Geoforum 40 (2009) 873–883

Contents lists available at ScienceDirect

Geoforum

journal homepage: www.elsevier.com/locate/geoforum

Social segregation and academic achievement in state-run elementary schools in the municipality of Campinas, Brazil

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ARTICLE INFO

Article history:
Received 5 July 2007
Received in revised form 3 June 2009

Keywords:
Social segregation
Residential segregation
Metropolitanization
Academic achievement
Campinas city—Brazil

ABSTRACT

Space not only reflects social inequality, it also reinforces the advantages or disadvantages associated with social class. However, the study of how neighbourhoods affect their residents has only recently entered the debate on urban poverty in Latin America. We use 2000 data from the Brazilian population census, school census, and the state of São Paulo's educational evaluation system to analyze the relationship between school infrastructure, school academic achievement, and the neighbourhoods in which these schools are located. Our analyses indicate that state-run elementary schools located in areas of concentrated poverty have lower academic achievement in mathematics tests and Portuguese than mixed and affluent areas of the city, even though these schools are all administered by the same government body. We end with a discussion of the relationship between Brazilian education policy and its influence on spatial differences in São Paulo State.

1. Introduction

Space not only reflects social inequality, it also reinforces the advantages or disadvantages associated with social class (Massey, 1996). However, the study of how neighbourhoods affect their residents has only recently entered the debate on urban poverty in Latin America. The deleterious effects of residential segregation by social class arguably are multiplied in a context of rapid urbanization; because of a unilateral focus on accumulation and growth, questions related to guaranteeing greater equality among citizens—such as the quality of public education—often go unanswered.

In the Brazilian case, neighbourhood effects on schooling have recently begun to be investigated (e.g., Torres et al., 2005). However, the bulk of these studies focus on the primate cities (São Paulo and Rio de Janeiro), and do not consider whether these results hold true in the smaller, faster growing intermediate size cities. Campinas is one such city.

In the last 20 years this city and its Metropolitan Region, located about 100 km north of the city of São Paulo, has had one of the highest annual demographic growth rates of the state of São Paulo. In 2000, 6.32% of the state's population lived within the region (more than 1 million people). This area can be classified as an "emergent metropolis", in that the majority of its growth has occurred within recent decades. As such, the processes and consequences of urban expansion within the region have been largely unexplored (NEPO/NESUR, 2004).

We use 2000 data from the Brazilian population census, school census, and the state of São Paulo's educational evaluation system (SARESP) to analyze the relationship between school infrastructure, mean school academic achievement, and the neighbourhoods in which these schools are located. Our analyses indicate that state-run elementary schools located in areas of concentrated poverty have lower academic achievement in Math tests than mixed areas or more affluent areas of the city, even though these schools are all administered by the same government body. We end with a discussion of how the policy of universal elementary education instituted by the Constitution of 1988 has highlighted spatial differences in the quality of schools administered by the state of São Paulo, and how this policy of universalization presents challenges to addressing spatial inequalities in public schooling.

2. Background

2.1. Campinas: the city and its "emerging" metropolitan area

The municipality of Campinas, Brazil, lies approximately 100 km north of the city of São Paulo. Today Campinas, with its

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doi:10.1016/j.geoforum.2009.06.003

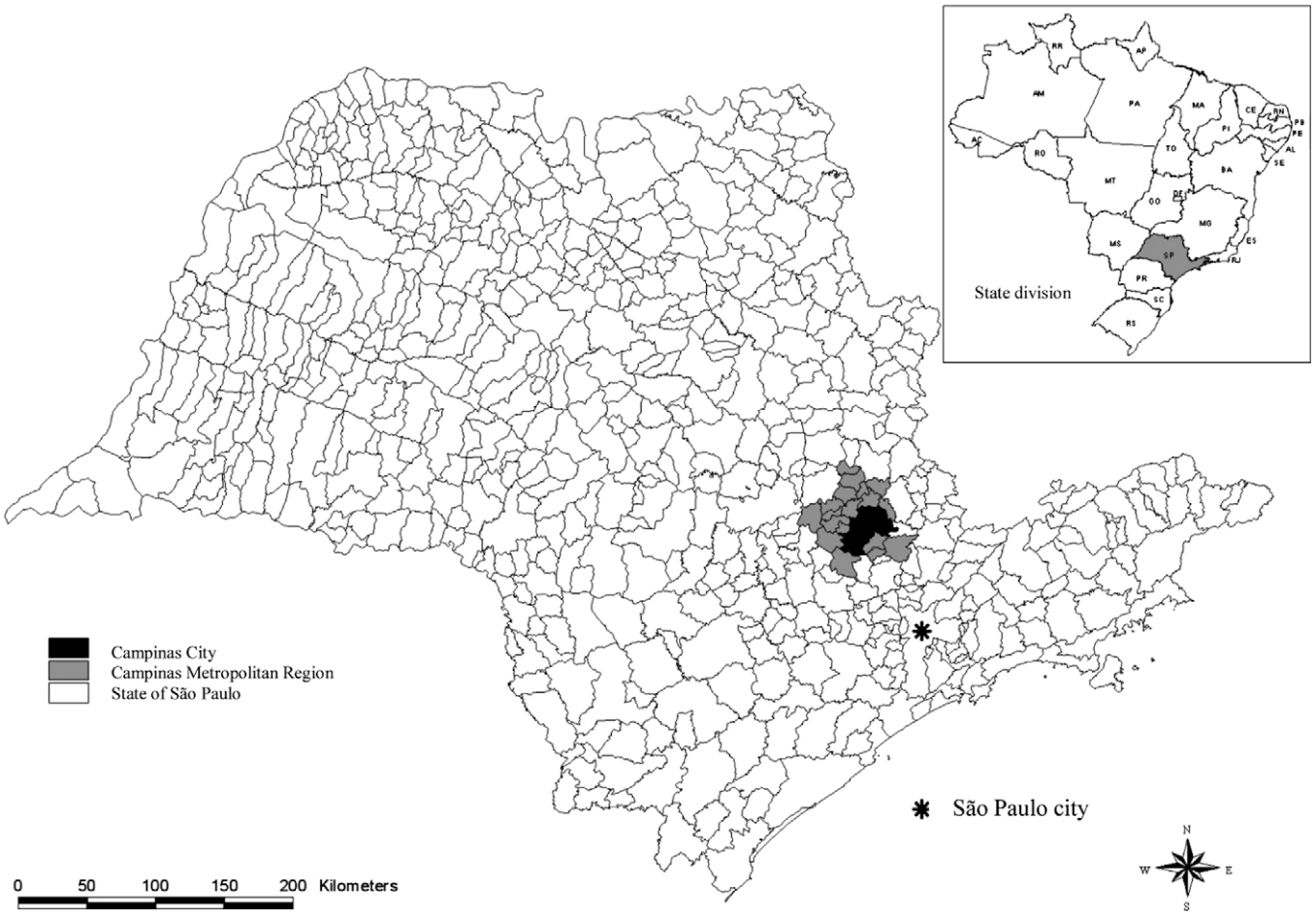

Fig. 1. Location of the Metropolitan Region of Campinas and the municipality of Campinas, state of São Paulo.

approximately 1.1 million inhabitants, is characterized mainly as an industrial city and a center for technology and services, but it also has a long history of employment based on agriculture. Campinas and its 18 surrounding smaller municipalities comprise the Campinas Metropolitan Region. During the last 30 years time, the Campinas Metropolitan Region has registered one of the highest population growth rates in the country.

