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Impact of Demographic Trends on Educational Development, Problems and Solutions: A Case Study of District Lahore

Arisha Arif
Institute of Geography, University of the Punjab, Lahore 54000, Pakistan.
Sumaira Kousar (Corresponding Author)
Institute of Geography, University of the Punjab, Lahore 54000, Pakistan.
Sumaira.geog@pu.edu.pk
Malaika Muzaffar
Faculty of Computer Science and Information Technology, The Superior University, Lahore, Pakistan
Aqsa Aziz
Department of Earth Science, Freie Universitat Berlin

ABSTRACT
Lahore's fast urbanization has put more strain on the city's educational system, making it harder to provide equal access to education. Using a mixed-methods approach, this study investigates the combined effects of school distribution and population dynamics throughout Lahore's five tehsils. It combines GIS-based spatial analysis of school sites and population distribution with data from teacher surveys. In order to evaluate perceived and regional disparities in educational access, data from 202 teachers were examined in conjunction with spatial datasets. The results show that teachers firmly believe that big class sizes hinder efficient instruction and learning. Significant differences in school availability are also revealed by spatial analysis, with distant tehsils like Raiwind and Shalimar having longer travel times to schools and Lahore City having the lowest per-capita school provision. Overall, the findings show that inadequate planning and fast urban growth are the main causes of the unequal spatial distribution of educational resources. The study concludes that educational inequity in Lahore is strongly linked to population pressure and uneven spatial planning of schools, recommending GIS-based planning for improved equity. These findings provide actionable evidence for policymakers to prioritize equitable school allocation, improve accessibility in peripheral areas, and align educational infrastructure development with rapid urban population growth trends in Lahore. Pakistan in the future planning framework.

Keywords: *Lahore, Educational Accessibility, Spatial Analysis, GIS, Population Density, School Distribution, Urbanization, Educational Equity*

Introduction

The demand for educational infrastructure is strongly impacted by population increase, urbanization, and migration, all of which have a significant impact on educational development. It is often acknowledged that education is a major factor in both economic and national growth (Jones, 1976; Singh, 2001). Rapid population expansion has put tremendous strain on the educational system in emerging nations like Pakistan, leading to overcrowded classrooms, inadequate infrastructure, and unequal access to education. Additionally, education is directly

related to societal development and sustainability, necessitating ongoing adjustment to shifting economic and demographic circumstances (Schank and Rieckmann, 2019).

Rapid urbanization and population growth have made schooling more difficult in Pakistan, especially in Lahore. The city has grown into a significant center for education, drawing students from all around the nation and outside, which has put more strain on the infrastructure already in place (Nasar-U-Minallah et al., 2021). However, the distribution of educational institutions has become uneven due to unplanned urban expansion and poor infrastructure development, especially in fast increasing urban and peripheral areas (Hasan, S., 2021; Malik et al., 2019). Similar patterns have been noted in other situations where demographic changes have a detrimental effect on educational institutions' capacity and sustainability (Tsymbalenko et al., 2019).

Within Lahore, population growth from 11.1 million in 2017 to 13.0 million in 2023 has significantly increased pressure on schools, leading to overcrowded classrooms and reduced learning effectiveness (Pakistan Bureau of Statistics, 2023). Uneven spatial distribution of schools further contributes to accessibility challenges, forcing students to travel longer distances or attend overcrowded institutions.

Geographic Information Systems (GIS) offer a useful tool for examining the spatial connections between educational infrastructure and population. According to earlier research, GIS can be used to discover differences in resource distribution and accessibility in urban settings (Xu et al., 2018; Al-Rashid, Rao, & Ahmad, 2020). Similar methods can be used in Lahore to promote evidence-based planning for educational equity and identify underserved areas.

