STEM Fellowship Big Data Challenge 2020

# The Impact of Teacher's Background on Student Performance

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## 1 Abstract

In her 1954 essay The Crisis in Education, Hannah Arendt says, "Education is the point at which we decide whether we love the world enough to assume responsibility for it." While education has been much more widespread and available in the 20th Century, it is important to focus on all aspects of learning. The push for Global Education goes beyond just being able to access education. Instead, the United Nations and much of the world must focus on the equity and quality of every student's future. Improving the quality of education around the world is not a simple task. Thus, one of the most significant areas that Team TAMM decided to focus on is Student Performance impacted by the number of years teaching, experience, and salary of a teacher; as well as the student's socioeconomic status impact on their performance.

We hypothesize that, with a closer lens, being put on the quality of education around the world will make a profound impact on students. We obtained the statistics on education using available OECD, World Bank, and government data of 52 states and 51 socioeconomic groups. We organized the data into 4 significant representations which included looking at SES vs student math and reading scores, a correlation between 10 indicators, and year over year percent change. The results indicate the constantly progressing decline in standards throughout each country's education system and highlight the areas that need to be fixed. The implication is that although teacher salaries are increasing, the quality at which students are receiving their education is not.

## 2 Introduction

One of the most pressing concerns regarding education and access to it is the quality at which it is being given and received. Poorly resourced facilities, unsafe learning environments, and inadequate teaching practices are the biggest issues in modern education. In this report, we will seek to analyze how the different experience levels of teachers affect the overall quality of education and performance of students. Our metric for measuring student performance will be based on student test scores, graduation rates, region performance, and success. In a previous study at the University of Kufa studying the External and Internal Factors Affecting Students' Academic Performance, the university concluded that students were directly suffering from outdated textbooks and faculty issues. Therefore, we hypothesize that the greater experience levels of teachers will lead to an increase in student performance, but the correlation will not be significant at the 5% level, meaning the absolute value of correlation will be less than 0.05.

## 3 Materials & Methods

To conclude how factors related to success, the measurement of success needed to be determined. We decided graduation rates, math and reading test scores, and grades would best reflect our intentions. School systems will continue to evolve and use different metrics that better reflect success, but there is still a lot of research to be done to improve our metrics.

First, we sought to analyze the relationship between socioeconomic status and student Math and Reading scores. This was done by obtaining the percent of each Math and Reading quartile for different SES groups. Each SES group cumulatively adds up to 100

For our analysis of the correlation between 10 indicators, we created a correlation matrix to identify the strength of each correlation. We obtained our data on total enrollment in elementary and secondary schools (in thousands), Enrollment as a percentage of 5 to 17-year-olds, number of high school graduates (in thousands), number of teachers and faculty, total expenditure for public schools (in millions), the annual salary of classroom teachers, total expenditures per pupil in ADA, and national income per pupil in ADA from CED government data. The sample size was 938 schools across 58 different counties. The specific file we worked with was *File: Calculation of current expense (cost) of education per average daily attendance (ADA) pursuant to Education Code Section 41372* (California Department of Education, 2018). From the collected data, we created the correlation matrix in Python in order to further understand the relationship between different teaching factors and student performance. Finally, the cutoffs for each graph were arbitrarily chosen before processing the data in order to remove bias due to seeing the data before choosing the groups.

# 4 Results

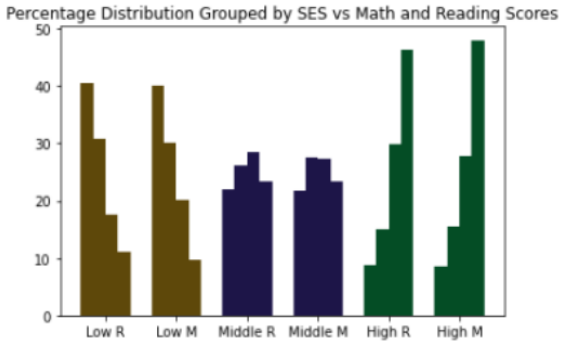


Figure 1: Shows quartile distribution on math and reading tests (first to fourth quartile, left being first, first being lowest) compared to SES (low, middle, and high), represented by three bars for each SES (first bar representing the percentages for low SES, the second representing middle SES, and the third representing high SES), in the US for secondary school students.

