TO: Donna Silver
FROM: Dylan Antovich
DATE: 07/12/20
RE: School District of San Metropolis - Model Middle Schools Academy

Summary
The School District of San Metropolis' (SDSM) has designed a program to increase teacher retention by allowing exemplary middle schools to model their practices. Given this goal, I propose that Riverside Middle School serve as the initial workshop site in the upcoming school year. The school has demonstrated a significant improvement in retention rate, 30% over two years, that is not readily explained by changes in other variables predicting teacher retention. This suggests that the school has developed retention strategies that may benefit other schools.

Background
The SDSM school district comprises 170 schools, serving over 150,000 students. The Model Middle Schools Academy (MMSA) program will target the district's 35 middle schools to improve their teacher retention rate, currently at 80%. The program will allow exemplary middle schools to model their success to district principals via bimonthly onsite visitations. Importantly, this program may have effects beyond teacher retention. Teacher retention rates are correlated with student performance and poor retention rates may disproportionately affect students of color[1]. Therefore, improving teacher retention may be a cost-effective way to improve school performance. Past work has noted several factors that affect teacher retention, such as salary, workload, administration support, and student factors[2], some of which are addressed below.

Findings and Recommendations
The data represent 33 middle schools and 2,825 teachers. Transfer data were available for two of the three years in the dataset. To detect whether any schools demonstrated significant change in retention over time, I examined school-level random effects from a binomial mixed effects model assessing change in retention over the two-year period. These data reveal that only one school, Riverside Middle School, demonstrated a statistically significant increase in retention during that time period, with an improvement in retention of over 30% (see Figures 1-3). This is particularly impressive, as Riverside had the lowest retention at baseline.

Riverside's improvement suggests that a strategy targeting schools with low retention rates has the potential to rapidly impact the district's overall teacher retention. This is evident from the bimodal distribution of retention rates across the district (see Figure 3). A majority of schools fall around the mean retention rate (79.7%), but a small cluster of schools maintain particularly low retention rates (see Figure 4), which skew the overall distribution downward. If schools in the bottom quartile for 2017 teacher retention improved their 2018 retention by the same amount as Riverside in the prior year, the retention rate for the whole district would increase by nearly 7%.

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[1] Ronfeldt, Loeb, and Wyckoff, 2013
[2] Boyd et al., 2011; Hughes, 2012

To further assess the best model school for the new program, I conducted a mixed effects logistic regression assessing teacher factors in retention across the entire district and both timepoints of transfer data. Of the 16 available predictors, being a new hire, having national board certification, and being tenured were significant protective factors, reducing the likelihood of teacher attrition. However, receiving poorer teacher evaluations based on principal observation or student growth metrics increased the likelihood a teacher would leave the school. A similar model assessing school-level factors suggests that schools with larger proportions of students with free/reduced lunch or higher English language arts scores and schools with smaller proportions of minority students or lower math scores had increased attrition rates.

A follow-up logistic regression reveals that several of these factors are also predictive of retention in the subset of observations for Riverside (i.e., board certification, tenure, student scores). However, a series of chi-square tests demonstrate that there were no significant changes in these teacher factors from 2016 to 2017 at Riverside (see Table 1). This suggests that there may be unmeasured factors that account for the change in teacher retention. Thus, a site visit to the school may help illuminate how Riverside has rapidly improved retention.

Alternatives
An alternative approach for selecting a model school is to identify schools with consistently high retention rates (e.g., Maple, Magnolia, Acacia; see Figures 2-3). However, it is likely that these schools have fixed traits (e.g., student population, teacher salary, etc.) that account for their high retention rates, as seen in Table 2. Those traits might not be easily altered by other schools to improve retention, and thus they might not provide a useful example for improvement.

It is also possible to look at which schools teachers most commonly transferred to within the district (see Figure 5), with the assumption that those schools might have important traits that draw teachers. However, the top schools that received in-district transfers (e.g., Sequoia, Pleasant, Sutherland) were all high retention schools at both timepoints (see Figure 3). These schools, like the other schools with consistently high retention rates, likely have fixed traits that are less suitable to the present program.

Limitations and Barriers
The present analysis would be improved by the availability of additional years of retention data. For example, while Riverside had the largest increase in retention between 2016 and 2017, additional time points would help determine whether this was part of a larger trend. Additionally, no data were available for two of the schools. It is possible that one of those schools could present a better fit for the model school program.

