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Socio-Spatial Conditions of Educational Participation: A Typology of Municipalities in the Canton of Zurich

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Abstract: The Canton of Zurich is characterized by strong socio-spatial polarization typical for large and dynamic metropolitan areas. A helpful way to depict spatial dimensions is spatial typologies. Existing spatial categorizations of the Canton of Zurich are limited for education because they focus primarily on economic factors, which are not the only predictors of educational behavior and success. In this paper, we develop a typology of municipalities in the Canton of Zurich that is useful for educational analyses and administrative activity. Theoretically, we consider socio-spatial structures as opportunities and constraints of the spatial and social contexts related to educational participation. We differentiate between two levels: socioeconomic composition and regional structures. The socioeconomic composition of a neighborhood is assumed to influence the way residents think and act through social interactions. Regional structures refer to the variation in the specificity and accessibility of institutional settings of the labor market, the education system, and extracurricular stimulation. The analyses are based on official statistics. We use factor analysis to identify the main components within the two levels. Their combination results in a spatial typology consisting of five types. They show significant differences in indicators of educational participation, which illustrates the relevance of the typology for the education sector.

Keywords: educational disparities; socio-spatial structures; typology of municipalities; educational governance

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1. Introduction

Strong socio-spatial polarization is characteristic of large and dynamic metropolitan areas [1]. This also holds for the metropolitan area of Zurich, which is a center of international finance and has a large agglomeration [2,3]. The baccalaureate rate in the Canton of Zurich, for instance, shows a wide variation between municipalities ranging from 5.5 to 44 percent [4]. Empirical evidence suggests that the residential area where individuals live is associated with educational behavior and success [5–7]. While the gap in educational disparities between rural and urban areas has narrowed over the decades, the regional dimension has gained importance due to demographic changes [8].

A common way to depict spatial dimensions is to group spatial units such as districts or municipalities according to certain characteristics [9]. These characteristics refer to the object of investigation—a typology useful for the education sector needs to include spatial components, which are important for educational behavior and success. The spatial categorizations of the Swiss Federal Statistical Office (FSO) primarily focus on economic factors, but these factors are not the sole predictors of educational behavior and success. In addition, some rural categories of this typology are rarely present in the Canton of Zurich. Consequently, this typology offers only limited knowledge gain in the field of education.

The Swiss Confederation is a federal republic of 26 cantons. Based on Art. 61a and 62 of the Federal Constitution, the cantons play an important role in education governance. In compulsory education, the cantons are in charge of legislation and institutional parameters [10]. The introduction of the administrative reform of New Public Management has

altered the governance and the decision-making processes in education since the 1990s. Whereas the public sector had previously managed the system using an input-oriented provision of funds, the focus has since shifted to the intended effects [11]. In Switzerland and, particularly, in the Canton of Zurich, this reform has strengthened school autonomy [12]. While the cantons have retained the main role, the municipalities and schools have obtained greater responsibility in pedagogical, personnel, and organizational issues [13]. This shift in responsibilities has raised interest in how municipalities and schools implement the institutional parameters. As a result, the cantons needed more information about conditions, activities, and outcomes at municipalities and schools to achieve targeted and effective quality assurance [14]. Accordingly, the cantonal administration developed new tools, for example, quality management guidelines or competence-based testing, to inform government action [15]. The government has also increasingly used the results of analyses and evaluations to develop policies. The explanations above have shown that it is important for the cantons to know the differences between municipalities and schools and the corresponding socio-spatial patterns to review and, if necessary, adjust the institutional parameters on this basis.

On this account, this paper aims to work out a spatial typology of municipalities in the Canton of Zurich that is useful for educational analyses and administrative activity. Based on socio-spatial factors drawing on theoretical reflections [16,17], we derive groups of municipalities that are distinctive in terms of the educational participation of the population. The levels include the variation in the socioeconomic composition between spatial municipalities ("socioeconomic composition") and the variation in the specificity and accessibility of institutional settings ("regional structures") with a set of indicators relevant for educational participation. We employ official statistics that are of high quality, given precision and completeness.

The typology developed aims to improve the knowledge gain of analyses, as well as to inform the action of the cantonal administration. In educational reporting, regional clustering may help to reduce the large differences in contextual conditions to a manageable number of categories. In educational analyses, the typology offers a way to include the contextual level in explanatory models on educational disparities. The typology may also serve to draw representative samples for studies in the field of education when pursuing a stratified random sampling. In the field of administration, the typology may point to patterns of differences between municipalities in contextual conditions relevant to education. Based on this distinctive knowledge, the canton can tailor its actions to the specific needs of the municipality, for example, by adjusting the institutional parameters or by providing more extensive information and support.

