The Impact of Territorial and Demographic Factors on Academic Performance in Public Schools Across Catalonia

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Abstract

Decades-old studies found students in schools from small municipalities academically lagging behind urban peers due to location and economic factors, but recent data reveals some schools in these areas now match or surpass urban school performance gains. For this reason our study examined the influence of territorial and demographic size on academic achievement in public schools in Catalonia. The data for this analysis were obtained from the publicly accessible database of the Department of Education, which contains the results of the assessments of basic skills and knowledge at the end of primary education from 2009 to 2023. Advanced statistical methods were applied to explore the relationship between academic achievement and demographic variables, such as population size and the territorial area of the students' municipality of residence. The results demonstrated a significant correlation, but of limited magnitude, between territorial size and academic performance in the subjects evaluated.

Keywords: primary school, academic achievement, demographic variables, statistical analysis

1. Introduction

The academic performance of elementary school students can be influenced by several factors, including the population size and territorial area of the municipality in which they reside. Studies have shown that the population size of a municipality can affect the efficiency of its government and spatial distribution of the resident population (Bartolacci et al., 2022).

In many studies conducted decades ago, students from low-population towns tended to underperform urban students, with school location being a significant factor in academic achievement after controlling for student background variables (Young, 1998). In addition, economic factors, such as willingness to move and perceptions of local employment opportunities, influence rural students' attitudes toward education and academic achievement Broomhall & Johnson. (1994).

However, in recent years, findings have emerged showing that schools from small municipalities are not necessarily inferior to urban schools. And some rural schools achieving average annual performance gains that equal or exceed urban schools (Reeves & Bylund, 2005).

It should be noted that high-achieving students from low-population towns often have strong community attachment, and local economic conditions influence their postsecondary residential aspirations more than school boards or poverty levels (Petrin, Schafft, & Meece, 2014). In addition, cooperation between municipalities of different sizes may vary, with smaller municipalities showing a lower proportion of positive responses compared to larger municipalities (Kunc et al., 2021; Wood, 2023).

On the other hand, population density and municipality size can influence per capita government expenditures, suggesting that the higher the population density, it is crucial to determine whether the influence on municipal expenditures is due to disparities in density ("Brazilian Municipal Expenditure and Scale Economies: Evidence from São Paulo", 2021). Likewise, municipality size has been identified as a significant predictor of municipal cultural expenditure, being more relevant than spatial effects (Getzner, 2021).

Thus, some studies continue to demonstrate the existing gap in certain countries and contexts. In the case of China, students from low-population towns show an achievement gap in the arts, humanities, and STEM fields compared to urban students, but not in the environmental sciences. This gap decreases during the third and fourth year of college Zhao, K. (2020). Peer effects at both the class and individual levels significantly influence the academic performance of rural migrant students, suggesting that class assignment and study groups could improve outcomes Min, Yuan, Wang, & Hou (2019).

However, in the same context, studies have shown the opposite. In a longitudinal study, rural students performed as well or better than their peers in metropolitan schools in math, science, reading, and environmental studies after adjusting for socioeconomic status. Fan & Chen, (1998), Ortiz & Fonnegra. (2019) also find a limited impact of municipal context on individual academic achievement.

In Spain, evidence has also demonstrated the persistence of educational disparities, particularly within rural schools and during the early stages of education (Yulia Solovieva, Emelia Lázaro & Luis Quintanar, 2013)

Although the municipal context does not seem to have a significant direct impact on individual academic performance. The study highlights the importance of other factors, such as the school and family context, in the formation and development of students.

Other studies have followed this line, differentiating the population density variable from other socioeconomic variables. Regarding the impact on education, large-scale residential segregation, average school size, and the number of students in the municipality may be key determinants for the mixing of students from different neighborhoods, which in turn may affect academic performance (Malmberg & Andersson, 2020). In addition, students' self-confidence, influenced by economic, cultural, and social factors, may affect mathematics achievement (Çiftçi & Kumru, 2019).

