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Targeted Funding: What Missouri data tells us about the impact various factors have on student outcomes

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Abstract:
This paper uses data from the Missouri Department of Elementary and Secondary Education to study various input data and their effect on student outcomes. The data pulled were related to school district, local, and personal wealth; student demographics; classrooms and classroom teachers. A multi-factor regression was then completed to assess which of these factors was significant in relationship to the percentages of students scoring proficient or advanced in English Language Arts and mathematics, as well as the districts' overall Annual Performance Report score. The goal of this research was to identify which input data were significantly related to student outcomes and use that information to discuss school district implications.

Keywords:
Student outcomes, student achievement, targeted funding, Missouri, district budgets, education finance

Introduction

In a 2020 review of global education practices, World Population Review published an article assessing each country by student outcome data ("Education Rankings by Country 2020", 2020). After giving each country a score based on student proficiency in reading, mathematics, and science, they found that education in the United States fell behind that of 23 other countries. While the United States fell behind countries that are known for a rigorous educational program, like China and Singapore, it also fell behind countries like Liechtenstein, Slovenia, and Estonia. The United States was ranked second in a global survey assessing the perceptions of education in various countries but did not fall within the top five countries when assessed for primary school, secondary school, high school, or collegiate-level completion rates ("Education Rankings by Country 2020", 2020, para. 3).

It is not uncommon to hear that the United States is behind other countries in terms of providing a quality education. In fact, it is a constant source of tension for American educators. Politicians and school leaders are always looking for ways to improve the nation's schools; from adjusting national and state standards to making recommendations for appropriate class sizes. In reality, researchers and administrators have a significant number of factors to consider that could contribute to student outcomes in some way. Funding is certainly a substantial factor, and a contentious one at that, that can impact the quality of United States schools and the education they offer. Nicole Galloway, running for Missouri governor in the November, 2020 election states, "As Governor, I will put more money in classrooms and pay teachers what they deserve, work to expand pre-kindergarten to help give kids the head start they need and parents the peace of mind that their children are safe," (The Best Place in America to Raise Kids, 2020). Many politicians, like Galloway, discuss education at length during election season. Galloway specifically mentions teacher salaries, expansions to preschool, and offering more funding to schools. In doing so, Galloway is already targeting funding, attempting to use funds in ways that have been proven to improve student outcomes.

According to Education Week, the national average for per-pupil spending is $12,756 ("Map: How Much Money Each State Spends Per Student", 2019). Vermont and Utah are at the extreme ends, spending $20,540 and $7,635 per student, respectively. The difference in spending between these two states, at a total of $12,905, is higher than the average per-pupil spending across the United States and the District of Columbia; a value of $12,756, according to this data. Further, the Education Week data has a standard deviation of almost $3000 when considering the per-pupil spending of all 50 states and the District of Columbia. Cost of living can vary greatly among states, as can the cost of supplying an education, both contributing in some way to the difference in state spending patterns. Still, a standard deviation of $3000 amounts to nearly half of Utah's per student expenditure amount. School spending is clearly quite varied across the country. It is no surprise, then, that the success of American schools is equally varied.

While Utah spending an average of $12,905 per student less than the schools in Vermont is significant, there are variances just as significant within individual states. Per pupil expenditures, specifically, can vary significantly between school districts in the same state. According to Education week data, Missouri spends just under the average at $11,756 per student. The Missouri school districts considered in this study had an average per-pupil expenditure of approximately $11,000 in 2018, but ranged from roughly $7,300 to $26,400 ("Current Expenditure per ADA 2009-10 to 2017-18", 2018). Bosworth R-V, the Missouri school district that spends the most per student, more than triples the spending of Richards R-V, the district that spends the least. Districts' per-pupil expenditures cover everything from salaries and benefits to school supplies for classrooms. Because there is a wide range of funding considerations that fall under per-pupil expenditures, even districts with identical per-pupil expenditures could have any number of different spending habits that may or may not be correlated to specific educational outcomes.

Courtenay Stevens ranked each state by comparing the average starting teacher salary to the average salary of all occupations, teachers included (Stevens, 2019). While this does not guarantee that the state rankings would stay the same if they were to consider experienced teacher's salaries, and Stevens says as much, this is one way to measure how different states prioritize teacher salaries and improvements to education. Missouri, which falls 49th in Stevens' rankings, certainly has room for improvement in regard to teacher salaries. Without any significant conversation surrounding how money could be targeted and which spending practices will substantially increase student outcomes, American education cannot be expected to surpass that of other countries. If schools are to be held accountable for student outcomes, funding should be targeted to the specific line items that will impact students most. In Missouri, districts that use their funding to prioritize teacher salaries see statistically significant improvement in student outcomes as shown by this research.

