provide a visualization that shows both how the whole class is doing on standards, and also how individual students are performing on standards.
- I think using color could be effective. For example, making "This class" diamonds its own color would help it stand out from the gray circles representing "Other class".

Assessment View (Figure 3)

"Are any elements on the view not clear?"

- How the names related to As, Bs, Cs, etc.
- Confused about the student list. What do the percentages indicate?
- Some color on the various histograms would be very helpful.
- I would add some color-blind safe color choices to make the visualization more apparent.

- The idea is clear, but the interface is not. It took me a while to realize that the assessments were a subset of the standard.
- What happens if there are more students on the side view that can be shown on the screen?
- Is the 70 on the right the average score?

"Other feedback for the view?"

- In the chart on the right a horizontal line separating each grade boundary might be helpful.
- I really really like that the students are sorted in descending score order with that vertical line at 70... I think that's something so simple yet extremely useful

Student View (Figure 4)
"Are any elements on the view not clear?"

- I'm really not sure how the assignments and quizzes are ordered.
- Performance over time. How is it calculated (every test same weight)?

"Other feedback for the view?"

- Allow score sorting by assignment type?
- It would be helpful to show how far the student is through the class to know how much time they have left to improve their grade.
- I think the student view could include more feedback on how to improve not just from a general strategy sense, but also by breaking down the types of problems that they have struggled with to provide them more feedback.
- The ordering could be customized by the user.

I also asked respondents to provide additional comments and questions at the end of the survey. Feedback was overwhelmingly positive. I've included some constructive criticisms.

- I like the animations. It might be helpful to add some different background colors to the Standards and Assessments to help guide the users eye to the appropriate area. Once you expand the Standard it was hard to tell where the Assessments stopped and the next Standard began.
- Is there a standard template that teachers need to input to the dashboard parses the csv [file] correctly? Also could you change the ID's in the view to Student names? It seems like you had done this above.
- The only suggestion I would say is rather than staying mono-chromatic, perhaps use, green, yellow, red to indicate various levels of progress against standards.
- The only thing I'd recommend is the ability to draw that vertical line (currently 70) at different numbers (e.g. 80 or 85 or dynamic)

The feedback I received from LPS included…

- This looks awesome, and it's very practical that you've built it to accept a csv file that we can easily generate from JumpRope. The visualization on both the student and class overviews is excellent and the navigation very easy and quick.
- The only missing piece would be a count of standards (what they call Learning Targets or LTs) per class. Would it be possible to add that - perhaps as a line beneath the class selection and above the rest of the data? Also, it would be better to call those entities LTs.

FEATURES

After integrating feedback from LPS, peers, and colleagues, I arrived at a final product that improves upon the main ideas of the initial wireframes. The dashboard tool is hosted on Heroku and available at https://learning-progress-dashboard.herokuapp.com/.

CSV Upload

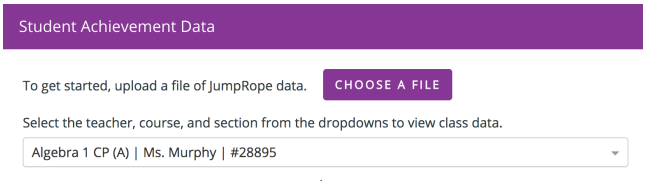


Figure 5. CSV File Upload and Dropdown

A csv file can be uploaded by clicking on "CHOOSE A FILE". The headers for the cvs file must conform to the schema provided in the README file. Data is not uploaded or stored on a remote server. The data is processed to create data objects that contain individual student performance as well as class performance on learning targets. Once the file upload is complete, a user can select a course, teacher, and section number (or class period) from the drop down. The user can type into the dropdown to search by course name, teacher name or section number, which results in data being displayed upon selection of one of the results.

Learning Targets

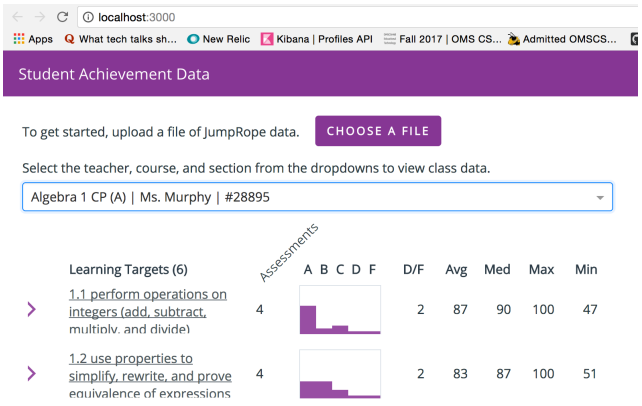


Figure 6. Learning Targets and and statistics on class performance, including a histogram of letter grades.