Despite this rapid growth, the metropolitan region (see Fig. 1) is now facing population volumes and social problems that can be considered more manageable than those in the even larger urban agglomerations in Brazil, especially São Paulo (17 million inhabitants) and Rio de Janeiro (10 million). In fact, indicators such as the Human Development Index (HDI)[1] show that the living conditions in the Campinas region and, especially, in the municipality itself, are among the highest in the country. This is partially the result of its economic history, since, in the late 19th and the early 20th centuries, it developed as an important coffee-producing region, and was consequently able to accumulate considerable capital. It currently generates wealth through economic activity based not only on traditional industry, but also on advanced technology businesses, attracted both by its strategic geographical position – excellent highways and proximity to the larger centers in the country, like São Paulo city – as well as the presence of important universities and research centers.

As a result, it is hoped that, by taking Campinas as a case study for analyzing the effects of segregation and poverty on academic performance, we will be contributing to the mosaic of studies that have already been published. We thus intend to identify the degree of correspondence among results concerning a number of other social, economic and spatial contexts.

2.2. Neighborhood effects on schooling

The effects of socio-spatial segregation on the living conditions of families and individuals in the general population have recently entered the discussion of urban poverty in the Brazilian and Latin American literature. Based on the premise that "space matters" (Flores, 2006; Torres et al., 2005; Torres, 2004), a number of behaviors and outcomes can be investigated to evaluate the effect that socio-spatial segregation –the concentration in space of households of similar socioeconomic status – has on the ability of families and individuals to cope with risks and challenges to their well-being. This type of analysis includes studies examining children's academic performance (Torres et al., 2005; Flores, 2006), as well as criminality (Sampson et al., 1997) and the living conditions of young people (Galster and Mikelsons, 1995; Jencks and Mayer, 1990).

According to Flores (2006), the mechanisms through which segregation operates to influence the lives of individuals are identified according to the theoretical approach adopted, each of which emphasizes different aspects, ranging from questions related to

[1] According to HDI (Human Development Index) estimates for 2000, conducted by the UNDP (United Nations Development Program), the municipality of Campinas was in 24th place in Brazil (out of 5560 municipalities) with an HDI of 0.852. Considering the indexes calculated for all the metropolitan regions in Brazil, Campinas was ranked fourth (0.835).

social capital formation to those that stress differences between neighbourhoods in terms of access to services and other opportunities that are available at the city level. Taken as a whole these mechanisms point to the effect that neighbourhoods have in shaping the opportunities, and subsequently the life choices, of residents, what Galster and Killen (1995) refer to as "the geography of metropolitan opportunity."

Additionally, the place where people reside is important in people's day-to-day life, given that in many of these neighbourhoods their social composition, history of occupation, or even their location in the city becomes the source of stigma. As Wacquant (1996) points out, the largest cities of the world will always contain areas whose development reinforces the idea of "stigma of place" that, "superimposes itself on the already pervasive stigmata of poverty" (p. 124). It could be said that in addition to the elements such as feelings of blame or shame, living in these places, regardless of whether they actually are deteriorated, marginalized, dangerous, etc., could have a decisive impact on its in habitants given that this stigma could have significant effects on various dimensions of residents' lives. As such, the "place effect" could emerge from diverse mechanisms touching not only on questions of community, but also social networks and social gaps, as well as symbolic elements that could affect (for better or for worse) residents' access to employment and certain public services such as security, health, and education.

Although education has traditionally been seen as "the great equalizer" (see Breen and Jonsson (2005), for a recent review of literature on education and social mobility) if the quality of educational services varies such that children who reside in poor neighbourhoods have lower academic achievement, the education that these children receive does nothing to ameliorate the intergenerational transmission of poverty. On the basis of these initial premises, we propose the following question: once certain individual characteristics have been controlled, is there evidence that segregation has an impact on the school performance of children?

As Ainsworth (2002) notes, "knowing the degree to which neighbourhood characteristics influence educational outcomes is important to our understanding the processes that reproduce social inequality," (p. 118). Although neighbourhood effects on schooling are generally agreed upon by researchers, the mechanisms through which these effects operate are less known. In their review of the literature, Ellen and Turner (1997) identify six major mechanisms through which neighbourhood characteristics affect individual-level outcomes. These six mechanisms include the following: quality of local services, socialization by adults, peer influences, social networks, exposure to crime and violence, and physical distance and isolation (Ellen and Turner, 1997). Research studying the mechanisms of neighbourhood effects include, for example, examining the strength (or weakness) of normative expectations that exist in the communities (Kaztman and Filgueira, 2006), the way certain behaviors are disseminated, how collective socialization takes place through the transmission of role models (Wilson, 1991; Kaztman, 1999), and the levels of social control existing in neighbourhoods (Sampson et al., 1997).

Thus, while research has included several measures of the above mechanisms, little attention has been given to studies of school quality in shaping measures of academic achievement. Indeed, Meyer (2002) writes, "Sociologists who study neighbourhood effects have been less interested in school finance and more interested in the benefits that affluent residents might generate for their neighbours," (p. 155).

Neighbourhoods can affect the educational outcomes of their school-age residents by influencing the quality of schools located within their boundaries. In the United States, the political economy of school financing perspective posits that children who come from poor neighbourhoods have worse educational outcomes because their school districts have less financing for schooling than school districts that are comprised of wealthier neighbourhoods (Mayer et al., 2000). However, neighbourhoods can also influence their schools in other ways as well, for example, in difficulties with teacher retention (due to the perception of some neighbourhoods as undesirable to work in).

As Menezes-Filho and Pazello (2005) note, although returns on education are high in Brazil, children from poor families tend to drop out of school early on, possibly due to the poor quality of public schooling they receive. The quality of public schools is particularly salient to the lives of children from low-income families because few of these children will ever attend private school (conversely, the student body of Brazilian public schools tends to unilaterally come from economically disadvantaged homes).

Studies during the 1950s and 1960s emphasized the importance of community and families, arguing that schools were not able to change the academic reality of their students, since the thesis of social determination of reality was hegemonic (Soares, 2003). This approach was questioned at the end of the 1970s, by research methods that explored the internal processes of schools, including the quality of schools. The results of this latter research helped to make comprehensible the sociological determinism of the previous phase with the motto that "schools make the difference" and highlighting their importance in the learning process. Present research in the field does not deny the importance of these factors, but the discussion revolves around the relative weight of each and appropriate methodologies to better capture their influence on student performance.

It should be noted that recent studies have confirmed the appreciable differences (we might even say, the enormous gap) that exist between the more effective and the less effective schools. Recent research has sought to understand the internal processes in schools that determine their effectiveness, that is, their ability to positively influence the performance of their students (Soares, 2003).

