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Educational Socio-Spatial Segregation in Ankara

Ankara'da Eğitimsel Sosyo-Mekansal Ayrışma

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ABSTRACT

Socio-spatial segregation has always been a big phenomenon for cities and it is getting more crucial while the social and spatial environment of cities transforming and restructuring in line with the hegemony of globalization. This study aims at discussing the socio-spatial segregation of education in Ankara city for 478 Ankara neighborhoods from 2008 to 2014 regarding the three education levels, primary, secondary and tertiary, respectively. To do so, we analyzed the spatial distribution and spatial dependency of the socio-spatial segregation of all education levels. Then, we estimated how the spatial distribution and spatial dependency of the socio-spatial segregation of all education levels are evolved, spatially. Advanced spatial analyses methodologies like the exploratory spatial data analyses, segregation measures, and spatial statistics methods are used for uncovering the spatial dynamics of educational segregation in Ankara. This study reports significant results (i) each educational level have different trends and spatial dependency patterns are apparent in the socio-spatial segregation, (ii) tertiary education level has a fast decreasing trend, (iii) the south-north dualism restructured.

Keywords: Ankara; education; segregation; spatial segregation.

ÖZ

Sosyo-mekansal ayrışma, kentler için her zaman büyük bir olgu olmuştur ve kentlerin sosyal ve mekansal çevresi küreselleşme temelli hegemonyaya paralel olarak dönüşürken ve yeniden yapılanırken daha da önem kazanmaktadır. Bu çalışma, Ankara ilinde eğitimin sosyo-mekansal ayrımının 2008'den 2014'e kadar 478 Ankara mahallesi için ve sırasıyla birincil, ikincil ve üçüncül olmak üzere üç eğitim seviyesi için tartışılmasını maçlamaktadır. Bu kapsamda, tüm eğitim düzeylerinin mekansal dağılımı ve mekansal bağımlılığı analiz edilmiştir. Sonrasında, tüm eğitim seviyelerinin mekansal dağılımı ve mekansal bağımlılığın mekansal olarak nasıl değiştiği tahmin edilmiştir. Mekansal veri analizleri, mekansal ayrışma yöntemleri ve mekansal istatistik yöntemleri gibi ileri mekansal analizler, Ankara'da eğitimsel ayrımcılığın mekansal dinamiklerini ortaya çıkarmak için kullanılmıştır. Bu çalışma, önemli sonuçları ortaya koymaktadır (i) her eğitim seviyesinin farklı eğilimlere sahiptir ve sosyo-mekansal ayrışmada mekansal bağımlılık paternleri belirgindir, (ii) yüksek öğretim eğitim seviyesinin hızlı bir düşüş eğilimine sahiptir, (iii) güney-kuzey düalizminin yeniden yapılanmıştır.

Anahtar sözcükler: Ankara; eğitim; ayrışma; mekansal ayrışma.

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Introduction

The historicity of socio-spatial segregation dates back to the beginnings of cities themselves. Socio-spatial segregation maintains itself in a multi-layered way in social and spatial environments by reproducing and repositioning itself by conjectural norms and patterns (Schelling, 1971; Clark, 1999; Fossett, 2006; Andersen, 2011; Bailey et al., 2013, 2016). Various theoretical analyses have examined socio-spatial segregation, and have incorporated contexts that include income, consumption, individual behaviour, educational level, and cultural associations and oppositions (Wong, 1999; Newbold & Foulkes, 2004; Johnston et al., 2006, 2013; Brama, 2008; Holdsworth, 2008; Sage et al., 2011; Branden, 2012; Hochstenbach, 2014; Catney, 2015; Aradhya et al., 2016; Gustafsson; 2016). Importantly, some studies report that socio-spatial segregation is deeper for educational level than for income, ethnicity and other socio-demographic factors (Domina, 2006; Persson, 2008). Analyzing socio-spatial segregation of educational level is crucial because socio-spatial segregation and social stratification decrease the tendency towards coexistence and the heterogeneity of urban spaces, and these lead to conflicts and unstable urban living environments.

Socio-spatial segregation approaches vary because cities are subject to dynamic restructuring processes triggered by flow of capital, migration (the millions and include both domestic and international migrants) and the speed of the capitalist production. Thus, cities incorporate different individuals, forms of social life, social capital, income differences, preferences, attitudes and heterogeneous communities, and these are the main drivers of the simultaneously reproduction and transformation of urban spaces (Harvey, 1989).

When considering socio-spatial segregation in the processes that affect urban spaces, it is important not to overlook the unequal spatial distribution of educational level. According to Bourdieu (2006), an educational level is a tool for legitimizing and perpetuating class conflicts. Thus, higher educational level is associated with higher class privilege, superior reputation, and participation in a club comprising the more highly educated, all of which can serve as tools to reproduce the existing hegemony (Sullivan, 2002; Bourdieu, 2006). The unequal spatial distribution of educational level or the concentration of educational level in specific spaces reflects the reproduction and repositioning of hegemony derived from the socio-spatial segregation of educational segregation in urban spaces.

Socio-spatial segregation of educational level maintains itself in urban spaces as the tension between city areas. On the one hand, gentrified, gated and isolated city areas are inhabited by groups with higher levels of income and education, while satellite cities are inhabited by the new middle classes. On the other hand, city areas with poorer spatial quality and living environ-ment are inhabited by groups with lower levels of income and education (Logan et al., 2004; Yüceşahin and Tüysüz, 2011).

The permeability between these differing and segregated city areas reflects individual participation in a more desired class. Restated, leaving a city area with the lower spatial quality, living environment for one with a distinguished and elite population and living environment is associated with Bourdieu's (2006) argument that positive externalities derived from the accumulation of educational level in a specific place strongly affect the socio-spatial segregation.

