

Fragmented spaces in the urban landscape: A socio-spatial analysis of educational supply in the city of Madrid

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Abstract

The geography of school choice critically shapes families' educational opportunities. Residential segregation, social inequalities and the educational marketplace interact in complex ways and produce spatialised educational opportunities for families. This paper analyses the link between these dimensions and how they structure families' educational opportunities in the city of Madrid. Based on several administrative datasets that capture students' residential location, their socio-economic position, the schools they attend and the characteristics of school supply, our analysis reveals the uneven spatial distribution of the different school modalities in Madrid, where advantaged families and neighbourhoods have more diversified and socio-economically homogenous nearby schooling options. The results also depict the way the city is spatially divided along a continuum of 'privileged' residential and educational assets. The paper reflects on how reforms expanding school choice and diversification of the educational market undertaken by the regional government may have increased the link between residential and school segregation.

KEYWORDS

education policy, educational supply, geographic information systems, Madrid, school choice, socio-spatial inequalities

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Key insights

What is the main issue the paper addresses?

The main issue is the socio-spatial distribution of school supply.

What are the main insights that the paper provides?

The main insights are that advantaged families and neighbourhoods have more diverse and socio-economically homogenous schooling options.

INTRODUCTION

Across Southern European cities, the rise in economic and social inequalities in recent decades has translated into growing levels of residential segregation (Arbaci, 2019; Leal & Sorando, 2015; Tammaru et al., 2020). The intensification of spatial divisions may imply that families have differentiated access to assets based on where they reside (Yoon, 2020). A critical element of this dimension is the geography of the school supply. School choice and educational opportunities are issues inextricably related to notions of space, place and geography (Waitoller & Lubienski, 2019). In combination with other critical policies—such as the regulation of choice—the geography of the educational marketplace is a significant element shaping families' choices and opportunities (Rujas et al., 2020). The configuration of local education markets confirms a strong hierarchical ordering of urban spaces. The best-performing and most attractive schools are frequently concentrated in the most affluent areas, while the most deprived neighbourhoods have less access to quality educational resources (Burgess et al., 2011; Fjellman et al., 2019).

The link between residential segregation and the unequal distribution of educational supply has been well documented in the literature (Boterman et al., 2019; Oberti, 2007; Yoon, 2020). It is an essential factor in understanding processes of school segregation. However, the relationship between residential segregation, spatially differentiated school supply and school choice is complex, as urbanistic, educational and individual elements interact to create diverse geographies of educational opportunities. Schools may be allocated according to the specific urban development model of the city (Davis & Oakley, 2013). On other occasions, the educational supply is the result of particular policy planning decisions, either aiming to achieve an equitable and balanced distribution of schooling or focusing on promoting schools' competition (Zancajo et al., 2021). These elements generate complex dynamics of educational supply and demand and may produce significant spatial asymmetries, particularly in contexts where quasi-markets and school diversification are incentivised.

The city of Madrid (Spain) represents a particularly relevant and interesting area of study in terms of the relationship between spatial inequalities and the geography of educational opportunities. First, the city has one of the highest levels of school segregation of low-income students in Spain, Europe and the Organisation for Economic Co-operation and Development (OECD) countries (Murillo & Martínez-Garrido, 2019). Second, education policy reforms have been characterised by a strong privatisation *of* and *in* education, through the promotion of free choice, a strong private subsidised network and the increase in linguistic curriculum differentiation via school autonomy, in which a school may opt for a Spanish or a bilingual (Spanish/English) option¹ (Prieto & Villamor, 2012; Rodríguez, 2019). Finally, in

the last two decades the levels of social inequality and residential segregation have grown in parallel in the city, questioning the persistence of the so-called 'Mediterranean exception' model of urban development² (Sorando & Leal, 2019).

In this regard, research in the city of Madrid in this field has not yet explored the socio-spatial dimensions of school choice for universal and compulsory education. Only the study of Rujas et al. (2020) has provided an analysis of the inequalities of educational supply for post-secondary education options, showing clear patterns of spatial inequalities between vocational and academic tracks and among curriculum modalities within each track. The case of Madrid is particularly interesting, as the school map is structured into different options of schooling based on the school sector (public, private subsidised or private independent schools) and the level of school autonomy (bilingual or non-bilingual schools). The interaction of these two elements is critical for understanding how these forms of provision are combined and are spatially expressed in the city.

In line with works examining Paris (Oberti, 2007), Santiago de Chile (Elacqua et al., 2011) and Barcelona (Bonol et al., 2021; Scandurra et al., 2022), this article depicts the spatial inequalities of the educational supply in the city of Madrid, showing how different educational assets are unequally distributed in different territories and for various social groups. The article is structured as follows. The following second section reviews key literature on how the socio-spatial inequalities of the school supply in local education markets generate different structures of educational opportunities. In the third section we present the main geographical and educational characteristics of Madrid as a local education market, including recent education reforms that may have contributed to the spatial ordering of the educational supply. The fourth section defines the two research questions of the study, and describes the data and methods used in the analysis. The fifth section maps out the socio-spatial inequalities of the educational supply in the city, relates them to residential segregation and provides evidence on the different choice opportunities available in various territories. The sixth and final section discusses the main results and reflects on some of the policy implications of our findings.

School choice, marketisation and socio-spatial inequalities

One critical component that shapes the construction of educational opportunities is the socio-spatial dimension of choice. The residential allocation of families and their immediate school supply are crucial factors that influence their choice sets and educational opportunities (Boterman, 2021; Scandurra et al., 2022). Given how varying social groups—based on their class and country of origin—can occupy different spaces in the urban landscape, have dissimilar access to schools based on their location, and possess distinct rationalities, preferences and capital when choosing schools, studying these interacting elements is crucial to understanding socio-spatial inequalities in education.

Proximity plays a significant role in the selection of schools for all families, especially for those who are more disadvantaged and do not have the economic capital to consider longer travel distances (Alegre & Benito, 2012). Still, proximity is a significant factor regardless of socio-economic background. While more privileged families consider other elements (e.g. school composition, school ethos or curriculum offer), school proximity is nonetheless a relevant dimension in their choice sets (Burgess et al., 2015). As such, the fact that proximity plays a significant role in the selection of schools implies that choice is geographically contingent, while it is at the same time shaped by institutional factors and families' own preferences.

Choice can be geographically constrained and differentiated when the allocation of schooling options is unequally dispersed. Evidence shows that the distribution of the educational

supply is related to the socio-economic composition of neighbourhoods across the city. More affluent areas tend to have a more diversified and quality offer, with a more homogeneous and socially privileged composition, while the opposite is the case for less privileged neighbourhoods (Oberti, 2007). Besides, the capacity of middle and upper classes to navigate the system makes them less dependent than working-class families from residential segregation and the unequal distribution of school supply (Córdoba Calquin et al., 2017). Beginning with Reay and Lucey's (2003) pioneering study demonstrating how working-class children concentrated in lower-income and racialised neighbourhoods in England had fewer 'highly ranked' schools in their areas of residence, studies have revealed geographical inequalities within the school supply in different countries (Bonal et al., 2021; Burgess et al., 2015; Elacqua et al., 2011; Owens & Candipan, 2019; Scandurra et al., 2022). Particularly in the case of Spain, the unequal geographical distribution of different forms of school supply has been evidenced in cities such as Barcelona (Bonal et al., 2021; Scandurra et al., 2022), Valencia (Rodríguez, 2019), Sevilla and Malaga (Gómez-Espino, 2019), the region of the Basque Country (Bonal et al., 2023) and Madrid, the latter for the case of post-secondary schooling options (Rujas et al., 2020).