Research Question

There are many factors that go play a part in student outcomes. Of those that schools can control, like per-pupil spending or teacher salaries, which input factors have a significant relationship to Missouri students' outcomes, and can be used by school districts to improve those outcomes?

Literature Review

In 2015, Stoneberg discussed the cost-benefit analyses that are common in educational research, stating that they often misrepresent data (Stoneberg, 2015). To make the point that higher funding does not lead to higher test scores, researchers often look at historical spending and student achievement measures over time. In doing so, Stoneberg argues that they typically compare interval data to ratio data. "Unlike dollars (ratio scale), a percentage increase in scale scores cannot be calculated for NAEP scale scores (interval scale)" (Stoneberg, 2015). Even when researchers aren't specifically using NAEP scores, they tend toward SAT and other interval scale measures that assess scaled scores and do not compute in the same way dollar values can. Stoneberg noted that without comparable metrics, these studies aren't providing accurate comparisons, making it nearly impossible to show that funding does not lead to improved student outcomes.

Jackson, Johnson, and Persico, argue that most tests are limited by their focus on test scores in general, because test scores do not necessarily lead to higher degrees and higher income levels after high school (Jackson, Johnson, & Persico, 2015). Rather, they say that measures like "educational attainment, high school completion, adult wages, adult family income, and the incidence of adult poverty" are better measures of school success because of their long-term significance (Jackson, Johnson, & Persico, 2015). Likewise, they argue that comparing school funding to educational outcomes can be challenging because the schools most in need of extra funding typically have more low-income students. For those students, there are other factors at play that can hamper their scores, making an actual comparison to schools with less low-income families challenging. In a study of 15,000 people, born between 1955 and 1985, Jackson, Johnson, and Persico, found a significant relationship between school spending and educational attainment for students from low-income families more so than for students not in low-income families:

For children from low-income families, increasing per-pupil spending by 10 percent in all 12 school-age years increases educational attainment by 0.5 years. In contrast, for non poor children, a 10 percent increase in per-pupil spending throughout the school-age years increases educational attainment by less than 0.1 years, and this estimate is not statistically significant. (Jackson, Johnson, & Persico, 2015, para. 18)

Similarly, they found that the same spending increase boosted hourly wages for children from low-income families by 13 percent, while the effect on non-poor students was statistically insignificant.

In 2016, Della Sala, Knoeppel, and Marion conducted a study of 470 elementary schools that had assessment scores for students in 3rd through 5th grade. They argue, "[because] the goal of current educational accountability policy is for all students to reach proficiency, [states] must provide adequate educational resources to meet the learning needs of all students" (Della Sala, Knoeppel, & Marion, 2016, pg. 181). Even school and district level studies aren't appropriate, they add, because those studies do not account for differences in funding at the classroom level. To measure the effect on student outcomes, Della Sala, Knoeppel, and Marion looked at student-related factors like students with disabilities, students outside of the typical age range for each grade, and students that are gifted. They also used school-related factors, including things like student-teacher ratios and the number of professional development days per teacher. They concluded that educational resources significantly affect student outcomes. Thus, using financial resources strategically would help states to provide more equitable and appropriate educational settings for students. They write, "Funds for teacher incentive strategies would make more sense than additional funding toward instructional condition variables given the non-significant relationship between schools' instructional conditions and student achievement measures" (Della Sala, Knoeppel, & Marion, 2016, pp. 198-199).

Methodology

Missouri's Department of Elementary and Secondary Education tracks and publishes school data yearly, allowing for some amount of transparency in school spending. In an effort to realize a multitude of variables that could impact student outcomes, regardless of their financial nature, the data considered for this study looked at school district, local, and personal wealth; student demographics; and data related to classrooms and classroom teachers. These factors were used to assess their relationship to three different measures of student outcome data. The goal of this research was to determine which factors would impact student outcomes, as well as whether or not there are significant factors school districts can control. Ideally, those factors could then help districts use their finances to impact and improve student outcomes.