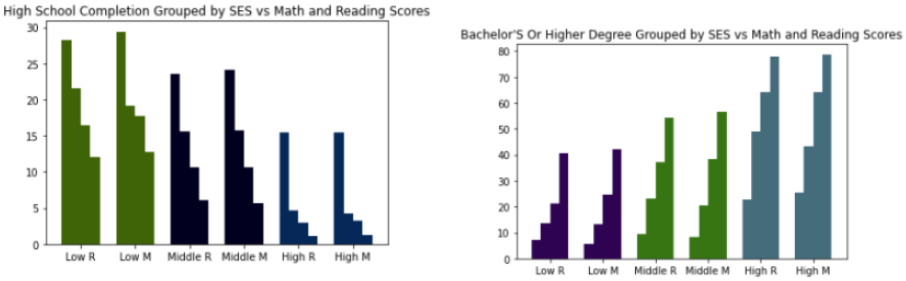


Figure 2: Shows the number of students (in thousands) whose highest education was high school and whose highest education was a bachelor's degree, respectively, with corresponding math and reading quartiles and socio-economic statuses

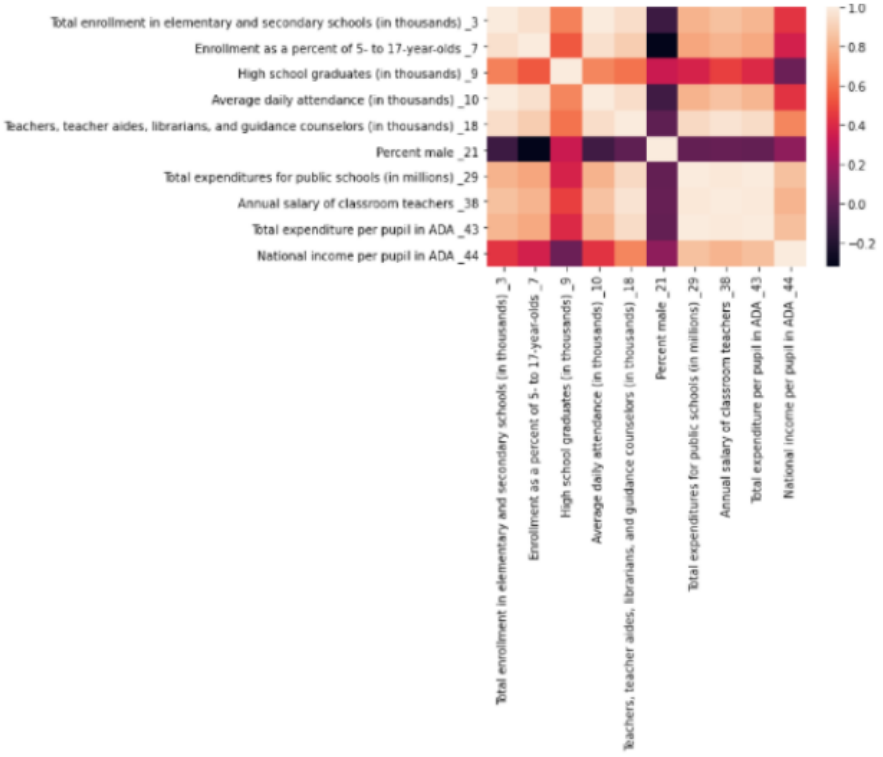


Figure 3: Shows the correlation coefficients between two respective variables, with data from all missing years replaced by the average