The paper is structured as follows: first, we summarize the most important factors influencing educational participation at the individual, family, and school levels. Subsequently, we derive two socio-spatial levels relevant to educational participation, socioeconomic composition, and regional structures, drawing on theoretical reflections of Ditton [17]. Then, we elaborate on the associations between the indicators of socioeconomic composition and regional structures and educational participation. After a brief overview of the data and methods, the result section identifies the important factors within each level. Next, we construct the typology and examine its relevance with respect to educational participation. Finally, we point out the content-related importance of the typology and discuss the limits of the data.

2. Socio-Spatial Structures Related to Educational Participation

Numerous studies in educational research have analyzed factors contributing to educational success [18–22]. The studies indicate that many factors on the individual, family, and school levels determine educational success directly or through mediating effects [23,24]. Research has extensively shown that cognitive abilities are important to predict educational success [25]. Additionally, studies suggest that noncognitive factors such as academic self-efficacy, motivation, and educational aspiration positively support

skill acquisition and hence shape educational careers [26–28]. Since the middle of the last century, research has focused on the family as the main provider for learning opportunities and educational participation of the next generation, with a direct influence of the family or mediated through the children's cognitive abilities [29–32]. On the one hand, the family hands down competencies and language skills that are important for school and career development. The resources of the family, everyday interaction with children, and the level of cognitive stimulation in the home environment play a crucial role [33–35]. On the other hand, educational aspirations specific to the social class of the family and assessments of the costs and benefits of educational participation shape the educational trajectories of children [23,24]. Furthermore, research on the school context has shown that the curriculum, the quantity and quality of schooling, and the social relationships within the school also influence educational outcomes [16,19]. In particular, the relationship between teacher and student plays a decisive role in learning and educational success [18]. Teachers shape learning by individual support, but they often also carry out a main role in the selection process and thus act as gatekeepers at transitions, affecting educational processes in the long run [36].

A collective or a context only becomes relevant to an individual's actions through social interactions [17]. However, people do not only interact with central "local environments", namely families as socialization and schools as teaching and learning environments [16]. In their social actions, people also interact with their wider spatial and societal context, forming opportunity structures where resources are available or missing [17,37,38]. These contexts shape value orientations, preferences, behaviors, and actions. A whole range of research has shown that spatial and societal contexts influence educational outcomes beyond the impact of individual skills, the family, and the school [16,17,39–41]. In turn, individuals in different socio-spatial milieus attribute different meanings to social spaces [42,43]. People shape the contexts in which they are embedded by social actions in the various phases of their life and thus contribute to social change and social development [16].

Ditton distinguishes analytic features of a context from global features [17]. While analytic features are obtained by aggregating the properties of the members of the context, global features do not contain information about these properties. In line with this, we distinguish two types of socio-spatial contexts relevant to educational participation: socio-economic composition and regional structures. Personal ties are an important motive for choosing a residential area, along with factors related to the labor market [44]. As these ties are closer among persons belonging to similar social groups, residential areas, neighborhoods, and schools tend to be socially segregated. On the one hand, this results in privileged neighborhoods whose residents favor academic pathways to avoid a loss of status [7,41]. On the other hand, there are neighborhoods that face major socioeconomic challenges. That is why we describe the *socioeconomic composition* of a context in terms of socioeconomic resources and challenges. The socioeconomic composition of a residential area or neighborhood influences the way residents think and act through social interaction [6,45–52]. Actors draw inspiration for their actions from frequent exchanges with the same partners. Thus, different patterns of interaction and probabilities for interactions and learning emerge depending on the composition of a neighborhood or a school [17].

Regional structures are considered as global features of a context that have an impact on the individual in this context [17]. The specificity of institutions (structure of the labor market and the education system and their institutional arrangements), as well as the accessibility of institutions, creates opportunities or restrictions to the acquisition of knowledge, competencies, and education [16,17]. Regional structures relevant to education include local specificities such as labor market conditions, specificity and accessibility of the education system, and extracurricular stimulation potential [19]. It is to be assumed that the influence of regional structures increases with the frequency of interaction [17].

Socioeconomic composition and regional structures affect the educational pathways in various ways. The collective socialization perspective focuses on the social interaction within a neighborhood [53]. Neighborhoods are socially stratified milieus that repre-

sent different social learning environments. Daily interactions within a neighborhood network serve as sources of information, provide support, and offer access to relevant resources [47,54]. Epidemic theory addresses how individuals internalize norms by interacting with others or observing the behavior of others [55]. The attitudes and expectations acquired by the internalization of norms may either facilitate or impede educational goals [56]. One mechanism is the spillover of values, aspirations, and behaviors that either promote or impede learning. In this sense, stratified neighborhoods allow shared experiences and give meaning to local rules and norms. This leads to the identification, demarcation, and (re)production of difference [57,58]. The institutional model says that neighborhood effects are a function of the quality of services available in the immediate vicinity [17]. Thus, the institutions in a neighborhood and their personnel are important catalysts for socialization effects.

