

EVOLVING PATTERNS OF CLASSROOM STAFFING INEQUALITY: A LONGITUDINAL ANALYSIS OF STUDENT–TEACHER RATIOS AND IMPLICATIONS FOR EDUCATIONAL PRACTICE

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Abstract

Staffing conditions in classrooms are directly correlated with the quality and equity of educational provision, but student-to-teacher ratios can be viewed through system-wide averages and mask inequalities in schools and regions. We need a longitudinal view of these ratios to determine how they change and their unequal distribution. This study examined temporal patterns, geographic variation, and distributional inequality in student–teacher ratios as an indicator of classroom staffing conditions across public schools. A quantitative longitudinal design based on secondary data analysis was employed, using school-level records from 2017–18 to 2024–25. After data cleaning and filtering, the final analytical sample consisted of 18,118 observations. Descriptive statistics, trend analysis, county-level comparisons, and coefficient of variation were used to assess patterns and inequality, alongside one-way ANOVA and Kruskal–Wallis tests for year-wise differences. The mean student–teacher ratio was 14.07 (SD = 5.09), with substantial variability and a positively skewed distribution, indicating that a subset of schools experienced disproportionately high staffing pressure. Temporally, the ratio declined from 15.17 in 2017–18 to 13.14 in 2020–21, followed by a gradual increase to 14.11 in 2024–25. Geographic disparities were pronounced, and inequality peaked in 2020–21, remaining elevated thereafter. Differences across years were statistically significant, though the effect size was small. Classroom staffing conditions were thus uneven across schools, years, and regions, highlighting the importance of interpreting student–teacher ratios as indicators of distributional inequality rather than simple averages.

Keywords: student–teacher ratio, classroom staffing, educational inequality, longitudinal analysis, school resource distribution

1. Introduction

The classroom settings have a significant role in influencing the teaching and learning processes, both in terms of cognitive and behavioral outcomes in students. Classroom arrangement, physical conditions, instructional arrangement and distribution of resources also help in determining the effectiveness with which learning activities are conveyed and received. Empirical data show that the difference in classroom conditions can be an important factor that influences the development of literacy and academic involvement in a more general way, which is why the structural conditions in educational settings need to be studied (Rance et al., 2023). This point of view is also supported by the way students view their classroom environment, with the discrepancy between traditional and innovative classrooms linked to the differences in engagement, motivation, and learning experiences (Woo et al., 2022). In this larger context, structural variables like staffing and resource allocation continue to play a crucial role in classroom operation. The student teacher ratio (STR), which is a popular way of measuring classroom staffing, is a measure of the ratio between instructional demand and teaching resources. Even though it does not directly gauge pedagogical quality, STR helps to understand the ability of classrooms to facilitate individualized learning and efficient management. The interplay between classroom climate, teacher-related variables, and student performance implies that structural circumstances and professional relations are not independent of each other, as they influence the overall student performance in education (Arifin et al., 2024). Due to this, the analysis of STR can become a useful source of insight into the development of classroom conditions and how they can affect the teaching and learning processes.

The role of classroom arrangement as a means of facilitating the instruction process has been the focus of existing research. The concept of scaffolding is one of the major dimensions since the classroom setting helps guide learning by the establishment of a supportive system. Distributed scaffolding focuses on how various classroom factors, such as teacher accessibility and teaching materials, can help students learn more (Puntambekar, 2022). These results indicate that proper staffing conditions are needed to ensure effective instructional support. There are also factors associated with teachers that have a major influence on classroom outcomes. Teacher expectations have an impact on student performance, usually through the degree of interaction and attention that teachers may offer (Basree & Malik, 2025). In the same manner, institutional factors, such as personnel and resource distribution, also lead to differences in student performance, and the role of structural variables in education systems should not be overlooked (Khan et al., 2024). All these studies lead to the same conclusion that classroom environment, teacher capacity, and student outcomes are interrelated.