Some studies have defended the thesis that schools cannot change the academic reality of their students, as this aspect is seen as largely determined by factors outside the schools, namely, the students' socioeconomic reality (Coleman et al., 1996; Bressoux, 1994). Another line of research has argued that "schools do make a difference," or, at least, that "schools can make a difference" (Brookover, 1979). Such studies have shown that, no matter how slight the effect of the schools might be, it does exist, and does weigh on the students' academic lives. Lee et al. (1993) say that this approach has demonstrated the internal differences that exist among schools, and that such factors are invisible in entrance–exit analyses.

Barbosa (2005) asserts in his investigation on the relationships between the quality of schools and student results that the evaluation in mathematics made it possible to better detect the influence of school factors, whereas the language test (Portuguese) proved to be more sensitive to family variables. According to Barbosa "these results are compatible with the hypotheses raised by Bourdieu (1979) on the different levels of the process of socialization. The formation of the primary *habitus* would seem to occur on the basis of family life, which is also responsible for the stronger or weaker mastery of the native language. This means that the evaluation of performance in language is highly affected by the socioeconomic position of the students' families, as was also shown by Basil Bernstein. It is obvious that performance in mathematics is a more clearly and strongly taught subject, and is therefore more susceptible to the characteristics of the schools where the children study" (p. 111).

The authors posit that there are three mechanisms which indicate that segregation does have an effect on students' performance: (1) the family, (2) the community, and (3) the school

itself. Studies such as those by Flores (2006) show that all three of these levels must be considered in order to discuss the question in depth. Some sources of information, such as the SARESP, used in this study, enable us to conduct multi-leveled analyses. Unfortunately, however, the microdata in these sources are still not available, a fact that limits the reach of the current analysis.

In a study on the quality of the public school system in São Paulo, Rus Perez (2000)[2] described the great heterogeneity of public schools during the 1990s. Based on this study, Rus Perez noted that the public schools in the state of São Paulo were far from being uniform. Some schools were able to provide a good-quality educational product and others failed to provide their students with even the minimum opportunities for academic success. This is a surprising finding considering that all these schools are administered by the same governmental body (the state of São Paulo), which by law sets the per capita expenditure on all students residing in the state, regardless of where they live. In the 1990s schools had no other alternative sources of financing. Although some resources were available from the Parents and Teachers Associations, they were insignificant. Nowadays this situation has changed very little.

Several hypotheses could be raised to explain the origin of this distinction in state-run schools, such as the age of the school and the fact that construction standards for school facilities changed with time due to factors related to the financial resources available (Menezes-Filho, 2007; Beltrão, 2002; Soares, 2003). The location of the schools is another important factor, since those in the more central regions of the city indirectly benefit from better infrastructure existing in these neighbourhoods. These schools are usually characterized by a stable team of teachers and other educational professionals, who are better organized and better able to obtain resources from the nearby offices of the State Department of Education and city government, than schools located in the periphery (which tend to be the poorest regions of Brazilian cities).

The Brazilian Federal Government's SAEB Database (*Sistema de Avaliação de Educação Básica*—Basic Education Evaluation System), related to the National Performance Evaluation (*Avaliação Nacional de Desempenho*), resulted from a sampling of students in the 4th and the 8th grades of elementary education and the final year of high school. Studies based on these data (Menezes-Filho, 2007; Beltrão, 2002; Soares, 2003) have shown that there are great differences in performance among schools in the same state and even in the same educational system, this being true even when socioeconomic variables of the students' families are controlled. This conclusion suggests that the role of the school does have an effect on students' performance.

Some authors like Menezes-Filho (2007) stress that the condition of the infrastructure and the educational equipment at schools have not proved to be major factors in academic performance, since all schools have minimum physical facilities that can guarantee the students' progress. Despite this, we agree with Soares (2003) about the importance of schools' characteristics. According to this author "a well-maintained physical environment is associated with high levels of learning and with a sense of well-being. Good maintenance of school buildings favors environments that are more conducive to study. In the opposite direction, lack of maintenance seems to encourage vandalism and an atmosphere of indiscipline in schools. Positive physical conditions of school buildings also tend to indicate that the respective principals are able to administer the institutions well, especially in the case of Brazilian schools, which often lack adequate financial resources, a situation that calls for greater management capacity of the individuals involved" (Soares, 2003, p. 54). For these reasons these conditions are taken into account here, and not only because of the dearth of more direct information on factors such as the quality of the teaching and the organization of the schools. It should also be recalled that there is no reason why schools in the same system (in the present case all schools analyzed belong to the São Paulo State Public School System) would not offer the same basic physical conditions.

We therefore looked into the conditions of the infrastructure, including the existence, at each school, of a library, an athletic area, science and computer laboratories for student use, among other types of spaces and equipment. In this way, we were seeking, even though indirectly, to identify those schools that have the best teachers, the most active principals, the best possibilities for carrying out more creative educational activities, etc., recognizing that data are not currently available from existing sources.

2.3. The characteristics of public elementary education in Brazil

Brazilian political administration is highly decentralized, consisting of 27 state systems (including the Federal District) and 5560 autonomous municipal systems. As the Brazilian educational system is markedly decentralized, there is no standard curriculum for all the schools in the country. Mechanisms for hiring and firing, determining wages, and training teachers can be quite different from one system to another, as can the selection of school administrators.

Elementary education includes first through eighth grades, and the government must offer public education to the population free of charge beginning at age seven (although students may also qualify at age six), including free elementary education. The law also provides that the yearly minimum class load be 800 h, distributed during at least 200 school days of actual academic work, not including time reserved for final examinations. Federal educational legislation defines public elementary education as primarily the responsibility of the municipalities. However, state governments are instructed to cooperate with municipal governments in order to address any unmet demand for public schooling, which is usually the case. The diversity found among educational establishments in terms of their human, physical and material resources directly reflects the co-existence of different educational systems operating at the same time. Diversity even exists within educational institutions administered by the same governmental authority, as we shall see below.

Nationally, with regard to teachers and educational professionals, the law requires that each governmental education system establish their own by-laws and career plans for professionals employed in their system. For this reason, there is no single standardized set of laws that covers all educational professionals. These professionals are divided into six fields of work: teachers, administrators, planners, supervisors, inspectors, and guidance counselors. Persons may only pursue teaching careers in public education through participation in competitive public selection processes. Administrative and managerial positions in public school systems are filled through three ways: (1) through participation in a competitive selection process, (2) through nomination by the mayor or governor, based on the applicant's qualifications, or (3) through participation in a competitive selection process combined with a nomination from a school's principal.

It is possible to assert that public schools management is done haphazardly and their educational policies vary widely. One reason for this is that principals do not select the personnel who will work on their faculty. Each teacher chooses the school at which he or she will teach. Those with higher points awarded in the competitive selection process have greater precedence for being assigned to the school which they select. Once assigned to a school, a teacher

[2] This analysis was carried out on the basis of a study conducted in 1991, whereby questionnaires were mailed to principals of public schools operated by the government of the State of São Paulo, based on a large sample (630) of state schools. The rate of return of the questionnaires was 39.6%.

may then remain at the school as long as he or she wishes. This manner of assigning faculty to schools results in constant turnover of both teachers and principals—especially in less desirable schools. This makes it practically impossible for schools to establish stable teams of teachers and long-term educational projects.