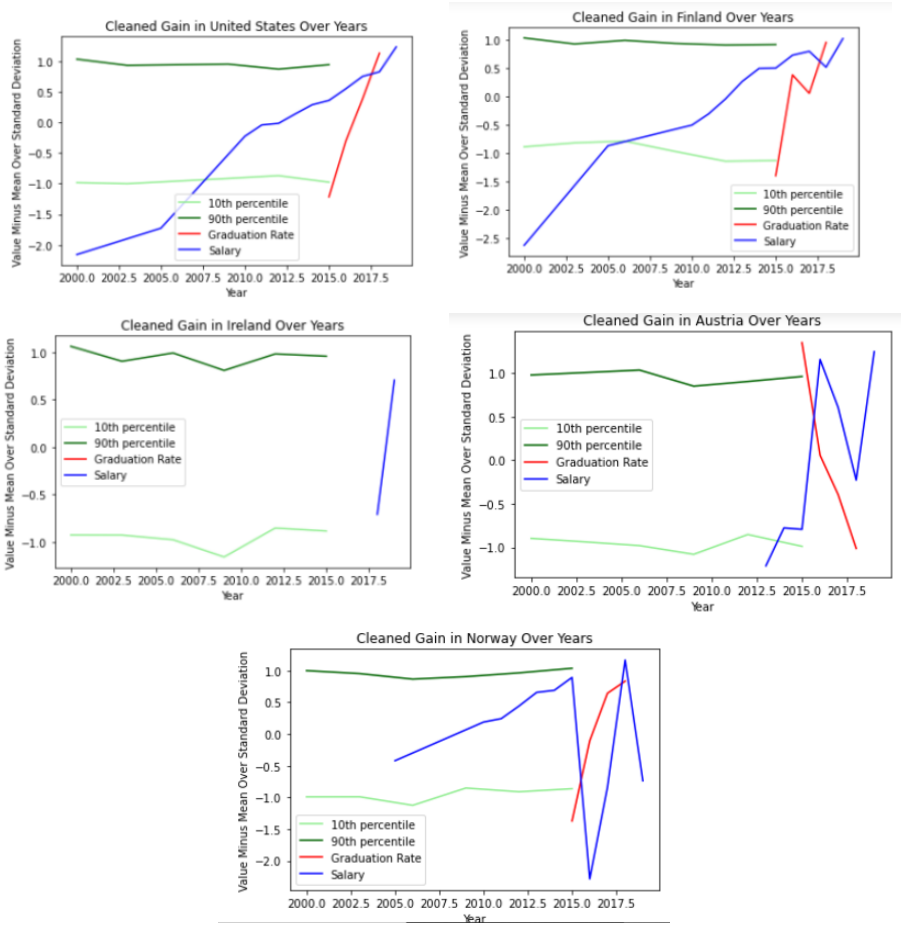


Figure 4: Compares teacher salary to graduation rate and, high and low PISA test performance.