There has been a large amount of literature on the correlation between the size of classes and academic performance. The effects of class size reduction, frequently measured by lower student-teacher ratios, have been found to positively impact student performance, especially in the initial and foundational years of schooling. There are indications that the extra funding allocated to the employment of more teachers can have quantifiable effects on the results of students, but the size of these effects can differ based on the context (Borgen et al., 2025). Likewise, the student behavior and engagement have been attributed to the class size, as smaller classes tend to create more favorable learning conditions and fewer behavioral issues (Wang & Calvano, 2022). Another important aspect of classroom functioning is teacher workload. The higher the student-to-teacher ratios, the more workload is usually involved, and it may adversely influence the effectiveness of teaching and quality of teaching. Researchers have indicated that overwork may reduce the effectiveness of teachers in providing effective teaching and classroom engagement (Christogonus-Anyanwu & Imiruaye, 2024). Moreover, workload stress has been associated with decreased well-being and diminished teaching performance, which serves to substantiate the value of balanced staffing conditions in promoting sustainable teaching processes (Magalong & Torreon, 2021). Moreover, structural limitations affecting student-teacher relationships, which are key to academic success, include class size and availability of resources, especially in the context of socioeconomic differences (Olsen & Huang, 2021).

Even though there is a lot of literature on classroom set-up and class size, a number of limitations are still apparent in the literature. A lot of the current literature concentrates on cross-sectional studies or experimental treatments, and tends to concentrate on the average effects, but not on the distributional patterns of educational systems. Because of this, the variation of school and region student-teacher ratios over time has not received much attention. Moreover, although structural conditions are recognized as significant in previous literature, not many have explored how unevenly disparities in staffing are distributed within a system. There is limited knowledge on the effects of classroom staffing conditions to contrast with the longitudinal, school-level analyses, but whether inequalities exist or decrease as time passes. To fill these gaps, a thorough study of the temporal trends and distributional features of student-teacher ratios is needed.

The purpose of this study is to analyse the changing trends of student-to-teacher ratios as a measure of teaching staffing statuses in more than one academic year. It aims to examine the dynamics of these ratios over time, determine the degree of variation between schools and geographical areas, and determine the distributional nature that indicates inequality of classroom conditions. Combining temporal, descriptive and comparative methods, the study offers a holistic insight into the development of structural features of classroom settings and how staffing inequalities can impact educational practice.

2. Methodology

2.1 Research Design

The research design of this study is a quantitative longitudinal research design that relies on secondary data analysis. It is a descriptive, comparative design, which can be used to examine patterns, trends, and changes in the student-teacher ratio over time and across different organizational units. The longitudinal method was chosen to address the changes in the conditions of staffing classrooms, both over time and the structural changes in the conditions. The emphasis of the analysis is on the determination of distributional features and differences, but not on the determination of the causal relationships.

2.2 Data Source

Data in this study were taken from an official public education reporting system, which reports school-level data on student-teacher ratios at several administrative levels. The dataset will be based on annual records of the 2017-2018 to 2024-2025 academic years, disaggregated by school, district (Local Education Agency), regional service units and by state-level aggregates. Student-teacher ratio is considered to be the number of enrolled students to one teacher in each reporting unit (Washington Office of Superintendent of Public Instruction, 2026).

2.3 Data Preparation and Sample Selection

The initial data has observations at various organizational levels. In this paper, observations at the school level were limited to the analysis, as these are the most direct observations of classroom conditions. Preparation of data entailed a number of steps. To start with, the variables that included the number of students, the number of teachers, and the student-to-teacher ratios were transformed into numeric form to make them consistent. The analytical sample was restricted to records that had no values in key variables (student count, teacher count, or student-teacher ratio). Also, non-positive teacher counts were eliminated to prevent undefined or misleading ratios.

In order to guarantee the reliability of data, the reported student-teacher ratio was cross-validated with the calculated values based on student and teacher totals. Minor differences were kept, which could be due to rounding errors in the reported occurrences. After cleaning and filtering, the final analytical sample comprised 18,118 school-level observations in eight academic years.

2.4 Variables

The student-teacher ratio (STR) is the main variable of interest in this study and is considered a continuous variable indicating the conditions of classroom staffing. The variables that should be supported are: SchoolYear, which is the academic year of a school at a time and is used to study the tendencies over time; County, which is the geographical location of schools and will be used to verify the ratio reported as well as to explain it contextually; TeacherTotal and StudentTotal, which are the number of teachers and students respectively and are used to verify the ratio reported and to explain it in context. This analysis uses STR as a proxy measure of the conditions in the classroom instruction, acknowledging that it is a measure of structural capacity, as opposed to measures of pedagogical practice.