By focusing on the socio-spatial segregation and measuring it using educational level, this study aims to investigate the uneven geography of educational segregation: i.e., its spatiality and geography. Concerning the socio-spatial distribution of educational segregation, this study answers the following questions: What are the spatial distributions of educational segregation categories such as primary, secondary and tertiary educational levels? How do the spatial distributions of these categories exhibit spatial dependency patterns? And how have the spatial distribution and dependency of socio-spatial segregation evolved across the 478 Ankara city neighborhoods studied here from 2008 to 2014?

The next section outlines the socio-spatial segregation literature and discusses educational socio-spatial segregation. The third section shows the data and methodology used in this study. The fourth section reveals the spatial distribution patterns of socio-spatial segregation, its spatial dependence and the evolution of such spatial distribution and dependency patterns during the study period. The fifth section presents the results and discussion of socio-spatial segregation analyses. The final section gives conclusions.

Literature Review

Socio-spatial segregation approaches include design-based approaches, economic analyses (which identify city areas based on differences in economic activity), economic reductionist approaches (focused on social classes) and different fields of cultural deterministic approaches. Socio-spatial segregation has been reduced to a design problem by the design-based approach provided the instrumentalization of the design could solve socio-spatial segregation problems and provide a more stable and high-quality urban living environment. In the neoclassical approach, socio-spatial segregation is determined by economic indicators. Focused solely on economic dynamics, the neoclassical approach ignores indicators such as social class, racial mix, and educational level. The Chicago School stresses the need for more complex and relational analyses of socio-spatial segregation. The behavioral approach sees socio-spatial segregation as derived from individual preferences, percep-
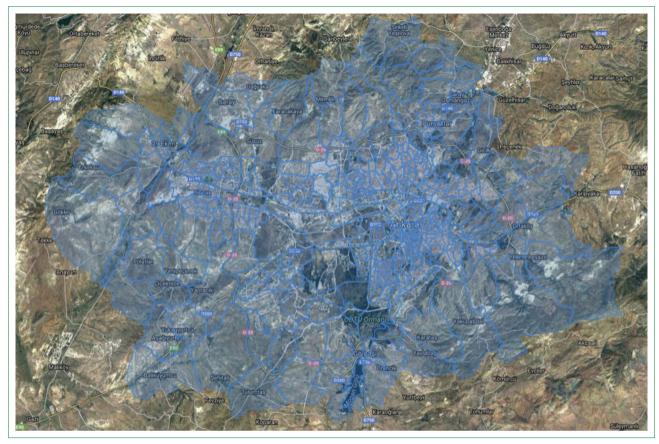
Figure 1. Study area Ankara city.

tions, and decisions. The cultural and environmental determinist approach claims that socio-spatial segregation results from cultural and environmental degradation. The Marxist approach stresses the class aspect of socio-spatial segregation in cities and emphasizes that segregation analyses based on culture and ethnicity (among other factors) manipulate inter-class conflicts derived from socio-spatial segregation (Caner & Fulin, 2013).

The hegemon creates an object of desire and develops various strategies to manipulate this object (Bourdieu, 2006). Thus, increased competition due to inequality in urban and social spaces encourages individuals to pursue capital and status symbols to increase their prestige and position in society. This is the main reason behind the spatial concentration of educational segregation in specific city areas reflects the contradictions and conflicts between classes in terms of their desire to attain higher class privileges (living or being closer to the educated population accumulated part of the city) and constructs the fundamental forms of social stratification and socio-spatial segregation (Bolt et al., 1998; Naidoo, 2004).

The segregation literature mostly comprises studies exploring cultural and economic segregation. Massey and Denton (1987, 1993), Logan et al. (1996) and Harris (1999) focused

on racial segregation, while Castells (1977), Harvey (1989) and Massey (1996) focused on economic segregation. Socio-spatial segregation analyses based on educational segregation are limited in the literature to date, although several studies have reported that segregation at the educational level is deeper than that at the income, social, racial, and other levels (Naidoo, 2004; Domina, 2006; Persson, 2008). Turkish segregation studies include various socio-spatial segregation studies: Güvenç (2001), Güvenç and Işık (2002) and Işık and Pınarcıoğlu (2001, 2009) explored income; Akpınar (2009, 2010) explored consumption; Türel (1981) examined house prices; Ataç (2016) and Yüceşahin and Tüysüz (2011) studied indexes of segregation, which consist of various indicators; and Bektaş and Yücel (2013) focused on slums while Şanlı and Sönmez (2016) focused on upper-class neighborhoods. This study contributes to the literature by analyzing the socio-spatial segregation of educational level with exploratory spatial data analysis (ESDA) methodology. Educational level was categorized into three intervals: i.e., the primary, secondary and tertiary levels. The spatiality of these educational categories was to measure the concentration tendencies of educational segregation in specific Ankara city neighborhoods. The data, methods, and categorization used in this study are discussed in the following section.

Data and Methods

Annual population census data were used to analyze the social-spatial segregation of educational segregation across 478 Ankara city neighborhoods (Fig. 1) from 2008 to 2014 (7 years). Thus, the dataset comprises 3346 (7×478) observations. The lack of neighborhood-level data for the older dates limited the analysis to the period 2008–2014. This study covers all the of the Sincan, Etimesgut, Yenimahalle, Keçiören, Pursaklar, Çankaya, Altındağ and Mamak districts because they are located within the Ankara metropolitan area. However, neighborhoods with less than 500 residents in the southern rural areas of Elmadağ and Gölbaşı were neglected because of a lack of proper data. Table 1 shows the number of neighborhoods for each district analyzed in this study.

Segregation in educational level across Ankara city neighborhoods was measured for different educational levels: i.e., primary, secondary and tertiary. Analyzing the uneven geography of educational socio-spatial segregation is quite important since the educational level or education is an economic issue which requires allocation of capital to achieve better statue, prestigious jobs or living conditions, etc. which refers to the investment of the part of the income of individuals or families to increase their position in the society. Second, socio-spatial segregation is a dynamic process changing over time and this makes education data valuable since measuring segregation through the educational level gives the possibility to display and evaluate the evolution of socio-spatial segregation in time interval rather than in one-year observation. With this regard, the absence of the proper data for neighborhood-level such as income, gender, and consumption, etc. necessitates the data of educational level for measuring the socio-spatial segregation across the neighborhoods.