The input variables originally included in the multi-factor regressions were average teacher salaries, average years of experience, and the percent of teachers with a master's degree or higher, with the goal of assessing the impact that school related variables would have on student outcomes. The output data pulled were districts' Annual Performance Report (APR) scores, as the percent of total points available; the percent of students that were proficient or advanced in English Language Arts (ELA), for all assessed grade levels; and the percent of students that were proficient or advanced in Mathematics, for all assessed grade levels. Using a 90% confidence interval, multiple F-tests were used to compare all of the input data in combination to each of the output data individually. Although the original tests did show some significance within the factors, the adjusted r-squared value for the F-test was low enough, with the highest adjusted r-squared value at 0.17, to determine that there were extra factors, not included in the study, that needed to be considered. Without finding and including these extra factors, the data would not show a strong enough relationship and would be unlikely to lead to any real conclusions regarding Missouri school funding.

For the next series of multi-variable testing, the school related input data pulled included per-pupil expenditures, average student to classroom teacher ratios, average teacher salaries, average years of experience for teachers, and the percent of teachers with a master's degree or higher for each district in the state of Missouri. These factors are those that school districts can control. To capture data related to the families and surrounding community in each district, in an attempt to measure personal and community wealth, the input data considered were the percent of students receiving free or reduced priced lunches and the per-pupil local tax effort. Also included in the input data were student demographics. Missouri school districts report the percent of students that identify as Asian, Black, Hispanic, Indian, Multiracial, and Pacific Islander, and White. There were some districts that had unreported student demographic data, percentages that did not account for 100% of students, or very small percentages in one or more categories. To account for all of this, the data included the percent of students that identify as white and the percent of student that identify as students of color. Asian, Black, Hispanic, Indian, Multiracial, and Pacific Islander were grouped together as the percent of students that identify as students of color.

All data used was from the 2017 - 2018 school year, as that was the most recent year for which all of the chosen data points could be acquired from the Missouri Department of Elementary and Secondary Education website. Any districts with district related data points that were not reported to or by Missouri's Department of Elementary and Secondary Education were eliminated from the study. Eliminating this data ensured that the multi-factor regression would accurately capture Missouri trends. The schools that were eliminated from this study were primarily Charter Schools that did not report the test scores used as outcome data. Schools that did not report 100% of their student demographic data were not eliminated from this study, as releasing this information is left to the discretion of families upon enrollment. This left 508 school districts for a series of multi-factor regressions. Because there were more input variables to consider, a 95% confidence interval was used for this series of tests. After removing factors that were not significant in this series of testing, the F-tests were run again to evaluate the significance of the only the variables previously identified as significant against the same output variable.

Results

The first series of F-tests compared all inputs to each individual output. When used in combination, all of the input variables have a significant relationship to scores on the Annual Performance Report (APR) as well as the percent of students that are proficient or advanced in English Language Arts and Mathematics, as shown by the p-value for each overall F-test. When looking at the p-values for individual input variables, however, not all input variables are statistically significant when compared to those chosen output variables.

Figure 1 displays the F-test relating all of the chosen input variables to districts' APR scores. In the initial test, years of experience, percent of teachers with a master's degree, and student demographics were not found to be significant. This left expenditures per ADA, student to classroom teacher ratios, average teacher salaries, the amount of local tax effort per ADA, and the percent of students that receive free or reduced-price lunches as significant variables. The adjusted r-squared value for this test was approximately 0.34, meaning all input variables, even those that were not individually significant, account for about 34% of districts' APR scores.

Figure 1
Predicting Districts' APR Scores Using All Inputs

Linear Regression

Dependent variable	% on APR Report
Independent variables	Expenditures per ADA, Student to Classroom Teacher Ratio, Average Salary, Years of Experience, Percent of Teachers with Masters+, Local Tax Effort per ADA, Free and Reduced Lunch Percentage, % of Students of Color, % of White Students
N	384

Regression Statistics

R	0.59825	***R-Squared***	**0.35790**	*Adjusted R-Squared*	0.34245
MSE	0.00158	***S***	**0.03974**	*MAPE*	3.37561
Durbin-Watson (DW)	2.23506	*Log likelihood*	698.75692		
Akaike inf. criterion (AIC)	-3.58728	*AICc*	-3.58602		
Schwarz criterion (BIC)	-3.48439	*Hannan-Quinn criterion (HQC)*	-3.54647		
PRESS	0.62732	*PRESS RMSE*	0.04042	*Predicted R-Squared*	0.31800