2.5 Data Analysis Procedures

Analysis was done with the help of standard statistical procedures that are suitable for descriptive and comparative research. To summarize the overall distribution of STR, descriptive statistics (mean, median, standard deviation, percentiles, skewness and kurtosis) were calculated in the first place. Second, to assess temporal trends, the values of the STR were aggregated by academic year to observe the changes over time. Third, the analysis of distribution was performed by means of graphical methods, such as histograms and boxplots, to evaluate the variability and find the extreme values. Fourth, geographic comparisons were conducted at the county level by summing the data. A minimum observation threshold was used to include the counties based on the data distribution in order to make the estimates stable. Fifth, a coefficient of variation (CV) was used to analyze inequality as a standardized measure of dispersion in comparison to the mean.

Parametric (one-way ANOVA) and non-parametric (Kruskal-Wallis) tests were used to statistically determine the difference between the years. It was necessary to use both approaches due to the non-normality of STR, as shown by the normality test. The eta squared (η^2) was used to estimate the effect size to determine the magnitude of differences between groups.

3. Results

3.1 Descriptive Statistics of Student–Teacher Ratio

The number of observations analyzed was 18,118 school-level observations with the academic years 2017-18 to 2024-25. Student-teacher ratio (STR) showed significant differences among schools, with a mean of 14.07 and a standard deviation of 5.09. The range was 0.00 to 44.40, implying that there are extremely low and high values in the dataset. The mean was near the median of 14.20, indicating a moderately symmetric central tendency; however, the positive skewness (0.655) and excessive kurtosis (4.937) imply that the distribution is skewed towards the right (Table 1).

Table 1. Descriptive Statistics of Student–Teacher Ratio Across Public Schools (2017–2025)

Statistic	Value
Number of observations	18118
Mean	14.07
Standard deviation	5.09
Minimum	0.00
25th percentile	11.80
Median	14.20
75th percentile	16.50
Maximum	44.40

Skewness	0.655
Kurtosis	4.937

Note: $N = 18,118$ school-level observations. Student–teacher ratio represents the number of students per teacher.

3.2 Temporal Trends in Student–Teacher Ratio

An annual analysis showed that there was a clear non-linear trend in STR with time. As shown in Figure 1, the mean STR declined steadily from 15.17 in 2017–18 to a low of 13.14 in 2020–21. This was preceded by a slow recovery period, where values went up to 14.11 by 2024–25. The trend observed indicates a strong shortening and recovery of the classroom staffing situation during the study time.

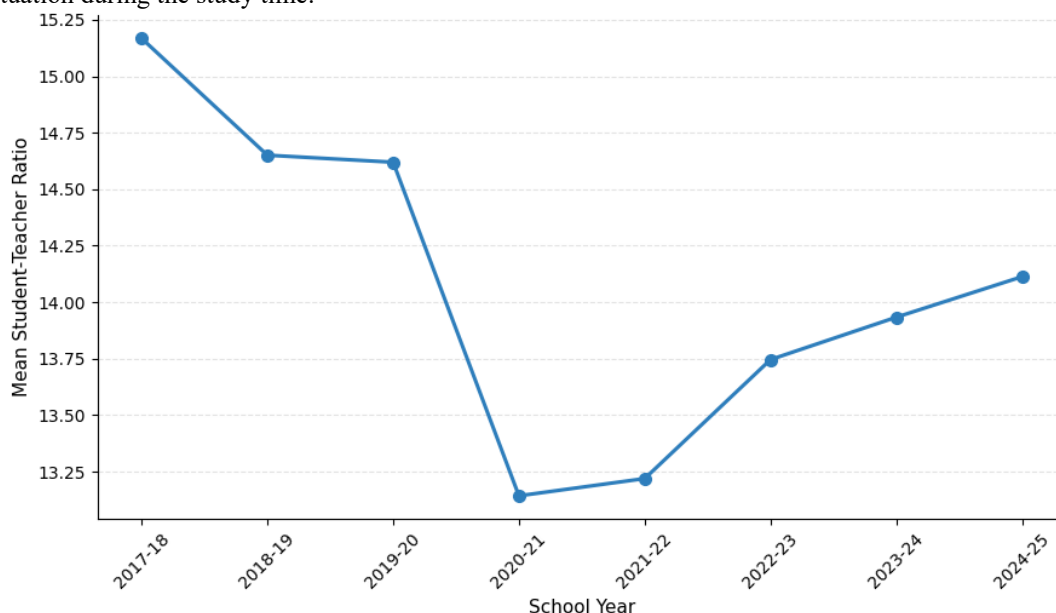


Figure 1. Mean Student–Teacher Ratio Over Time (2017–2025)

To supplement this visual trend, the summary statistics on a year-by-year basis confirm the alteration of the central tendency over the years. Median values showed the same pattern, decreasing in the middle period and then increasing afterwards, which also means that the trend was not propagated by the extreme values, but instead, it occurred throughout the distribution.