Educational levels were measured using the ratio of associated educational segregation relative to the total population for each neighborhood. Turkish educational data assign individuals to one of eight educational levels: illiterate, literate but not graduated from school, primary school graduate, junior high school graduate, high school or vocational school graduate, higher education graduate, masters graduate, and doctoral graduate. These data are published by Turkstat annually, cover individuals older than 6 years old, and have been available at the neighborhood level since 2008. The Turkstat educational data were regrouped to yield a simple scheme that classified individual educational levels into primary, secondary and tertiary level categories (Rodríguez-Pose & Tselios, 2009). Specifically, the illiterate population was omitted and excluded from the analysis, with the result that the sum of the primary, secondary and tertiary level categories were less than that for neighborhood educational segregation. All educational segregation associated with primary school

Table 1. Number of neighbourhoods for each district

Districts	Number of neighbourhoods
Altındağ	37
Çankaya	123
Elmadağ	21 (29)
Etimesgut	32
Gölbaşı	27 (43)
Keçiören	50
Mamak	65
Pursaklar	17
Sincan	54
Yenimahalle	52

Value within the brackets indicates the total number of neighbourhoods in the district.

graduates was assigned to the primary level, educational segregation associated with graduates of junior high school, high school or vocational school was assigned to the secondary level, and all educational segregation associated with those who had undertaken higher education, including masters and doctoral graduates, was assigned to the tertiary level.

The ESDA methodology was used to detect the spatial relations of the distribution of educational segregation across Ankara city neighborhoods. Global Moran I analysis was applied to all educational levels to test whether educational segregation is randomly distributed across different neighborhoods or exhibits spatial correlations in specific hubs.

The global Moran I statistic is expressed as (Rey & Montouri, 1999):

$$I_t = \left(\frac{n}{s_o}\right) \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} x_{i,t} x_{j,t}}{\sum_{i=1}^{n} \sum_{j=1}^{n} x_{i,t} x_{j,t}}, \quad (1)$$

where i and j are neighbors, W is a raw standardized spatial weights matrix, and w_{ij} takes the value 1 if i and j are neighbors and 0 otherwise. Moreover, $x_{i,t}$ is the log of educational segregation in year t, n is the number of neighbors, and s_o is the sum of all w_{ij} (Rey & Montouri, 1999).

Local Moran I tests were also applied to all educational levels to better understand the spatial correlation characteristics of educational segregation, including whether hubs differ from their surrounding neighborhoods. The local Moran I statistics

$$I_{i,t} = \left(\frac{x_i}{m_o}\right) \sum_{j=1}^{n} w_{i,j} x_{i,t}, \quad (2)$$

with

$$m_o = \sum_{i}^{n} x_{i,t}^2$$

Besides the global Moran I expression, m_o equals the sum of the elements of w_{ij}, (Rey & Montouri, 1999). In this study,

the HH cluster denotes high educational segregation neighborhoods that are themselves surrounded by other high social neighborhoods, the HL cluster refers to high educational segregation neighborhoods surrounded by low educational segregation neighborhoods, the LH cluster indicates low educational segregation neighborhoods surrounded by high educational segregation neighborhoods, and the LL cluster comprises low educational segregation neighborhoods surrounded by other low educational segregation neighborhoods.

Segregation according to educational level is measured by several indices: e.g., Gini, Atkinson, Theil, and coefficient of variation (CV) (Brown & Chung, 2006).

Additionally, convergence trends in educational levels were estimated and captured by the two forms of the spatial model: i.e., the spatial lag and error models. The spatial model was applied to estimate convergence trends in educational levels. The two forms were used as in equation 3, with spatial dependence as the dependent variable and in the error terms. The model comprises 2868 observations (6 years × 478 neighborhoods):

$$ln\, ln\left(\frac{ep_{i,t}}{ep_{i,t-1}}\right) = \gamma + \delta_1 ln\; ep_{i,t-1} + \mu_{i,t} \qquad (3)$$

$$\left(\frac{ep_{i,t}}{ep_{i,t-1}}\right) + \mu_{i,t\; and}\, \mu_{i,t} = \lambda W \mu_{j,t}\; \text{i=1,...,478 t=2008,...,2014}$$

where the dependent variable is the annual growth rate of educational segregation in the i at year t. The independent variable is the initial educational segregation, $ep_{i,t-1}$. δ_1 captures the increase/decrease trend so that a negative and significant δ_1 may indicate evidence of a convergence pattern, which means the level of educational segregation increased faster in low educational segregation neighborhoods than in high educational segregation neighborhoods (Barro & Sala-i Martin, 1992).

Explanatory Spatial Data Analyses

Background

After 1970, urban socio-spatial segregation became obvious as cities restructured and repositioned in the capitalist economy. After the 1970s, the market reproduced the spaces and spatiality needed to increase educational segregation accumulation and social mobility, and postpone financial crises (Lefebvre, 1991). Parallel to the accumulation of capital and the restructuring of cities and their neighborhood areas, the reproduction of social relations is converted into the hegemonic dynamic of socio-spatial segregation by commoditizing the desire to be 'outstanding' and 'exceptional'.

Ankara city was built in the context of political and ideological unity around the idea of a modern capital city. As a radical project city, the desire was that Ankara city should reflect the success of the new and modern Turkish republic. Thus, fast urbanization and migration rapidly saw Ankara city become the third biggest city in Turkey (Tekeli, 2006). Another of Ankara city's radical modern projects relates to its claim to be a ground for the formation of a newly 'distinguished' and 'indigenous bourgeoisie'. The newly generated classes in this modern capital city produced and reproduced their desired urban spaces, which formed socio-spatial segregation patterns through the power deriving from the project of creating a new modern republic. After becoming a capital city, Ankara city rapidly urbanized, with its population increasing by a factor of ten, from around 405,000 in 1927 to around 4 million in 2016. Of course, the city made changes, extensions, and shrinkages in a multi-layered way and these changes inevitably transformed socio-spatial segregation patterns. In the literature, this urbanization is frequently divided into four periods (Şenyapılı, 2004; Günay, 2006; Tekeli, 2006).