For each class in the dropdown menu a summary table is provided indicating the learning targets for the course. The learning targets represent knowledge and skills a student should master throughout the course. Each row in the table includes the name of the learning target, which is a clickable link, the number of assessments the teacher has given for that learning target, the distribution letter grades achieved by students on the learning target, the number of students with a D or F, and basic statistics for how students performed on the learning target across all assessments, including average score, median score, maximum score, and minimum score.

Assessments

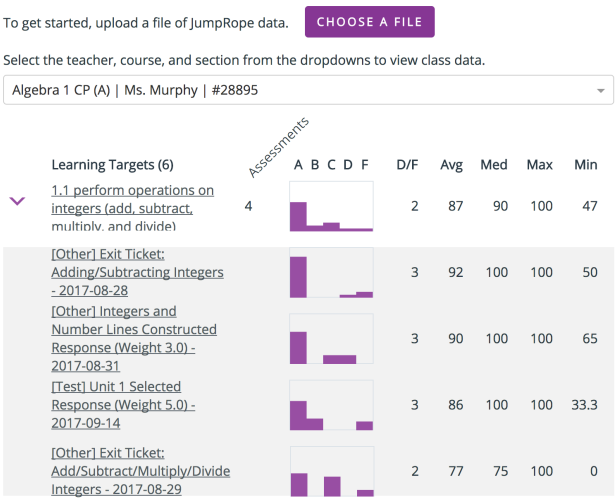


Figure 7. Aggregate performance for one class on 4 individual assessments related to a learning target.

By clicking on the purple arrow for each learning target, the user can unfold the performance of how students did on each assessment related to the learning target. Each learning target is the result of combining weighted scores from one or more assessments that students take to determine their proficiency on particular skills and knowledge related to the learning target. Users can drill down into particular assessments to understand the weight of the assessment, the distribution of students scores, and summary statistics for any one assessment. The rows of data for assessments are shaded with a light grey background to visually differentiate rows that learning targets from rows that are individual assessments.

Class Performance

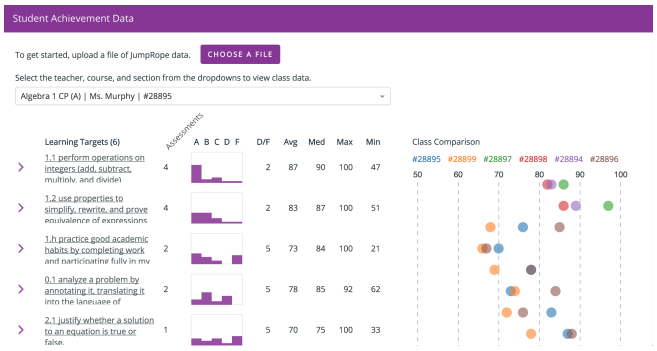


Figure 8. Class comparison dot plot (shown right) shows average score on learning targets for all offerings of a class.

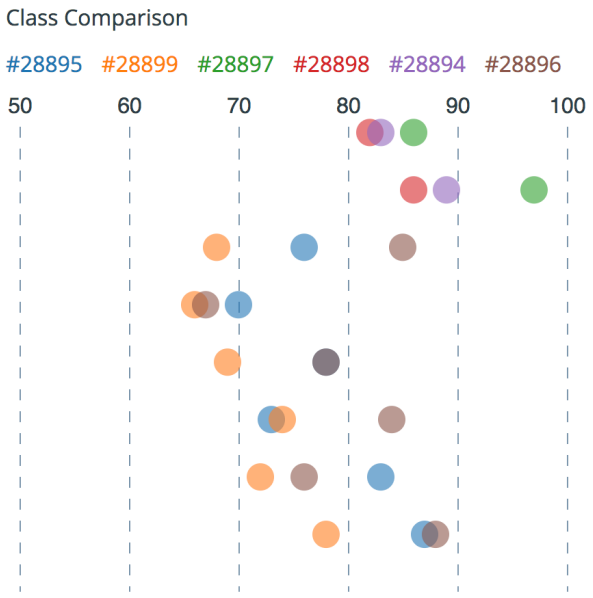


Figure 9. Class comparison could be used be coaches and teachers to promote collaboration (i.e. compare assessments and teaching strategies)