Table 2. Year-wise Distribution of Student–Teacher Ratio Across Public Schools (2017–2025)

School Year	Observations	Mean	Median	Standard Deviation	Minimum	Maximum
2017–18	2206	15.17	15.60	5.15	0.00	43.00
2018–19	2228	14.65	15.00	5.20	0.00	44.00
2019–20	2234	14.62	14.90	5.02	0.00	44.00
2020–21	2265	13.14	13.00	5.14	0.00	44.10
2021–22	2296	13.22	13.30	4.88	0.00	44.00
2022–23	2303	13.75	13.90	4.99	0.00	44.40
2023–24	2296	13.93	14.00	4.91	0.00	44.30
2024–25	2290	14.11	14.10	5.11	0.00	44.10

Note. Values represent school-level aggregates for each academic year.

3.3 Distributional Characteristics

The mean distribution of the STR shows that the value distribution is skewed towards the range of 10-18, and then gradually decreases as the values become larger. The distribution is positively skewed, as shown in Figure 2. The long right tail depicts that there are schools with significantly higher student-teacher ratios. There is also a small cluster of near-zero values at the lower end, which presumably refers to either specialized or non-standard instructional settings.

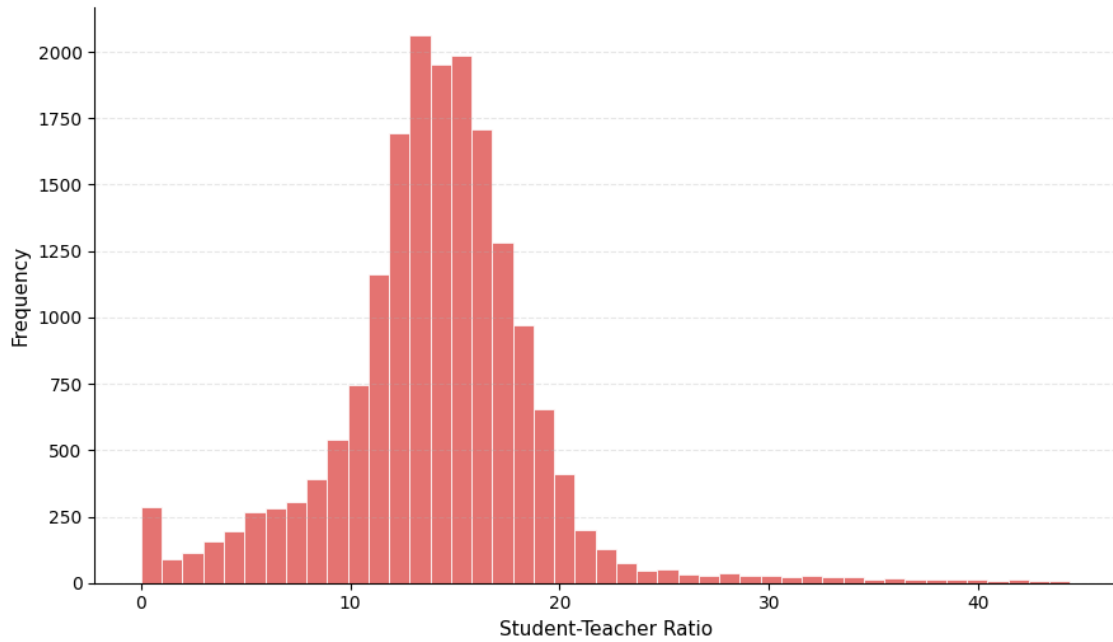


Figure 2. Overall Distribution of Student–Teacher Ratio

This trend indicates that although the majority of schools have a relatively limited spread of STR, there is a group of schools with disproportionately high ratios, which enhances general inequality in the classroom environment.

3.4 Geographic Variation in Student–Teacher Ratio

STR was significantly different among counties. Comparison of major counties, as indicated in Table 3, indicates that the mean values of STR varied between 11.90 in Greys Harbour County and 16.25 in Benton County. The relatively high average ratios of 15 or more were noted in several counties, such as Snohomish and Pierce, whereas 12 and nearer were noticed in such counties, like Chelan and Walla Walla.