The first period of urbanization covers 1923 to 1950; during this time, the shares of the agricultural and service sectors increased significantly relative to the city's economic structure, and simultaneously the migrant population also increased. The second period runs from 1950 to 1980 and was characterized by industrial capital development driven by import substitution industrialization policies. During this period, the creation of the socio-spatial patterns of the city was heterogeneous. The third period, from 1980 to 2000, as defined by liberalization policies focused on the liberalization of trade and the privatization of state-owned enterprises, and consequently saw the emergence of low-quality urban sprawl around central Ankara city. Mirroring global trends, in the fourth period, beginning in 2000, gated living zones, gated trade and entertainment zones, gated and distinguished education centres, and transportation alternatives became more visible, reflecting social stratification and differing class demands in these areas, driven especially by the desire of members of the higher social strata to live near similar others.

Plans by Lörcher (1924) and Jansen (1928) transformed Ankara city into a relatively planned macro form and so planted the roots of the city's north-south dualism. That is, prestigious neighborhoods like Devlet and Bahçelievler were established for higher-income groups in southern Ankara city and neighborhoods for low-income groups were formed in northern Ankara city (Yüceşahin & Tüysüz, 2011; Görmez, 2004; Şenyapılı, 2004; Ataç, 2016). This north-south pattern later became entrenched further, leading to the emergence of to higher-income groups in southern Ankara city and neighborhoods appealing to lower-income groups in northern Ankara city (Güvenç, 2001; Şenyapılı, 2004). Thus, Ankara city developed a heterogeneous spatial pattern consisting of the socio-spatial dualities derived from the unity of homogenous

city areas. Ankara city became the third biggest city in Turkey after it transformed into a hub that received migration from every part of the country. In accordance with this migratory pattern, the residential patterns of skilled labor in service sectors and low-skilled labor in marginal sectors reinforced the north-south dualism of Ankara city as both groups segregated in their residential neighborhood selections (Şenyapılı, 2004; Yüceşahin ve Tüysüz, 2011; Ataç, 2016). After the 1980s, neighborhoods like Batıkent, Eryaman, Ümitköy, Konutkent, and Koru emerged and the recent urbanization trends of Ankara city reflect the demands of the upper and middle classes (Şenyapılı, 2006; Ataç, 2016).

The Level of Socio-Spatial Segregation

Historically, Ankara city has seen a pattern of socio-spatial segregation by which poor neighborhoods are concentrated in the north of the city, while the 'elite' upper and middle classes are concentrated in the south. The socio-spatial segregation of Ankara city is discussed in this subsection considering the unequal or equal distribution of educational segregation across Ankara city neighborhoods using an empirical ESDA methodology.

Quartile maps were generated and used to show the spatial distribution patterns of primary, secondary and tertiary level educational segregation across Ankara city neighborhoods and to detect differences in their spatial distribution. In 2008, the lowest and highest neighborhood rates of primary school graduates (corresponding to primary level educational segregation in the neighborhood/neighborhood population) were 0.103 and 0.781, respectively. This compared with figures of 0.059 and 0.844, respectively, for 2014. Thus, in 2008 the highest and lowest primary level educational segregation neighborhoods differed by a factor of 7.58. In other words, the neighborhood with the highest primary level educational segregation had over 7.5 times more of this educational segregation than that with the lowest level in 2008, and this gap increased to 14.3 times in 2014. Thus, the gap between the with the lowest and highest educational segregation almost doubled from 2008 to 2014.

Several rural Ankara city neighborhoods lack any secondary or tertiary level educational segregation, preventing comparison between the lowest and highest neighborhoods. To overcome this problem, a comparison was instead made using those neighborhoods with the lowest levels of secondary and tertiary level educational segregation that nevertheless exceeded 0.

Regarding the distribution of secondary level educational segregation across Ankara city neighborhoods in 2008, the lowest and highest ratios for secondary level educational

segregation were 0.038 and 0.540, respectively. In 2014, the ratios were 0.042 and 0.551, respectively. The comparison of the neighborhoods with the highest and lowest scores for secondary level educational segregation found gaps of 14.21 times in 2008 and 13.1 times in 2014. The distribution gap between the lowest and highest neighborhoods in terms of secondary level educational segregation thus decreased slightly from 2008 to 2014.

When similar comparisons were made for tertiary level human capital, the gap between the neighborhoods with the lowest and highest tertiary-level educational segregation decreased significantly from 2008 to 2014. Considering the spatial distribution of tertiary-level educational segregation, the lowest and highest neighborhood ratios in 2008 were 0.005 and 0.441, respectively. In 2014, these ratios were 0.018 and 0.527, respectively. The gap between the highest and lowest tertiary level educational segregation, therefore, was 88.2 times in 2008 and 24.5 times in 2014. The gap thus shrank by nearly three quarters from 2008 to 2014, but the distribution of tertiary-level educational segregation across Ankara city neighborhoods remains very unequal despite significant equalization having occurred during the study period.

Regarding the spatial distribution of educational segregation across Ankara city neighborhoods, specifically the comparisons of neighborhoods with the highest and lowest ratios of primary, secondary and tertiary level educational segregation, at first glance, the inequality in the distribution of primary level educational segregation gap is increasing, that for secondary educational level is slightly decreasing, and that for tertiary educational level is significantly decreasing.

