Education Quality vs. Spending, Case Study on Educational Spending in Montana

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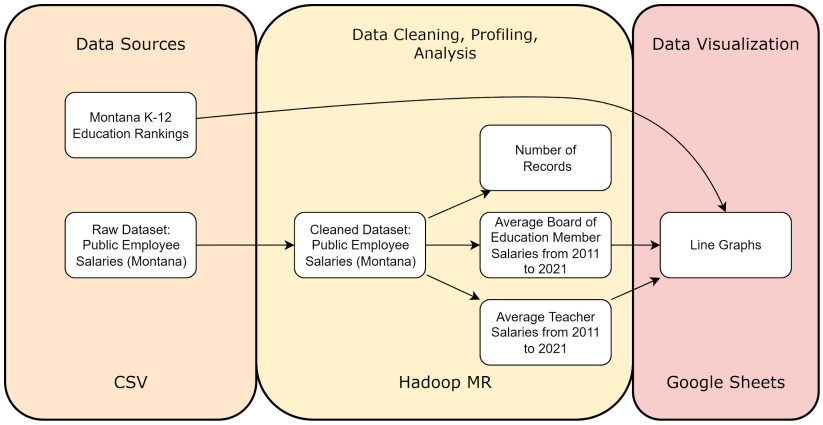
Abstract

As the nationwide education budget has seen severe budget cuts over the past several years, it has become increasingly critical that we properly allocate funds to optimize educational quality. One of the obvious areas we can look to optimize is the salaries of people in the educational sector, primarily teachers and administrators. The goal of this paper is to observe the relationship between the salaries of teachers and the salaries of board of education members with the quality of education within a state. This research is specifically aimed to be a case study of the state of Montana, seeing how average teacher and board of education member salaries from 2011 to 2021 affect the state wide education ranking (done by CNBC). Results show that when adjusted for inflation, salaries for teachers remained relatively stagnant (increase of 5%) over the ten year period whereas board of education members had seen more than a 23% increase. Similarly, the state of Montana over this same period had fallen from 20th to 36th in statewide education rankings by the end of 2021, demonstrating that increasing teacher salaries is crucial to improving educational quality and the salaries of board of education members have no significant impact on the education system.

Introduction

Educational quality has a significant impact on children's intellectual curiosity, their interest in academics, their relationship with the education system, and their overall success in life (Berg 2017). Low quality education causes students to abandon the educational system leading to severe consequences for the students and the general public. Understanding what causes increased educational quality will allow our governments to retain and improve the U.S. educational system while simultaneously having more to invest in other crucial sectors such as infrastructure. Prior to our study, it's generally known that increasing salaries results in increased performance in a majority of sectors, as well as in the education sector as well. The key extension that this study provides is differentiating the effects of teacher salaries from administrative roles on education quality, determining correlations of each job with the performance of the education system. This will be done by tracking average teacher and administrative salaries over a ten year period from 2011 to 2021 and plotting said averages against the state of Montana's education rankings over the same period, as shown in Figure 1.

Figure 1: Design Diagram



Motivation

Having gone through several educational systems (IB program, Gifted and Enriched Program, Public Education, Private Education), I've noticed how my interest in academics and overall life quality has been drastically impacted by the quality of my education. My motivation was to see whether my opinion was common across all students and hopefully provide insights on how we can improve the educational system for all future students.

Related Work

Although there haven't been many studies which compare the impact of different roles on the quality of education, several research papers have shown that increasing teacher pay increases the performance of their students. In 2016, David Reid, at the time a PHD student in educational policy at MSU and now an assistant professor at Seton Hall, published an article in which he states that increasing salaries is one manner to improve the quality of an education system as increasing salaries "has the potential to improve student achievement through retention" (Reid 2016). According to Reid (2016), there is "overwhelming research that finds that teachers improve as they gain experience and early career teachers often leave the profession at higher rates than their more experienced counterparts". A similar article was written in 2020 by "The Journalist's Resource" which stated that increased teacher salaries resulted in "improved teacher retention, gains in student performance, a larger percentage of high-achieving college students taking courses in education, an increased likelihood of hiring teachers who earned top scores on their educator certification exams" (Ordway 2020).