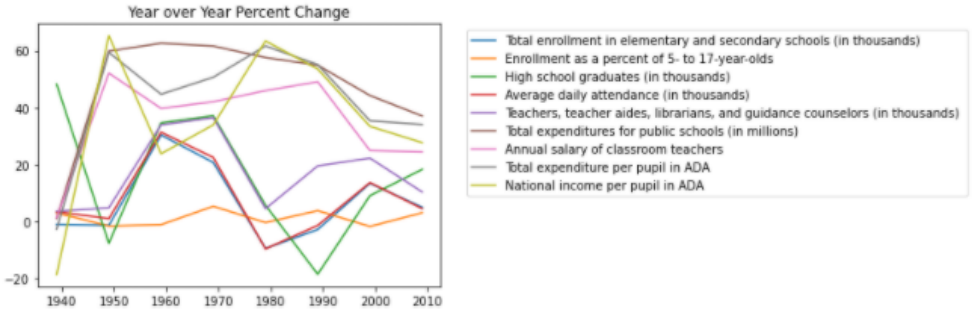


Figure 5: Shows the percent change of the respective indicator over each year

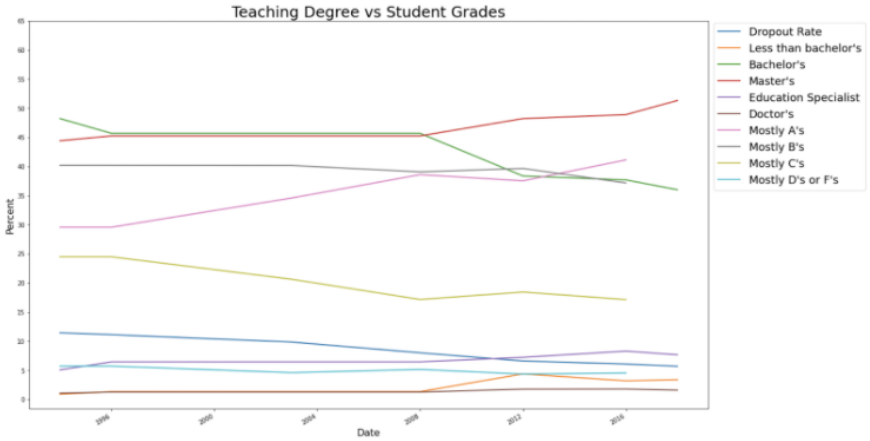


Figure 6: Displays the dropout rate, percentage of each grade received (A, B, C, D's) and the percentage of teachers in each degree category in the US for secondary schools.

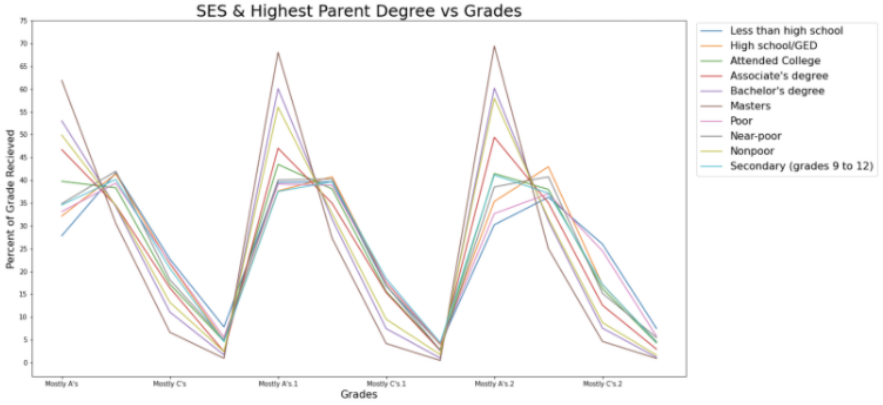


Figure 7: Displays the percentage of each grade received by SES and parents highest degree for years 1996-2016.

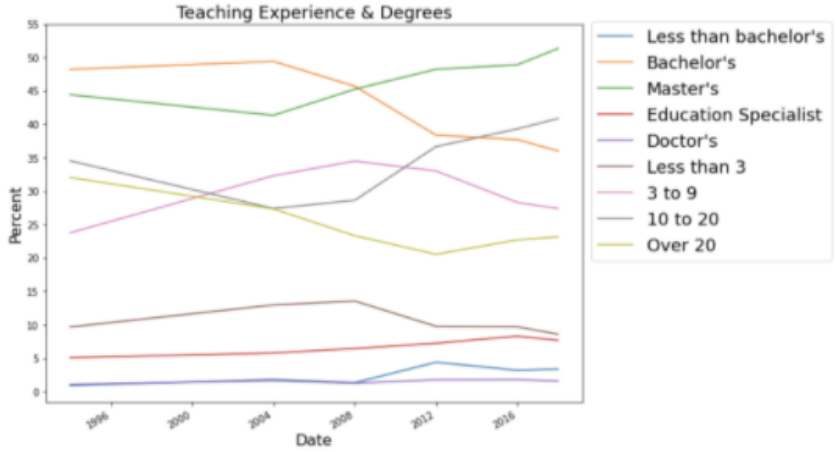


Figure 8: Displays the dropout rate, percentage of each grade received (A, B, C, D's) and the percentage of teachers' in each experience category in the US for secondary schools

# 5 Discussion

Overall, we found five major points.