Comparisons of Ankara city neighborhoods with the highest and lowest ratios of primary, secondary and tertiary level educational segregation reveal their spatial distribution patterns, changes, and evolution; however, such comparisons do not consider the changes and evolution deriving from all neighborhoods. Thus, the comparisons have only a limited ability to reflect the entire neighborhoods. To overcome the limitations of such comparisons, segregation indices and spatial panel estimation methodologies covering all neighborhoods were also applied.

Spatial Patterns of the Socio-Spatial Segregation

The differentiation in the distribution of educational segregation across Ankara city neighborhoods varies for each educational level. Nevertheless, revealing the spatial distributions and detecting whether that for each educational level was random or concentrated in specific hubs is important for analyzing the spatial distribution of educational segregation.
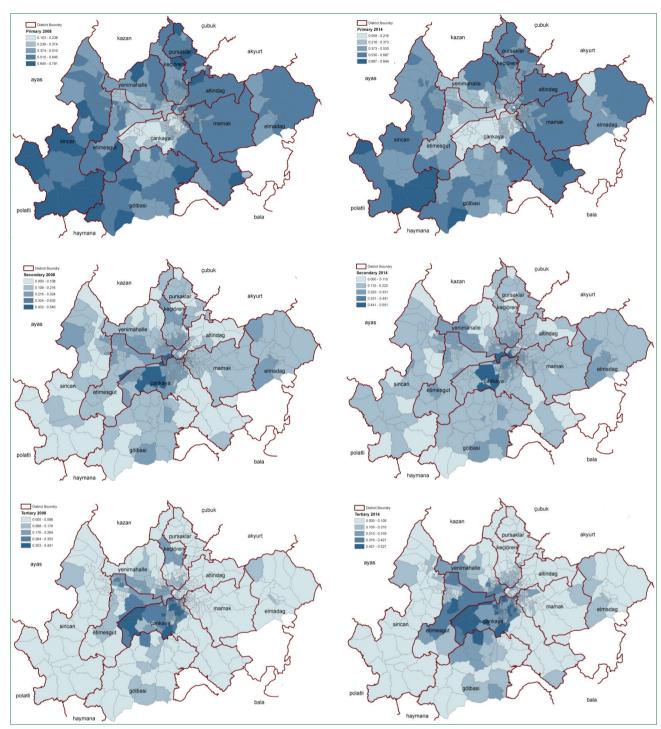
Figure 2. Spatial distribution of social capital.

To analyze the spatial content of the socio-spatial segregation of educational segregation, quartile maps were generated (Fig. 2), and global and local Moran I tests were applied using different spatial weight matrices for each educational level. The quartile maps show the spatial distribution of primary, secondary and tertiary level educational segregation across Ankara city neighborhoods for 2008 and 2014. The darker colors represent higher educational segregation for each educational level.

Concerning the spatial distribution of primary level educational segregation in 2008, the darker shading shows that it is concentrated in peripheral neighborhoods. The shading becomes lighter with distance from these peripheral neighbor-

Table 2. Global Moran I results for the socio-spatial segregation

	Primary	Secondary	Tertiary
2008	0.523324***	0.399651***	0.508466***
2009	0.406987***	0.299150***	0.415976***
2010	0.418004***	0.283661***	0.407896***
2011	0.452590***	0.278020***	0.424871***
2012	0.473957***	0.280708***	0.434967***
2013	0.473366***	0.221176***	0.404635***
2014	0.549802***	0.306684***	0.447484***

*** Denotes significance at 1 %; ** at 5%, * at 10%.

hoods towards central Ankara city, and the shading is lightest in the city center, indicating that the with higher primary level educational segregation are concentrated at the periphery. This spatial distribution pattern persists in 2014.

The maps of the spatial distribution of secondary educational level educational segregation exhibit a more homogenous distribution pattern than those for primary level educational segregation in 2008. Unlike the spatial distribution patterns of primary level educational segregation, the pattern of secondary educational level sees darker shading near the center and lighter shading near the peripheries. However, the dark shading is consistent throughout central Ankara city neighborhoods and this spatial distribution pattern persists in 2014.

Regarding the spatial distribution patterns of tertiary-level educational segregation, as expected the darker shading was clearly concentrated in the most central areas of Ankara city. Tertiary level educational segregation was concentrated within a circle with a diameter of approximately 20 km. The spatial distribution pattern of tertiary-level educational segregation remained almost identical in 2008 and 2014, but the shading of several neighborhoods near the circle darkened from 2008 to 2014.

The spatial dependence of the spatial distribution of educational segregation for each educational level was tested using global Moran I tests with different spatial weighting methodologies to reveal whether primary, secondary and tertiary level educational segregation distributed across neighborhoods randomly or exhibited spatial concentrations. Table 2 reports the global Moran I scores. The tests for each educational level reported higher Moran I scores, which are significant at the 1%. The global Moran I tests were consistent with the results derived from the quartile maps. From Table 2, spatial distributions of primary and tertiary level educational segregation have higher global Moran I scores, which refer to their tendency toward higher concentration. The global Moran I scores were lower for the spatial distribution of secondary

level educational segregation, which is also consistent with the quartile map results. Restated, secondary level educational segregation was more randomly distributed across the neighborhoods that were primary and tertiary educational level educational segregation.

The global Moran I scores for each year from 2008 to 2014 show that closeness and spatial proximity increased for primary level educational segregation, but decreased for secondary level educational segregation. The spatial proximity of tertiary-level educational segregation also decreased, but higher scores indicate that its spatial proximity is extending (Table 2).

Global Moran I tests with differing spatial weight matrices was applied to analyze the spatial dependency of the spatial distribution of educational segregation across Ankara city neighborhoods. To go one step further and check the results of the quartile maps and global Moran I tests, local Moran I tests was applied to uncover the spatial proximity characteristics of educational segregation clustered and not clustered in hubs. Figure 3 indicates the results of the local Moran I tests for each educational level for the years 2008 and 2014.