% on APR Report = 1.04907 - 4.29898E-6 * Expenditures per ADA - 0.00256 * Student to Classroom Teacher Ratio + 1.60671E-6 * Average Salary + 0.00147 * Years of Experience + 0.00021 * Percent of Teachers with Masters+ + 2.86428E-6 * Local Tax Effort per ADA - 0.00039 * Free and Reduced Lunch Percentage - 0.00224 * % of Students of Color - 0.00091 *

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-value*
Regression	9	0.32921	0.03658	23.16298	0.00000
Residual	374	0.59061	0.00158		
Total	383	0.91982			

	Coefficients	*Std Err*	*LCL*	*UCL*	*t Stat*	*p-value*	*H0 (5%)*	*VIF*	*TOL*
Intercept	1.04907	0.29334	0.47227	1.62588	3.57632	0.00039	*Rejected*	**	**
Expenditures per ADA	-4.29898E-6	1.80489E-6	-7.84800E-6	-7.49972E-7	-2.38185	0.01773	*Rejected*	**	**
Student to Classroom Teacher Ratio	-0.00256	0.00114	-0.00481	-0.00031	-2.23915	0.02573	*Rejected*	**	**
Average Salary	1.60671E-6	5.73213E-7	4.79581E-7	2.73383E-6	2.80298	0.00533	*Rejected*	**	**
Years of Experience	0.00147	0.00129	-0.00105	0.00400	1.14619	0.25245	*Accepted*	**	**
Percent of Teachers with Masters+	0.00021	0.00020	-0.00017	0.00060	1.08473	0.27874	*Accepted*	**	**
Local Tax Effort per ADA	2.86428E-6	1.38446E-6	1.41983E-7	5.58657E-6	2.06888	0.03924	*Rejected*	**	**
Free and Reduced Lunch Percentage	-0.00039	0.00014	-0.00067	-0.00012	-2.84599	0.00467	*Rejected*	**	**
% of Students of Color	-0.00224	0.00296	-0.00806	0.00358	-0.75692	0.44957	*Accepted*	**	**
% of White Students	-0.00091	0.00299	-0.00679	0.00497	-0.30410	0.76122	*Accepted*	**	**

A second test limiting the input variables to only those shown to be significant previously found an adjusted r-squared value of approximately 0.16 as shown by figure 2. Thus, expenditures per ADA, student to classroom teacher ratios, average teacher salaries, the amount of local tax effort per ADA, and the percent of students that receive free and reduced-price lunches account for about 16% of districts' APR scores, when used without the extra variables.

Figure 2
Predicting Districts' APR Scores Using Reduced Inputs

Linear Regression

Dependent variable	% on APR Report
Independent variables	Expenditures per ADA, Student to Classroom Teacher Ratio, Average Salary, Local Tax Effort per ADA, Free and Reduced Lunch Percentage
N	508

Regression Statistics

R	0.40851	***R-Squared***	**0.16688**	*Adjusted R-Squared*	0.15858
MSE	0.00195	***S***	**0.04416**	*MAPE*	3.63694
Durbin-Watson (DW)	2.00428	*Log likelihood*	867.17618		
Akaike inf. criterion (AIC)	-3.39046	*AICc*	-3.39022		
Schwarz criterion (BIC)	-3.34049	*Hannan-Quinn criterion (HQC)*	-3.37086		
PRESS	1.00685	*PRESS RMSE*	0.04452	*Predicted R-Squared*	0.14297

% on APR Report = 1.08224 - 4.50467E-6 * Expenditures per ADA - 0.00361 * Student to Classroom Teacher Ratio + 1.92404E-7 * Average Salary + 1.55865E-6 * Local Tax Effort per ADA - 0.00081 * Free and Reduced Lunch Percentage

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-value*
Regression	5	0.19605	0.03921	20.11091	0.00000
Residual	502	0.97875	0.00195		
Total	507	1.17481			

	Coefficients	*Std Err*	*LCL*	*UCL*	*t Stat*	*p-value*	*H0 (5%)*	*VIF*	*TOL*
Intercept	1.08224	0.02156	1.03987	1.12460	50.18612	0.00000	*Rejected*	**	**
Expenditures per ADA	-4.50467E-6	1.35051E-6	-7.15801E-6	-1.85133E-6	-3.33555	0.00091	*Rejected*	**	**
Student to Classroom Teacher Ratio	-0.00361	0.00089	-0.00536	-0.00187	-4.06651	0.00006	*Rejected*	**	**
Average Salary	1.92404E-7	4.00431E-7	-5.94324E-7	9.79132E-7	0.48049	0.63109	*Accepted*	**	**
Local Tax Effort per ADA	1.55865E-6	1.16792E-6	-7.35952E-7	3.85326E-6	1.33456	0.18263	*Accepted*	**	**
Free and Reduced Lunch Percentage	-0.00081	0.00011	-0.00103	-0.00060	-7.51373	0.00000	*Rejected*	**	**