Description of Datasets

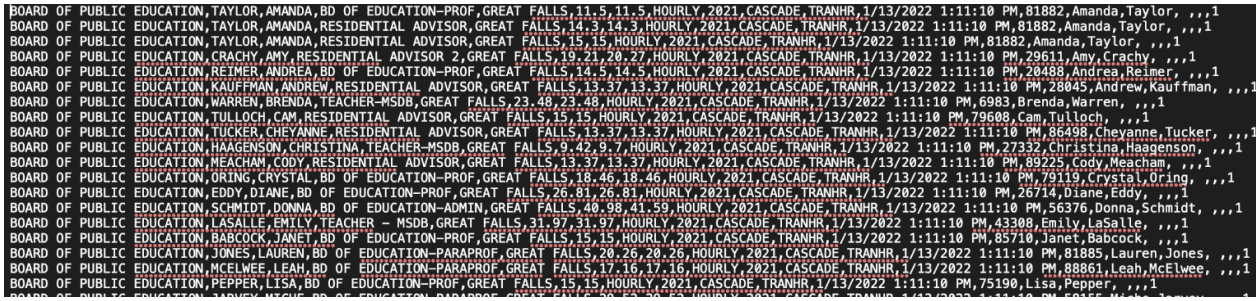
The dataset used for this research was gathered from Montana Transparency in Government, found in the link below.

https://dataportal.mt.gov/t/DOASITSDDataPortalPub/views/SABHRSStateEmployeeData/EmployeeDataDashboard?%3Aembed=y&%3AshowAppBanner=false&%3AshowShareOptions=true&%3Adisplay_count=no&%3AshowVizHome=no. This dataset offers several versions however I choose the full dataset which includes all available columns.

The schema for this dataset is:
Department, STRING: The department the employee works for
Last Name, STRING: employee's last name
First Name, STRING, employee's first name
Job Title, STRING: employee's job title
City, STRING: The city in which the employee works
Base Salary, DOUBLE: The employee's base salary, pay rate described in the column "Frequency"
Total Salary, DOUBLE: The employee's total compensation, pay rate described in the column "Frequency"
Frequency, STRING: The frequency in which the employee is paid
Year, INT: The year in which the salary was reported
County, STRING: The county in which the employee works
Cre By, STRING: The entity which submitted this information
Cre Dt, STRING: The date on which the entry was submitted
Emp Id, STRING: Id of the employee
F Name, STRING: First name of the employee
L Name, STRING: Last name of the employee
M Name, STRING: Middle name of the employee
Mod By, STRING: The entity which last modified this entry
Mod Dt, STRING: The date on which this entry was last modified
Number of Records: The number of entries for this employee in the specified calendar year

A sample of several entries are shown in Figure 2.

Figure 2: First 20 Entries of Dataset



Analytic Stages

The dataset was readily available from the “Montana, Transparency in Government” website via their Tableau workbook meaning data ingestion only consisted of downloading the dataset and uploading it to the HDFS. The dataset consisted of thousands of entries, each entry describing an employee’s payment information, columns described in the dataset section.