Considering the primary educational level of 2008, concerning the local Moran I test results, the HH cluster comprises the neighborhoods of Sincan, Pursaklar, Alltındağ, and Mamak districts and the southern neighborhoods of Gölbaşı district, while the LL cluster comprises the of Çankaya district. At a glance, the spatial proximity pattern of the primary educational level is persistent in 2014. Nevertheless, the neighborhoods of Sincan district, located in the western urban sprawl area, transformed from HH to LL; thus, the blue cluster concentrated on central Ankara city diffused westward.

Considering the spatial distribution of secondary educational level educational segregation in 2008, the HH cluster clearly includes the neighborhoods of Çankaya, Etimesgut and Yenimahalle districts, all near central Ankara city, and the LL cluster comprises the peripheral neighborhoods. Local Moran I tests revealed insignificant results in 2014 for some neighborhoods located in the HH cluster in 2008, which shows that the HH cluster shrank from 2008 to 2014. The spatial dependency pattern for the LL cluster was unchanged in 2014.

The spatial concentration pattern for the spatial distribution of the tertiary educational level was the opposite of the spatial accumulation pattern for the spatial distribution of the primary educational level. That is, the HH clusters were located in central Ankara city and the LL clusters were located in peripheral areas. In 2008, several neighborhoods of Çankaya district and neighborhoods of Etimesgut and Yenimahalle
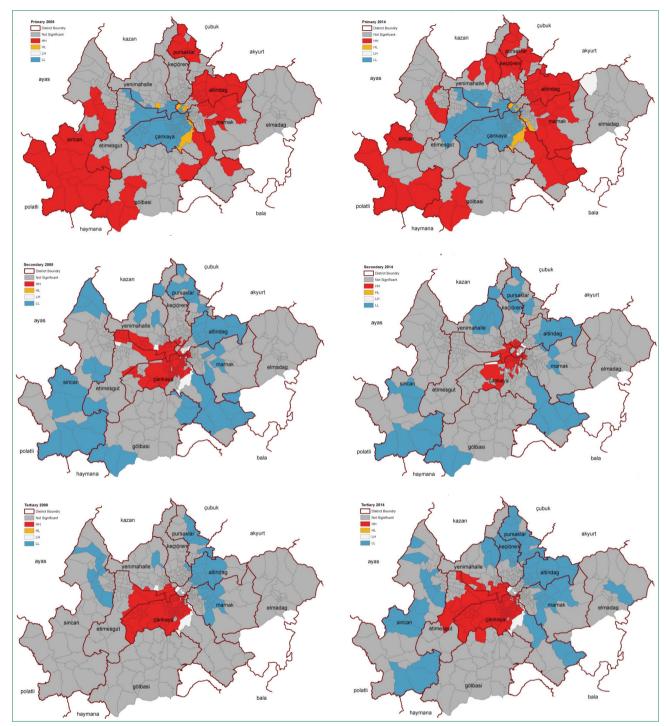
Figure 3. Local Moran I maps of the distribution of the social capital.

districts located near Çankaya comprise the HH (red) cluster. In 2014, the HH cluster diffused westward because the number of HH neighborhoods in the Etimesgut and Yenimahalle districts increased.

The global and local Moran I tests show the dichotomy between the spatial concentration of primary and tertiary educational level educational segregation. The HH neighborhoods of tertiary educational level educational segregation are concentrated in central Ankara city and the LL neighborhoods are concentrated on the periphery. In contrast, for primary educational level educational segregation, the LL cluster is in central Ankara city and the HH cluster is in peripheral neighborhoods.

At first glance, this dichotomy looks consistent with the differentiation of the educational profile of urbanized central Ankara, which has a population of mostly working in non-agricultural sectors, such as industry and the provision of services to the rural periphery, which has a population of mostly working in the agricultural sector. However, concerning the spatial distribution of tertiary-level educational segregation, the local Moran I tests show that some HH neighborhoods located in the western sprawl zone (northeast of the red cluster) are distant from the LL neighborhoods located nearer central Ankara city (Fig. 3).

Figure 3 clearly shows that although the neighborhoods belonging to Mamak, Altındağ and Keçiören districts are very centrally located, they are not included in the HH cluster for either 2008 or 2014. The boundary of the HH cluster in 2014 continues to reflect the historical segregation of the city, and the HH cluster does not diffuse to the neighborhoods of Mamak, Altındağ and Keçiören districts despite their close proximity.

Evolution of Socio-Spatial Segregation

This subsection combines and checks the results of the socio-spatial segregation indices with the two spatial models, i.e., the spatial error and spatial lag models, respectively. Quartile maps were used to uncover the spatial distribution patterns of educational segregation across neighborhoods for 2008 and 2014. The global and local Moran I tests were applied for 2008 and 2014 to investigate the spatial distribution and socio-spatial segregation of educational segregation described in the previous sections.

Accordingly, this section aims to reveal the level and evolution of educational segregation during 2008–2014 using the Gini, Atkinson, Theil and CV indices. Table 3 shows the socio-spatial segregation scores and Figure 4 shows the evolution of socio-spatial segregation across the 478 Ankara city neighborhoods for 2008–2014. Table 3 and Figure 4 (Atkinson index) obviously indicate that the level and evolution patterns of socio-spatial segregation differ according to educational level. The socio-spatial segregation of education is highest at the tertiary educational level, while at the secondary and primary educational levels the socio-spatial segregation scores are much lower and also closer together. The results obtained from the socio-spatial segregation indices are clearly consistent with those obtained from the quartile maps.

