Bridging The Educational Gap

Modelling Optimal Locations for New CTA Rail Stations To Address Educational Inequality in Chicago

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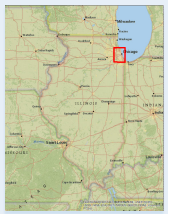
Background

Like many other American cities, Chicago experiences widespread racial and income inequalities. Although the overall population is evenly racially divided, 18 neighborhoods in Chicago, with most in the South Side, are over 90% black.[1] Recent studies have also found that Chicago's white households are wealthier than the national average, while black households have substantially less wealth than the national average.[1] A central theme in the literature is that economic reform in Chicago in the 1980s-1990s led to a drain in investment in lower-income, non-white neighborhoods, including social infrastructure such as schools and public transportation.[2] In order to study the result of this trend , I will examine the association between high school racial and socioeconomic student demographics and respective student attendance and graduation outcomes across 49 neighborhood high schools in Chicago. I will also study the role of Chicago Transit Authority(CTA) Rail Stations in bridging the gap in educational outcomes across high schools with differing racial and socioeconomic demographics, and map locations for new CTA Rail Stations to optimally do so.



Methodology

For this analysis, I used High School Profile and Progress Report Excel data, and Attendance Zone shapefile data from Chicago Public Schools, available on the Chicago Data Portal. All data was imported into ArcMap as dBase tables or shapefiles, and a raster calculator was used to generate low-income and white student percentage fields in the Progress Report dBase table. Then, an attribute join was done with the High School Attendance boundaries shapefile using School ID as the unique identifier. Figures 1 and 2 were created by then generating symbology based upon Low-income and White Student Proportion attributes, using a 5-class, Natural Jenks classification. Figure 3 was generated in Microsoft Excel. The mean Student Attendance and Graduation rates were obtained using statistics of these fields, after school zones were selected by income and racial categories using the Select by Attributes option in the Attribute Table.

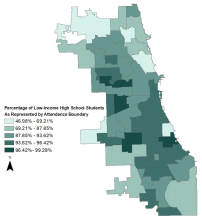


Figure 1- Percentage of Low-Income High School Students in Chicago Neighborhood High Schools in 2019

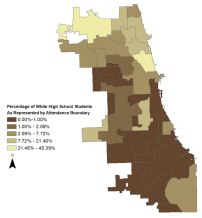


Figure 2- Percentage of White High School Students in Chicago Neighborhood High Schools in 2019

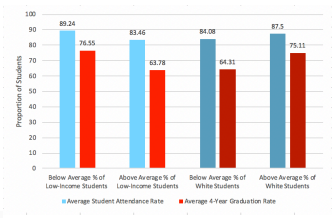


Figure 3- Student Attendance and Graduation Rates Across High Schools of Different Socioeconomic & Racial composition

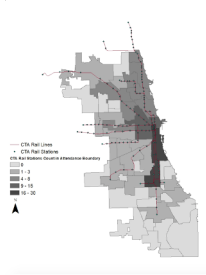


Figure 4- Number of CTA Rail Stations within High School Attendance Zones in Chicago in 2019

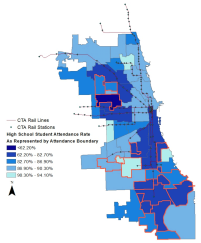


Figure 5- High School Attendance Rates in Low-Income, Non-White Attendance Zones with <2 Rail Stations in Chicago in 2019

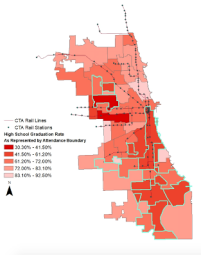


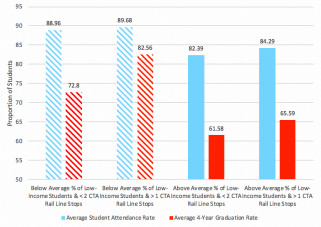
Figure 6- High School Graduation Rates in Low-Income, Non-White Attendance Zones with <2 Rail Stations in Chicago in 2019

In order to generate Figure 4, shapefiles for CTA Rail Lines and CTA Rail Stations were uploaded to ArcMap from Chicago Data Portal. A spatial join was conducted based upon the containment of CTA Rail Station points with high school attendance boundary polygons, and a 5 class, natural jenks classification was generated using the Rail Station Count variable.

An attribute join was conducted to merge student attendance, graduation, low-income ratio, and white student ratio with this file. Afterwards, all attendance zones with above average count of low-income and non-white students, as well as less than 2 rail stations were selected for. Figure 5 was created using a 5-class, natural jenks classification based on the Student Attendance rate variable, with the selected attendance zones highlighted in red. Figure 6 was created using a 5-class, natural jenks classification based on the 4-year Graduation rate variable, with the selected attendance zones highlighted in light blue.

In the same layer's attribute table, the average student attendance and graduation rates were obtained by looking up each field's statistics with different attributes selected. For Figure 7, this included collecting mean attendance and graduation rates after selecting attendance zones with below and above average percentage of low-income students, as well as less than and greater than 2 CTA rail stations. For Figure 8, this included collecting mean attendance and graduation rates while selecting those with below and above average percentage of white students, as well as less than and greater than 2 CTA rail stations. Both Figures were created using Excel.