In 1990 Brazil implemented a federal system of external evaluation of students, known as the National System for Evaluating Basic Education (*Sistema Nacional de Avaliação de Educação Básica*). This evaluation test is applied bi-annually by the Ministry of Education. Performance evaluations are carried out every 2 years on representative samples of students in public and private schools. The results of the performance tests in mathematics illustrated that nearly a third (32%) of students enrolled in state schools performed at a critically low level, whereas in the private schools this percentage was only 1.9% (MEC/INEP, 2003). The results of these federal evaluations make it clear that, even though state schools are offering ever greater numbers of vacancies and building more elementary and high schools, the quality of the education in these schools is far below the minimally acceptable standards.

In 1996, the São Paulo State Department of Education implemented its own evaluation system (SARESP). The objective of this test is to evaluate the performance of elementary and high school students enrolled in state-run schools in various subjects (the subjects included in the test vary from year to year). These performance evaluations are applied at all state-run schools as well as at municipal schools that opt to participate. It should be recalled that, according to the legislation, primary education in Brazil can be handled by either the state or the municipal government. In some cases, therefore, state-run and city-run schools can co-exist in the same municipality, operating with partially different curricula but aimed at the same target population, generally, students from low-income families.

The information obtained through these tests serves as a diagnosis to aid schools in their planning. It is especially important for establishing curricula in Portuguese, mathematics, science, history and geography, as it indicates critical aspects of the curriculum that require rapid intervention and priority by teachers, schools, departments of education and the entire educational system.

3. Data and methods

Here it is useful to bring up a few methodological considerations as to the meaning of this segregation and how it is measured. Although studies on segregation in the United States often examine spatial differences according to race, populations can also concentrate geographically according to their socioeconomic status, age and/or ethnic group (Frisbie and Kasarda, 1988). In the case of Brazil, it is evident that socioeconomic status is a better predictor of a person's residence than his or her race (Telles, 1992, 1995). In any case, residential segregation refers to the phenomenon where two or more social groups live in areas that are physically distant from one another in the urban fabric (Massey and Denton, 1988). It is important to recall, however, that residential segregation (that is, physical distance) is not necessarily equivalent to social exclusion (that is, social distance), although it can be considered an indicator of this process (as argued by Park (1967)). Nevertheless, researchers (Sabatini, 2004; Rodríguez Vignoli, 2001; Massey and Denton, 1988, among others) have accepted the idea that residential segregation is a complex phenomenon that can be examined on several dimensions.

In their works on residential segregation in the US, Massey and Denton identify five dimensions of segregation: evenness, exposure, concentration, centralization, and clustering (Massey and Denton, 1988, 1989). However, as other researchers warn (such as Sabatini, 2004), not all these five dimensions of segregation are applicable to studies on urban areas. In point of fact, Sabatini (2004) argues that clustering is the only "true" measure of segregation.

However, many measures of residential segregation are aspatial. These measures do not take into account the population's distribution across the territory, in that they provide a summary statistic of segregation, without providing an indication of the spatial pattern of segregation. For example, the same aspatial segregation measure value can be arrived at for two cities with very different patterns of segregation. As such, aspatial measures of segregation mask differences in the levels of segregation within the urban fabric. In order to address this methodological problem Anselin (1995) argues in favor of the identification of spatial patterns using local indicators of spatial association (LISA). These indicators are ones where a summary and aspatial measure of clustering can be decomposed into individual values for each spatial unit under analysis. Clustering refers to the way a population is distributed in space, and it indicates whether the sub-areas occupied by a part of the population with the same characteristic (being poor, for example) are spatially close together or dispersed throughout the urban area.

The local Moran's I allows for the identification of contiguous areas of high and low values of a particular characteristic within the city, so called hot spots and cold spots (Anselin, 1995).[3] The global Moran's I is the summed values of the local Moran's I, and it indicates the degree to which the characteristics of a defined area are a significant predictor of the characteristics of its neighboring areas in a given territory (e.g., a metropolitan region).

Even though this indicator has some advantages, it too is affected by the choice of the area and the scale by which the segregation is studied, as are other measures of segregation. The problem of the variability of the areal units (MAUP) often exists in spatial analyses because of the arbitrary nature of the designation of the spatial units (for example, census areas). Usually—the present case included—the spatial units employed are arbitrarily designated on the basis of methodological facility, and do not necessarily reflect the boundaries of what residents consider to be their neighborhoods.

Data from the 2000 Brazilian Demographic Census at the level of census sectors (*setores censitários*—the lowest level of information available) was used to characterize the neighborhoods where schools are located. In order to measure segregation across census sectors we use a combination of socio-demographic indicators that reflect not only the human capital of households, but also factors related the quality and the composition of households and neighborhoods. A factor analysis was carried out to obtain poverty indicators on the basis of the significant factors identified.[4] Three distinct factors were arrived at, namely, socioeconomic status, neighborhood characteristics, and family life cycle. For the purposes of this study, only the first factor (socioeconomic status) was em-

[3] In general, a hot spot can be described as a zone where a sub-area (in this case, a census sector) with high levels of the variable chosen for the analysis is surrounded by others with similar values. In contrast, a cold spot is a zone where sub-areas with low levels of the variable in question are surrounded by sub-areas that also show low values.

[4] The following characteristics of census sectors were used in the factor analysis: Percentage of children 7–14 years old who are illiterate, percentage of illiterate heads of households, percentage of heads of households with an elementary school education or less, average years of schooling of the heads of households, average monthly head of household income, percentage of households without garbage collection, percentage of households without piped water, percentage of households without a bathroom, percentage of households not connected to the sewage system, percentage of rented households, percentage of head of households 10–29 years old, average age of the head of household, percentage of the population who are young or old-age dependants, and the percentage of heads of households who are female with an elementary school education or less.

Table 1
Global Moran's I by socioeconomic status poverty indicator, municipality of Campinas and the Metropolitan Region of Campinas, 1991 and 2000.

Poverty indicator (factorial scores)	1991	2000
Municipality of Campinas	0.5163	0.4062
Metropolitan Region of Campinas	0.5370	0.3776

Source: Brazilian Demographic Census, 1991 and 2000.

Table 2
Elementary and high schools by administrative body, municipality of Campinas, 2000.

Administrative body	Elementary schools		High schools		Total	
	#	%	#	%	#	%
State	153	58.0	74	62.0	227	60.0
Municipal	39	15.0	0	0.0	39	10.0
Private	70	27.0	45	38.0	115	30.0
Total	262	100	119	100	382	100

Source: Edudatabrasil/MEC/INEP.

ployed because it was the indicator with the highest percentage of variance explained (43% in 1991 and 38% in 2000). From here on forward it is referred to as the "poverty indicator".