Table 3. County-level Variation in Student–Teacher Ratio Among Major Counties

County	Observations	Mean	Median	Standard Deviation
Benton	502	16.25	15.70	4.46
Snohomish	1492	15.06	15.00	4.59
Pierce	1957	15.04	15.20	4.64
Okanogan	249	15.01	13.50	7.19
Cowlitz	335	14.95	14.80	4.56
Grant	426	14.80	15.05	5.55
Yakima	806	14.65	14.90	5.09
Thurston	672	14.59	14.80	4.33
Clark	1069	14.59	14.40	4.65
King	3932	14.36	14.45	4.17
Stevens	266	14.36	12.85	8.50
Kitsap	576	14.14	14.05	5.27
Lewis	321	13.79	13.90	4.29
Whatcom	518	13.76	13.50	5.04
Spokane	1302	13.65	13.50	4.74
Skagit	371	13.64	14.00	5.42
Franklin	269	13.40	13.50	4.69
Chelan	304	12.53	12.90	5.75
Walla Walla	219	12.25	13.40	4.69
Greys Harbor	341	11.90	12.80	5.61

Note. Counties included based on a minimum observation threshold.

To further represent these differences, Figure 3 shows the mean STR of major counties, indicating the relative location of each county in the distribution.

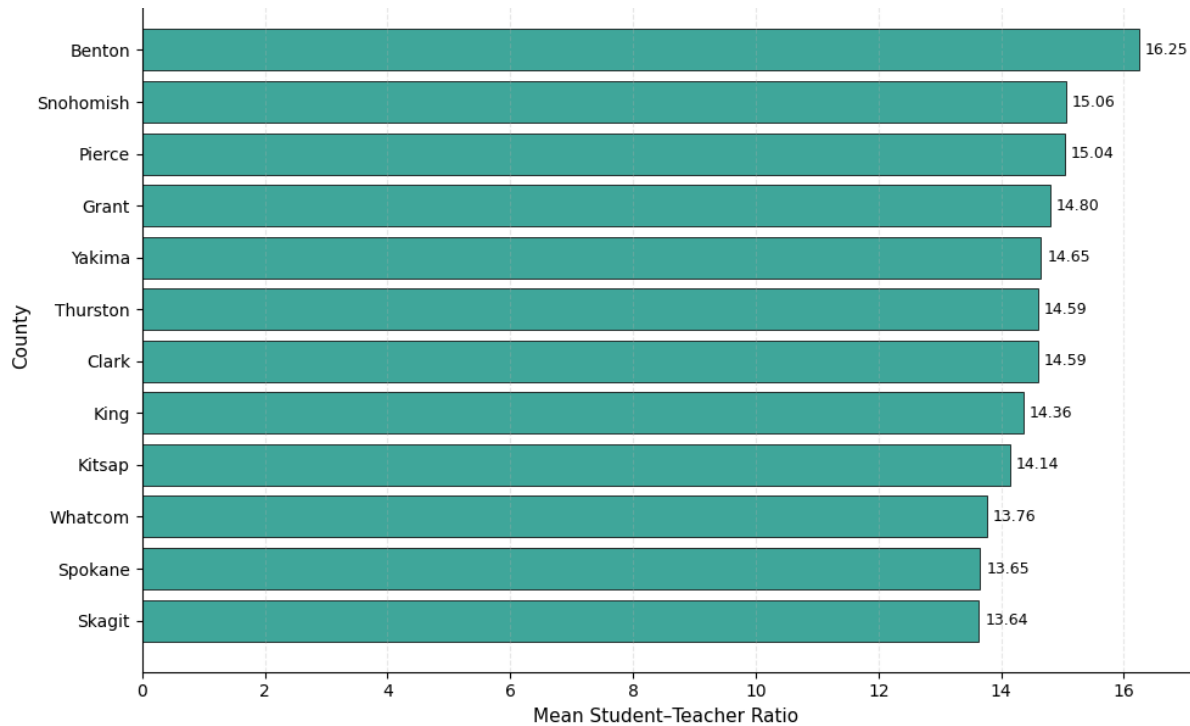


Figure 3. Mean Student–Teacher Ratio Across Major Counties

The degree of the variation between counties implies that classroom staffing factors are not evenly distributed geographically, with some areas always having higher student-to-teacher ratios than others.