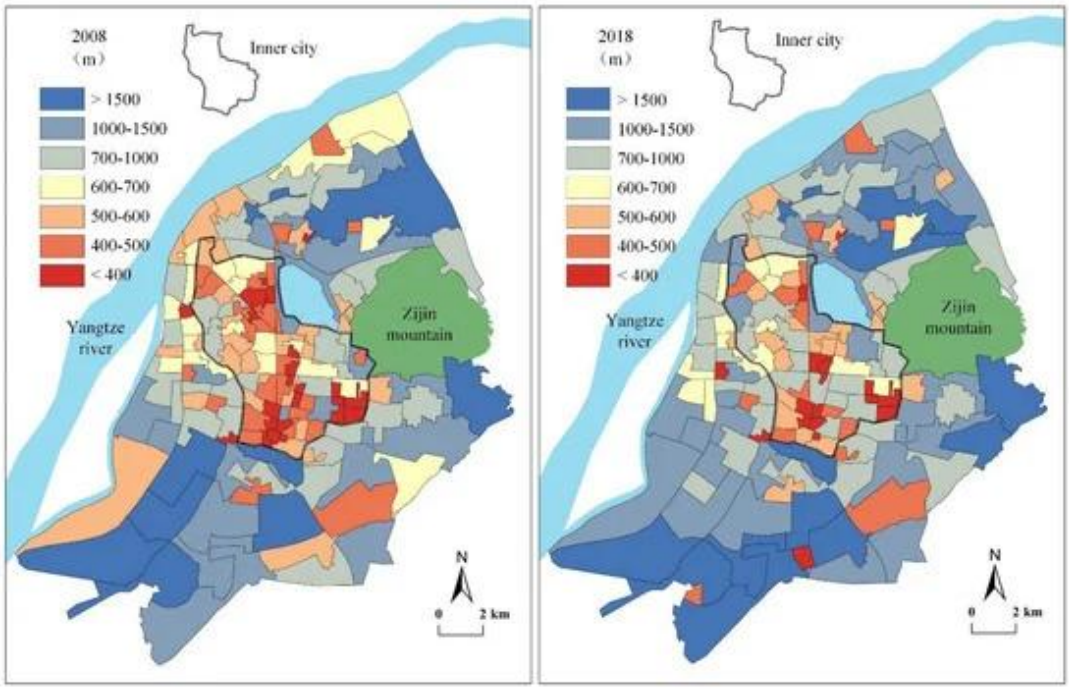

Figure 1 Map of public primary schools in Nanjing, China, showing social-spatial accessibility. Source: (Xu et al., 2018).

Objectives of the Study

1. To investigate the connection between teachers' opinions of students' academic achievement and classroom congestion (class size).

2. To examine how schools are distributed geographically in proportion to population density in the main tehsils of Lahore.
3. To evaluate spatial discrepancies between school sites and population distribution in order to pinpoint accessibility problems and infrastructure shortages in the educational system.

Methodology

In order to investigate the connection between demographic pressure and educational infrastructure in Lahore District, Pakistan, this study uses a mixed-methods research approach that combines quantitative survey analysis with spatial methodologies based on Geographic Information Systems (GIS).

From problem identification to literature evaluation, data gathering, geographic analysis, and final synthesis, the research follows an organized approach. A questionnaire survey of 202 teachers from Model Town Tehsil's public and private schools was used to gather primary data. The Pakistan Bureau of Statistics (PBS) and OpenStreetMap provided secondary spatial datasets, such as population statistics, road networks, and school locations.