Data on schools come from two sources—the average scores on the SARESP test, described in the previous section, and the school census (*censo escolar*). The Brazilian federal Ministry of Education school census collects data on approximately 52,000,000 students and 266,000 public and private schools located in 5560 municipalities in Brazil. Information is obtained on the functioning and infrastructure of schools, as well as data specific to students, teachers and staff. From the school census we arrive at the following four dichotomous indicators of school infrastructure, which present the most variability across schools: the presence of a sports field, science laboratory, computing laboratory, and library.

We limit our analysis to state-run schools located within the municipality of Campinas, as the SARESP is only administered to this group of schools. In 2000, third, fifth and seventh grade students were tested in mathematics and Portuguese. The results presented here are only for the test scores of fifth graders in mathematics. Consequently, for the time being results are only presented for state-run elementary schools that teach 5th–8th grades (some state-run elementary schools teach only 1st–4th grades).

Although ideally we would analyze the SARESP scores by individual students, the São Paulo State Department of Education only divulges SARESP scores by the mean scores of all students in the same grade at a particular school, by test subject. As such, we can only deal with the level of the school in our multivariate analyses.

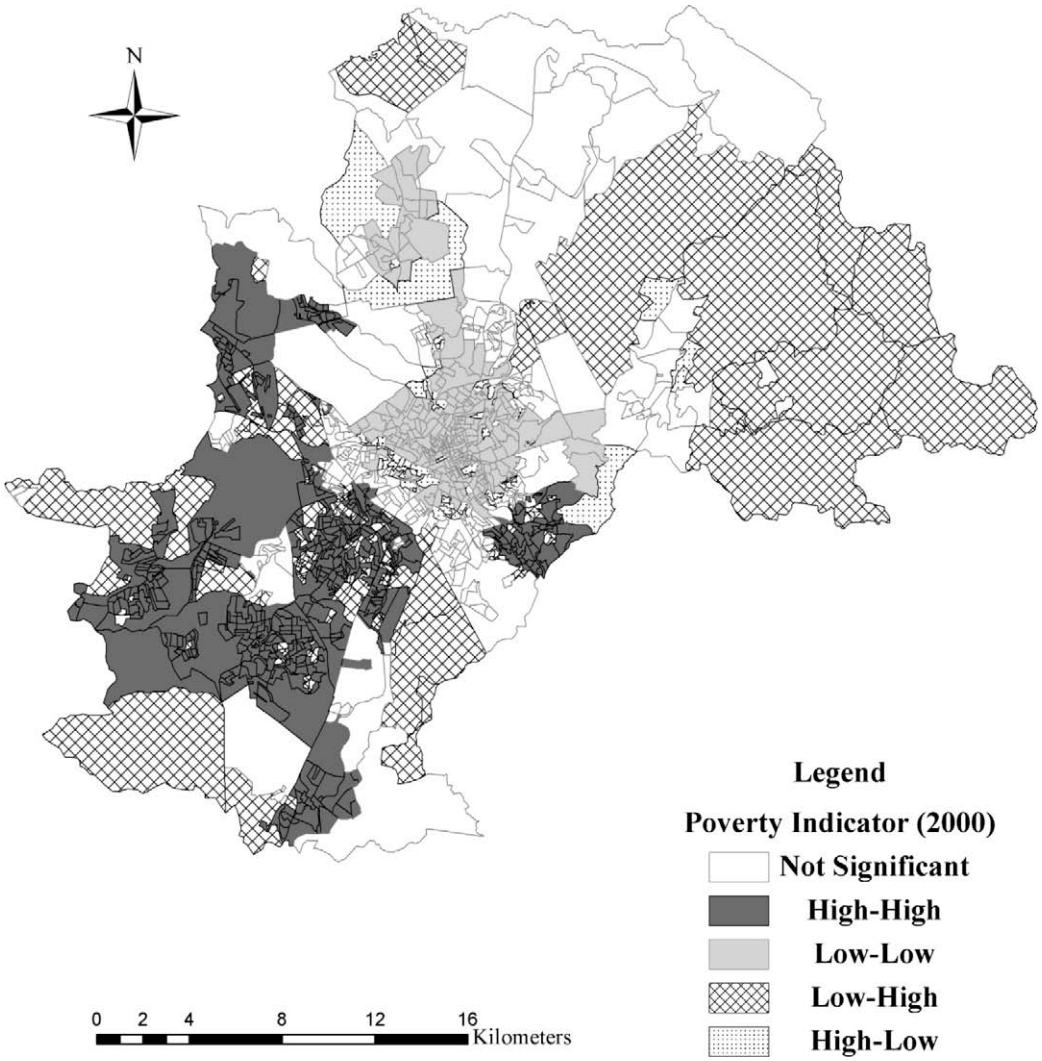

Fig. 2. Local Moran's I by poverty indicator, municipality of Campinas 2000. *Source:* Brazilian Demographic Census, 2000.