The class comparison chart shows the average score for a given class on a given learning target. Each row in the plot represents a group of classes that assessed the same learning target. For example, three classes or sections (#28897, #28898, and #28894) had average scores ranging from 83-86. It's important to note that the 3 different classes may or may not be taught by the same instructor. However, the tool can be used as a reflection point for teachers to think about differences between students' abilities, assessment designs (if giving multiple versions of an assessment), and teaching strategies.

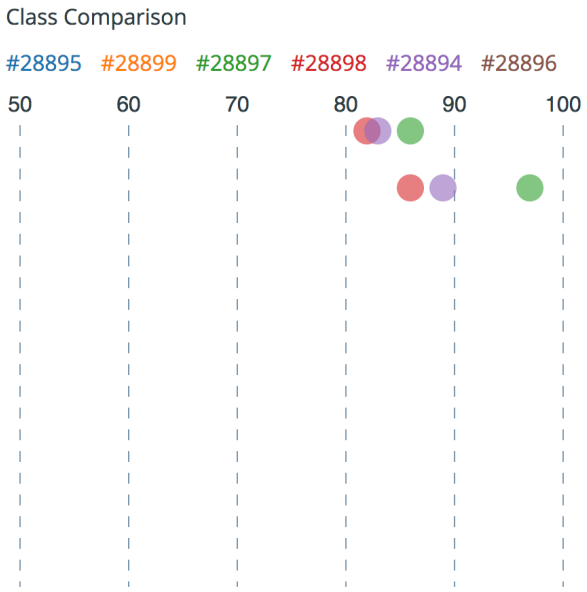
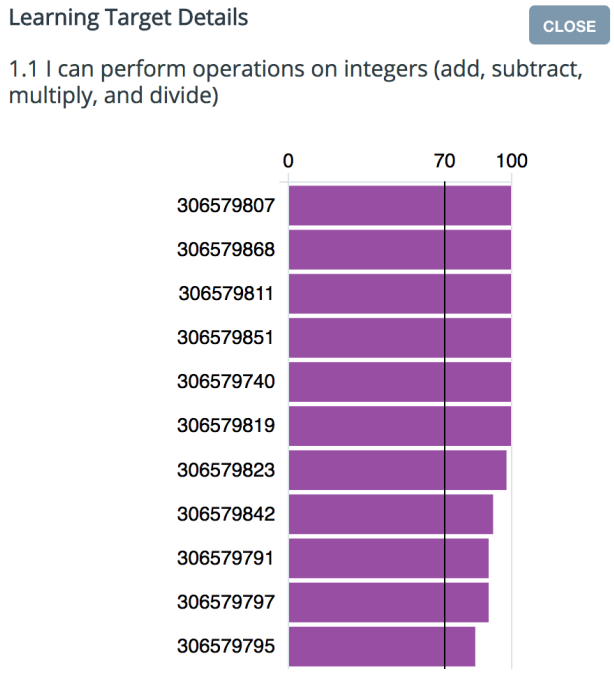


Figure 10. Individual classes can be toggled "on" and "off" more easily observe differences between select classes.

In the color-coded legend above the dot plot, each section number or class can be clicked. Clicking on a class (e.g #28895) in the legend causes the corresponding dots in the plot to be shown or hidden. Finally, a tooltip will be displayed when hovering over any one dot, which represents an average score on one learning target (not shown).