In the F-test relating all of the chosen input variables to the percent of students marked as proficient or advanced in mathematics or ELA for each school district, average teacher salaries and the percent of students receiving free or reduced-price lunches were significant in both. The average number of years of experience for teachers was another significant variable for the test of mathematics scores, as shown in Figure 3.

Figure 3
Predicting the Percent of Students Proficient or Advanced in Math Using All Inputs

Linear Regression

Dependent variable	%Prof/Adv Math
Independent variables	Expenditures per ADA, Student to Classroom Teacher Ratio, Average Salary, Years of Experience, Percent of Teachers with Masters+, Local Tax Effort per ADA, Free and Reduced Lunch Percentage, % of Students of Color, % of White Students
N	384

Regression Statistics

R	0.65568	***R-Squared***	**0.42991**	*Adjusted R-Squared*	0.41620
MSE	73.02799	***S***	**8.54564**	*MAPE*	17.54713
Durbin-Watson (DW)	2.08527	*Log likelihood*	-1,363.64794		
Akaike inf. criterion (AIC)	7.15442	*AICc*	7.15967		
Schwarz criterion (BIC)	7.25730	*Hannan-Quinn criterion (HQC)*	7.19522		
PRESS	29,260.34248	*PRESS RMSE*	8.72919	*Predicted R-Squared*	0.38926

%Prof/Adv Math = 102.06715 + 0.00015 * Expenditures per ADA + 0.17080 * Student to Classroom Teacher Ratio + 0.00059 * Average Salary + 0.56524 * Years of Experience - 0.02591 * Percent of Teachers with Masters+ + 0.00009 * Local Tax Effort per ADA - 0.18394 * Free and Reduced Lunch Percentage - 1.07184 * % of Students of Color - 0.84838 * % of White Students

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-value*
Regression	9	20,596.89355	2,288.54373	31.33790	0.00000
Residual	374	27,312.46645	73.02799		
Total	383	47,909.36000			

	Coefficients	*Std Err*	*LCL*	*UCL*	*t Stat*	*p-value*	*H0 (5%)*	*VIF*	*TOL*
Intercept	102.06715	63.08104	-21.97081	226.10510	1.61803	0.10650	*Accepted*	**	**
Expenditures per ADA	0.00015	0.00039	-0.00062	0.00091	0.38112	0.70333	*Accepted*	**	**
Student to Classroom Teacher Ratio	0.17080	0.24579	-0.31251	0.65410	0.69489	0.48756	*Accepted*	**	**
Average Salary	0.00059	0.00012	0.00035	0.00083	4.78292	2.49081E-6	*Rejected*	**	**
Years of Experience	0.56524	0.27650	0.02156	1.10892	2.04430	0.04182	*Rejected*	**	**
Percent of Teachers with Masters+	-0.02591	0.04251	-0.10950	0.05768	-0.60943	0.54261	*Accepted*	**	**
Local Tax Effort per ADA	0.00009	0.00030	-0.00050	0.00068	0.30107	0.76352	*Accepted*	**	**
Free and Reduced Lunch Percentage	-0.18394	0.02978	-0.24250	-0.12537	-6.17589	1.71852E-9	*Rejected*	**	**
% of Students of Color	-1.07184	0.63679	-2.32398	0.18030	-1.68318	0.09317	*Accepted*	**	**
% of White Students	-0.84838	0.64265	-2.11203	0.41528	-1.32013	0.18760	*Accepted*	**	**

The initial test of districts' math scores showed that the variables chosen account for about 42% of the students' scores. A second F-test using only the significant variables, shown in Figure 4, accounted for about 28% of students' scores, as shown by the adjusted r-squared value.