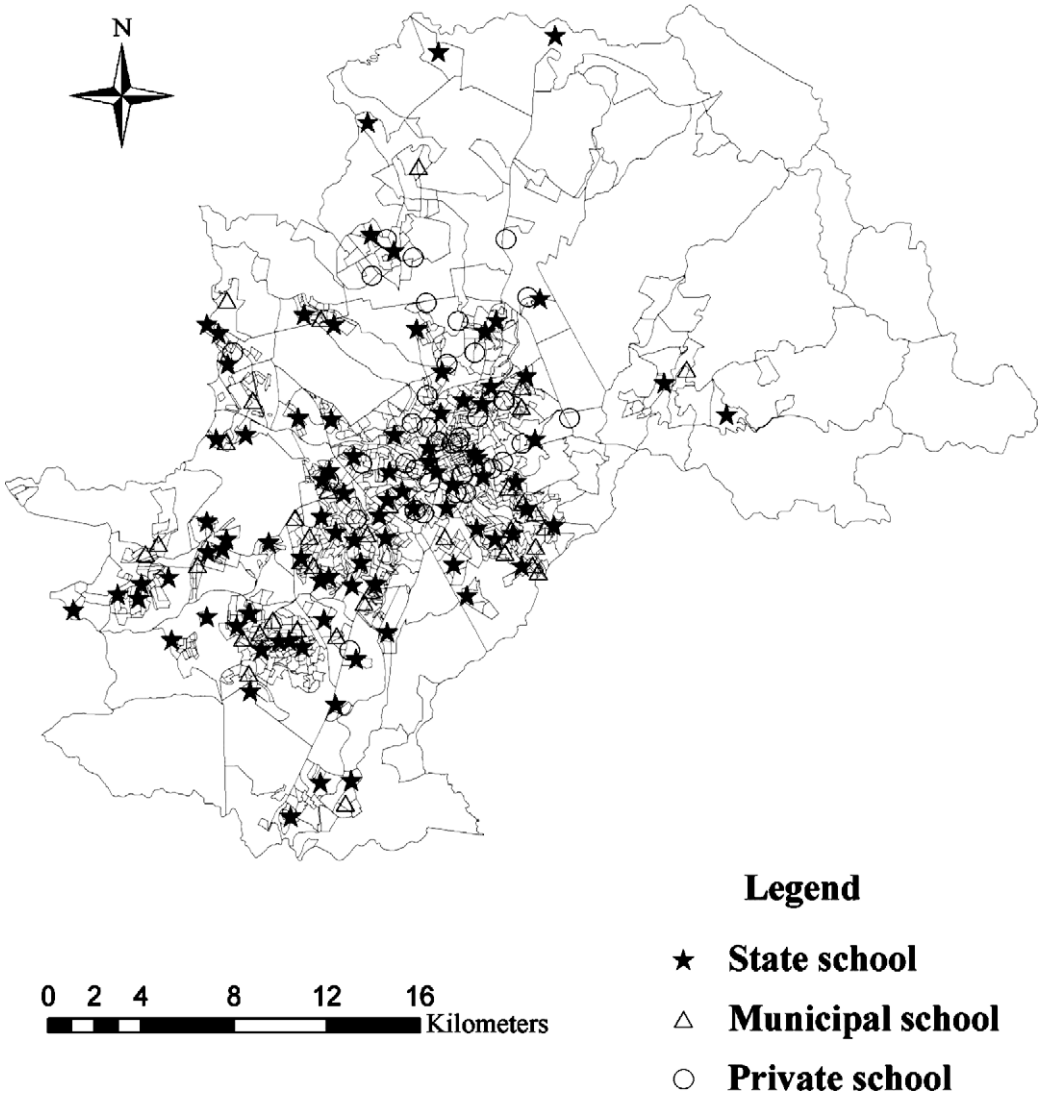

Fig. 3. Location of schools with 5th–8th grades by administrative body, municipality of Campinas, 2000. *Source:* Brazilian Demographic Census and School Census, 2000.

It should be noted that this analysis performed may be running the risk of committing the so-called ecological fallacy, i.e., of assigning values to individuals that were not necessarily consistent with their socio-demographic characteristics. However, considering that, as shown by Luhr and Cunha (2004), in the city of Campinas there is a low variability of the SARESP grades between state schools for elementary education (average 45.1% of accuracy with standard deviation of only 5%), it can be argued that the variability between individuals was not high, a fact which, if not eliminates, at least reduces the impact of limiting the data used here.

4. Results

4.1. Campinas: a city divided between rich and poor

The first observation to be made regarding the process of segregation in the region of Campinas is that the levels of segregation in the municipality itself were very similar to those seen in the metropolitan region as a whole (Table 1). This means that, on the one hand, the city of Campinas also shows a clear spatial divide between affluent and poor households, even though, in certain regions, especially those closer to downtown, this division is not so clear. This result illustrates that the situation in the metropolitan region as a whole reflects, in general, what has been taking place in the municipality itself.

The local Moran's I demonstrates a broad separation between rich and poor in Campinas. There is a clearly delimited and uniformly poor area in the southwestern portion of the municipality and in the far eastern portion. On the other hand, the central areas and the neighbourhoods to the north and northeast of Campinas are populated primarily by higher-income households (see Fig. 2).

It is also interesting to note that this division, geographically delineated by the Anhangüera Highway,[5] is related to historical determinants involving the process of urban occupation in the municipality that, in its early stages of growth, reserved the central areas of the city for the higher-income population, and the areas considered less aristocratic (to the west of the highway) to the poor population. More recently, the areas of fertile land to the north of the highway, which were so valued for agriculture in the past, began to be occupied by new forms of settlements, especially gated communities.

[5] The Ananhgüera Highway is a major highway connecting the city of São Paulo with the northern region of the State of São Paulo, and passes through Campinas.

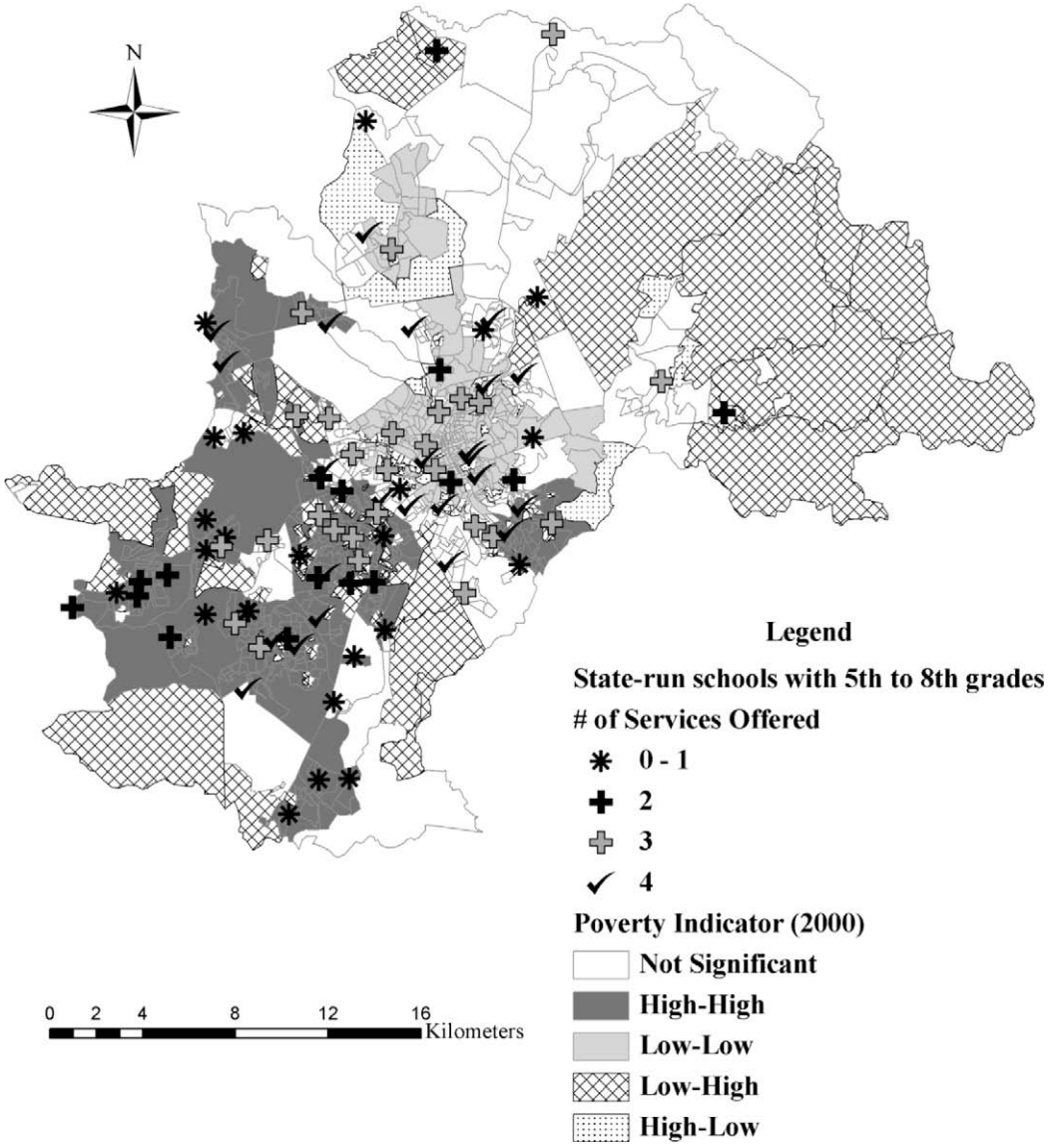

Fig. 4. State schools with 5th–8th grades, by number of infrastructure characteristics ("services"), and local Moran's I by poverty indicator, municipality of Campinas, 2000. *Source:* Brazilian Demographic Census and School Census, 2000.