Finally, it should be noted that the configuration and organization of schools from small municipalities is also a key factor in reducing this gap. Franklin, B., & Glascock, C. (1996) analyze the relationship between grade configuration in rural schools and student academic achievement. Schools with different structures were compared, such as elementary schools (K-6), middle schools (usually middle grades), high schools, and combined schools (e.g., K-12). He found that students in elementary schools (K-6) and combined schools (K-12) tended to have better academic performance and higher attendance than students in isolated middle or high schools. This study suggests that rural schools with grade configurations that cluster elementary students in the same setting may favor academic performance and attendance. Isolated middle or high schools may present greater challenges to learning in a rural context.

On the other hand, it is also a complex variable Borland & Howsen (2003) analyze the relationship between elementary school size and student academic achievement. Previous studies have shown contradictory results, sometimes finding a positive or negative relationship. This study found a nonlinear relationship between elementary school size and academic performance. No simple improvement or detriment was observed in larger or smaller schools. Instead, the results suggest the existence of an optimal school size to maximize students' academic achievement. Optimal school size benefits learning. Schools that are either too large or too small can have a negative impact on academic achievement.

2. Method

This study examined the academic performance of sixth-grade students in public schools in Catalonia over four academic years: 2019/20, 2020/21, 2021/22, and 2022/23, with a total population of 55,486, 56,369, 56,291, and 58,522 students, respectively.

The data for this analysis were obtained from the publicly accessible database of the Departament d'Educació, which contains the results of the assessments of basic skills and

knowledge at the end of primary education, from 2009 to 2023. The last update of these data was on February 22, 2024. The sample has been the academic results of 999,999 students.

The variables assessed are competencies in Catalan, Spanish, mathematics, Environmental Sciences and English. The database provides a representative sample of students, covering diverse population density and territorial areas in Catalonia.

- Territorial areas: Consorci d'Educació de Barcelona, Lleida, Girona, Barcelona Comarques, Vallès Occidental, Vallès Occidental, Catalunya Central, Tarragona, Baix Llobregat, Maresme - Vallès Oriental, Terres de l'Ebre.

- Population density: densely populated municipalities (More than 10.001); (sparsely populated municipalities) less than 10.000

To preserve the confidentiality of the study participants, anonymized codes were used for each student in the database.

Advanced statistical methods were applied to explore the relationship between academic achievement and demographic variables such as population size and the territorial area of the municipality of residence of the students. Pearson's correlation coefficient was used to determine the strength and direction of the association between grades and demographic characteristics. In addition, analysis of variance (ANOVA) was implemented to establish whether there are statistically significant.

Differences in academic performance associated with variations in population size and territorial area.

3. Results

3.1 Competences Catalan

For densely populated municipalities, classified as category "1," it was observed that the average score in Catalan is 74.4, with a median of 77.2, accompanied by a standard deviation of 15.5. This variability suggests considerable dispersion of the scores. On the other hand, municipalities with lower population density, category "2," present a slightly higher mean score in Catalan of 75.8 and a higher median of 78.2. In addition, the standard deviation is 14.4, indicating that the scores are slightly higher and present less variability than those of more populated municipalities.

This study examined the relationship between Catalan grades and municipal population size. The Pearson correlation coefficient between grades and population density was 0.03640148, revealing a positive, although minimal, correlation. Nevertheless, this correlation is identified as statistically significant, with a t-value of 36.022 and 977982 degrees of freedom, and a p-value of less than 2.2e-16. Although weak, this relationship was consistent and detectable in the analyzed sample.

Statistical significance was reaffirmed by the ANOVA test, where an F-value of 1298 and a p-value of less than 2e-16 were obtained, indicating highly significant differences in the means of Catalan grades between municipalities of different population densities.

These results highlight the influence of population size on the academic performance of students in the Catalan study area.

3.2 Competencies Spanish

The most densely populated municipalities (category "1") have a mean score of 74.2 and a median of 77.2, with a standard deviation of 15.4, reflecting some variability in the results. In contrast, municipalities with smaller populations (category "2") exhibit an almost identical mean of 74.3, a slightly lower median of 77 and a standard deviation of

14.8. This indicates that the scores in less-populated municipalities are slightly more homogeneous than those in more-populated municipalities, although the differences are subtle.