1. In certain countries like the United States, Norway, Austria, and Finland (Fig 4-8), the general trend of student graduation rates increases and decreases along with teacher salaries. Thus, there is a moderate correlation between graduation rates and teacher salaries. This is further supported by leading researchers such as Susanna Loeb and Marianne E. Page that claim that "the quality of education can be improved by raising teacher salaries."

2. It is also possible that graduation rates and teacher salaries have no correlation or causation, rather due to factors like demand (regarding teaching experience) and improvement in education quality (regarding dropouts) have resulted in these changes. For different SES groups of low, middle, and high, it is important to note that, looking at the 4th quartile, SES groups with higher household income tend to have higher scores on both and reading and math tests (Fig 1); while SES groups with lower household income tend to score lower on both reading and math tests. This is strengthened by conclusions in Fig 11, where the percentage of Grade A students is highest among the "non poor" SES. While the percentage of Grade D students are the highest among the "poor" SES.

3. Additionally, additionally, only the worst students with high SES tend to only have completed high school (Fig 2.1), although not a lot of high SES students who have only completed high school, and the number of students with bachelor's degrees rose considerably with higher SES (Fig 2.2). Based on this data, we can see that teacher salaries and student performance are loosely tied together and it is important to identify the growing concern of access to resources. SES groups of high household income may have more access to private resources that SES groups of low household income may not. Thus, leading to higher graduation rates, reading scores, and math scores.

4. In Fig 11, those who receive a high percentage of A's are determined by highest parent degree (60% of A's are received by parents with a Master's degree), more than SES (50% of A's are received by students with a "non poor" SES). Similarly, the lowest percent of A students is not those with a "poor" SES, but those whose parents highest degree was less than a GED. This opposite holds true for D students, suggesting that SES is a large contributing factor, but not the most important for determining a student's grades.

5. From 1994 to 2018, the percentage of students who receive mostly A's has steadily increased (34% - 41%), and the percentage of Master degree teachers have increased (44% - 51%) while the number of Bachelor degree teachers have decreased (48% - 36%). This could suggest a teacher's degree can improve student grades, but can't be stated as a correlation. On the other hand, a teacher's years of experience does not have a clear connection to student grades, but again, can not be disregarded as a possible correlation.

## Conclusions

Our results show a low correlation between Student Success and Teacher Experience and Salaries. Based on four of our researched countries, the graphs indicate that student graduation rates increase with teacher salaries. In addition, SES groups, from low, middle, and high, have demonstrated a relationship between scores and household incomes, as well as private resources. Moreover, with the findings from the graphs, students' success, including graduation rates and PISA reading and math scores, are largely affected by the financials of students and teachers. This may be caused by many reasons. For example, students from high-income families may have access to tutors or are favoured due to their high standing. To conclude, the three discussed points above demonstrate a relationship between student performance and teacher's financial background that can not be directly stated as a correlation.

## Future Steps

Potential correlations between SES, teacher's highest degree, teacher salary and parent's highest degree must be explored in more depth. By analyzing case by case data in specific schools, more specific data will be accessible and the increased volume will strengthen or disprove the correlations. For example, if a parent's highest degree is a more important factor than SES for determining student performance, the Government's top priority should be to decrease dropout rates to near 0

## Acknowledgements

We would like to acknowledge Mr. Stephens, our teacher coordinator for providing us with the opportunity to work on this challenge; the countless teachers around the world who provide students with a quality education; and the various education research institutions whose previous research and findings were able to assist us in getting to our conclusion.

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