Table 3
Descriptive characteristics of state-run schools with 5th–8th grades, municipality of Campinas, 2000.

Neighborhood characteristics	
Local Moran's I	
Hot spot of poverty (%)	44.6
Cold spot of poverty (%)	18.1
Sector of low poverty surrounded by high poverty (%)	9.6
Sector of high poverty surrounded by low poverty (%)	4.8
No significant clustering (%)	22.9
Average years of schooling of the household head	7.4
Average monthly income of the household head (R$)	1265.00
School infrastructure	
Computer lab (%)	48.2
Library (%)	72.3
Sports field (%)	95.2
Science lab (%)	53.0
School academic achievement	
Average SARESP Math score	44.0

Source: Brazilian Demographic Census, School Census, SARESP 2000.

Table 4
Mean number of school infrastructure indicators and average SARESP scores for 5th graders in math, municipality of Campinas, 2000.

Local Moran's I	Mean number of school infrastructure indicators	Average SARESP math score
Hot spot of poverty	2.5	38.9
Cold spot of poverty	3.1	51.6
Low–High	1.9	45.7
High–Low	3.3	45.9
No significant clustering	3.0	46.9

Source: Brazilian Demographic Census, SARESP, School Census (INEP).

In the case of the municipality of Campinas, 58% of the elementary schools (*ensino fundamental*—1st–8th grades) are operated by the São Paulo state government and 15% by the municipal government, while 27% are private (Table 2). As can be seen in Fig. 3, the distribution of the schools illustrates the reality of the socio-spatial segregation that exists. It is clear that the great majority of the

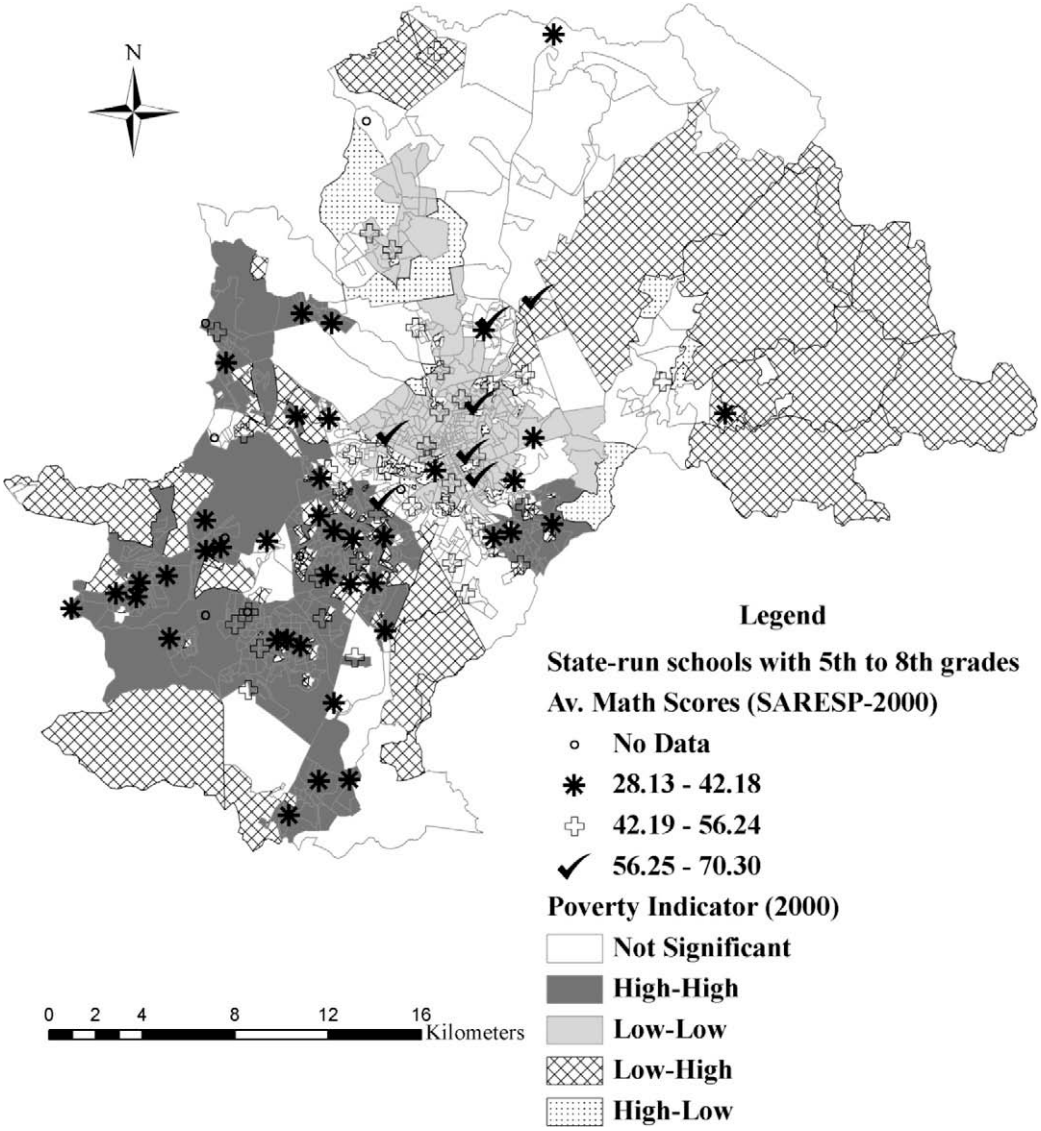

Fig. 5. Average SARESP math scores in state elementary schools with 5th–8th grades, and local Moran's I by poverty indicator, municipality of Campinas, 2000. *Source:* Brazilian Demographic Census and SARESP, 2000.

private schools are located in the affluent neighborhoods in central Campinas. A number of public schools are also located in the central region of Campinas, but this does not prevent students living in the periphery from attending these schools. Luhr and Cunha (2004) provide evidence supporting this fact when discussing the case of one of the oldest schools in Campinas (Escola Estadual Carlos Gomes), located downtown and, therefore, in one of the richest areas in the municipality. Although Brazilian law requires that children study at schools as close as possible to their homes, this law oftentimes is difficult to enforce. Notwithstanding, few students in Campinas frequent schools located outside of their immediate neighborhood. This fact can be supported by our own survey carried out in 2007.[6] According these data, more than 78% of children below 15 years old attending school take up to 15 min to go to school; if we consider the group that take up to 30 min, this percentage would reach 96%.