Despite the indices reporting different values for the socio-spatial segregation of educational segregation, they reveal similar evolutionary trends, and so their results are consistent. The socio-spatial segregation indices show a slight increasing trend in socio-spatial segregation at the primary educational level. At the secondary educational level, socio-

Table 3. Geo-segregation indices results for socio-spatial segregation

	Gini	Atkinson	Theil	CV
Primary				
2008	0.1629	0.023102	0.044154	0.046474
2009	0.168395	0.025065	0.047662	0.050449
2010	0.228291	0.011054	0.089466	0.068643
2011	0.186259	0.032356	0.065748	0.065243
2012	0.187031	0.032095	0.065706	0.064714
2013	0.20241	0.038243	0.077117	0.077231
2014	0.202805	0.035699	0.067813	0.072046
Secondary				
2008	0.240105	0.066242	0.07826	0.134755
2009	0.221291	0.066449	0.062347	0.135183
2010	0.254265	0.054235	0.07019	0.121381
2011	0.199012	0.058639	0.057404	0.119051
2012	0.208638	0.063975	0.060209	0.130065
2013	0.20202	0.050974	0.068572	0.103282
2014	0.188702	0.048525	0.052281	0.098257
Tertiary				
2008	0.570085	0.325196	0.400136	0.714143
2009	0.551012	0.29965	0.38026	0.652522
2010	0.548661	0.273058	0.345788	0.63334
2011	0.519121	0.266678	0.337008	0.574631
2012	0.500016	0.249893	0.307442	0.535651
2013	0.464389	0.209467	0.279659	0.443522
2014	0.446207	0.198448	0.249963	0.418822

Gini is the Gini coefficient, Atkinson gives Atkinson's measure and CV computes Coefficient of Variation.
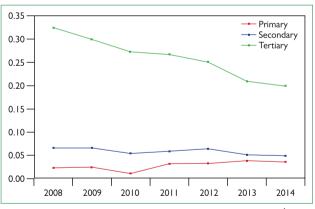

Figure 4. The evolution of the socio-spatial segregation (Atkinson İndex).

spatial segregation is decreasing, while at the tertiary educational level it is decreasing significantly.

Spatial panel estimation is another methodology frequently used in the segregation literature to detect the evolution of socio-spatial segregation (Anselin, 2005; Erdem, 2016). Two spatial models, namely the spatial lag and spatial error models

Table 4. Spatial panel estimations for the socio-spatial segregation

	Primary	Secondary	Tertiary
α	0.196 ***	0.058 ***	0.024 ***
ln education	0.469 ***	-0.291 ***	-0.106 ***
rho	0.954 ***	0.814 ***	0.889 ***
lamda	0.926 ***	0.614 ***	0.774 ***
N	2868	2868	2868

*** Denotes significance at 1%; ** at 5%; * at 10.

were used to capture trends in the evolution of the socio-spatial segregation of educational segregation and its spatial proximity, and to check previous results obtained from quartile maps and socio-spatial segregation indices.

Table 4 presents the results of the estimation using the spatial model. The data used in spatial panel estimations consists of 2868 observations (6 years × 478 neighborhoods). The dependent variable is the logarithm of the rate of annual change of educational level, and the explanatory variable is the logarithm of the educational level for the initial year. For spatiality, an inverse distance spatial weight matrix was used as a weighting methodology.

Concerning the spatial panel estimation results, the coefficient of primary level educational segregation is positive and significant at the 1%, which indicates increasing socio-spatial segregation of primary level educational segregation across neighborhoods. The estimation results were negative and significant at the 1% for the socio-spatial segregation of secondary and tertiary level educational segregation. These results indicate that the socio-spatial segregation of secondary and tertiary level educational segregation is decreasing. The results reported by the spatial model are consistent with those of the quartile maps and socio-spatial segregation indices.

The spatial panel estimations also show that the spatial lag and spatial error models report positive and significant results at 1% (Table 4), which indicates that educational segregation for each level diffuses from each neighborhood to those surrounding it (positive spillover). That is, changes in the spatial distribution of educational segregation have spatial proximity based on diffusion between neighborhoods. These results are consistent with those of the local Moran I tests indicating that the HH (red) and the LL (blue) clusters are diffusing in an integrated way.

Results And Discussion

As Bourdieu claimed, educational segregation reproduces its socio-spatial segregation patterns in accordance with factors such as the desire for membership or closeness to higher status prestigious groups. With this regard, although the socio-spatial segregation of educational segregation in Ankara city dates to the beginning of the new modern republic of Turkey, its recent form can be tracked from the uneven spatial distribution of educational segregation. In line with the fundamental paradigm of the establishment of the new republic, the capital city Ankara had to be successful regarding every aspect of its environment since it reflected the success of the new state (Tekeli, 2006). Ankara city was developed and grew with this motivation by policymakers as the southern part belongs to the higher income levels and northern part belongs to the working class and low-income groups. Today, such south-north duality still persists but the geography of segregation has changed in particular spatial patterns in accordance with the development of the city (Akpınar, 2009, Ataç, 2016; Uzun, 2006).

Bourdieu claims that educational segregation is the main contributor and regulator of social conflicts and relations in urban spaces, with this effect mainly determined by spatiality in socio-spatial segregation. With this regard, analyses of the socio-spatial segregation of Ankara city in the literature show that the urban development process does not exhibit random socio-spatial segregation patterns, but rather specific geographic patterns consistent with the results of Uzun (2006) and Ataç (2016).

As expected, in line with the discussion so far, the socio-spatial segregation tendencies and their spatial distributions for different levels of educational segregation show different trends and spatial distribution relationships. Concerning the evolution of the segregation of educational segregation across the neighbors of Ankara city, at a glance, the tertiary educational level educational segregation demonstrates the highest socio-spatial segregation across the neighborhood of Ankara city (Fig. 2, Table 2) and its decreasing tendency is very rapidly (Fig. 4). The socio-spatial segregation for primary level educational segregation increased during 2008–2014 and the socio-spatial segregation for secondary level educational segregation slightly decreased during the same period. These results are consistent across the different methodologies (quartile maps, inequality indices, and spatial models).