Independently of the historical, urbanistic or political decisions leading to inequalities in the geography of educational opportunities, the existence of a differential spatial structure of educational supply generates dynamic processes reproducing spatial and educational inequalities. On the one hand, the promotion of a diversified offer can shape the residential decisions of families, who might wish to be close to better schooling options. Research has shown that the quality of schooling options is a relevant factor in understanding families' residential allocation decisions (Lareau & Goyette, 2014). However, the ability to relocate to neighbourhoods with preferred schooling options is uneven across households. For example, Ramond and Oberti (2020) illustrate how some middle-class families in Paris opt for renting instead of tenure to be able to access the neighbourhoods where better schools are located.

These decisions are, however, mediated by the institutional design of school admission policies and the housing system. In contexts with greater free choice, the school-based residential allocation strategies of families may be less common, as choice is not strictly determined by location and higher-income families can travel longer distances to access their preferred school option (Ely & Teske, 2015). In situations in which choice is geographically constrained by specific catchment areas, families have incentives to choose areas that match their preferred school options (Ely & Teske, 2015). Yet, access to quality school possibilities for the middle classes is linked to housing resources and the ability of families to navigate stratified housing regimes (Ramond & Oberti, 2020).

On the other hand, families' patterns of educational demand influence schools' logics of action, including decisions regarding their strategic geographical location (van Zanten, 2009). The geographical distribution of private schools in the urban space usually has a strong correlation with wealthier areas (Bonal et al., 2021). When the school location is not ideal, private schools develop other strategies to attract families of a specific socio-economic profile. They may become a protection for native and high-income families in areas with a high migrant concentration (Zancajo & Bonal, 2020), or have incentives to boost innovative pedagogies to create 'market niches' for middle-class families that demand alternative forms of education or are unable to access the 'best' schools located in the most affluent areas of the city (Keddie et al., 2020; Lubienski, 2006). As higher-income and native families demand differentiated curricular offers to enhance their cultural and linguistic capital (Yoon & Gulson, 2010), schools in more affluent areas may respond to these claims by incorporating these specific pedagogical programmes.

The case of Madrid: Spatial divisions in a context of privatisation

Madrid, as with many other Southern European cities, has been distinguished by high levels of social inequality in parallel with lower residential segregation indices (Arbaci & Malheiros, 2010; Domínguez et al., 2012). This 'Mediterranean exception' has been explained by the specific historical, structural and institutional aspects that characterise Southern European cities (Sorando & Leal, 2019). Specifically, one critical aspect accounting for this phenomenon has been Spain's 'familist' welfare regime (Leal & Sorando, 2015). With a weak welfare state in terms of the provision and regulation of social housing, families' reliance on networks of mutual support has encouraged processes of social mixing, as proximity is a critical factor in residential choices (Leal & Sorando, 2015).

However, in the last two decades, Madrid has been gradually losing its condition of 'Mediterranean exception'. Several studies have shed light on the alignment between social inequality and residential segregation since 2000 (Musterd et al., 2017). In fact, research has shown that Madrid has been one of the global cities with the highest increases in residential segregation in Europe and Spain (e.g. Sorando & Leal, 2019; Tammaru et al., 2020). This process has resulted in a clear dividing line between, on one side, the higher-income urban centre and northern peripheries, and on the other, the lower-income southern peripheral neighbourhoods. However, while this segmentation is clearly visible in the city, Sorando et al. (2021) have depicted a more complex picture. Rather than being divided in two separate areas, the city of Madrid is fragmented into several spatial structures, conforming to what the authors refer to as an 'Edge City'. On this basis, the researchers argue that the city of Madrid is fragmented into a continuum of spaces that have followed different trajectories of impoverishment, gentrification, or further privilege, resulting in neighbourhoods that range from ethnic enclaves to areas with persistent native privilege.

This practice of increasing urban fragmentation has run in parallel to one involving the consolidation of a market-based education policy, due to the uninterrupted presence of the conservative party (Popular Party) in the regional government (*Comunidad Autónoma de Madrid*, CAM, using its Spanish acronym) since 1995 and the culmination of the decentralisation of educational policy to regional governments at the end of the twentieth century (Cotallo, 2016). Beginning in 1999, the CAM became the ideological and strategic 'laboratory' of the Popular Party, consistent with the growing Thatcherite 'modern conservative' paradigms in education (Rodríguez, 2019). Since then, education policy in the region has followed a long-standing process of privatisation *in* and *of* education (Ball, 2009). *Endogenous* forms of privatisation in Madrid have entailed the promotion of a market-oriented school autonomy model, results-based management and free parental choice. *Exogenous* privatisation(s) have involved the contracting out of services, the funding of private subsidised schools and the concession of public school land to the private sector for building new schools (Cotallo, 2016; Prieto & Villamor, 2012; Villamor & Prieto, 2016). Specifically, two elements are critical when thinking about how spatial contingency can shape school segregation dynamics in the city of Madrid: its school zoning and educational planning model.

First, while the Spanish system operates through a 'restricted free choice' system,³ the region of Madrid has almost shifted from this model to an 'open choice' system. The particularity of this approach in Madrid occurred between 2012 and 2013, where the Region changed the priority points given to proximity and abolished catchment areas in the city (Gortázar et al., 2020). Hence, the model turned from a 'restricted choice' system, whereby proximity and residence still had a weight in case of overdemand for certain schools, to an 'open choice' system whereby the proximity criterion was relaxed, and the region converted into a single catchment zone. While Madrid has been a highly particular territory in this sense,

other regions with similar ideological orientation adopted this model at some point (and then eliminated or sustained it), such as Valencia (Rodríguez, 2019) and Murcia (Vera, 2017).

Secondly, when studying the spatial configuration of the educational supply in Madrid, two critical elements are important to highlight: the public–private mix and the bilingual programme. First, since 2000 private subsidised and private independent schools have been gaining greater weight in Madrid. This is depicted in the gradual decrease in the total public school offer from 59% in 1995 to 54% in 2017 (Save the Children, 2018). The legal framework favoured the rise of public–private partnerships in education through regulations allowing contracts with private schools (*conciertos*) based on their level of social demand (2013 Law on the Improvement of Educational Quality; LOMCE, using its Spanish acronym) and enabling the concession of public land to private subsidised or private independent schools (Law 9/2001, Land-use of the Community Autonomous of Madrid). In addition, the gradual decrease in funding for state schools progressively unbalanced the educational budget in favour of private subsidised schools (Save the Children, 2018). Second, the educational supply in Madrid is also strongly determined by the school's language offer. Since 2002, the CAM has favoured school autonomy by allowing schools the possibility of developing specialised curricular projects proposed by the administration (Gortazar & Taberner, 2020). The most widespread has been the bilingual programme in Spanish and English, which began to be implemented in 2004/2005 in public schools at the primary education level. Since then, it has expanded in both public and private subsidised schools in primary, secondary and post-secondary education (Gortazar & Taberner, 2020). A critical characteristic of the bilingual programme is that schools decide whether to participate in it, by means of an application to the CAM's Department of Education. The department then incorporates these schools into the programme according to specific criteria, such as the school's characteristics (e.g. resources, number of students, co-teaching practices) and teachers' experience and their level of English, as well as the school's location (Gortazar & Taberner, 2020).