3.5 Inequality in Student–Teacher Ratio Over Time

To determine the evolution of inequality in STR, the coefficient of variation (CV) was used. Figure 4 depicts that inequality rose dramatically in 2020-21, peaking during the period of the study, and then slightly decreased in later years. Nonetheless, the CV was still higher in 2024-25 than it was in 2020 and implied that the difference between classroom conditions remained the same even as the average values of STR started to increase.

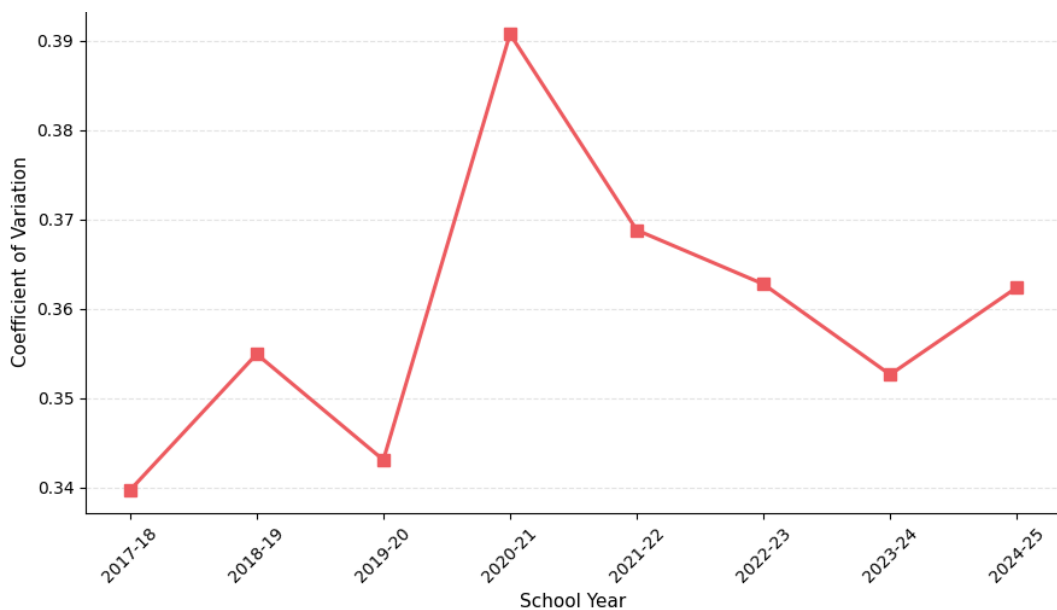


Figure 4. Inequality in Student–Teacher Ratio Over Time

This trend indicates that the structural change periods were not only related to the changes in the average conditions but also to the increase in the differences in schools.

4. Discussion

Student-teacher ratios are highly diverse in schools as well as unevenly distributed over time and space, providing valuable information on the conditions of classroom staffing. Although the average mean ratio indicates moderate system-level

staffing pressure, the dispersion observed, skewed to the right, and the long upper tail mean that the average values hide much heterogeneity. The majority of schools have a relatively limited scale, but there is a smaller group of schools that have significantly higher ratios, indicating a high level of concentration in staffing. This brings out the point that distributional patterns are more effective in understanding the classroom conditions in the absence of aggregate indicators. This interpretation is also supported by the temporal trajectory. The trend in the student-to-teacher ratio is non-linear, and the decrease in 2017-18 and the gradual rise in 2020-25 are not part of a stable trend but of a non-linear pattern. This implies a phase of structural contraction and a partial normalization. The magnitude of the effect of the temporal differences is, however, small, which implies that the changes were minimal as compared to the overall variability found in schools. That is, on the one hand, system-wide averages varied with time; on the other hand, the structure of inequality was not eradicated. Geographic inequalities give further support for unequal distribution. Variations in mean ratios between counties produce a result that the conditions of classroom staffing are not only influenced by the dynamics of the system level but also by the conditions of the local institutions and resources. The increase in inequality indicated by the coefficient of variation reaching its peak in 2020-21 and staying high thereafter indicates that inequalities were enhanced in times of structural disruption and did not necessarily revert to previous levels. These trends suggest that classroom inequality is not only stable but also receptive to systemic change.