Conclusion
Given the district's desire to leverage exemplary middle schools as tools for improving teacher retention, I recommend Riverside Middle School for the MMSA program given its exceptional progress in improving teacher retention.
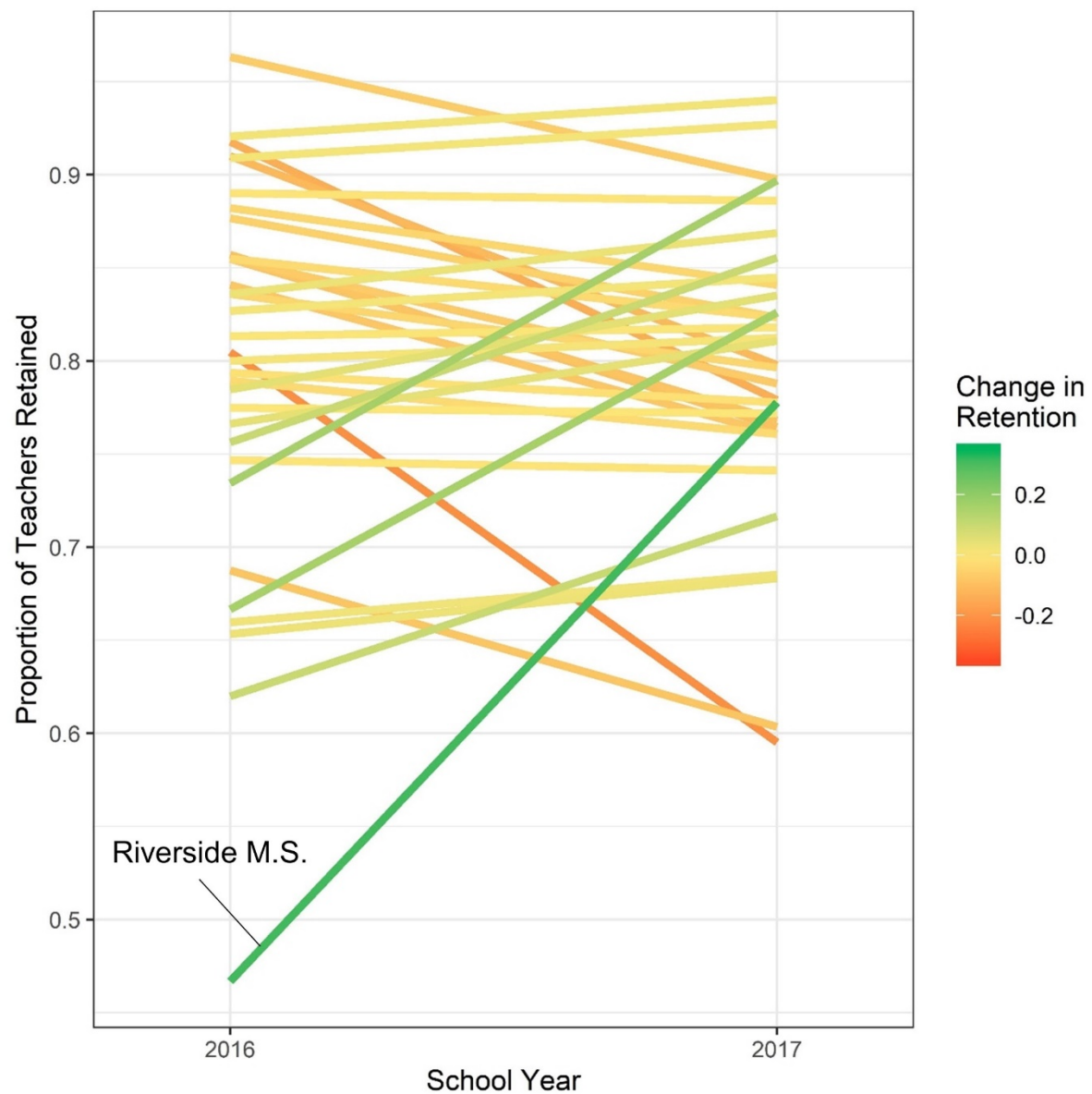