RESEARCH QUESTIONS, DATA AND METHODS

Research on education inequalities in the region has shown the contribution of the different public/private and bilingual/non-bilingual networks to school segregation (Gortazar & Taberner, 2020; Murillo et al., 2018). Madrid has the highest school segregation index in Spain and one of the highest among European regions and countries (Murillo & Martínez-Garrido, 2019). It also had the highest increase in the school segregation index of low-income students between 2006 and 2015 (Save the Children, 2018). The recent urban transformations in the city and the market-driven education reform make exploring differences in the characteristics of the educational supply and the consequences of their spatial distribution on the equality of educational opportunities particularly interesting. This article aims to answer two research questions related to the geography of educational opportunities in the city: (1) what are the characteristics of the educational marketplace in Madrid and how is it spatially distributed?; and (2) how does this spatial distribution structures different educational opportunities in various neighbourhoods and for differing social groups?

The data for the research study were collected through a combination of secondary unique administrative and census-based datasets from the CAM Education Department, CAM education web portal and the CAM Census Office (see Appendix A for a synthesis of the datasets used). Three datasets were linked to each other and were clustered at different levels of administrative disaggregation.⁴

Families' school applications

This dataset included information about families' application to early childhood, primary or secondary schools in 2016. For each applicant, the dataset contained information on (1) their top-ranked and assigned school and (2) demographic data (households' geolocation and the child's country of birth). For this dataset, the population of interest included families who lived in the city of Madrid and who apply to schools within that geographical boundary. The focus was on households who applied to preschool education at the age of 3 years, as this is the period when the majority of families make their school choices (Gortázar et al., 2020). The total population for 2016 represented $N=16,958$ students.

School database

This database was constructed by combining information provided by the regional government and the CAM School Selection Portal. The resulting database contained information on the schools' geolocation, sector, autonomy model (bilingual or non-bilingual) and levels of education. The dataset included a total number of 546 primary schools for the year 2016.

Residential database

To construct a residential dataset, two sources of information were obtained through open-source data provided by the Census Office of Madrid. The first provided information on the average income by each census tract, which was used to approximate the household income. The second included information on the number of individuals with different levels of education by census tract. These were disaggregated into 13 categories, which were reduced to six following the method used by Gortázar et al. (2020).

This study used individual, institutional and contextual variables to characterise the educational supply (see Appendix B).

Students' socio-economic characteristics

Two variables were used to characterise students' socio-economic conditions: economic class and migrant status. The former was approached through the mean household income at the census tract level. Families were also categorised by economic class following the OECD's (2019) methodology.⁵ Through this approach, income equated to economic class and median income indicators were employed to classify families. The second variable for migrant status was measured as a dummy (i.e. being migrant or native) through the child's country of birth.

Schools' characteristics

We used four variables to differentiate the characteristics of educational supply among neighbourhoods: the share of different school types and admitted students by neighbourhood, the mean number of school types within 750m of their residence, the mean distance to the closest school type and the share of migrant students at the school. The second and the third variables, which provide a more nuanced picture of families' proximity schools, were

analysed by exploiting families' and schools' geolocations through Quantum Geographic Information System (QGIS).

Neighbourhoods' characteristics

Finally, three variables were used for neighbourhoods' characteristics: the share of tertiary-educated and migrant families at the neighbourhood level and the mean share of students at schools within 750 m of their residence according to economic class and migrant status.

The characterisation of neighbourhoods, schools and students made it possible to map territorial and social inequalities in the city. Inequalities could be expressed by showing the uneven spatial distribution of schools' characteristics among neighbourhoods and districts, as well as by observing how distinct social groups have access to different types of educational assets depending on their place of residence. Specifically, to understand the socio-spatial structure of the educational supply in Madrid, we (1) utilise the CAM's School Selection portal on admitted students by school to analyse enrolment patterns for different forms of educational supply, (2) analyse the social geography of Madrid's neighbourhoods through INE's data on household income and migrant population and (3) use the geo-location of schools to map the percentage of different forms of educational supply among distinct neighbourhoods. In addition, to understand how this spatial supply affects different social groups we utilise families' geo-location and demographic data and develop a 750 m buffer around each family's location to (1) analyse the number of different types of school supply in their area of residence and (2) calculate the average of school composition in their proximate area of residence within 750 m.⁶ Finally, through the combination of this data, we develop a typology of residential and school supply patterns in distinct neighbourhoods through a *k*-means cluster analysis.

RESULTS

The socio-spatial structure of local education markets in Madrid

To answer the first research question, we provide an overview of the school supply in the city of Madrid, showing quantitative differences based on the schools' characteristics and illustrating their socio-spatial differentiation.⁷

Figure 1 provides an overview on the nature of the school supply (in terms of the share of admitted students) in the city of Madrid. As shown, private subsidised schools are more prevalent—at 58%—followed by the public school network (42%). When comparing the number of schools (rather than admissions places), the trends are similar: 50% are private subsidised, 44% are public and 6% are private independent schools. When considering the combination between the different school sector/autonomy models, the private subsidised/bilingual model is the most prevalent (35%), followed by the public/bilingual and private subsidised/non-bilingual schools (25% and 24%), with the public/non-bilingual model having the lowest share of students (17%).

Additionally, the presence of bilingual and non-bilingual schools is relatively similar, with a greater presence of bilingual (60%) than non-bilingual (40%) schools. For the case of public and private subsidised schools, the proportion between bilingual and non-bilingual schools is relatively similar, with both types having a greater share of students in the bilingual network.

Overall, this initial mapping of the institutional structure reveals the strong presence of the privately owned network (either subsidised or private), as well as a significant diversification

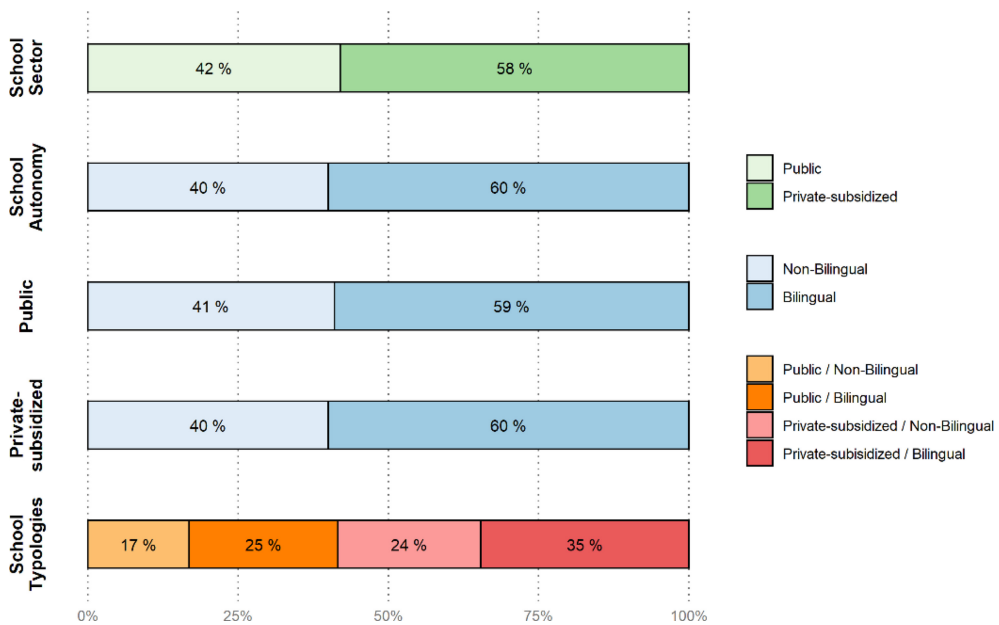


FIGURE 1 School supply in the city of Madrid (2016). *Source:* Own elaboration from CAM School Selection portal. [Colour figure can be viewed at wileyonlinelibrary.com]

of the school offer via the bilingual programme. Equally important, the different school sector/school autonomy combinations depict how this diversification through the bilingual programme has reached the different sectors (public or private subsidised) at an almost equal proportion. This overview clearly reveals the diversified educational marketplace in the city, showing how the bilingual network interacts with the public–private sector and how this school autonomy model has penetrated both sectors.