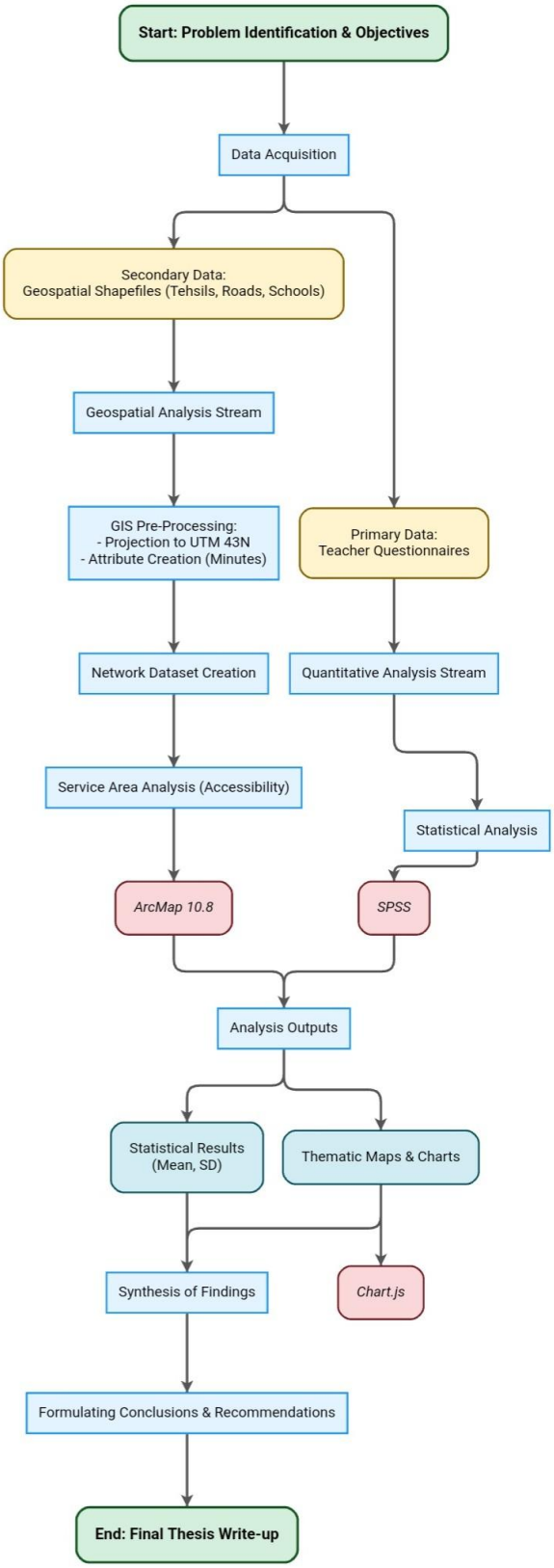

Figure 2 Research Methodology Framework

Data Processing and GIS Analysis

All spatial datasets were projected into UTM Zone 43N to ensure geometric accuracy. A network dataset was developed in ArcMap 10.8, and a service area analysis was performed to compute walkability-based accessibility using travel time thresholds (5, 10, 15, and 30 minutes).

Travel time was computed using:

$$T = \frac{D}{V} \quad (1)$$

where:

T= Travel time (minutes),

D= Distance (meters),

V= Walking speed (assumed constant).

Population density was calculated using:

$$PD = \frac{P}{A} \quad (2)$$

where:

PD= Population density (persons/km²),

P= Total population,

A= Area (km²).

School accessibility was measured using per-capita availability:

$$SA = \frac{S}{P} \times 100,000 \quad (3)$$

where:

SA= School accessibility per 100,000 people,

S= Number of schools,

P= Population.

For spatial service availability, a walkability-based catchment approach was applied using network analysis outputs to generate accessibility zones around each school.

Quantitative Analysis

Survey data were analyzed using SPSS, employing descriptive statistics:

Mean:

$$\bar{X} = \frac{\sum X_i}{n} \quad (4)$$

Standard Deviation:

$$SD = \sqrt{\frac{\sum (X_i - \bar{X})^2}{n-1}} \quad (5)$$

These statistics were used to evaluate teachers' perceptions regarding class size and academic performance.

GIS Visualization

ArcMap 10.8 and Google Earth Engine were used to create spatial outputs, and Chart.js was used to create graphs and charts. The identification of population pressure zones and educational accessibility gaps was made possible by the combination of data and geographical outputs.

Results and Discussion

Using survey data (n = 202 instructors), statistical analysis (SPSS), and GIS-based spatial approaches, this study examined demographic and educational trends in Lahore. The findings are arranged according to the spatial distribution of educational infrastructure and teacher perceptions.

Demographic Profile of Respondents

Teachers were evenly distributed in the sample, with 52% of respondents being female and 48% being male. 65.3% of individuals attended private schools, compared to 34.7% who attended public schools. In order to ensure representativeness across primary and middle education, teaching levels were equally dispersed between the fifth (48.5%) and eighth (51.5%) classes.