Figure 4
Predicting the Percent of Students Proficient or Advanced in Math Using Reduced Inputs

Linear Regression

Dependent variable	%Prof/Adv Math
Independent variables	Average Salary, Years of Experience, Free and Reduced Lunch Percentage
N	508

Regression Statistics

R	0.53244	*R-Squared*	0.28349	*Adjusted R-Squared*	0.27923
MSE	107.22283	*S*	10.35485	*MAPE*	22.10041
Durbin-Watson (DW)	2.02989	*Log likelihood*	-1,906.23978		
Akaike inf. criterion (AIC)	7.52063	*AICc*	7.52072		
Schwarz criterion (BIC)	7.55384	*Hannan-Quinn criterion (HQC)*	7.53369		
PRESS	55,018.77712	*PRESS RMSE*	10.40695	*Predicted R-Squared*	0.27052

%Prof/Adv Math = 37.67391 + 0.00009 * Average Salary + 1.15642 * Years of Experience - 0.25863 * Free and Reduced Lunch Percentage

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-value*
Regression	3	21,381.44691	7,127.14897	66.47045	0.00000
Residual	504	54,040.30386	107.22283		
Total	507	75,421.75077			

	Coefficients	*Std Err*	*LCL*	*UCL*	*t Stat*	*p-value*	*H0 (5%)*	*VIF*	*TOL*
Intercept	37.67391	4.05432	29.70646	45.63936	9.29220	0.00000	*Rejected*	**	**
Average Salary	0.00009	0.00007	-0.00005	0.00022	1.26354	0.20698	*Accepted*	**	**
Years of Experience	1.15642	0.22891	0.70667	1.60616	5.05174	6.13167E-7	*Rejected*	**	**
Free and Reduced Lunch Percentage	-0.25863	0.02433	-0.30643	-0.21083	-10.63079	0.00000	*Rejected*	**	**

In the test of students' proficiency in English Language Arts, the percent of students that are non-white was significant along with average teacher salaries and the percent of students receiving free or reduced lunch. The r-squared value for the test of districts' ELA scores was approximately 0.49 for both the original test and the test with reduced input variables. This shows that teachers' average salary, the percent of students receiving free or reduced lunch, and the percent of students that are non-white account for nearly 50% of the students' ELA scores, regardless of the inclusion of the other input variables, as shown in Figures 5 and 6.

Figure 5
Predicting the Percent of Students Proficient or Advanced in English Language Arts Using All Inputs

Linear Regression

Dependent variable	% Prof/Adv English
Independent variables	Expenditures per ADA, Student to Classroom Teacher Ratio, Average Salary, Years of Experience, Percent of Teachers with Masters+, Local Tax Effort per ADA, Free and Reduced Lunch Percentage, % of Students of Color, % of White Students
N	384

Regression Statistics

R	0.70752	*R-Squared*	0.50058	*Adjusted R-Squared*	0.48856
MSE	48.55792	*S*	6.96835	*MAPE*	11.12825
Durbin-Watson (DW)	1.88617	*Log likelihood*	-1,285.29554		
Akaike inf. criterion (AIC)	6.74633	*AICc*	6.74758		
Schwarz criterion (BIC)	6.84921	*Hannan-Quinn criterion (HQC)*	6.78714		
PRESS	19,446.43472	*PRESS RMSE*	7.11630	*Predicted R-Squared*	0.46522

% Prof/Adv English = 128.00609 + 2.36747E-6 * Expenditures per ADA + 0.25333 * Student to Classroom Teacher Ratio + 0.00058 * Average Salary + 0.25794 * Years of Experience - 0.00558 * Percent of Teachers with Masters+ + 0.00010 * Local Tax Effort per ADA - 0.16030 * Free and Reduced Lunch Percentage - 1.24011 * % of Students of Color - 1.00902 * % of White Students

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-value*
Regression	9	18,202.97576	2,022.55286	41.65238	0.00000
Residual	374	18,160.66171	48.55792		
Total	383	36,363.63747			