Several research traditions are based on these two types of socio-spatial contexts. Studies about neighborhood effects have traditionally highlighted that the socioeconomic composition of a spatial context is important for educational success [6,45–52]. Multiple studies have shown that the neighborhood indeed impacts educational pathways, but the magnitude of the influence depends on the method employed and on the measurement level of the neighborhood context [48,50,59,60]. In addition, no research can fully decompose the effects of neighborhoods and schools. In the Canton of Zurich, the place of residence and the places available in a school serve as the basis of the allocation of students to a school. Therefore, the socioeconomic composition of neighborhoods mirrors school compositions and thus leads to school segregation [7,60].

Indicator-based social space research is a research tradition that includes indicators for socioeconomic composition and regional structures but does not differentiate them conceptually. This research strand analyses educational inequalities through spatial dimensions such as regions or municipalities [37]. Various indicators such as regional unemployment rates or social welfare rates are employed as conditions of the social context and are related to local educational participation [61]. Studies that rely on administrative data often use spatial units of analysis based on statistical rates. These kinds of studies are frequently undertaken in German-speaking countries *(Sozialraumanalyse)* [62]. They mainly inform regional governance and provide a sound basis to identify areas in need of compensation for inequities. Although the approach is criticized for its insufficient theoretical foundation [63], the indicator-based approach has eligibility in education reporting, due in part to the ease with which official statistics can be used for comparative analyses of social space [61].

3. Indicators of Socioeconomic Composition and Regional Structures

In this section, we describe the indicators assigned to the levels of socioeconomic composition and regional structures and elaborate on their possible association with educational participation. As mentioned above, the composition level distinguishes between socioeconomic resources and challenges. Regional structures comprise the local labor market situation, specificity and accessibility of the education system, and extracurricular stimulation potential. First, we elaborate on the educational pathways from the upper secondary level onward to understand the relationships between the indicators and participation in education. Roughly summarized, two paths can be chosen on the upper secondary level: general education programs and vocational education and training (VET) programs [64]. The general education programs include the Baccalaureate schools and the upper secondary specialized schools *(Fachmittelschule, FMS)*. In the Canton of Zurich, 20 percent attend full time Baccalaureate schools, and 3 percent choose specialized schools [65]. VET, in which adolescents learn an occupation, is mostly completed at training companies (apprenticeship) combined with learning at a VET school [64]. It can also be completed at full-time vocational schools. In the Canton of Zurich, approximately 70 percent of the school leavers start VET programs. A total of 17 percent acquire an additional Federal Vocational Baccalaureate Certificate (FVB) during or upon completion of a VET Diploma [4].

FVB or FMS offer direct admission to universities of applied sciences, whereas students with Baccalaureate certificates are entitled to enroll at universities. A minority of young adults express difficulty with their educational trajectories after compulsory school: less than 10 percent of young adults in the canton of Zurich do not complete upper secondary education by age 25 [66].

3.1. Socioeconomic Composition

We classify the following aspects of socioeconomic composition as resources: the age ratio, the average fiscal capacity, and the average price of building land. High fiscal capacity and high prices of building land indicate a high proportion of individuals in the population with a high socioeconomic status [67]. Retirees tend to be more financially secure than younger population groups because they have generally accumulated more financial savings due to their age [68]. Thus, a high age rate indicates a more advantageous average socioeconomic composition of a municipality, which is positively related to academically oriented educational pathways [69].

Youth ratio, unemployment rate, social assistance rate, and foreigner rate are aggregated characteristics of the residents in a municipality that indicate socioeconomic challenges. The higher the youth ratio, the lower the average financial savings of a municipality's population. A relatively high unemployment rate, a relatively high rate of social assistance, and a relatively high percentage of foreigners suggest that a relatively high percentage of residents have a low socioeconomic status. A less favorable average socioeconomic status, in turn, is negatively related to academically oriented educational pathways.

3.2. Regional Structures

Indicators of the local labor market conditions include the municipality's employment density, the municipality's ratio of small and medium-sized companies (SMEs) in all companies, and the percentage of workplaces in the second sector. Employment density informs on labor market opportunities in a municipality. In Switzerland, SMEs offer an above-average number of apprenticeships [70]. In addition, the widest range of apprenticeships exists within the commercial and industrial sectors [71]. Therefore, a higher proportion of SMEs and a higher proportion of workplaces in the second sector, representing indicators of the specificity of the labor market, are assumed to favor vocational educational pathways.