To interpret the socio-spatial differentiation of the educational supply, we illustrate the indicators of residential segregation in the city and their correspondence with the different types of provision of schooling. The deregulated housing regime and increased economic inequality have led to a city with relevant socio-economic fragmentations. [Figure 2](#) shows the clear socio-economic dividing line between the centre/north and southern areas. Higher-income groups and natives tend to be overrepresented in the urban centre and northern peripheries of Madrid. The centre is distinguished by increased processes of gentrification and the persistent privilege of native groups. Moreover, the low-density neighbourhoods at the north of the city are undergoing the expansion of affluent native families. Meanwhile, the southern peripheries, historically subjected to large-scale urbanisation and industrialisation, are overrepresented by lower income quintiles and migrant populations. These neighbourhoods are also experiencing distinctive dynamics of residential change. Some neighbourhoods are characterised as having ethnic enclaves, consolidated early migrant population, impenetrable native working-class areas (i.e. spaces whereby autochthonous working classes are anchored in the territory) or ones whereby migrants are being integrated into these working-class zones (Sorando et al., 2021).

To observe the spatial differentiation of the school supply in the city, we differentiate educational provision depending on school sector (public vs. private subsidised) and school autonomy (bilingual vs. non-bilingual). The resulting four combinations in the city's neighbourhoods illustrate the ordering of different types of educational provision in the urban space. [Figure 3](#) provides a picture of the spatial distribution of the school supply among Madrid's neighbourhoods. Educational provision distinguishes schools resulting from the

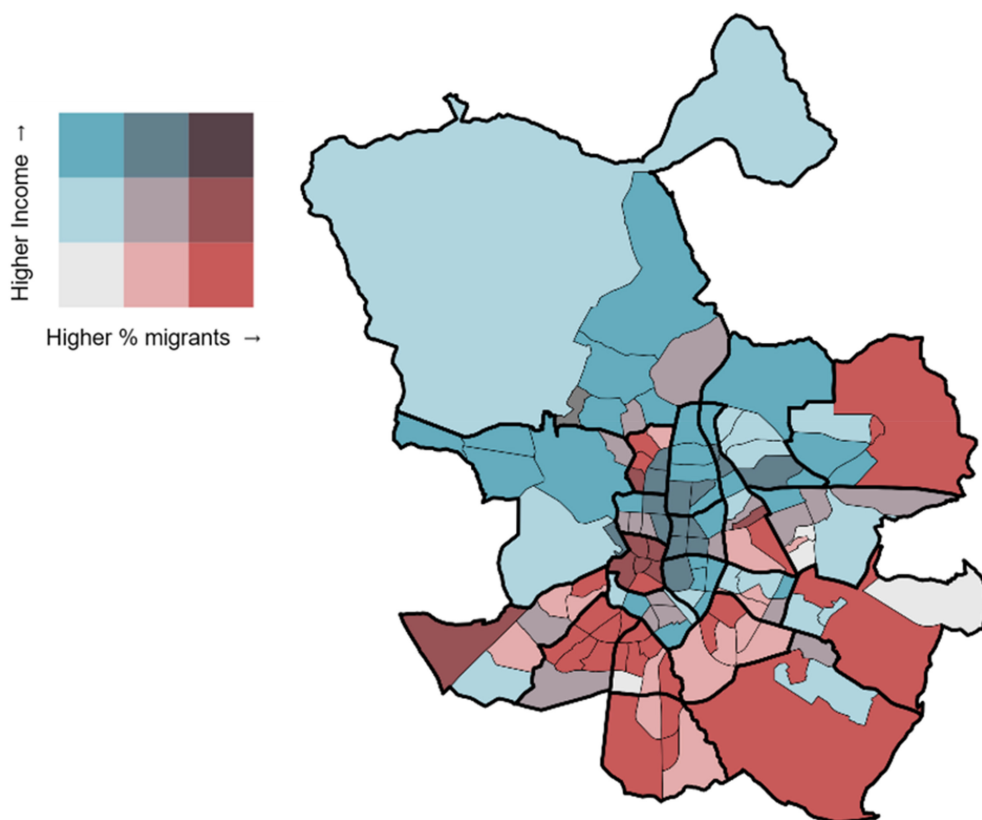


FIGURE 2 Household income and migrant population (quantiles) by neighbourhood (2016). *Source:* Own elaboration from CAM Census Office. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/doi/10.1002/berj.3889)]

combination of school sector (public/private subsidised), and linguistic model (bilingual/non-bilingual). Three main patterns emerge. First, higher-income districts in the city centre have a greater proportion of private subsidised/non-bilingual, private subsidised/bilingual schools and private independent schools. Secondly, the higher-income northern peripheries are distinguished by an offer where the public and private sectors have a relatively similar weight, with the public/bilingual offer being slightly more prevalent. Finally, the lower-income southern areas are also characterised by this more balanced public–private subsidised supply, with a stronger presence of either private subsidised/non-bilingual or public/non-bilingual schools depending on the neighbourhood. In summary, the hierarchical ordering of the urban space appears clear. However, the figures also show the existence of a local education market of private subsidised schools for lower-income families, which are mainly non-bilingual.

Overall, these results shed light on the diverse patterns of the spatial differentiation of distinct school networks in the city of Madrid. What characterises these spaces is the absence of public and non-bilingual schools in more affluent areas in the centre/north and the higher concentration of these in the southern peripheries. This unequal offer among these two models produces spatial asymmetries in the city. The higher-income areas in the centre have a greater share of bilingual and non-bilingual private subsidised schools. Moreover, while the northern and southern peripheries have a public–private network with relatively similar weights, the higher-income districts in the north have a larger share of public/bilingual schools, while the lower-income southern areas have a greater presence of non-bilingual public or private subsidised schools.