The Pearson correlation between Spanish grades and municipal population size was positive, although very weak, with a correlation coefficient of 0.00363656. The statistical significance of this correlation was supported by a t-value of 3.6036 and 981.916 degrees of freedom, leading to a p-value of 0.0003139. Although the p-value indicated a statistically significant correlation, the proximity of the correlation coefficient to zero suggested that the association was minimal. The 95% confidence interval for this correlation coefficient was between 0.001658643 and 0.005614448, confirming statistical significance but underscoring the weakness of the relationship.

ANOVA analyses showed significant differences in Spanish scores in relation to the population size of the municipality, with an F-value of 12.99 and a p-value of 0.000314. These results indicate that there is an effect of population size on scores; however, the

effect is much less pronounced than that observed for Catalan, implying that, although there is an impact, it is considerably more limited.

3.3 Mathematical Competencies

In the analysis of mathematical competencies, a favorable trend was found in municipalities with smaller populations. For municipalities with a larger number of inhabitants (category "1"), the mean mathematics scores was 76.9 and the median was 80.3, with a standard deviation of 16.8, reflecting a considerable dispersion in the scores. However, for the least populated municipalities (category "2"), the mean score rises to 78.3 and the median was 81.2, accompanied by a standard deviation of 15.8. This suggests that students in areas with lower population density not only obtain, on average, better results in mathematics but also show less variability in their scores.

Pearson's correlation coefficient yielded a value of 0.033726, indicating a positive, albeit minimal, correlation between municipal population size and mathematics scores.

Although statistically significant, with a p-value of less than 2.2e-16 and 984189 degrees of freedom, the magnitude of this correlation is very small, indicating that any increase in mean

scores is modest as the municipal population increases. The 95% confidence interval, which ranges between approximately 0.032 and 0.036, reinforces the idea that, although there is a statistically significant relationship, its intensity is low. The results of the analysis of variance (ANOVA) confirmed the existence of significant differences in mean mathematics scores between different municipality sizes.

With an F-value of 1121 and a very small p-value ($p < 2e-16$), it is suggested that the size of the municipality exerts a considerable influence on the mathematics performance of students, similar to what was observed in the case of Catalan. These findings point to the relevance of demographic context as a significant factor affecting mathematical competencies.

Thus, it should be noted that although the results of the Catalan, Spanish and mathematics competencies indicate that there is an association between the population size of the municipality and the Catalan, Spanish and mathematics scores of the students, the magnitude of this relationship is so limited that its significance in educational or public policy contexts may not be substantial.

3.4 Environmental Sciences

The study on the influence of the population size of municipalities on academic achievement in the environmental sciences provides significant results. In the municipalities with the largest number of inhabitants, labeled (1), the mean of grades in these areas is 71.5 and the median is 74.4, with a standard deviation of 17.9, which indicates notable variability in the grades. On the other hand, municipalities with a smaller number of inhabitants (2) show mean ratings of 73.2 and a median of 76.1, accompanied by a standard deviation of 17.0, indicating that not only are the ratings on average higher, but they are also slightly more consistent.

The Pearson correlation coefficient for these study areas was 0.03866915, reflecting a positive but weak correlation with municipality population size. Statistical significance is high with a p-value of less than 2.2e-16, which minimizes the probability that the result is a random coincidence, supported by a large number of degrees of freedom (df = 433668). Although the 95% confidence interval for the true population correlation is between approximately 0.036 and 0.042, the correlation is still low,

Although it is slightly stronger than that in mathematics. This might suggest that although there is statistical evidence of a relationship between population size and science achievement, the influence is so minimal that its practical relevance may be questionable. It would be prudent to analyze other factors that might exert a more direct and significant influence on academic performance.

Additionally, ANOVA yielded a highly significant difference in science scores according to population density (F-value = 649.4, $p < 2e-16$), indicating that municipality size had a considerable effect on performance in this area of study. These findings suggest that demographic factors are a significant component to be considered when evaluating academic performance in the environmental sciences.