The spatiality of socio-spatial segregation clearly does not exhibit random spatial transformation and diffusion patterns because it is closely related to the social conflicts and relationships constructed by educational segregation (Fig. 3). This non-randomness in the spatial diffusion patterns of educational segregation is remarkable since it shows the novelty of this study. Figure 5 shows the sprawling boundaries of the planned development of Ankara city which means Ankara city growing from core to its periphery in every direction. In the
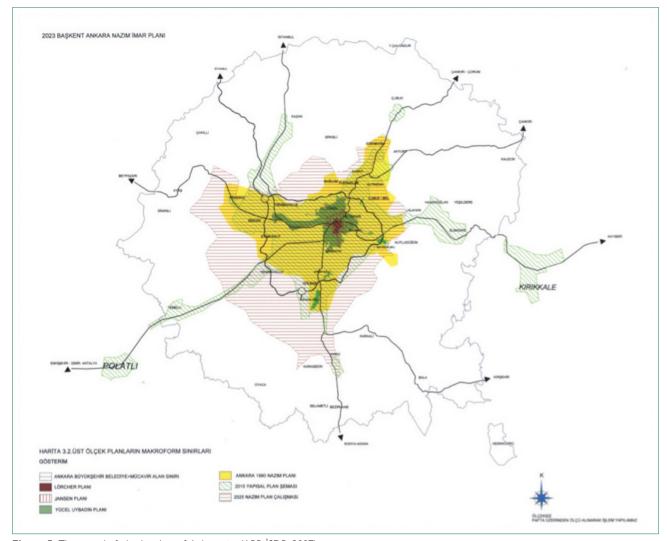
Figure 5. The sprawl of plan borders of Ankara city (ABB-İŞDB, 2007).

1990 city plan, new urban development areas were allocated in both the northern and southern parts of the city. However, this allocation for new urban development areas unchanged the spatial distribution of educational segregation which is specified in the tendency to cluster in the southern neighborhoods of Ankara city.

Analyses show that the transformation and evolution of the spatiality of socio-spatial segregation in Ankara city containing particular geographical references. This is observable in the diffusion patterns of tertiary educational level educational segregation, namely diffusion from the HH cluster to adjacent western neighborhoods. The concentration of tertiary-level educational segregation in central (Çankaya District) neighborhoods does not diffuse to adjacent eastern and northern neighborhoods (Keçiören, Altındağ and Mamak districts) despite their relative proximity to the city center. The spatial concentrations of primary and tertiary educational level

educational segregation and their diffusion among neighborhoods show a complementary pattern, with one being highly concentrated where the other is less concentrated (Fig. 3).

The HH cluster does not diffuse to nearby neighborhoods located beyond the district borders (Keçiören, Altındağ and Mamak districts), but rather to western urban fringe neighborhoods of Yenimahalle and Etimesgut districts where the new large scale urban redevelopment projects are mainly concentrated (Ataç, 2016). The question of why tertiary level education diffusing to the distant western neighborhoods rather than the closer adjacent eastern and northern neighborhoods? is come to the fore. Local Moran I analyses showed that most of the HH cluster boundaries for the tertiary level overlap with the district borders; a situation that persisted during 2008–2014 and the borders that separate districts exert a strong geographical effect on the diffusion patterns of the HH cluster of Çankaya district. The HH clus-

ter at the tertiary educational level is diffusing, possibly because of migration motivated with the desire of residents to locate themselves close or into the where the educational segregation clustered, and population increase (Fig. 3). However, careful monitoring of the spatial diffusion of the HH cluster of tertiary-level educational segregation reveals that this diffusion is not occurring randomly but rather it is diffusing to the neighborhoods closer or at the edge of the HH cluster and have big scale housing development projects (Ataç, 2016).

This trend is consistent with Bourdieu's educational segregation pattern, where the possibilities, instruments, and attractiveness of educational segregation determine the patterns of its socio-spatial segregation in cities. The desire to live in or near neighborhoods in the educational segregation clusters reflects the spatial equivalent of educational segregation that arises from the value attributed to material and symbolic goods. Tertiary level educational segregation uses symbolic goods as an input to establish power in the community and society to reinforce its power, attract more attention, prestige, recognition, and self-improvement. Besides the historical roots of socio-spatial segregation of Ankara city, this study claims that other remarkable reason transformed recent geographical concentration and diffusion patterns are rooted in the hegemony, instruments, and attractiveness of the educational segregation.

Conclusion

Discussion of segregation dates to the very beginning of civilization. Segregation currently maintains itself in new and sensitive ways by current transitions in cities and society. Many scholars approach socio-spatial segregation from the perspectives of income, consumption, education, culture, religion, ethnicity and social status in cities. This study approaches socio-spatial segregation using Bourdieu's concept of 'educational segregation'. By focusing on differences in educational level across, this paper (i) measured the degree of socio-spatial segregation of educational segregation at the neighborhood level in Ankara city, the capital of Turkey, during 2008–2014; (ii) showed the spatial patterns of segregation across neighborhoods; and finally (iii) explained how segregation across evolved during the study period. Significant results were reported. First, socio-spatial segregation across neighborhoods differs with level of educational segregation, being high for the tertiary educational level, but relatively low for the primary and secondary educational levels. Second, the trend of socio-spatial segregation also differs according to educational segregation level. Specifically, socio-spatial segregation is decreasing rapidly for educational segregation at the tertiary educational level, and differences across neighborhoods are also rapidly decreasing. Meanwhile, social-spatial segrega-

tion at the secondary education level is also decreasing, but progress is much slower than for the tertiary educational level. However, socio-spatial segregation across neighborhoods is increasing for the primary educational level. The spatial dependence of the socio-spatial segregation of educational segregation is obvious. The north-south dualism is still clear, and remarkably, it is changing in a particular spatial pattern. The HH neighborhoods for the tertiary level are agglomerated at the very center of Ankara city, mostly in the Çankaya district. During 2008–2014 this agglomeration sprawled into the western neighborhoods located some distance from the city center. However, the agglomeration did not sprawl into the closer northern or eastern neighborhoods. The changes in the geographic concentration and diffusion of educational level across the Ankara city are consistent and confirm there positioning of the spatiality of educational segregation.

Acknowledgements

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