The data analyzed here for the year 2000 illustrate that the conditions described by Rus Perez (1996) continue to be valid. It would be no exaggeration to state that, since public schools operate on the basis of a single educational policy (same wages, forms of access and composition of faculty, school lunch programs, educational material, training of teachers, etc.), there would be no reason why these schools, especially those operated by the state government, should be heterogeneous, at least from the point of view of their infrastructure. However, information on Campinas state schools show that there are major differences from one school to another and, more importantly, that this difference is related to the location of the schools within the municipality. As can be seen in Fig. 4, the hot spots of poverty (high–high on the map) contain the highest concentrations of poorly equipped schools, whereas the better or best equipped schools are located in the center of the city and other areas where the more affluent live. It can therefore be seen that most of the schools with the lowest quality (such as those that offer no, or only one, "service") are located in the peripheral areas of the municipality, although some are located in the central region. This does not mean, however, that better equipped schools cannot be found in poorer areas.

Tables 3 and 4 complement the information presented in Fig. 4. Approximately 45% of the state schools are located in the hot spots

[6] This survey was performed during the second semester of 2007 with a sample of 1680 households (5902 people) in the Metropolitan Region of Campinas.

of poverty, while only 18% are located in more prosperous areas of the city. They also show the strong heterogeneous nature of these schools, especially in regard to their having a computer lab or science lab.

The other aspect related to the schools considered in this analysis is their students' academic performance. The first point to be noted is the low average scores attained by the students in the municipality. However, even with this low average, significant differences can be noted among schools, especially if one compares the more central schools with those located in the hot spots of poverty. As can be seen in Table 4, there is a considerable difference between the grades attained in the hot spots of poverty and those achieved in the cold spots. Fig. 5 illustrates a high correlation between school performance and the location of the school in the city. The maps show that, in general, the lowest grades (lowest third) were found in the most distant and poorest outlying areas.

Lastly, as a way of demonstrating the statistical relationship between the location of schools and school performance, a linear regression model was run to estimate the effect of location on schools' mean academic performance (Table 5). This aspect was represented by each school's average scores on the SARESP test. The predictive variables were the location of the school in a segregated area (measured by the local Moran's I), the average years of education and monthly income of the head of household in the census sector where the school is located, and school infrastructure.

As can be seen here, although household head income was not significant, household head education was, in that a 1 year increase in head of household income is associated with a two point increase in SARESP score. However, the most important predictors were those of the spatial location, which surpassed the characteristics of school infrastructure. All else being equal, location in a hotspot of poverty lowers a school's average on the SARESP math test by more than three points. Another important variable to math scores is the existence of a computer lab. Rather than indicating that the presence and use of computers improves student performance in math, this result could also be understood as an indication of the impact that a school's infrastructure has on the performance of its students. Therefore, from the statistical point of view, there is a clear indication of the effect that the location in the city may have not only on the quality of a school's facilities but, primarily, on its students' performance.

Table 5
Linear regression predicting mean SARESP math scores for 5th graders, municipality of Campinas, 2000.

Variable	
Intercept	26.5***
School neighborhood characteristics	
Local Moran's I (ref group = not significance areas)	
Hot spot of poverty	−4.39*
Cold spot of poverty	−2.40
Low poverty surrounded by High	−2.91
High poverty surrounded by Low	−3.69
Mean years of education of the head of household	2.33*
Mean monthly income of the head of household	0.00
School infrastructure	
Computer lab	3.14†
Library	1.78
Sports field	2.24
Science lab	−0.60
Adjusted *R*-squared	0.42
N	83

Source: Brazilian Demographic Census, SARESP, School Census (INEP).
* p<.05.
*** p<.001.
† p<.10.

5. Conclusions

The urban fabric of the Metropolitan Region of Campinas shows a pattern of social, demographic, and economic segmentation, as well as by the expansion of peripheral areas with low quality of living, substandard housing, and deficiencies in urban infrastructure. Public schools stand out especially with regards to this area of problems in infrastructure.

There seems to be consensus that education is one of the factors that contributes to reductions in inequality. Schools are therefore essential in providing opportunities, especially to children from low-income families. Schools could contribute to the minimization of the effects of social segregation, which is an important characteristic of Brazilian cities.

By using an analytic approach that enables researchers to advance understandings of the spatial distinctions that exist in the urban fabric, the authors hope to have provided information that contributes to the formulation of social policies, especially in the area of education. It is presumed that such policies will aim at increasing the capacity of families to react to the many risks existing in the urban space.

Using aspects of the infrastructure found in schools as general indications of their quality, a high correlation can be seen between schools in poor physical condition and great poverty, in the same areas of the municipality of Campinas. This result is not surprising when one takes into account the considerable socio-spatial inequality in the municipality (Cunha et al., 2006). Even so, the result especially stood out in one important detail: all the schools analyzed had been built by the state government and their maintenance was under its responsibility. It might therefore be imagined that there would be no reason for these considerable differences. This visible and undeniable degeneration of public services in the more peripheral urban areas in Brazil is obviously a further element to be combated if social equality is to be attained.

However, the findings obtained in the multivariate analysis related to this study came up with some important information. For example, even when variables related to the quality of schools were controlled, together with other variables that are also admittedly influential in student performance, such as parents' educational and income levels, the effect of the geographical location of the school nevertheless remained significant, especially regarding students' performance in the mathematics tests. According to Barbosa (2005), math scores are more strongly influenced by the "school" factor than by the family, as mentioned above.

This fact leads us to reflect on the many different factors that could possibly explain this relationship, many of which are treated theoretically in this article, but not gone into empirically due to the lack of specific information about them. In fact, if the quality of the school and the school environment are important aspects, other elements that were probably not considered in our model but expressed on the basis of the "school neighbourhood characteristics" variable may also exert major effects. As noted earlier, we recognize that segregation has an effect on student performance through three mechanisms, namely the family, community and school. However, this study did not have access to the SARESP microdata, restricting our ability to including information on these mechanisms.

It is clear that mechanisms related to the assignment and distribution of teachers in Brazil exacerbate spatial differences since, as a rule, the teachers themselves have a say in where they will work. A number of other factors are also influential regarding the disparities discussed here, such as the so-called neighbourhood effects, peer effects, and roll effects. In any case, we must agree with the many authors mentioned in this study who posit that the effect of place of residence opens up an important and promising path

of research, especially in view of what this means in terms of proposals for public policies. This and other studies clearly show that, even though both socioeconomic indicators and poverty in general are important factors in explaining the educational performance of students, the factor of space, or what it means in the process of social reproduction, also seems to be an aspect that should always be taken into account. Thus, the effect of a school's location must also be taken into account when examining possibilities for improving elementary school education in Brazil. This is particularly important given that Brazil has reached near universal enrollment of elementary age children, an achievement which other countries of the region have yet to reach.

Therefore, although the entire discussion is still in a process of maturation, the authors hope to have presented a contribution by pointing in new directions toward the improvement of equality in education.

Acknowledgements

This study is part of the project entitled "*Dinâmica Intrametropolitana e Vulnerabilidade sócio-demográfica nas metrópoles do interior Paulista*" (intrametropolitan dynamics and socio-demographic vulnerability in the large cities of the state of São Paulo, Brazil), carried out at the Population Studies Center (NEPO), the State University of Campinas (UNICAMP), with financing from FAPESP and CNPq.

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