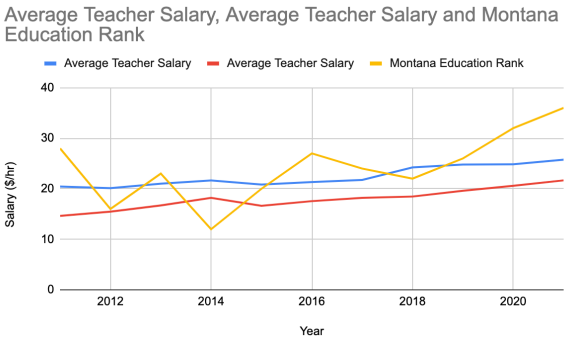
The data profiling consisted of one MapReduce job, CountRecs.java, which checks how many rows were in a given dataset. CountRecs.java ensures that the number of rows prior to cleaning is the same as the number after. Data cleaning was the lengthiest process in the project, which was done using the MapReduce job Clean.java. Initially, the sole purpose of the Clean.java was to extract from the numerous columns the “Job Title”, “Total Salary”, and “Year” columns, however, the cleaning process was later used to remove an unexpected bug. Hidden in the csv dataset, were invisible characters in every odd index. This means that the “Total Salary” and “Year” columns are unparsable producing the error shown in figure X. Therefore, the second and main goal of the Clean.java is to remove all non-alphanumeric characters from the csv, removing all the invisible characters and making all columns suitable for analytics and numerical operations.

The analytics component was focused on finding the average salary per year for teachers and board of education members. This was done with the two MapReduce jobs, AverageTeacherSalary,java and AverageBoardSalary.java. Both jobs had very similar processes, where the mappers would extract all entries with its associated title (All entries with “TEACHER” and all entries with “BDOFEDUCATION”, respectively) and send the key value pairs of the salary and year in which it was recorded. The reducers would then find the average salaries of both roles by year, giving us data to plot the trends related to salaries of both roles against Montana’s education rank.

Graphs

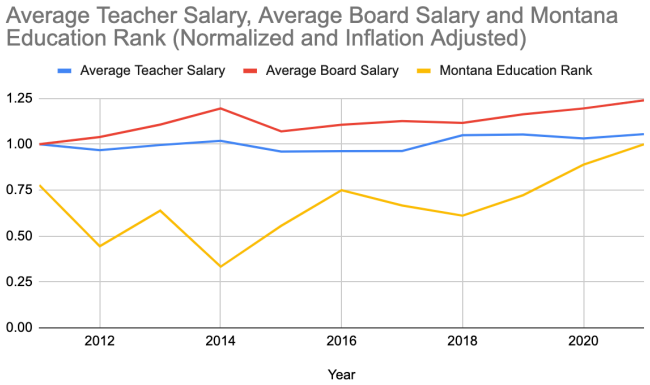
The average salaries of both roles are plotted against the state education rank given by CNBC’s annual state rankings, shown in Figure 3.

Figure 3: Salaries vs Education Rank



Initially there appeared to be no significant correlation as teacher salaries and board of education salaries had continued to increase from 2011 to 2021 while Montana's education ranking had been gradually decreasing, salaries shown in figures 3, however, if we normalize the fields and account for inflation, the teacher salaries are shown to remain stagnant while board of education member salaries have increased higher than the rate of inflation, as shown in figure 4.

Figure 4: Salaries vs Rank, Inflation adjusted and normalized



Conclusion

From the soaring wages of administrative roles and the non-increasing wages of teachers, we can see that a combination of the two results in a gradually deteriorating educational system within the state of Montana. As teacher salaries have remained the same over the ten year period when adjusted for inflation, we can directly link the salaries of board of education members to the educational performance of the state of Montana. Although administrative salaries have risen over 23% in the past 10 years, Montana's rank in the CNBC Education section has fallen 24 ranks from its peak at 12th in 2014 to its current 36th in 2021. We can draw the conclusion that increasing the salaries of board of education members has no significant improvement on the quality of education, and linking this alongside the other research papers, we should be diverting these funds allocated to administrative roles towards increasing the pay of teachers. The implications of this finding is that we do not need to balloon our education budget to maintain a high quality public education. These findings show that there exists roles that we should be prioritizing in terms of funding and that we can maintain a healthy budget for public education by reducing prioritizing teachers. From this study, several new questions emerge related to delving deeper into the importance of the subcategories of each group. Are there certain subjects that we should prioritize funding and which administrative roles create the most impact? Although this study does demonstrate the importance of teachers in the educational sector, it also serves as a gateway to further explore this topic of the optimization of the educational industry.

References

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