Table 1 Demographic Information of Respondents (N = 202)

Sr.#	Demographic	Description	Frequency	Percentage
1	Gender	Male	97	48.0
		Female	105	52.0
		Total	202	100.0
2	Type of School	Public	70	34.7
		Private	132	65.3
		Total	202	100.0
3	Grade Level	5th Class	98	48.5
		8th Class	104	51.5
		Total	202	100.0

Teacher Perceptions of Class Size

Large class sizes, according to teachers, have a negative impact on their ability to teach (M = 3.14). They found that overcrowding decreases the availability of learning materials (M = 2.94) and restricts student engagement (M = 3.02). The majority of respondents concurred that packed classrooms hinder efficient instruction and learning.

Table 2 Teacher's Perception of Class Size (N = 202)

Sr.	Statement	SDA	DA	N	A	SA	Means	SD
	Section 1: Perception of Class Size (PCS)							
1.	The current class size is too large to allow for effective teaching and learning.	30	37	35	74	26	3.14	1.283
2	Overcrowded classrooms limit my student's ability to participate actively in lessons.	38	38	30	73	23	3.02	1.329
3	The availability of classroom resources (e.g., books, chairs, projectors) is negatively affected by large class sizes.	47	30	31	77	17	2.94	1.342

Impact of Class Size on Academic Achievement

Findings show a strong consensus that smaller class sizes improve academic outcomes (M = 3.60). Teachers reported that large classes lead to:

- Reduced understanding of content (M = 3.28)
- Lower student motivation (M = 3.19)
- Poor focus and retention (M = 3.15)
- Less feedback and interaction (M ≈ 3.67–3.68)

These results confirm that overcrowding negatively influences student academic performance.

Teacher–Student Interaction

Teachers indicated that large class sizes significantly reduce teacher-student interaction quality. Key findings include difficulty addressing individual needs (M = 3.68), limited one-on-one interaction (M = 3.67), and reduced communication quality (M = 3.58). In contrast, smaller classes were associated with better engagement and approachability.

Table 3 Teacher's Perception of Teacher-Student Interaction in Relation to Class Size (N = 202)

Sr.	Statement	SDA	DA	N	A	SA	Means	SD
	Section 3: Teacher-Student Interaction (TSI)							
11	Overcrowding makes it difficult for teachers to address individual learning needs.	7	31	27	91	46	3.68	1.092
12	In large classes, teachers rarely have time for one-on-one discussions with students.	10	26	24	103	39	3.67	1.081
13	Students receive less constructive feedback from teachers in large classes.	4	45	43	67	43	3.50	1.116
14	Large class sizes limit opportunities to build rapport with students.	6	38	45	76	37	3.50	1.085
15	Teachers in small classes are more approachable for academic help.	8	22	46	72	54	3.70	1.098
16	Students feel more comfortable participating in discussions when class sizes are small.	8	28	42	67	57	3.68	1.142
17	Overcrowded classrooms reduce the quality of teacher-student communication.	11	24	45	80	42	3.58	1.109

Spatial Distribution of Schools and Population Density

An obvious spatial imbalance was found by GIS analysis. While remote locations like Raiwind have lower density but poorer infrastructural coverage, high population density areas like Lahore City and Shalimar have comparatively fewer schools per population load. Peripheral Union Councils are underserved since schools are focused on core urban areas.