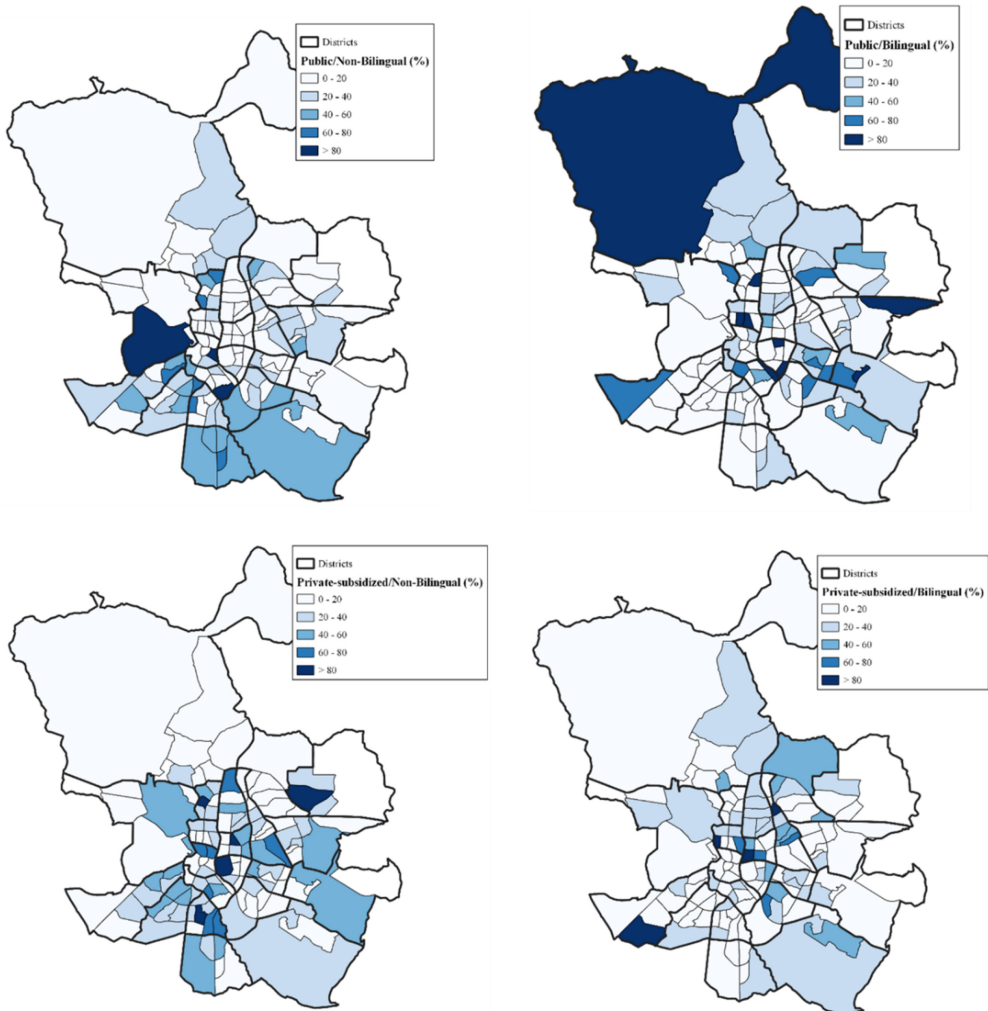


FIGURE 3 Share of school sector and autonomy model at neighbourhood level (2016). *Source:* Own elaboration from CAM Education and School Selection portal. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/doi/10.1002/berj.3889)]

The school choice set among social groups

To answer the second research question, we analyse how families' choice opportunities differ depending on their location and their sociodemographic characteristics. We carry out this analysis to illustrate how families' geographical choice sets differ 'horizontally' (in terms of the different types of school provision) and 'vertically' (various schools' average social composition). Geographical choice sets are defined as the characteristics of the educational supply that families have within 750 m of their residence, which is the average distance that families in Madrid commute to take their three-year-old children to school as revealed from our own analyses.⁸

The 'horizontal' geographic choice set

Table 1 presents the mean number of schools families have available within 750 m of their residence according to their demographic characteristics. As shown, lower-income and

TABLE 1 Average number of school types within a 750 m distance by economic class and migrant status. Source: Own elaboration from CAM Education.

Class	Total	School sector model			Autonomy model			School typologies			
		All schools	Public	Private-subsidised	Private	Bilingual	Non-bilingual	Public/non-bilingual	Public/bilingual	Private-subsidised/non-bilingual	Private-subsidised/bilingual
High	5.14	1.24	3.17	0.72	2.88	1.54	0.25	1.00	1.29	1.88	
Upper-middle	4.80	1.94	2.55	0.30	2.76	1.73	0.58	1.36	1.15	1.40	
Middle	5.02	2.15	2.69	0.18	2.51	2.33	0.87	1.28	1.46	1.23	
Lower-middle	6.25	2.73	3.38	0.14	2.33	3.78	1.62	1.11	2.16	1.22	
Low	6.91	3.29	3.49	0.13	2.14	4.64	2.38	0.91	2.26	1.23	
Native	5.68	2.43	3.03	0.22	2.45	3.01	1.28	1.15	1.73	1.30	
Migrant	6.56	2.86	3.51	0.18	2.31	4.07	1.83	1.03	2.24	1.28	
Total	5.78	2.48	3.08	0.21	2.43	3.13	1.34	1.14	1.79	1.30	

TABLE 2 Average distance (in meters) to closest school type by economic class and migrant status. *Source:* Own elaboration from CAM Education.

Class	School sector model			Autonomy model			School typologies			
	School	Public	Private-subsidised	Private	Bilingual	Non-bilingual	Public/Non-bilingual	Public-bilingual	Private-subsidised/Non-bilingual	Private-subsidised/Bilingual
High	319	567	454	1010	411	861	1435	619	956	541
Upper-middle	366	482	522	1357	451	729	1040	585	947	634
Middle	299	405	482	1857	431	556	873	590	757	673
Lower-middle	246	345	365	1900	419	415	596	630	545	624
Low	221	318	330	1882	440	276	398	703	425	633
Native	279	395	424	1754	430	513	774	625	680	634
Migrant	243	349	361	1759	438	356	563	661	489	656
Total	275	390	417	1754	431	496	751	629	659	636

migrant families have a greater mean total number of schools within 750m than higher-income and native ones. This is partly explained by the fact that higher-income and native families live in less densely populated areas in the city of Madrid.

Moreover, significant differences appear when the mean number of schools is disaggregated by school type. In this regard, higher-income and native families have significantly fewer public and non-bilingual schools than lower-income and migrant households, while the number of private subsidised schooling options is relatively similar across the groups. When these two models combine, differences appear between income levels and migrant status. Higher-income and native families have fewer public/non-bilingual and private subsidised/non-bilingual schooling options than lower-income households. These results are further confirmed in [Table 2](#), whereby similar patterns are found for the mean distance to the closest type of school based on geographical characteristics.

Spatially, this 'horizontal' diversification shows similar patterns to the ones highlighted in the previous section. [Figure 4](#) presents the asymmetries in the range of school options for each individual family within 750m of their residence. The figure depicts the absence of a public school supply for families in the city centre, and the greater proportion of private subsidised schools in their choice set. Secondly, the presence of bilingual school options for families in the southwest region is highly unequal compared with the city centre. On the other hand, the non-bilingual offer is more prevalent in the south and less available for families in the centre and northern peripheries.

Thus, while lower-income and migrant families have on average a higher number of schools in their choice set, the type of provision is mostly composed of public and non-bilingual schools.

The 'vertical' geographic choice set

Following similar analyses from Burgess et al. (2011) and Scandurra et al. (2022), [Figure 5a,b](#) depict the different types of school composition—based on economic class and migrant status—for different families within 750m of their residence. These figures illustrate the social characteristics of schools near to students' homes, based on the average proportion of different social groups in these schools.

[Figure 5a](#) reveals important differences in the socio-economic composition of schools for both families from different economic groups and migrant status within 750m of their household. For example, within this distance, low-income families have, on average, schools with 90% of low-/lower-middle-income children. On the other hand, for high-income families the presence of low-/lower-middle-income children in schools is only 15%. This represents a drastic pattern across income groups and migrant status. As income increases, the presence of lower-income groups in schools decreases, and the rate of higher-income groups is more prevalent. Similarly, for migrant status, the presence of low-/lower-middle-income groups is much stronger for migrants (79%) than for natives (61%).

Moreover, [Figure 5b](#) indicates the proportion of migrant students for different social groups within 750m of their residence, again depending on their economic class and migrant status. A similar pattern to [Figure 5a](#) is found. As the income group increases, the presence of native children is higher, while that of migrant children gradually decreases. For example, for low-income students, the proportion of migrant school children within 750m of their residence is 25%, while for high-income pupils it is only 6%. A similar, but less stark trend occurs between migrant (23% migrant children) and native (17% migrant children) students.