Figure 1. Change in teacher retention by school and year. Each line represents a different school, with line color indicating the direction and magnitude of change.
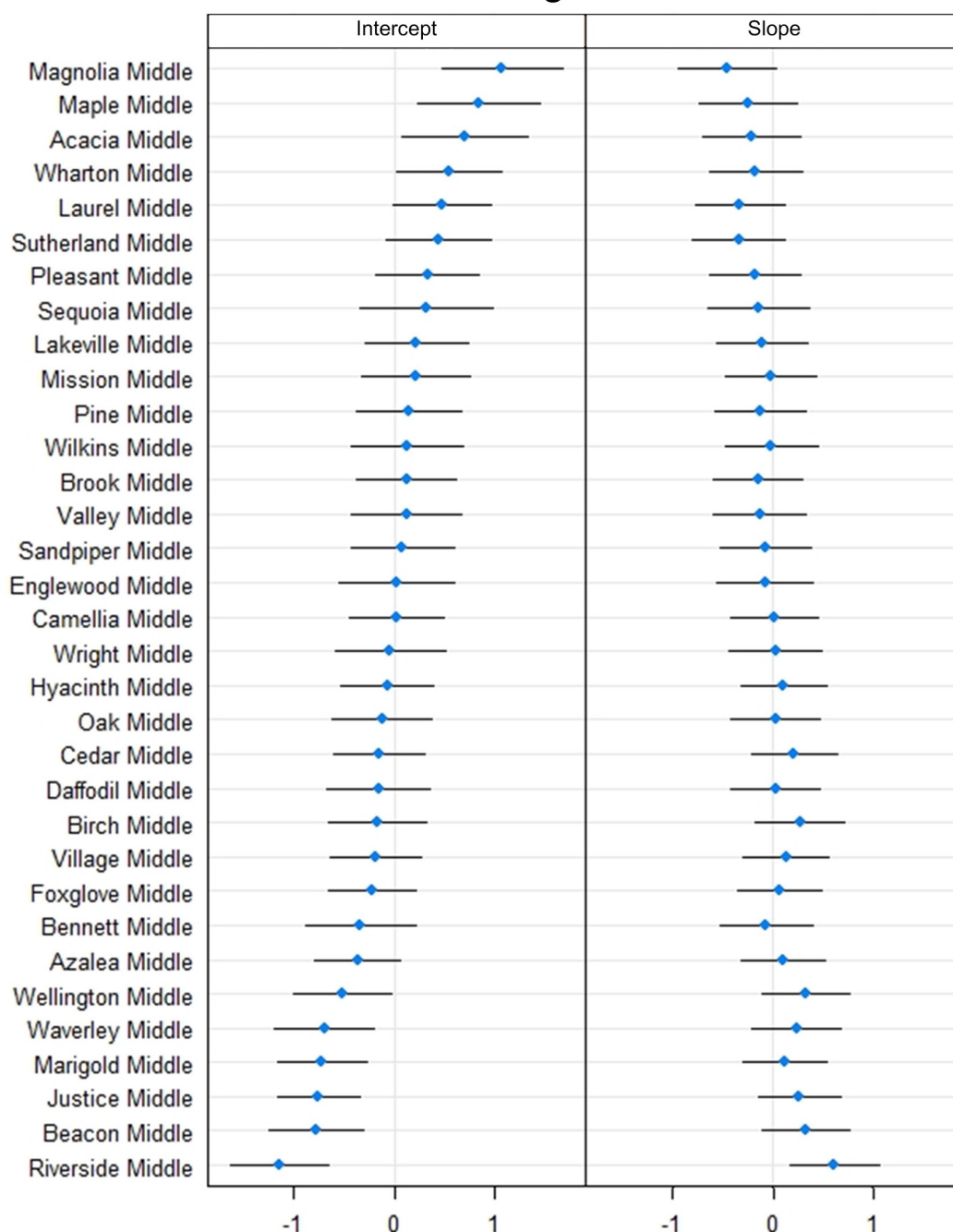
Figure 2. School-level random effects intercepts and slopes with 95% confidence intervals for mixed effects model