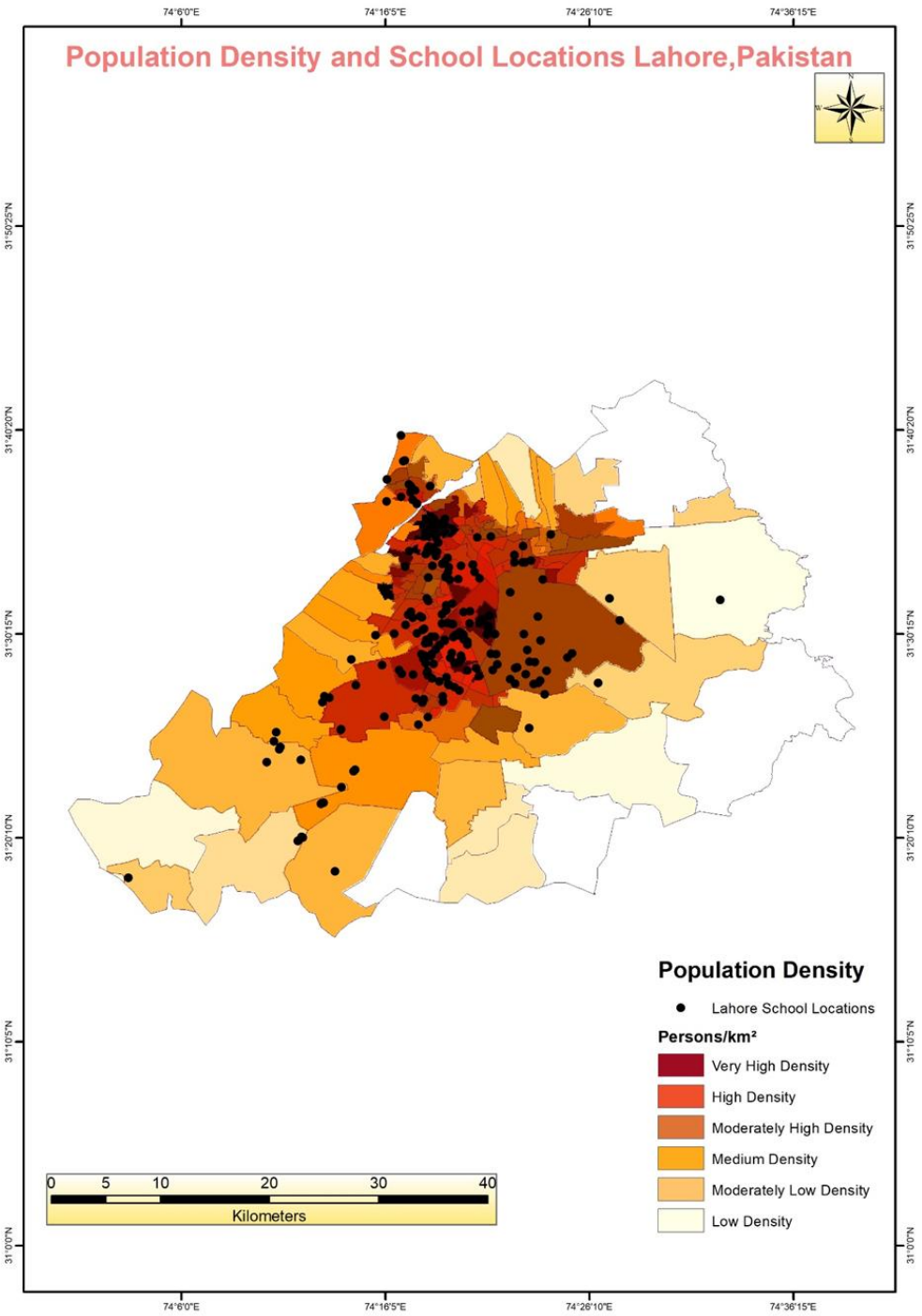

Figure 4 Population Density and School Locations in Lahore, Pakistan

Demographic Trends and Educational Infrastructure

Results show a mismatch between population growth and school provision:

- Lahore City has the highest population but low per-capita school availability (13.34/100,000)
- Lahore Cantonment has the best provision (18.57/100,000)
- Peripheral areas face longer accessibility times (15–30 minutes walk)

Walkability analysis confirms a strong urban–rural divide, where central areas are well-served and peripheral zones suffer from "educational accessibility gaps."