To summarise, the two analyses reveal significant differences across income groups and migrants/natives in relation to (1) the characteristics of their nearby schools and (2) their social composition. First, the presence of specific types of schools varies across

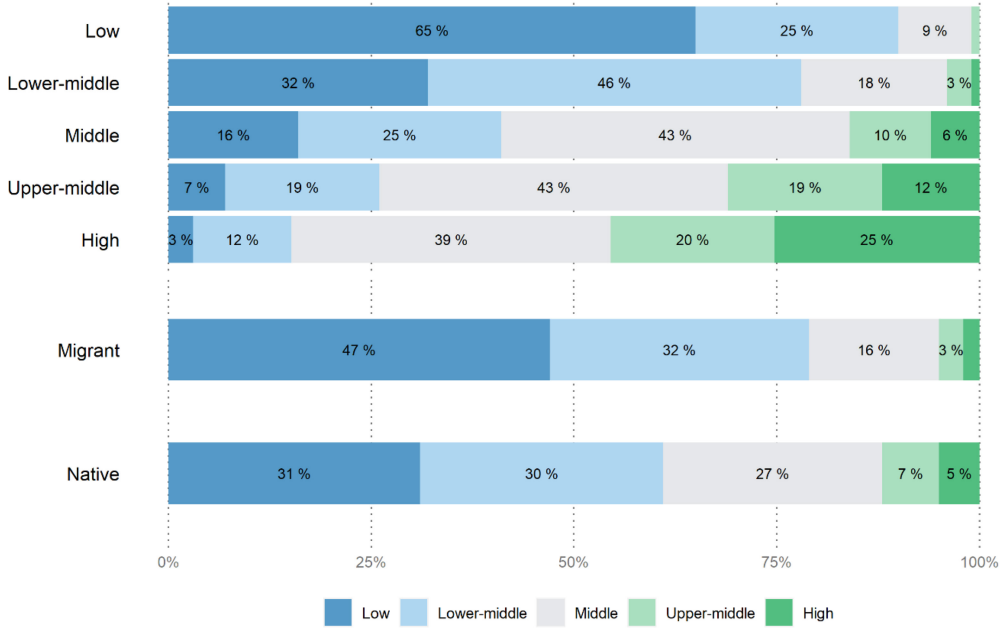


FIGURE 4 Schooling options for each family within 750m of residence (2016). *Source:* Own elaboration from CAM Education and School Selection portal. [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/doi/10.1002/berj.3889)]

income and (non-)migrant groups, creating unequal opportunities in schooling options for distinct families. Mainly, the analysis reveals an absence of the public and non-bilingual network—and its combination (public/private subsidised and non-bilingual)—for higher-income families and natives in their proximate supply. Secondly, it depicts a drastic trend in school socio-economic composition across income groups and migrant status. There is a significant gradual decline in the presence of lower-income and migrant children as the income level of the group rises. This is also similar for migrant status, as native individuals have a lower presence of lower-income and migrant children within their nearby schools.

Finally, to synthesise inequalities in educational opportunities in the city of Madrid, we explore the relationship between residential and school supply patterns across neighbourhoods. To characterise these unequal patterns, we conduct a *k*-means cluster analysis to create a typology of different neighbourhoods based on residential and school-related

(a)



(b)

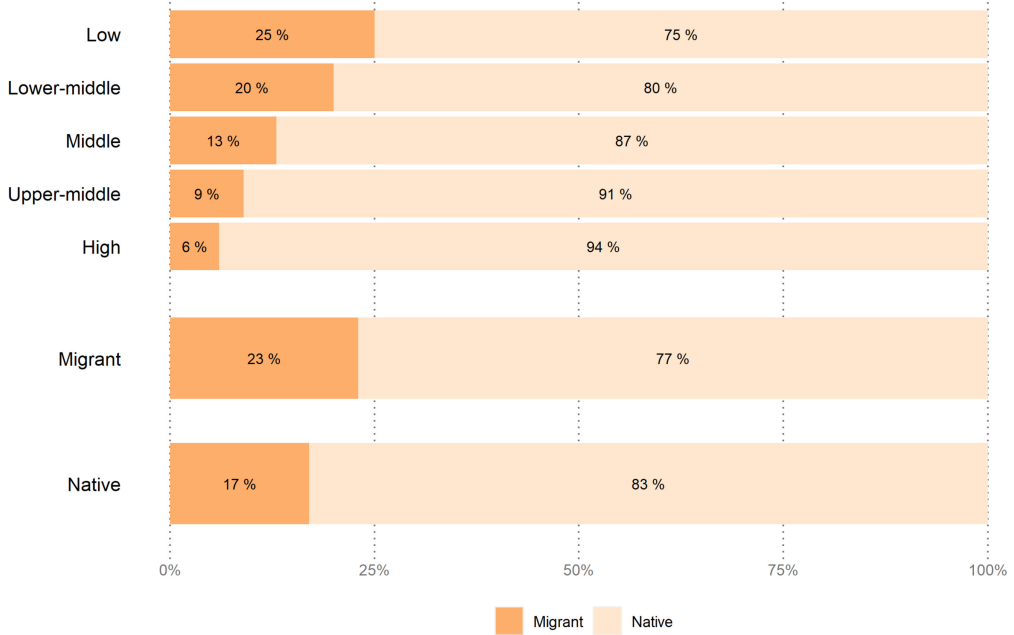


FIGURE 5 School composition (proportion of economic class and migrant/native groups) within 750m of students' residence based on economic class and migrant status: (a) by economic class; and (b) by migrant status. *Source:* Own elaboration from CAM Education. [Colour figure can be viewed at wileyonlinelibrary.com]

dimensions. The cluster analysis among the neighbourhoods is based on (1) their average income, (2) the share of migrants and (3) the share of schools based on the school sector (public, private subsidised, private independent) and linguistic model (bilingual/non-bilingual). The *k*-means cluster analysis (see Appendix C) reveals that the city has six different spaces as types of neighbourhoods' characteristics (see Figure 6). These different forms are expressed on a continuum of low- to high-privileged spaces with different residential and educational assets.

Firstly, affluent and native areas with a high private offer are predominantly located in specific neighbourhoods of the city centre. Secondly, upper-middle and homogeneously native areas with a high private subsidised offer and a balanced bilingual/non-bilingual offer are also found in the city centre. Thirdly, middle-income and native areas with a higher concentration of public/bilingual supply are primarily situated in the northern peripheral neighbourhoods. Fourthly, middle-income neighbourhoods with a low/mixed migrant density, a balanced public/private offer and a high bilingual supply are primarily distributed in the northern peripheries and some specific areas in the south. Fifth, lower-middle income areas with a mixed/high migrant composition and a predominant private subsidised/non-bilingual offer are mostly based in the southern peripheries and some particular neighbourhoods in the city centre. Finally, low-income areas with high migrant density and a predominant public/non-bilingual supply are present in the southern peripheries of the city.