	Coefficients	*Std Err*	*LCL*	*UCL*	*t Stat*	*p-value*	*H0 (5%)*	*VIF*	*TOL*
Intercept	128.00609	51.43601	26.86213	229.15005	2.48855	0.01326	*Rejected*	**	**
Expenditures per ADA	2.36747E-6	0.00032	-0.00062	0.00062	0.00748	0.99404	*Accepted*	**	**
Student to Classroom Teacher Ratio	0.25333	0.20042	-0.14077	0.64742	1.26396	0.20703	*Accepted*	**	**
Average Salary	0.00058	0.00010	0.00038	0.00077	5.72723	2.09978E-8	*Rejected*	**	**
Years of Experience	0.25794	0.22546	-0.18538	0.70127	1.14405	0.25333	*Accepted*	**	**
Percent of Teachers with Masters+	-0.00558	0.03467	-0.07374	0.06259	-0.16088	0.87227	*Accepted*	**	**
Local Tax Effort per ADA	0.00010	0.00024	-0.00038	0.00058	0.42024	0.67455	*Accepted*	**	**
Free and Reduced Lunch Percentage	-0.16030	0.02429	-0.20806	-0.11255	-6.60054	1.40528E-10	*Rejected*	**	**
% of Students of Color	-1.24011	0.51926	-2.26115	-0.21908	-2.38824	0.01742	*Rejected*	**	**
% of White Students	-1.00902	0.52403	-2.03944	0.02140	-1.92549	0.05493	*Accepted*	**	**

Figure 6
Predicting the Percent of Students Proficient or Advanced in English Language Arts Using Reduced Inputs

Linear Regression

Dependent variable	% Prof/Adv English
Independent variables	Average Salary, Free and Reduced Lunch Percentage, % of Students of Color
N	384

Regression Statistics

R	0.70210	***R-Squared***	**0.49295**	*Adjusted R-Squared*	0.48895
MSE	48.52146	***S***	**6.96573**	*MAPE*	11.21749
Durbin-Watson (DW)	1.87397	*Log likelihood*	-1,288.20710		
Akaike inf. criterion (AIC)	6.73025	*AICc*	6.73041		
Schwarz criterion (BIC)	6.77140	*Hannan-Quinn criterion (HQC)*	6.74657		
PRESS	18,778.91101	*PRESS RMSE*	6.99310	*Predicted R-Squared*	0.48358

% Prof/Adv English = 33.28236 + 0.00062 * Average Salary - 0.15459 * Free and Reduced Lunch Percentage - 0.24960 * % of Students of Color

ANOVA

	d.f.	*SS*	*MS*	*F*	*p-value*
Regression	3	17,925.48203	5,975.16068	123.14470	0.00000
Residual	380	18,438.15544	48.52146		
Total	383	36,363.63747			

	Coefficients	*Std Err*	*LCL*	*UCL*	*t Stat*	*p-value*	*H0 (5%)*	*VIF*	*TOL*
Intercept	33.28236	3.50291	26.39484	40.16987	9.50135	0.00000	*Rejected*	[illegible]	[illegible]
Average Salary	0.00062	0.00007	0.00049	0.00075	8.34046	0.00000	*Rejected*	[illegible]	[illegible]
Free and Reduced Lunch Percentage	-0.15459	0.02259	-0.19901	-0.11018	-6.84431	3.09317E-11	*Rejected*	[illegible]	[illegible]
% of Students of Color	-0.24960	0.02809	-0.30484	-0.19437	-8.88597	0.00000	*Rejected*	[illegible]	[illegible]

Discussion and Recommendations

The Annual Performance Report is a measure of Missouri district's overall success that considers a variety of data points. "Included in the data are [achievement scores], as well as updated markers on a district or charter school's college and career readiness, attendance and graduation rates" (Madsen, 2019). The results of this F-test show that all input data accounts for approximately 34% of districts' APR scores, regardless of the significance of each individual input variable. Likewise, all input variables account for about 42% of students' mathematics scores. Both tests comparing input data to students' ELA scores show that the inputs considered account for 49% of students' scores. In a perfectly linear study, the F-tests would have a 100% relationship to the output data, as measured by the adjusted r-squared value. In that case, the input data would account for 100% of student or district scores. While each of these F-tests show a significant relationship between the variables, the adjusted r-squared values imply there are factors not included in this study that also impact student and district scores. Still, there are two variables that prove to be consistently significant among these studies. Districts' average teacher salary and the percent of students that receive free or reduced-price lunches within each district are variables that are significant when assessed against all three output variables.

The percent of students receiving free or reduced-price lunches was chosen as an input variable because it speaks to poverty and its presence within each district. In each of the F-tests, this percent was significant, and the corresponding coefficient of the variable was negative. The negative coefficient in each of the studies shows that poverty negatively influences student outcomes. Put simply, this model shows that districts with lower percentages of their students receiving free or reduced priced lunches have higher APR scores and a higher percentage of students that are proficient or advanced in ELA and mathematics. Unfortunately, there is no simple fix to this finding. While this is a significant variable, and one that should be acknowledged in funding formulas and funding conversations, school districts cannot control the percent of students receiving free or reduced-price lunches, like they might other variables. However, this should be considered an important conversation piece in the state, as the Missouri funding formula includes dollar value modifiers that attempt to account for the difficulties present in schools with higher percentages of students in poverty.