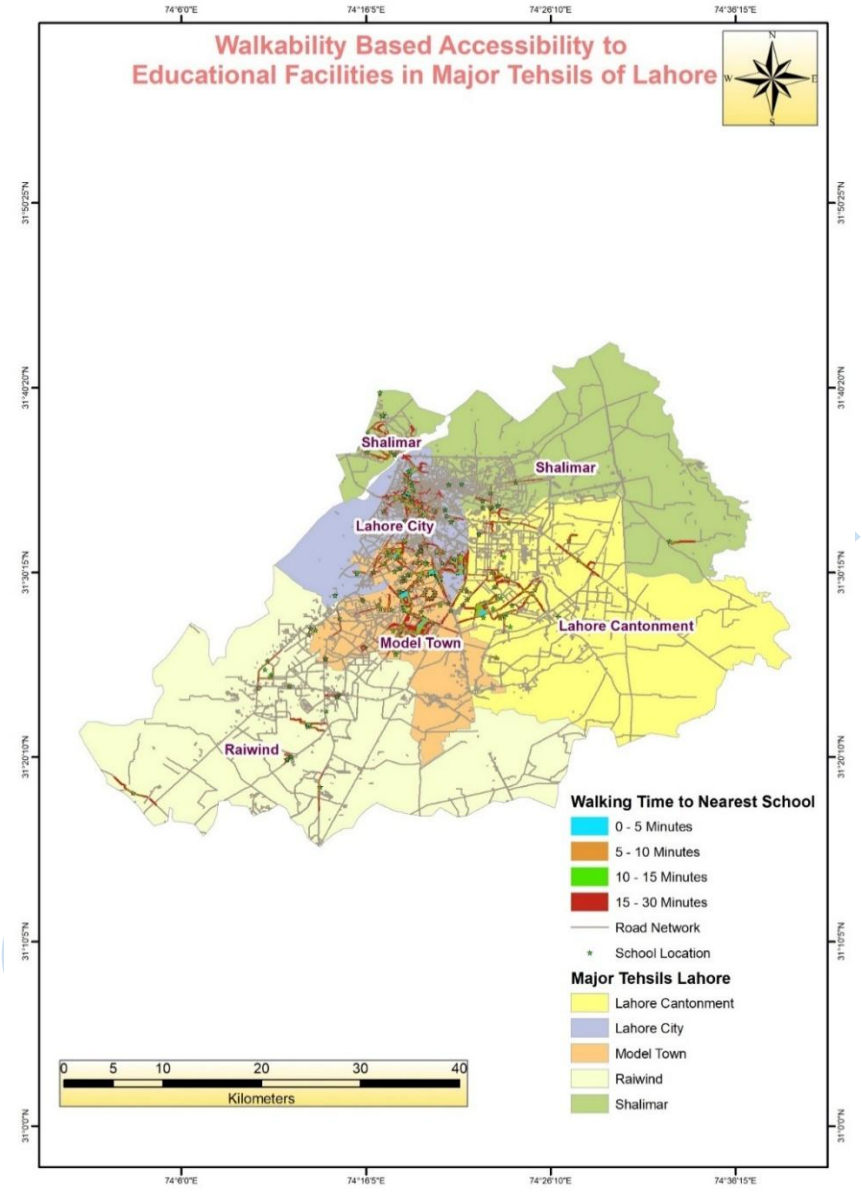

Figure 5 Walkability Based Accessibility to Educational Facilities

Limitations

It is important to recognize the limitations of this study. Only 202 respondents from particular parts of Lahore were included in the teacher perception statistics, which might not accurately reflect all tehsils. Furthermore, rather than focusing on the caliber of instruction or learning outcomes inside institutions, the study mainly examined the number and geographic dispersion of schools. Transportation availability, traffic conditions, safety, and socioeconomic constraints were not taken into account in the GIS-based accessibility analysis, which was focused on walking distance. Additionally, the study's cross-sectional design makes it more difficult to document long-term shifts in educational and demographic dynamics. Future studies should look at

educational quality in addition to spatial accessibility, incorporate qualitative comments from parents and students, and use a larger sample size from all tehsils.

Conclusion

This study used a mixed-methods approach that combined teacher views with GIS-based spatial analysis to investigate the relationship between demographic trends and educational development in Lahore. The results show that the education system is under a lot of strain due to the fast urbanization. Large and packed classrooms have been shown to have a detrimental impact on academic engagement, student participation, and instructional efficacy. The unequal distribution of educational infrastructure among Lahore's five tehsils was further validated by spatial analysis. While peripheral locations like Raiwind and Shalimar confront significant accessibility challenges due to longer walking distances to schools, high-density urban areas like Lahore City suffer from a per-capita scarcity of schools. Overall, the study finds that imbalanced population expansion, poor spatial planning, and infrastructure that has not kept up with demographic change are the main causes of educational disparities in Lahore.