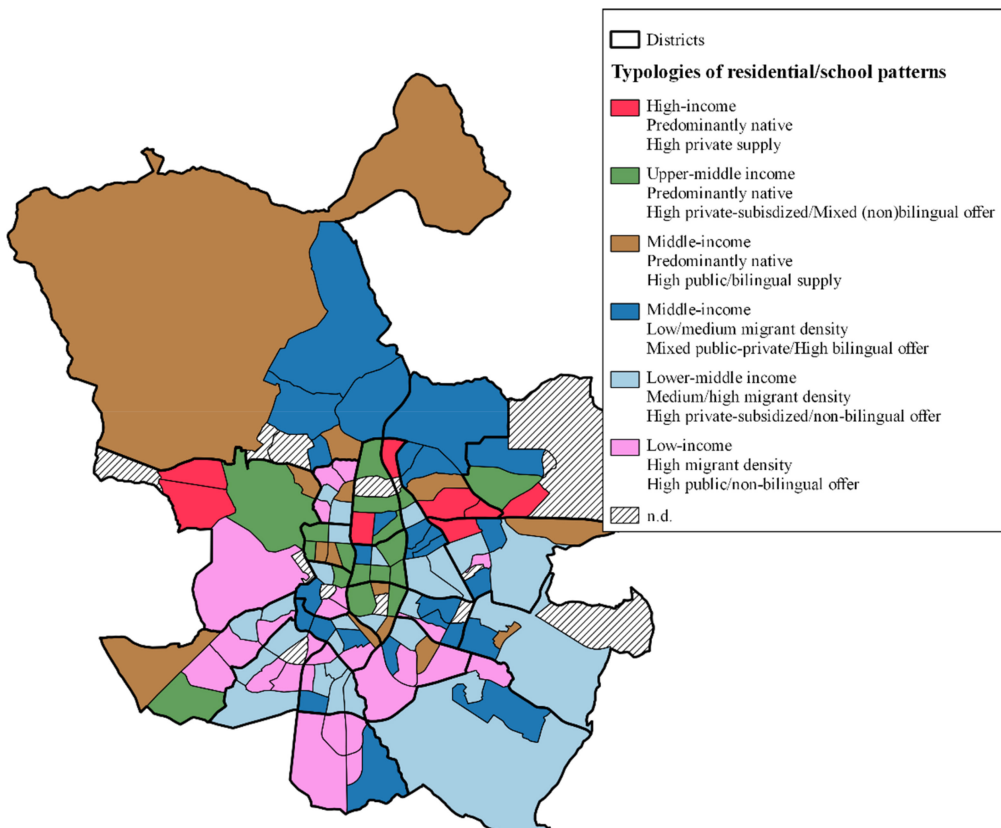


FIGURE 6 Relation between residential and school supply patterns by neighbourhood (2016). *Source:* Own elaboration from CAM Education. [Colour figure can be viewed at wileyonlinelibrary.com]

This analysis reveals the diverse expressions of the urban landscape of Madrid and supports the notion of the 'Edge City' in the educational domain. When considering residential and school supply aspects, the city of Madrid shows important spatial asymmetries. As the analysis illustrates, the neighbourhood dynamics of the city can be divided into a continuum of socio-economic and educational supply assets. These range from neighbourhoods with a predominant working-class/migrant population and a high public/non-bilingual supply, to high-income/homogenously native areas with a strong share of private schools. This typology thus illustrates the uneven spatial distribution of residential and educational assets.

CONCLUSIONS

Research has provided significant evidence on the role that geography plays in shaping families' school choices and educational opportunities. Several studies have explored how the socio-spatial differentiation of families' residential position and their educational offer can create unequal educational opportunities. However, the link between residential segregation and a spatially differentiated educational supply remains complex. The specific residential patterns of the city as well as the urbanistic and educational policy decisions in the provision of the educational offer interact to create diverse geographies of educational opportunities.

This study has attempted to interlink educational and geographical elements in order to carry out a comprehensive socio-spatial analysis of the school supply in Madrid. Our analysis shows a strong diversification of the school offer in the city, with the private subsidised and bilingual offer having a similar or greater weight than the public and non-bilingual supply. The interaction of these models leads to a highly pluralistic supply. However, while the distinct types of schools have a similar share, these are not equally distributed. More affluent areas in the centre and northern peripheries have a significant lack of public and non-bilingual schools (and their interaction). Moreover, higher-income and native families tend to have a geographic choice set with a higher share of advantaged and native children. Consequently, the interaction of the residential dynamics of the city with the educational supply creates distinct 'cities' for different families. The study offers evidence that, when considering residential and educational supply aspects, the city of Madrid is characterised by fragmented geographies of educational opportunities. The findings are consistent with what different authors have found for other global cities, such as Paris (Oberti, 2007), Amsterdam (Boterman, 2018), Santiago de Chile (Elacqua et al., 2011) or Barcelona (Bonal et al., 2021; Scandurra et al., 2022). While Madrid adopted a system of complete free choice (like Amsterdam), the institutional designs of the other cities are today based on different degrees of restricted choice (Barcelona, Santiago de Chile) or absence of choice (Paris). Despite the specificities of educational supply and the differences between free or controlled choice models, the interlink between the geography of educational supply and the social composition of schools and neighbourhoods reproduces high socio-spatial educational inequalities in all the cities. Interestingly, middle- and upper-class families make use of alternative differentiation strategies depending on the level of residential segregation and the school admission policy. The absence of choice makes residential choice a crucial decision to avoid socially disadvantaged groups and may explain a higher correspondence between residential and school segregation. On the other hand, systems based on free or restricted school choice activate strategies of differentiation less dependent on residential choices, weakening the correspondence between residential and school segregation. Strategies used by the middle and upper classes are adapted to the context and in all cases generate higher levels of school segregation than residential segregation.

The study has shown how families with distinct forms of capital have differentiated assets based on their residence. This spatially divided educational offer interacts with the

fragmented spaces in the city. Thus, the concept of an 'Edge City' becomes relevant to understanding how distinct families experience the city on the basis of where they reside and the educational offer available to them. Indeed, the interaction between these residential and educational components is complex and mediated by urbanistic and education policy decisions. The positional capital (as a form of spatial capital) that different families hold depending on their residence increases the already existing unequal composition of both economic and cultural capital (Bartho & Monfroy, 2010; Yoon, 2020). This unequal positional capital results from the confluence of a market strategy of educational providers, of families' strategies to accessing an attractive educational supply and an education policy that has ignored educational planning as an equity strategy for balancing different educational assets in the city.

In addition, these findings are aligned with previous studies that have revealed the importance of geography in shaping families' educational opportunities. Several studies have demonstrated the spatial disparities in the educational supply for different families and its relationship with the residential patterns of the city. This study provides further evidence on the social geography of the school supply and offers a richer understanding of the link between residence and school supply by incorporating concepts from urban theory. In this sense, the analysis shows how the combination of the residential and educational patterns constructs 'different cities' for families from varying social groups.

This study has, however, certain limitations. At the data level, the study only covers the final public or private-subsidised school that families were assigned to. Thus, this data does not include families who prior or after the admissions process were enrolled in a private independent school. Moreover, as the dataset did not include each family's individual income, this had to be estimated by approximating the average income at the census level. Hence, this approximation is subject to issues of measurement error. At the analytical level, the usage of geographically constrained blocks provides a small picture of school accessibility. In free choice contexts where access is geographically constrained but not determined by proximity, other factors, such as transportation systems and social barriers influence school accessibility (Lee & Lubienski, 2021). In addition, further analyses could capture other relevant aspects at the supply side (e.g. school vacancies, the school's time shifts) that go beyond the school sector or autonomy model.

This study has relevant implications at the policy level for the planning of the educational offer. Firstly, while the dynamics of the city shape where families are located, education policy planning can mitigate or reinforce the patterns of the urban landscape. Policy instruments on the supply side—either through the promotion of quasi-markets and social demand or educational planning criteria—mediate the urban dynamics and create different geographies of educational opportunities (e.g. Ely & Teske, 2015; Ramond & Oberti, 2020).