Individual Student Scores by Class

The class comparison dot plot can be hidden and another chart can be shown in it's place. By clicking on the grey underline text of any learning target or assessment title (see Figure 6 and Figure 7), the user causes a bar chart to appear at the right of the screen. The bar chart displays the numerical score of each student on the given learning target or assessment as shown in Figure 11. Note that the student names have been removed to preserve anonymity according to an LPS data sharing agreement and FERPA (The Family Educational Rights and Privacy Act). The bar chart is sorted from highest to lowest scores from top to bottom. The chart also has a darker vertical line at a value or score of 70. The value of 70 is a C in terms of letter grades, and it is the minimum value a student needs to score to reach basic proficiency with a learning target or assessment at LPS. The bolder vertical line allows users to quickly see how many students are passing a given learning target or standard. Note that throughout many of the charts seen so far, gridlines, labels, and color are used sparingly to focus attention on the data. For example, a light grey color is used for the top vertical x-axis and right most horizontal y-axis. These lines fade into the background and serve as visual cues for containing the chart and allowing the eye to make comparisons. For detail ed information, tooltips are provided on most charts to give specific information about a data point. A user would be able to quickly identify which students have passing scores and which students do not have passing scores. Additional work could be done to add a visual indicator for students who were absent, may be exempt, or may not be ready to take the assessment. Clicking the "CLOSE" button at the top right of the chart



will hide the student scores and revert to showing the class comparison chart (Figure 10).

Figure 11. Bar Chart shows student scores for a class on any one learning target or assessment. The bar chart has been clipped at the bottom for presentational purposes.

Student Report Card and Class Progress

The final view of the dashboard is a modal, which shows one students overall grades across all classes as well as a line chart showing assessments scores over the duration of the course in chronological order. A modal is window that appears and covers or overlays part of the screen. Often times, the screen behind the modal is darkened or hidden to emphasize the information appearing in the appearing window or modal. A user can click on a student's name (the anonymized number shown in Figure 11) to open the modal. Figure 12 shows one students report card in a table at the left. The table includes numerical grade, letter grade, and course title for all courses the student is taking for a given grading period. Note the student's name has been omitted for privacy.

In the middle of the modal are several line graphs showing the student's assessment scores in each class over time. The top half of the line chart is shaded light grey because a

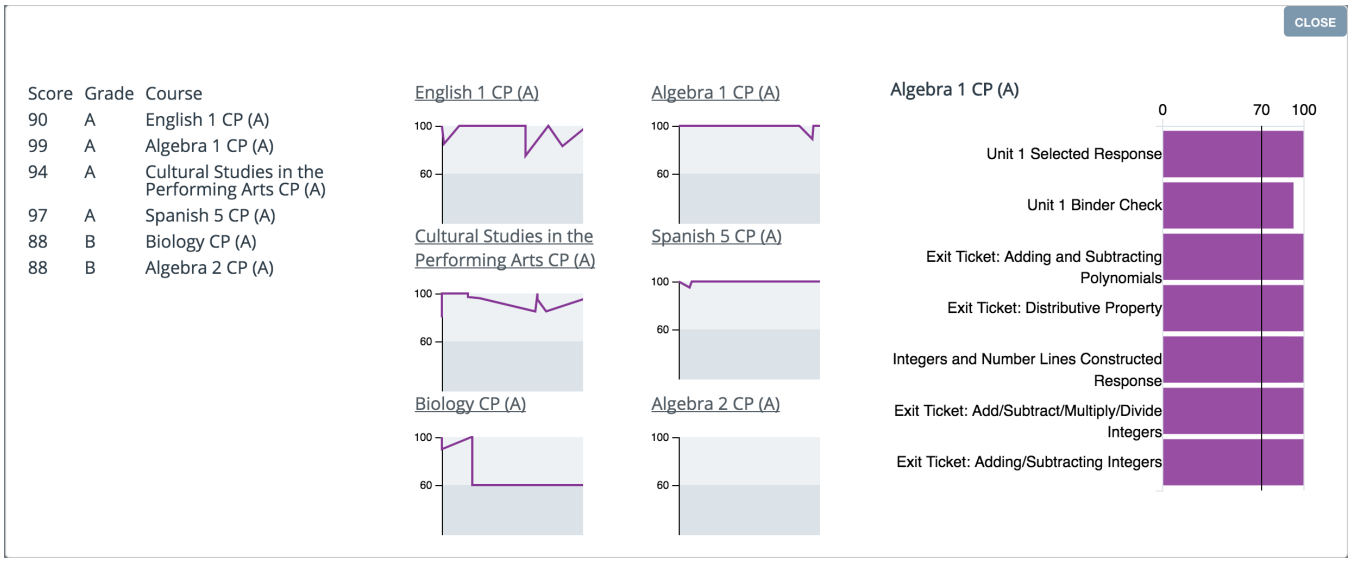


Figure 12. Modal shows one's student performance across all classes including grades and assessment scores in each class over time. The user can view the bar chart (shown right) by clicking on one of the course names above each line graph. They are displayed like a link similar to the title of Learning Targets and Assessments (See Figure 6 and 7).