Recommendations

In order to achieve equitable resource distribution, the report suggests that educational planning in Lahore switch from utilizing absolute school counts to a more egalitarian system based on per-capita and population density. Strategies like double-shift systems and vertical school development should be implemented in high-density places like Lahore City to lessen crowding. Additionally, training in active learning techniques, large-class management, and the use of digital teaching resources should be incorporated into teacher support programs. Additionally, neglected periphery areas found through GIS-based accessibility analysis should be given priority for building new schools, particularly those with walkability gaps of 15 to 30 minutes. To avoid future inequalities, urban planning regulations should also require all new housing projects to incorporate school infrastructure. Lastly, in order to expedite the construction of educational facilities in areas with limited resources, public-private partnerships (PPPs) ought to be encouraged.

References

Abdullah, S. A., Abbas, K. H., Harif, A. H., Alaa, R., & Hiba, S. (2023). Sustainable urban distribution of educational institutions and population density in Baghdad City using remote sensing techniques. *IOP Conference Series: Earth and Environmental Science, 1202*(1), 012015. https://doi.org/10.1088/1755-1315/1202/1/012015

Al-Rashid, M. A., Rao, M. N., & Ahmad, Z. (2020). Using GIS measures to analyze spatial equity of public parks in Lahore metropolitan. *Journal of Research in Architecture and Planning, 28*(8), 8–19.

Anjum, U. (2017). Assessing the need of modern education in madrassah system: A case study of Madaris in Lahore. *Arts and Social Sciences Journal, 8*(4). https://doi.org/10.4172/2151-6200.1000286

Asenahabi, B. M. (2019). Basics of research design: A guide to selecting appropriate research design. *International Journal of Contemporary Applied Researches, 6*, 76–89.

Baluch, M. U. H., & Shahid, S. (2008). Determinants of enrollment in primary education: A case study of district Lahore. *Pakistan Economic and Social Review, 46*(2), 161–200.

Bilsborrow, R. E. (2015). Concepts, definitions and data collection approaches. In *International handbook of population* (pp. 109–156). Springer. https://doi.org/10.1007/978-94-017-7282-2_7

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approach* (5th ed.). SAGE.

Farhat, K., Waseem, L. A., Khan, A. A., & Baig, S. (2018). Spatiotemporal demographic trends and land use dynamics of metropolitan Lahore. *Journal of History Culture and Art Research, 7*(5), 92–103. https://doi.org/10.7596/taksad.v7i5.1774

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). *Educational research: An introduction* (6th ed.). Longman.

Gobena, G. A. (2018). Family socio-economic status effect on students' academic achievement. *Journal of Teacher Education and Educational Practice*.

Hasan, S. (2021). Sustainable urbanisation in Pakistan and Lahore: Challenges and way forward. In *Livable cities for sustainable future* (pp. 1–16).

Hussain, Z., & Nadeem, O. (2021). The nexus between growth strategies of master plans and spatial dynamics of Lahore. *Land Use Policy, 109*, 105609. https://doi.org/10.1016/j.landusepol.2021.105609

Imran, N., Azeem, Z., Haider, I. I., Amjad, N., & Bhatti, M. R. (2011). Brain drains: Post graduation migration intentions among medical graduates from Lahore. *BMC Research Notes, 4*, 417. https://doi.org/10.1186/1756-0500-4-417

Jabbar, M., Aziz, M. A., & Zeb, S. (2011). Effect of demographic factors on achievement of secondary school students in Punjab. *International Journal of Academic Research in Business and Social Sciences, 1*(1), 15–25. https://doi.org/10.6007/ijarbss.v1i1.8

Jażdżewska, I. A., Lechowski, Ł., & Babuca, D. (2022). GIS-based approach for analysis of geographical education paths. *ISPRS International Journal of Geo-Information, 11*(1), 41. https://doi.org/10.3390/ijgi11010041

Jones, G. W. (1976). The influence of demographic variables on development via their impact on education. In *International handbook of population* (pp. 553–593). Palgrave Macmillan.