Figure 7- Student Attendance and Graduation Rates Across High Schools of Different Socioeconomic Profiles & # of CTA Rail Lines



In order to map Need for CTA Rail Stations across attendance zones, I used a raster calculator to generate a new field using the following formula:

$$\textit{Rail Station Need} = \frac{\textit{Proportion of LowIncome Students} + \textit{Proportion of NonWhite Students}}{\textit{Student Attendance Rate} + \textit{Student Graduation Rate} + \textit{Rail Station Count}}$$

Figure 9 was created using a 5-class Natural Jenks classification based on this new index. A base map, legend, compass, and title was added to Figure 9 as well. The Projected Coordinate System for all figures is is NAD 1983 State Plane Illinois East.

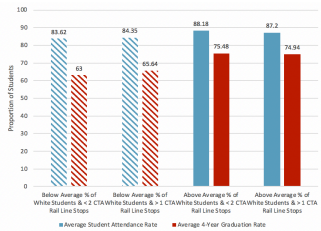
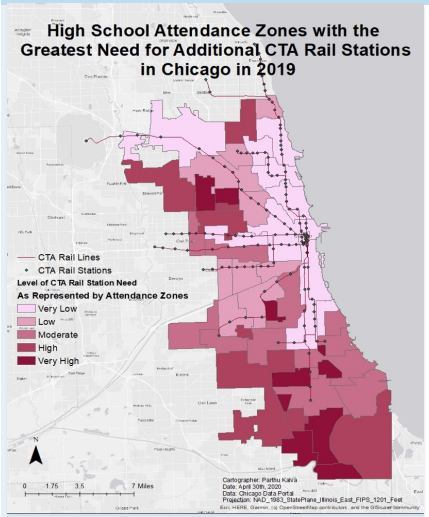


Figure 8- Student Attendance and Graduation Rates Across High Schools of Different Racial Profiles & # of CTA Rail Lines

Results



From Figure 3, and from visually comparing Figures 1 and 2 with Figures 5 and 6, we observe that high schools with a higher proportion of lower-income and non-white students experience lesser student attendance and 4-year graduation rates. The gap in student graduation is larger than the gap in student attendance. From Figures 5-8 , we can conclude that the presence of 2 or more CTA Rail stations is associated with greater student attendance and graduation rates, even when compared among schools with similar racial or socioeconomic profiles. Finally, Figure 9 shows us that attendance zones where new CTA Rail Stations are most likely to bridge the educational gap are largely in the southern and western parts of Chicago. In particular, these consist of zones where no CTA Rail stations currently exist.

Figure 9- High School Attendance Zones with the Greatest Need for Additional CTA Rail Stations in Chicago in 2019

Conclusion

From my analysis, I can infer that there is a link between racial/socioeconomic profiles and educational outcomes in Chicago's high schools. I can also support the hypothesis that the lack of equitable investment in CTA infrastructure across Chicago's neighborhoods has contributed to gaps in educational outcomes. My findings are consistent with previous studies that shed light on infrastructure disparities across neighborhoods with racial and socioeconomic differences in Chicago. Although past literature has advocated for construction of new CTA Rail Stations, this is the first analysis that maps the intersection of inequalities in both transportation and educational infrastructure across Chicago neighborhoods.[3]

This analysis was limited by a small sample size and little was done to control for confounding when measuring educational gaps between schools of different racial and socioeconomic profiles. For example, the gap in graduation rates was larger than that of attendance rates, likely due to time-variant socioeconomic factors. In addition, there was a very small count of majority-white high schools, making it difficult to create reliable conclusions about educational outcomes in these schools.

Asides from these limitations, the model is useful for policymakers to identify which neighborhoods in Chicago would most benefit from new rail stations. These findings may then be leveraged towards building policy that incentivizes CTA to invest in new stations in selected areas. In the future, a similar model should be created that ranks need for new CTA Rail Stations where a CTA Rail Line already exists. This would be less costly for CTA to implement, and more likely to be applied. Finally, a cost-effective analysis of new CTA rail stations would be a great policy resource and should be built by comparing marginal utility of new rail stations with incremental costs of rail station construction and maintenance.

References

[1] Novara, M. (2017). *Two Extremes of Residential Segregation: Chicago's Separate Worlds & Policy Strategies for Integration*. Retrieved from www.jchs.harvard.edu

[2] Lipman, P. (2002). Making the global city, making inequality: The political economy and cultural politics of Chicago school policy. *American Educational Research Journal*. https://doi.org/10.3102/00028312039002379

[3] Foote, P. J., LaBelle, S. J., & Stuart, D. G. (1997). Increasing Rail Transit Access to Airports in Chicago. *Transportation Research Record: Journal of the Transportation Research Board, 1600*(1), 1–9. https://doi.org/10.3141/1600-01

Data Sources

Chicago Public Schools - High School Attendance Boundaries SY1819, July 2018, Chicago Public Schools; published by Chicago Data Portal.

Chicago Public Schools – School Profile Information SY1819, January 2020, Chicago Public Schools; published by Chicago Data Portal.

Chicago Public Schools – School Progress Reports SY1819, November 2019, Chicago Public Schools; published by Chicago Data Portal.

CTA - 'L' (Rail) Lines - Shapefile, August 2015, Chicago Transit Authority; published by Chicago Data Portal.

CTA - 'L' (Rail) Stations - Shapefile, December 2018, Chicago Transit Authority; published by Chicago Data Portal.