student scoring 60 and above (a minimum of a letter grade D) would be trending towards received high school credit for the course. Any assessment score below a 60 would appear in the darker shaded region below the horizontal break at 60. The user could quickly see how a student has performed over time. To view all the assessment scores for given line graph or course, the user must click on one of the course titles which serve as link. Clicking a course title shows the student's scores for all assessments in the class (shown right in Figure 12). The user can click on another course title to see the assessments for a different course. Finally, the user can close the modal by clicking the "CLOSE" button in the top right of the modal window. The user will return to viewing the main dashboard page with the table of learning targets (Figure 6) shown on the right side of the screen and the bar chart of individual student scores (Figure 11) shown at the left of the screen. Essentially, the close of the modal acts as a back button taken the user to the previous view.

FUTURE WORK

The first iteration of the dashboard provides teachers and coaches many views of aggregate and individual student performance data, but there are some ways that the dashboard could be improved.

One group of changes involves presentational concerns arising from design or the data. First, the order of the learning targets could be improved for the class performance dot plot. The order or learning targets should be ordered by date so that reading down the chart corresponds to moving down the list of learning targets. A tooltip is present to help clarify details, however, the tooltip could either have more transparency or be positioned away from the chart avoid covering the chart. Second, the small multiples of line graphs showing student performance over time in classes could be jittered. If multiple assessments are given on the same date, then the data forms a vertical line because the x-axis represent time. The data could be jittered by day, or better yet, the data could be represented by a date timestamp to avoid the vertical line segments in the chart. Third, the labels on the bar charts for student performance on learning targets and individual assessments could be refined. Students with length first and last names may appear cut off at the beginning on the main view. In the modal view showing individual student performance, the assessment title label on the bar chart do wrap, but the labels could be better aligned. Additionally, the bar chart showing individual student performance on assessments in any one class should have a consistent, fixed width. Finally, the last recommendation would be to adjust styles for padding and color. I caution future adjustments on color because color can confuse the user who is making sense of the data. Color has the potential to focus or distract the reader's eye. Color should also be carefully chosen to take into account color-blind users.

Another group of changes includes views and reports that are not currently in the dashboard. Many respondents indicated having some notion of past performance for students or classes to compare data from a prior year or years. Care should be taken not to overwhelm the dashboard, but such data could be relevant to consumers of the data. Attendance could also be added to the student view. This would provide richer data and context to teachers and students when reflecting on achievement. The attendance could also be visually linked to missing assignments represented by an open circle in the line chart for each class. Finally, reports and visualizations for the performance of cohorts of students could be developed to investigate sub-populations within the school (i.e. African American males, English Language Learners). Again, care should be taken not to overwhelm the dashboard. An understanding of the user and the questions the user has of data set can inform the design.

CONCLUSION

The student achievement dashboard aims to provide an example to the educational technology field about visualizing student achievement data. Many software solutions require too much time and expertise from teachers, and others do not provide visualizations of data or take into account visualization principles in their designs. Teachers should be given time to explore newly implemented technology and research shows that teachers are more likely to use a particular technology if it assists them in their daily tasks and does not require much personal investment [21]. Efforts to should be made to make student achievement data portable, visual, and comprehensible for teachers. I developed a dashboard that attempts to put critical pieces of information together so that teachers, coaches or administrators can answer their questions about student performance and begin a cycle of inquiry around performance and instruction.

The dashboard is by no means complete. It could be extended or altered for school sites to mirror the information teachers, coaches, and administrators most often reference. For example, the dashboard does not provide attendance data or aggregate views for sub-populations of students such as grade level or racial status. Additional work could be done to generate such reports or views.

Whether or not a culture of data at school sites improves students outcomes is debatable. However, most experts agree data gathered from the learning process is useful and teachers, sometimes with additional training, are most equipped to make sense of that data. The key elements to working with and learning from data in educational contexts include professional development in technology and data literacy for teachers, strong leadership for supportive data climates, and collaboration and reflection among educators. Turning data into actionable insights is a complex process, but we can equip teachers with the skills and tools to become more informed, reflective practitioners.

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