Districts' average teacher salary was another variable that was significant throughout the final series of F-tests. Interestingly, the coefficient for average teacher salaries was consistently positive, showing that districts with higher average teacher salaries tend to also have higher APR scores and percentages of students that are proficient or advanced in ELA and mathematics. Unlike the percentage of students that receive free or reduced-price lunches, this is a variable that is controlled by districts. This should be a consideration in every Missouri district, as they make yearly budget considerations. Likewise, this is a variable that can be considered when the state is assessing the funding formula, as it includes state adequacy targets. The adequacy target within the Missouri funding formula attempts to ensure all districts have adequate funding for each student; these are funds that pay for teacher salaries, among other line items. Knowing that schools with higher salaries tend to have higher scores, the state can focus their efforts around targeting teacher salaries as an area of discussion, rather than focusing their efforts on per-pupil expenditures alone. This data gives reason for the state to target school funding in a way that will impact student outcomes.

The other significant school-controlled variables found in the F-tests were the average number of years of experience for teachers, which had a positive coefficient, and the student to classroom teacher ratio, with a negative coefficient. When Missouri school districts are discussing funding needs, this study suggests that simply using per-pupil expenditures to improve student outcomes does not necessarily correlate to improved scores across multiple measures. Instead, prioritizing teacher salaries, as well as using funding to decrease the student to classroom teacher ratio and improve the average years of experience value, will improve student outcomes as measured by the Annual Performance Report and the percent of students who score proficient or advanced on their English Language Arts and Mathematics tests. In finding ways to impact student outcomes through their spending habits, this study should be strongly considered by Missouri school districts.

Conclusions

We see from the World Population Review article that student scores in the United States fall behind the student scores of 23 other countries ("Education Rankings by Country 2020", 2020). While Education Week shows that Missouri falls just shy of the national average per-pupil expenditure amount, as compared to other states ("Map: How Much Money Each State Spends Per Student", 2019), Courtenay Stevens' work showed that Missouri is nearly last when comparing the average starting teacher salary to the average salary of all occupations, teachers included, across the nation (Stevens, 2019). Clearly there are some significant variations in spending both across the nation and within the state of Missouri.

Politicians and educators are constantly looking for ways to improve the nation's schools. If schools are to be held accountable for student outcomes, politicians and educators should target school funding toward the specific line items that will affect student outcomes. As shown in this research, districts that use their funding to prioritize the education, the experience, and the salaries of teachers, see statistically significant improvement in student outcomes, as measured by districts' APR scores and the percent of students scoring proficient or advanced in English

Language Arts and Mathematics. When yearly budget conversations are happening in Missouri school districts, teacher salaries should be prioritized. In lieu of salary increases, districts could also consider expanding non-salary benefits; increasing funding for graduate school assistance or for further certifications. Likewise, the state could consider expanding their loan forgiveness programs or offering other similar incentives for educators. If schools with higher salaries tend to have higher scores, focusing state and local efforts around targeting teacher salaries, either through direct increases or other related benefits, can impact student outcomes, as measured by districts' APR scores and the percent of students scoring proficient or advanced in English Language Arts and Mathematics

Implications for Future Research

This study leads to the conclusion that targeting Missouri's school funding can impact student outcomes. While significant variables were identified in this study, the adjusted r-squared values imply that there are other variables not yet included. One area that this study could not capture, using data pulled from Missouri's Department of Elementary and Secondary Education website primarily, was whether or not the student outcome data would be related to the districts' locations. Further studies could be done, for example, to see if a district's location, whether rural, urban, or otherwise, has a significant relationship to districts' APR scores and students' mathematics and ELA scores. Likewise, this study is limited by its focus on one year. Expanding this research by looking at Missouri trends over time, or even assessing other states to see if these trends are true across the country, would add to the discussion on targeting school funding to improve student outcomes. Further, while poverty was addressed within this study by including students receiving free or reduced-price lunches in each district, studies could continue to examine this data set. This study shows that the percent of students receiving free or reduced-price lunches is negatively related to student outcomes. Further research could examine factors that mitigate this tendency.

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