Kanyamwenge, S. L. (2017). The contribution of class size on students' academic performance in secondary schools. *Open University of Tanzania*.

Kothari, C. R. (2004). *Research methodology: Methods and techniques* (2nd ed.). New Age International.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*(3), 607–610. https://doi.org/10.1177/001316447003000308

Liu, J., Peng, P., & Luo, L. (2019). Family socioeconomic status and academic achievement: A meta-analysis. *Educational Psychology Review, 32*(1), 49–76. https://doi.org/10.1007/s10648-019-09494-0

Malik, S., Roosli, R., & Tariq, F. (2019). Informal housing challenges in Lahore. *Journal of Housing and the Built Environment, 35*(1), 143–170. https://doi.org/10.1007/s10901-019-09669-9

Matzavela, V., Chrysafiadi, K., & Alepis, E. (2017). Questionnaires and artificial neural networks in education. *IEEE EDUCON Conference*, 1700–1704. https://doi.org/10.1109/educon.2017.7943077

Nasreen, S., & Shah, M. (2021). Effect of demographic variables on teacher motivation. *Pakistan Journal of Educational Research, 4*(4).

Pakistan Bureau of Statistics. (2023). *Population and housing census 2023: Key findings report*. https://www.pbs.gov.pk

Rana, I. A., & Bhatti, S. S. (2018). Urbanization challenges in Lahore. *Cities, 72*, 348–355.

Rashid, K., & Mukhtar, S. (2012). Education in Pakistan: Problems and solutions. *International Journal of Academic Research in Business and Social Sciences, 2*(11), 332–343.

Raza, H., Mahmood, Q. K., & Jalil, A. (2019). Teaching and learning environment in Lahore. *Journal of Human Behavior in the Social Environment, 29*(5), 661–671. https://doi.org/10.1080/10911359.2019.1590278

Saeed, H., Saleem, Z., Ashraf, M., Razzaq, N., Akhtar, K., Maryam, A., & Rasool, F. (2018). Anxiety and depression among students in Lahore. *International Journal of Mental Health and Addiction, 16*, 1283–1298.

Sajjad, M., Munir, H., Kanwal, S., & Naqvi, S. A. A. (2022). Spatial inequalities in education in Pakistan. *Applied Geography, 140*, 102665. https://doi.org/10.1016/j.apgeog.2022.102665

Sarfraz, R., Jabeen, S., Sajid, M. A., & Ali, M. S. Z. (2020). Educational problems in Lahore schools. *Review of Education Administration and Law, 3*(3), 403–410.

Schank, C., & Rieckmann, M. (2019). Education for sustainable development. *Journal of Education for Sustainable Development, 13*(1), 67–91. https://doi.org/10.1177/0973408219844849

School Education Department. (n.d.). *EMIS district census Lahore*. Government of Punjab. https://schoolportal.punjab.gov.pk

Shah, S. I. H., Ahmed, A., & Nawaz, R. (2021). Land use change and population growth in Lahore. *Pakistan Journal of Science*, 73(2), 490–498.

Shah, Z. A., Malik, M. A., & Akhtar, J. H. (2020). Impact of demographic variables on science achievement. *Bulletin of Education and Research, 42*(1), 185–198.

Singh, N. R. (2001). Education and social change.

Tabassum, R., & Akhter, N. (2020). Demographic factors and academic performance. *Journal of Research & Reflections in Education, 14*(1).

Tavakol, M., & Dennick, R. (2011). Cronbach's alpha. *International Journal of Medical Education, 2*, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

Tsymbalenko, N., Tarasenko, I. O., & Bielialov, T. (2019). Demographic processes and education.

Umair, M., & Naz, L. (2019). Rural-urban migration in Pakistan. *Pakistan Journal of Social Sciences, 39*(3), 979–993.

WorldPop. (n.d.). Population density data. https://hub.worldpop.org

Xu, Y., Song, W., & Liu, C. (2018). Accessibility of educational resources in China. *Sustainability, 10*(7), 2305. https://doi.org/10.3390/su10072305

Ziegel, E. R., Levy, P., & Lemeshow, S. (1992). Sampling of populations. *Technometrics, 34*(3), 372.