of change in retention. Note that only the slope of Riverside Middle School significantly differed from the non-significant fixed effect slope.
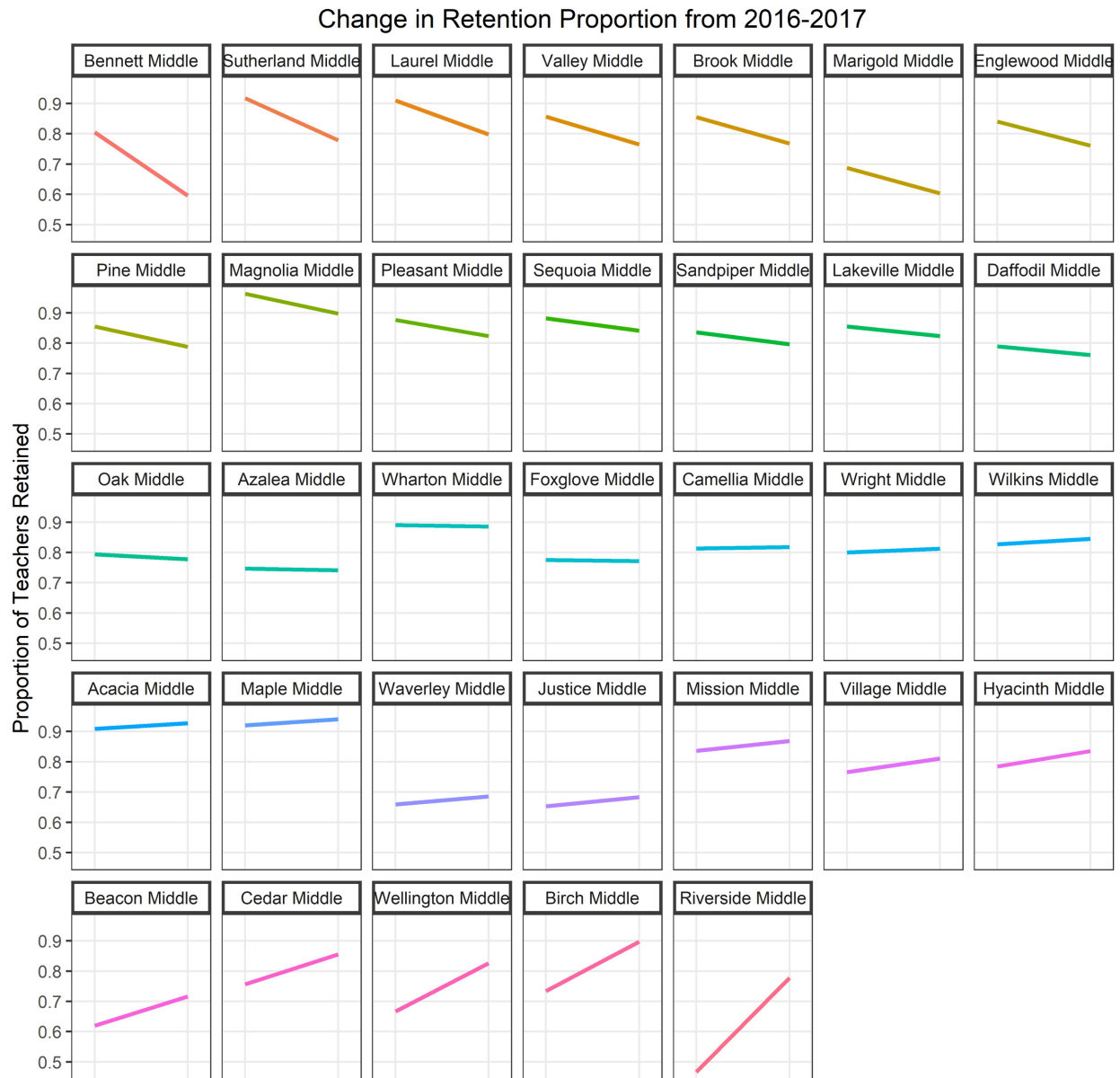
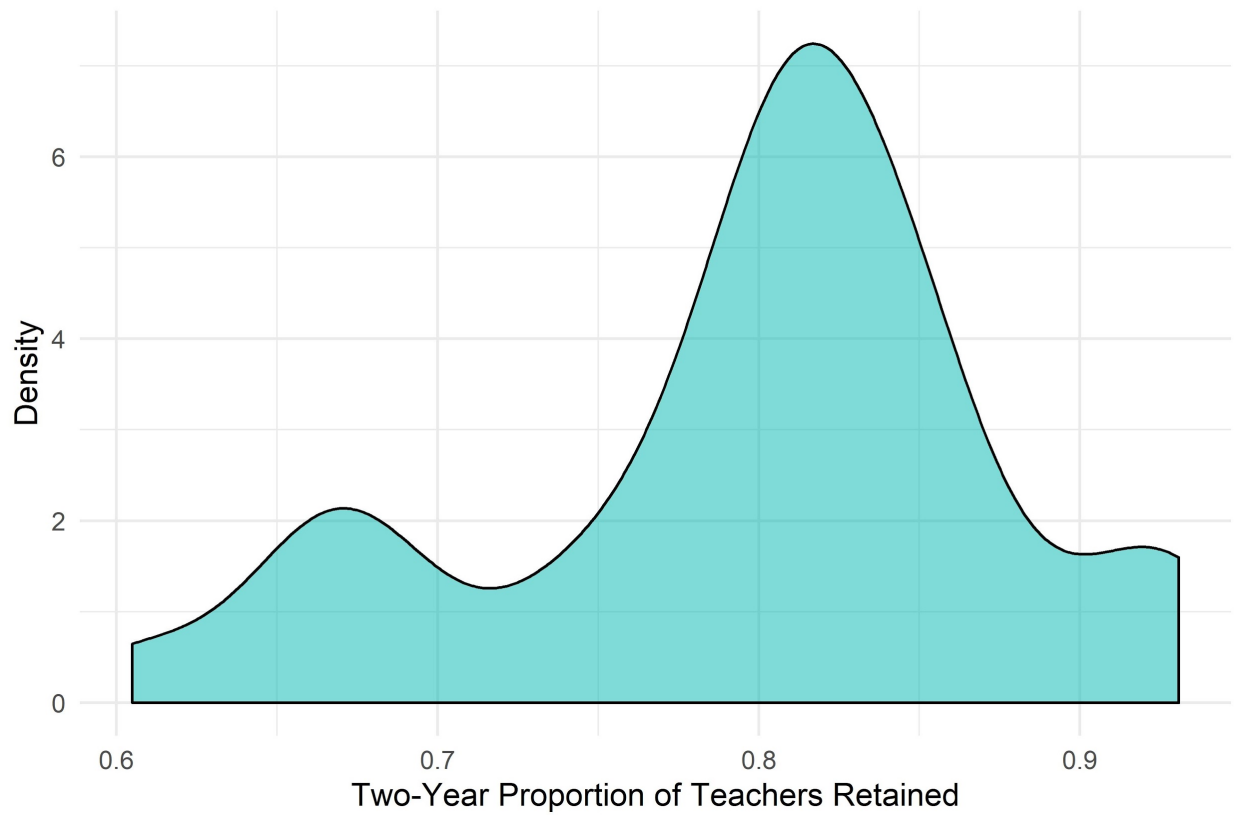*Figure 3.* Change in teacher retention between 2016 and 2017 by school.