3.5 English Competencies

The evaluation of English performance as a function of the population size of the municipality revealed that in both densely populated municipalities and those with fewer inhabitants, the mean scores were identical, settling at 75.9. However, there was a slight advantage in the median for municipalities with more inhabitants (80.4 compared to 79.6). The variability of the scores, measured by the standard deviation, was greater in larger municipalities (18.5) than in less populated ones (17.7).

The Pearson's correlation coefficient of -0.0003163113 shows an extremely tenuous negative relationship between English scores and municipality population size. With t-values of -0.3095 and 957.372 degrees of freedom, the obtained p-value of 0.7569 indicates that there is insufficient statistical evidence to rule out the hypothesis that there is no significant relationship between these variables. Furthermore, the 95% confidence interval for the correlation, which includes both negative and positive values, did not demonstrate a substantial difference from zero, reaffirming the absence of a clear correlation in the sample studied.

This suggests that the population size of the municipality within the context of this study has no discernible impact on students' English scores. The ANOVA test results corroborate this conclusion, showing a lack of significant differences in English scores in relation to the municipality's population size (F-value of 0.096 and p-value of 0.757). It is inferred that there are factors not examined in this research that could more directly influence English achievement or that population size, in itself, is not a relevant predictor for this educational outcome.

However, the magnitude of the correlation should be interpreted with caution as the coefficient is close to zero. This suggests that, although the association is statistically significant, its practical relevance may be limited. Therefore, the underlying factors contributing to this correlation should be further investigated to better understand the dynamics between the municipality's demographic context and educational outcomes in Catalan.

To visually compare the distributions of scores between population density below is the interpretation of the boxplots showing that the median scores, indicated by the line within each box, are comparable between the two groups of inhabitants for all variables analyzed.

The graph shows that the centers of the score distributions are similar regardless of the size of the municipality's population. The notable presence of outliers in both groups, for all variables is indicative of scores that deviate significantly from the common range. These outliers could indicate exceptional cases or special conditions that deserve further investigation to understand the reasons behind these deviations.
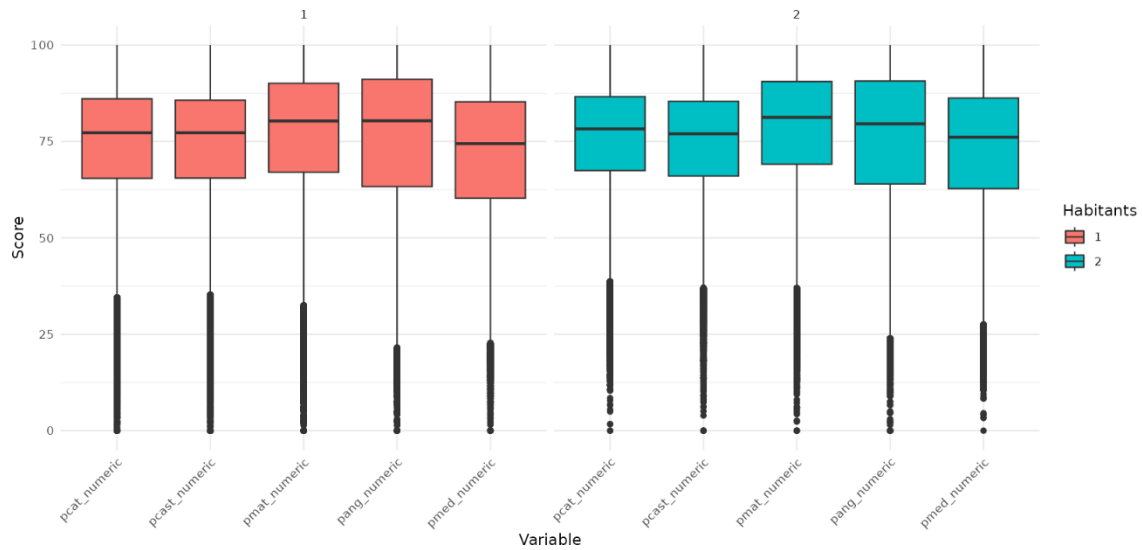
Figure 1. Score Distributions

In contrast, the interquartile range (IQR) showed that the variability of the scores within the most and least populated municipalities was similar for the variables studied.