In this sense, market-based mechanisms that incentivise social demand and competition via school differentiation can create unequal geographies of educational opportunities, with distinct social groups having different forms of available educational supply. In both contexts of high or low residential segregation and free choice, a strong school differentiation with an unequal allocation of supply can incentivise segregation dynamics, either by enabling more privileged families to distinguish themselves in 'mixed' areas, through 'white flight' processes or by reinforcing dynamics of high residential segregation. (Boterman et al., 2019). On the other hand, the design of policies that regulate these forms of public-private partnerships can revert some of these inequalities. In several contexts, public education administrations can establish specific requisites for the authorisation of new private providers (and school autonomy options) to avoid oversupply situations and ensure a more balanced geographical distribution of schooling options (Zancajo et al., 2021). Policy instruments here do not only consider the potential demand for schooling in specific areas but also how a new private provider or bilingual school option can affect the school composition of neighbouring schools

and student enrolment patterns within and between different zones (Zancajo et al., 2021). These instruments take the form of specific *educational planning criteria* (i.e. related to avoiding a new private provider that can affect neighbouring public schools, that contributes to the diversity of school supply or the distance, among others) or *bidding processes* that enable public authorities to have greater control over school supply and its allocation by means of different procedures (Zancajo et al., 2021).

Yet, these specific policy tools on the supply side, while important, have certain limitations unless they are accompanied by other instruments that consider the interaction between supply and demand. In the case of highly diversified markets, the fact that families have the same number and types of nearby schools does not prevent school segregation dynamics. Even if choice is equalised, higher-income and native households might still use their positional capital to access more advantaged or higher-quality schools (Scandurra et al., 2022). Thus, while the equitable supply of schools is a fundamental component in addressing school segregation, it needs to be accompanied by other tools that shape school segregation in multiple ways, such the school admissions requirements and assignment mechanisms and the ways of funding different forms of private providers, among others.

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CONFLICT OF INTEREST STATEMENT

None of the authors have a conflict of interest to disclose.

DATA AVAILABILITY STATEMENT

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ETHICS APPROVAL STATEMENT

Does not apply (secondary data analysis).

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ENDNOTES

- ¹ From 2017/2018, the Regional government has also included a pilot programme offering trilingual education (Spanish, English and French/German) in two public schools and has extended it to 48 public schools in 2019/2020. As our population and school sample captures the 2016/2017 school year, this pilot project was still not implemented.
- ² The 'Mediterranean exception' refers to a model of urban development identified at the end of the twentieth century in which the increase in socio-economic inequality did not translate into a rise in residential segregation (Maloutas & Fujita, 2016). It is a model involving relatively low residential segregation but high residential marginalisation (Arbaci, 2019).
- ³ The Spanish choice system is considered a quasi-market model since families have the capacity to express their school preferences, although in case of overdemand of schools it is regulated by criteria of proximity, the presence of siblings and family income. This process is regulated through the Boston mechanism, a centralised system whereby families submit their school preferences on an ordered ranking and an algorithm tries to match as many students as possible to their preferred school (Bonal & Zancajo, 2018).
- ⁴ In Madrid, there are three administrative levels: districts, neighbourhoods and census tracts. The city includes 21 districts, 131 neighbourhoods and 2462 census tracts. The latter is the most disaggregated unit of analysis, normally including between 1000 and 2500 individuals per census tract.

- ⁵ The OECD (2019) uses median income as a reference for defining economic class. The middle-income class is defined as the population with incomes ranging between 75 and 200% of the median. Middle income is then subdivided into three groups: 'lower-middle' (75–100% of the median), 'middle middle-income' (100–150%) and 'upper-middle income' (150–200%). Households with <75% of the median are defined as 'low-income' and those with an income >200% of the median are 'high-income'.
- ⁶ In this case, if families do not have any school supply within 750m of their proximate area, these are discarded for this specific analysis.
- ⁷ It is important to note that the first analysis was performed based on the number of admitted students by school type. Owing to the lack of available data on admissions for private independent schools, we conducted the rest of the analyses based on the number of schools, rather than the number of admissions. Indeed, owing to the relatively low presence of private independent schools, a comparison of the two methods for public and private schools showed similar patterns.
- ⁸ We apply the same methodology used by Burgess et al. (2015) or Scandurra et al. (2022).

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APPENDIX A

A.1 | Secondary datasets used for the study.

Data	Contains	Source
Application for preschool and primary education	Students who applied to Early Childhood (P3) school. For each applicant ($N=16,958$), data contains: <ul style="list-style-type: none"> • Top-rank school from rank list • Family demographic information (i.e. household geographic coordinate, country of birth) • Priority points obtained in the admissions • Assigned school 	CAM Education
School database	School supply (2016) in Madrid ($N=546$). Includes: <ul style="list-style-type: none"> • Geographic coordinate of school • Type: public, private-subsidised, private • Offer: bilingual, non-bilingual • Levels of education 	CAM Education, CAM School Selection Portal, CAM Education official reports
Household income and education level	Information from the Census Office in Madrid (2016): <ul style="list-style-type: none"> • Share of income by census blocks • Share of university educated families by census blocks 	CAM Census Office

Abbreviation: CAM, Comunidad Autónoma de Madrid.

APPENDIX B

B.1 | Variables utilised for the study.

Variable	Concept	Definition	Nature	Source
Student's socio-economic characteristics	Economic class	Mean household income at the census level, categorised as: <ul style="list-style-type: none"> • Low (<75%) • Lower-middle (75–100%) • Middle (<i>Median</i>) • Upper-middle (150–200%) • High (>200%) 	Ordinal	CAM Census Office
	Migrant status	Foreign status, native	Dummy	CAM Education
Educational resources	School supply	Share of school types by neighbourhood	Ordinal	CAM Education, Official CAM Reports and CAM School Choice Portal
	Choice set	Number of school types schools within 750 m Distance to closest school type Share of migrant students at school	Continuous, Ordinal	Own elaboration, CAM Education
Neighbourhood characteristics	Residential segregation	Share of families with university degree at the census block Share of migrants at census block Share of students at school within 750m of residence by migrant status and economic class	Ordinal	Own elaboration, CAM Census Office and CAM Education

APPENDIX C

C.1 | Cluster analysis.

C.1.1 | Cluster information.

Cluster	1	2	3	4	5	6
Size	9	14	18	28	27	26
Explained proportion within-cluster heterogeneity	0.156	0.073	0.208	0.195	0.173	0.195
Within sum of squares	46.131	21.614	61.397	57.538	51.182	57.773
Silhouette score	0.278	0.419	0.118	0.215	0.233	0.217
Centroid Z_Income	1.857	0.104	1.077	-0.513	-0.226	-0.658
Centroid Z_Migrants	-0.449	-0.360	-0.878	0.304	-0.301	0.942
Centroid Z_Public	-0.844	1.690	-1.189	-0.570	0.213	0.598
Centroid Z_Private_subsidised	-0.830	-1.527	1.290	0.720	-0.071	-0.484
Centroid Z_NonBilingual	-0.955	-1.229	-0.225	0.767	-0.630	0.977
Centroid Z_Bilingual	-0.509	1.415	0.296	-0.656	0.767	-0.882
Centroid Z_Private	3.042	-0.352	-0.141	-0.249	-0.266	-0.222

Note: The between sum of squares of the six cluster model is 551.37. The total sum of squares of the six cluster model is 847.

C.1.2 | BIC Plot