The results correspond to the general evidence that educational systems can be described as unevenly distributed resources, with the discrepancies being more conspicuous as one considers something other than average values. Lack of homogenisation of resources has been found to affect education quality, especially in a situation where policy is implemented differently in different regions (Okunlola & Hendricks, 2023). Equally, the comparative studies show that educational resources are unevenly distributed between governance levels and student population, which supports the notion that staffing imbalances are rooted in the system-wide imbalances (Lee et al., 2022). The geographic differences in student-teacher ratios also mirror the tendencies in the international environment, where the distribution of resources varies widely depending on the geographical area and leads to uneven access to education (Guo et al., 2020). These inequalities are not confined to the input of materials but are connected with institutional circumstances that precondition teacher growth and the support system, thus affecting the reaction of schools to staffing stressors (Shalem & De Clercq, 2019). The patterns are also in line with the quantity-quality tradeoff that has been observed in education research. An increase in student-teacher ratio can indicate increased access, but also restricts the instructional resources, preventing personalized support (Buckner & Zhang, 2021). Such a reading is aligned with the fact that the situation of unequal staffing persists and can contribute to disparities in educational experiences among schools.

The sociological viewpoint on differences in staffing conditions is directly connected to larger aspects of inequality. The variations of school settings tend to combine with social and economic elements, propagating the reproduction of educational inequalities (de Moll et al., 2024). Unequal ratios of students and teachers may be interpreted in this context as a part of a broader system of structural conditions that sustain existing inequalities. Policy-based research also points to the fact that to achieve educational equity, it is necessary not only that there is uniform access but also that the distribution of resources within contexts needs to be taken into consideration. The attempts to foster inclusive education emphasize the necessity of making sure that resources are distributed among underserved groups and minimizing differences in learning situations (Syafii et al., 2025). In the same vein, research on inter-district inequalities demonstrates that resource allocation disparities may result in major differences between communities in terms of educational environment (Sosina & Weathers, 2019). The consequences of staffing imbalance are also aligned with the findings of the literature on labor conditions in the field of education, where the lack of resources and financial stress may impact the capacity to instruct and institutional stability (Hearn & Burns, 2021). All these results together reinforce the opinion that student-teacher ratios are not standalone measurements but a component of a larger structure of educational inequality.

The findings have significant implications for educational practice, policy and leadership. Classroom-wise, the use of average student-teacher ratios can cloud localized pressures, and it is necessary to take into account the distributional variation in assessing instructional conditions. The ratio of students to teachers can be so high that it constrains the possibility of individualized instruction, and it can also affect the effectiveness of the classroom. In terms of policy, the results indicate that equity-based allocation policies must take into consideration disparities as opposed to using system-wide averages only. The variation across schools and regions can be monitored to find areas where there are disproportionate staffing pressures. On the level of leadership, the findings emphasize the value of data-driven planning, especially in times of systemic change, when disparities can be increased, although the situation, on the whole, can seem stable or even improving.

This research has a number of limitations. The secondary data will restrict the analysis to variables available and prevent the ability to obtain the nuances of the context. Although informative, the student-teacher ratio is a proxy measure of what occurs in the classroom and does not directly reflect the quality of instruction or pedagogical approaches. Also, outliers in the data set can indicate institutional circumstances that are special or rare and cannot be entirely compared to a typical classroom situation.

Further studies are required to combine student-teacher ratios with other pointers like student achievement, teacher experience, and socioeconomic background in order to comprehend better the cognition by which structural background can affect learning. Longitudinal and multilevel analyses might also help explain the development of disparities at various levels of the education system. The inclusion of qualitative methods would also help to gain a more in-depth perspective on the experience and management of staffing conditions in schools and give a more in-depth picture of classroom dynamics.

5. Conclusion

The conditions of classroom staffing proved to be skewed rather than homogeneous, with significant variations across schools, years, and counties. The total student-to-teacher ratio indicated moderate staffing pressure, but the distributional pattern indicated that a group of schools experienced significantly greater staffing pressure, indicating a concentration of strain in specific situations. The time series analysis indicated that inequality decreased and then gradually recovered, but the inequality was still high, meaning that the structural imbalances were not eliminated as the average conditions were getting better. These results emphasize the importance of getting beyond the system-wide averages in assessing classroom conditions. Student/teacher ratio is best informative as a distributional measure of staffing inequality as opposed to a pure descriptive mean. The outcomes also have an emphasis on the significance of geographically sensitive and equity-based planning, especially where localized inequalities are maintained over time. The future research that will help understand inequality in the classroom better will involve linking student outcomes, teacher traits, and contextual school variables to the staffing patterns. This would enhance the policy evidence base to enhance the average allocation of education resources, but also the equity of such allocation among schools and communities.

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