Figure 4. Kernel density plot of the two-year teacher retention average for each school. Note that the distribution is left skewed due to a small cluster of low-retention schools.
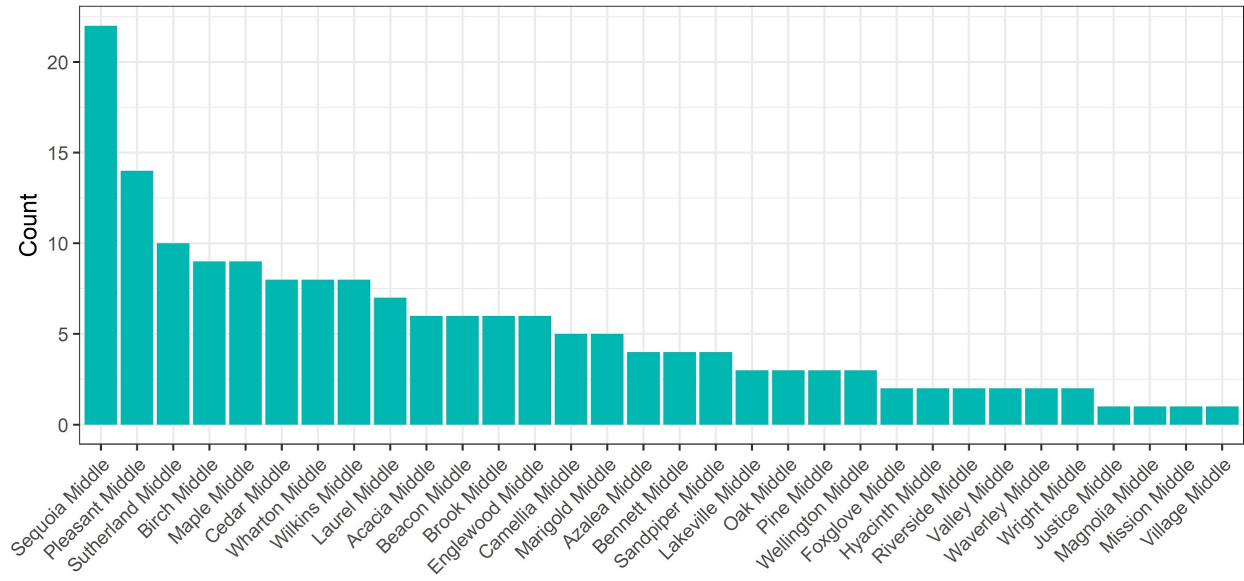
Table 1