Thus, when performing a visual analysis of the boxplots colored in red and blue, no appreciable differences were observed in terms of the median and IQR. Therefore, it can be inferred that the size of the population or the population group did not significantly influence the variability of the scores. Consequently, it is possible that other factors not considered in this analysis may have affected the scores and should be the subject of future research.

3.6 Territorial Areas

On the other hand, this study explored the impact of territorial and demographic size in different areas of Catalonia on academic scores in various subjects. The data collected covers ten different territories: 1 - "Consorci d'Educació de Barcelona", 2 - "Lleida", 3 - "Girona", 4 - "Barcelona Comarques", 5 - "Vallès Occidental", 6 "Catalunya Central", 7 "Tarragona, 8 "Baix Llobregat", 9 "Maresme - Vallès Oriental", 10 "Terres de l'Ebre"

The areas are differentiated by their population density, classified as 'inhabitants 1 densely populated municipalities ' and 'inhabitants 2 sparsely populated municipalities'

The results shown in the accompanying table 1 indicate variability in the average scores per subject according to territorial area and population density. For example, in the "Consorci d'Educació de Barcelona' (territorial area 1), students in the densely populated municipalities group achieved an average score of 79.3 in English, while in mathematics, the same sparsely populated municipalities group achieved an average score of 80.5.

Table 1. The Impact of Territorial and Demographic Size

Territorialarea	Inhabitants	Engish	Spanish	Catalan	Maths	Env.
1	1	79,3	76,4	76.4	78.8	73.1
1	2	75,8	74,1	76.8	80.5	NaN
2	1	77,6	74,8	76.0	77.7	72.9
2	2	77,5	75,1	76.9	79.0	74.2
3	1	74,7	72,3	73.8	75.5	70.0
3	2	76,2	74	76.2	78.1	72.6
4	1	73,6	72,6	72.1	74.7	69.0
4	2	72,6	72,4	73.7	76.3	72.4
5	1	75,7	74,5	74.2	76.9	71.6
5	2	74,4	74	74.4	78.3	73.4
6	1	74,5	72,1	74.0	76.1	70.6
6	2	76,4	74	75.9	78.2	73.0
7	1	74,2	73,3	73.4	76.2	70.9
7	2	73,9	73,8	74.8	77.9	72.9
8	1	75,3	74,5	74.1	76.8	72.1
8	2	76,2	74,7	74.9	77.4	72.8
9	1	75,4	73,9	74.4	77.1	71.8
9	2	76,6	75	76.0	78.6	73.3
10	1	75,6	74	75.4	78.0	73.3
10	2	76,3	75,4	76.8	80.0	75.4

It is notable that some areas present incomplete data, as in the case of the environmental sciences category for territorial Consorci d'Educació de Barcelona, sparsely populated municipalities where no score is available because a value is not available (NaN). Despite this, territorial area Terres de l'Ebre, with sparsely populated municipalities showed the highest scores in environmental sciences, at 75.4.

The lowest scores were observed in territorial area Barcelona Comarques, for both densely and sparsely in all the subjects evaluated.

The study also analyzed the influence of territorial size on several academic dimensions and found a statistically significant correlation in all of them. The results of the analysis of variance (ANOVA) show that territorial size significantly impacts academic performance in Catalan, Spanish, English, Mathematics and Environmental Science, as indicated by extremely low p-values (all less than 0.001) and high F-statistics values, ranging from 4.529 for Environmental Science to 2943 for English. These values indicate that territorial size explains a significant portion of the variability in the grades of the subjects studied. The only case that did not reach a p-value as low as the others was science, but it was still considered significant with a p-value of 0.0333. The consistency of these results across various academic disciplines underscores the need to consider territorial context as an important factor in the analysis of

academic achievement, and could have relevant implications for educational policy formulation and research in this field.

4. Discussion

The results of this study reflect a nuanced and evolving reality, where the influence of territorial and demographic size on academic achievement in Catalonia is significant but not uniform across the areas studied. The variability in average proficiency scores by territorial area and population density demonstrates that territorial context is a considerable factor that should be considered in educational policies and research. ANOVA analyses highlight the statistical significance of these differences but also suggest the existence of other factors that could contribute to variations in academic performance.

Thus, in the educational context of Catalonia, significant associations were found between academic performance and these demographic variables in several competencies assessed, including Catalan, Spanish, mathematics, environmental sciences, and English, but these associations were not highly relevant. Specifically, the population size of the municipality was found to have an impact on academic performance for most competencies. Generally, municipalities with smaller populations tended to have slightly higher test scores, although the differences were relatively small.

However, these effects varied according to the proficiency analyzed, while in Catalan and the environmental sciences, moderate positive associations were observed between population size and academic performance; in English, these associations were extremely weak and not significant.

In relation to territorial area, the result is similar; there is a significant relationship but of a slight magnitude. There is a general tendency to indicate better results in the territorial areas of the Delte de l'Ebre and Barcelona Metropolitan Areas, and the possibility that unmeasured factors influence these differences should be considered. The discrepancy in results between different areas and competencies highlights the complexity of educational factors and the influence of the environment on student learning.

It is important to keep in mind that while these associations are statistically significant, their magnitude is relatively limited, and their practical relevance may be less than expected. These findings reinforce the importance of considering contextual factors to understand students' academic performance.

5. Conclusion

Historically, rural students underperformed their urban peers because of multiple factors, including differences in school location and local economic conditions. Young (1998) and Broomhall and Johnson (1994) provided evidence of the importance of these factors in the academic attitudes and achievements of rural students. However, it is notable that the findings

of Reeves and Bylund (2005) and Petrin et al. (2014) challenge these perspectives, showing that rural students can not only match but, in some cases, outperform their urban peers, especially when community attachment and local economic conditions are considered.

The study found that there is a significant relationship between the size of municipalities and academic performance in subjects like mathematics and Catalan. This suggests that population size plays a role in shaping educational outcomes in public schools across Catalonia. Furthermore, the analysis of territorial factors, such as the size of the municipality, revealed that these factors have an impact on student performance in different subjects. While the associations between territorial factors and academic performance are statistically significant, their practical relevance may be limited.

The study highlights the complexity of educational factors and the influence of the environment on student learning. Factors such as population size, territorial area, and other contextual variables all play a role in shaping academic performance. Understanding these factors is crucial for developing effective and equitable educational interventions.

Although population size and territorial area may play a minor role in determining students' grades, it is crucial not to lose sight of other influential factors, such as school and family contexts. Thus, in the educational context of Catalonia, the results support research suggesting that population size and territorial area affect the quality of education (Reeves & Bylund, R., 2005).

The findings of the study have implications for educational policy formulation and research in the field of academic achievement. Considering territorial context as an important factor in analyzing academic achievement can help policymakers and educators develop strategies to improve educational outcomes in public schools across Catalonia.

Therefore, it is necessary to adopt a comprehensive approach that considers multiple contextual variables and recognizes the complexity of factors that influence students' academic performance. Ultimately, this study highlights the need for further research to better understand the dynamics between the municipality's demographic context and students' educational outcomes, with the goal of developing more effective and equitable educational interventions.

References

Bartolacci, F., Salvia, R., Quaranta, G., & Salvati, L. (2022). Seeking the optimal dimension of local administrative units: A reflection on urban concentration and changes in municipal size. *Sustainability, 14*(22), 15240. https://doi.org/10.3390/su142215240

Borland, M., & Howsen, R. (2003). An Examination of the Effect of Elementary School Size on Student Academic Achievement. *International Review of Education, 49*, 463- 474. https://doi.org/10.1023/A:1026348922511

Broomhall, D., & Johnson, T. (1994). Economic Factors that Influence Educational Performance in Rural Schools. *Economics, 76*, 557-567. https://doi.org/10.2307/1243666.