Riverside Middle School Retention Predictors by Year

	% Board Certification	% Tenured	Avg Student ELA	Avg Student Math
2016	11%	44%	-0.25	-0.30
2017	8%	33%	-0.39	-0.53

Table 2
School Retention Predictors by Middle School

School	% Board Certif	% New Hires	% Tenure	Avg Years Exper	Avg Salary (USD)	% F&R Lunch	% Minority Stu.	Avg Stu. Math	Avg Stu. ELA	% Profic. Princpal Eval	% Meets Expect Stud. Eval
Maple	15%	8%	67%	11.7	3588	30%	40%	-0.05	0.07	4%	66%
Magnolia	17%	10%	69%	11.7	3929	28%	40%	-0.07	-0.03	25%	51%
Acacia	32%	6%	78%	15.5	4188	20%	32%	0.36	0.29	16%	36%
Wharton	20%	6%	79%	12.9	3664	21%	34%	0.20	0.19	16%	53%
Sequoia	27%	20%	61%	10.3	3755	36%	50%	-0.17	-0.05	5%	32%
Laurel	9%	11%	61%	12.9	3698	23%	40%	0.31	0.19	7%	66%
Mission	6%	18%	47%	10.1	3883	32%	58%	0.41	0.39	24%	47%
Pleasant	37%	13%	54%	10.0	3902	13%	43%	0.49	0.35	18%	50%
Sutherland	34%	9%	70%	10.4	3470	10%	33%	0.66	0.50	17%	36%
Lakeville	8%	11%	77%	13.5	4126	40%	48%	-0.17	-0.17	15%	73%
Wilkins	9%	16%	48%	10.5	3801	39%	51%	-0.25	-0.19	52%	47%
Pine	10%	14%	65%	11.9	3932	29%	47%	0.28	0.23	16%	54%
Birch	17%	13%	64%	15.1	4231	31%	41%	-0.04	-0.06	24%	48%
Sandpiper	17%	13%	66%	11.1	3502	44%	59%	-0.29	-0.25	21%	64%
Camellia	28%	15%	70%	14.7	4267	40%	56%	-0.12	-0.03	7%	55%
Valley	10%	8%	81%	16.9	4370	39%	55%	-0.22	-0.21	11%	66%
Brook	19%	14%	62%	12.2	3971	12%	39%	0.63	0.50	21%	42%
Hyacinth	14%	16%	48%	11.2	3977	52%	77%	-0.65	-0.46	40%	54%
Cedar	26%	13%	63%	13.7	3696	29%	47%	-0.06	-0.03	15%	54%
Wright	15%	17%	59%	15.3	4237	53%	65%	-0.35	-0.43	27%	50%
Englewood	19%	14%	56%	11.2	3608	26%	50%	0.28	0.26	32%	68%
Village	8%	13%	63%	13.2	3946	20%	37%	0.08	0.12	28%	62%
Oak	26%	11%	66%	13.0	3670	14%	32%	0.46	0.36	21%	48%
Daffodil	12%	17%	55%	13.7	4177	47%	65%	-0.08	-0.09	20%	57%

School	% Board Certif	% New Hires	% Tenure	Avg Years Exper	Avg Salary (USD)	% F&R Lunch	% Minority Stu.	Avg Stu. Math	Avg Stu. ELA	% Profic. Princpal Eval	% Meets Expect Stud. Eval
Foxglove	12%	19%	45%	9.2	3742	54%	81%	-0.52	-0.42	66%	70%
Azalea	12%	19%	59%	12.0	3994	39%	75%	0.09	0.04	26%	64%
Wellington	3%	15%	49%	13.7	4015	21%	49%	0.18	0.09	69%	51%
Bennett	7%	24%	46%	10.7	3202	37%	59%	-0.22	-0.12	35%	57%
Waverley	16%	22%	45%	9.0	3799	53%	68%	-0.39	-0.36	58%	68%
Beacon	6%	26%	44%	10.5	3978	43%	59%	-0.46	-0.33	18%	54%
Justice	5%	18%	60%	10.2	3303	53%	69%	-0.34	-0.40	8%	55%
Marigold	15%	18%	58%	12.9	4038	27%	44%	-0.06	0.01	31%	53%
Riverside	8%	25%	38%	7.6	3066	40%	59%	-0.43	-0.34	53%	76%

Note. Middle schools are orderd by descending average retention from 2016-2017.