Chávez, H., Morocho, J., Alvites, C., Vega, J., Solis, R., Ruelas, J., ... & Salvador, B. (2017). Relationship between levels of depression and academic performance in pre- university students, from the 2015-1 ordinary cycle of a national university in metropolitan lima. *Revista De Investigación en Psicología, 20*(1), 107. https://doi.org/10.15381/rinvp.v20i1.13526

Cladellas, R., Muntada, M., Martín, M., & Busquets, C. (2015). Extracurricular activities and academic performance in primary school students. *European Journal of Investigation in Health Psychology and Education, 3*(2), 87. https://doi.org/10.30552/ejihpe.v3i2.38

Fan, X., & Chen, M. (1998). Academic Achievement of Rural School Students: A Multi-Year Comparison with Their Peers in Suburban and Urban Schools. *Journal of Research in Rural Education, 15*, 31-46.

Franklin, B., & Glascock, C. (1996). The Relationship between Grade Configuration and Student Performance in Rural Schools. *Journal of Research in Rural Education, 14*.

Hernando, Á., Oliva, A., & Pertegal, M. (2012). Family variables and academic performance in adolescence. *Studies in Psychology, 33*(1), 51-65. https://doi.org/10.1174/021093912799803791

Lombarte, S., Serrano, M., & López, R. (2020). Influence of physical activity and sport practice on the academic performance of secondary school students. *Sport Tk-Revista Euroamericana De Ciencias Del Deporte*, 95-100. https://doi.org/10.6018/sportk.454231. https://doi.org/10.6018/sportk.454231

Min, S., Yuan, Z., Wang, X., & Hou, L. (2019). Do peer effects influence the academic performance of rural students at private migrant schools in China?. *China Economic Review*. https://doi.org/10.1016/J.CHIECO.2019.02.004

Ortiz, M., & Fonnegra, J. (2019). The impact of the municipal context on individual academic performance. *Lecturas de Economía*.

Petrin, R., Schafft, K., & Meece, J. (2014). Educational Sorting and Residential Aspirations Among Rural High School Students. *Research Journal, 51*, 294-326. https://doi.org/10.3102/0002831214527493

Ramirez, W., Vinaccia, S., & Suarez, G. (2004). The impact of physical activity and sport on health, cognition, socialization and academic performance: a theoretical review. *Journal Of Social Studies,* (18), 67-75. https://doi.org/10.7440/res18.2004.06

Reeves, E., & Bylund, R. (2005). Are Rural Schools Inferior to Urban Schools? A Multilevel Analysis of School Accountability Trends in Kentucky*. *Sociology, 70*, 360-386. https://doi.org/10.1526/0036011054831215

Salazar-Rendón, J., Méndez-Domínguez, N., & Azcorra, H. (2019). Association between overweight and obesity with academic performance in high school students in The city of Merida, Mexico. *Boletín Médico Del Hospital Infantil De México, 75*(2). https://doi.org/10.24875/bmhim.m18000018.

Velásquez, L., & Vázquez, M. (2022). Interpersonal relationships and academic performance of fifth- and sixth-grade students. *Ciencia Latina Revista Científica Multidisciplinar, 6*(4), 5561-5680. https://doi.org/10.37811/cl_rcm.v6i4.3035

Wood, R. M. (2023). A Review of Education differences in Urban and Rural Areas. *International Research Journal of Educational Research*, *14*(2), 1-3. https://doi.org/10.1080/13547860.2021.1877240

Young, D. (1998). Rural and Urban Differences in Student Achievement in Science and Mathematics: A Multilevel Analysis. *School Improvement, 9*, 386-418. https://doi.org/10.1080/0924345980090403.

Yulia Solovieva, Emelia Lázaro & Luis Quintanar. (2013). Assessment of previous mathematical abilities in urban and rural preschool children. *Culture and Education, 25*(2), 199-212. https://doi.org/10.1174/113564013806631336

Zhao, K. (2020). Rural-urban gap in academic performance at a highly selective Chinese university: variations and determinants. *Development, 41*, 177-192. https://doi.org/10.1080/07294360.2020.1835836.

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