Indicators that represent the specificity and accessibility of the education system are the municipality's financial spending for education, the reachability of upper-secondary-level schools, and the ratio of students in the division with the lowest requirements of lower secondary schools. Although cantons regulate compulsory education, municipalities have some leeway to allocate resources. A more challenging socioeconomic composition of the population may raise education spending. However, increased education spending may well represent an intentional investment by a municipality to enhance school quality aimed at supporting successful educational trajectories. Despite the educational expansion in the 1960s and 1970s that was aimed at decentralized education facilities, the accessibility of secondary schools in the canton still varies significantly [72]. Studies indicate that the supply of higher-level educational institutions facilitates access to academically oriented tracks [73]. The municipalities also have a little leeway in the organization of lower secondary schools: they can choose between two divisions (A/B) or three divisions (A/B/C), where division A is the most cognitively demanding. We assume that a larger percentage of students in division C (as an indicator of the specificity of the education system) indicates the increased segregation of weak students, which reduces their chances of successful educational careers at the upper secondary level [74].

We assign the following indicators to extracurricular stimulation potential: child care supply; reachability of libraries; the ratio of public transport in total traffic on working days. Child care supply is an important location factor for parents aiming to reconcile work and family. Research has shown that child care of high quality has a positive impact on children's social behavior, language skills, and cognitive abilities, which are strongly related

to academically oriented tracks [59,75]. As countless studies point to the relevance of books as a cultural capital for educational success [18–22], one indicator is the distance to the nearest library. The third indicator is the rate of public transport, as this is the main means of mobility for young people [76]. Accessibility of the public transport system amplifies extracurricular opportunities and supports career prospects from the upper secondary level onwards.

4. Data and Methods

We used data from federal and cantonal official statistics, namely indicators on municipalities by the Statistical Office of the Canton of Zurich [77], FSO service accessibility data [78], federal population census [79], and data on child care and students from the Department of Education of the Canton of Zurich [80,81]. The data meet specific requirements because the spatial typology should not only be useful for educational analyses but should also inform the action of the cantonal administration: if possible, they are available for all municipalities in the canton, are as accurate as possible, and cannot be manipulated. The spatial unit represents municipalities because most of the data are not available at a lower spatial level. For various indicators, such as fiscal capacity or child care supply rate, however, the municipal level makes sense because these issues are regulated at this level. Table 1 provides an overview of the indicators on the two levels.

To derive the spatial typology, we chose a step-by-step approach, with different methods used for each of the five steps. In the first step, we performed a reduction in indicators at both levels using the Kaiser–Meyer–Olkin measure of sampling adequacy (KMO). KMO checks the proportion of variance in the set of indicators that might be caused by underlying factors. To further reduce the set of indicators and investigate which latent constructs are behind the chosen indicators on each level, we applied factor analysis in a second step. On both levels, we grouped categories in the third step by clustering methods based on factor scores. In a fourth step, we combined the categories across both levels and assigned the municipalities to the resulting types. In a final step, we assessed the typology with respect to differences in educational participation by applying an ANOVA for multiple linear regression. As indicators of educational participation, we used the rate of tertiary degree (M = 0.38, SD = 0.10) and the rate of persons without a degree at the upper secondary level (M = 0.16, SD = 0.05) in a municipality's population aged 25 to 64 [81], followed by the rate of persons with a Federal Vocational Baccalaureate Certificate (M = 0.17, SD = 0.06) obtained by a municipality's population aged 21 [81].

Table 1. Indicators of socioeconomic composition and regional structures.

	Data Source	Description	M	SD	Min	Max
Socioeconomic composition						
Land price 2015–2019	Statistical Office of the Canton of Zurich, 2021	Average building land price in CHF per square meter (median)	959.34	444.46	318.80	2776.20
Fiscal capacity 2015–2019	Statistical Office of the Canton of Zurich, 2021	Adjusted fiscal capacity per inhabitant in CHF (after fiscal equalization per inhabitant)	3771.08	656.57	3508.40	7061.00
Age rate 2015–2019	Statistical Office of the Canton of Zurich, 2021	Ratio of inhabitants over 64 years of age to inhabitants 20–64 years of age	29.12	5.50	16.72	48.12
Foreigner rate 2015–2019	Statistical Office of the Canton of Zurich, 2021	Ratio of people without Swiss citizenship in relation to the total population	0.19	0.82	0.05	0.46
Social assistance rate 2015–2019	Statistical Office of the Canton of Zurich, 2021	Ratio of people receiving financial assistance in relation to the total population	0.191	0.116	0.016	0.057
Unemployment rate 2015–2019	Statistical Office of the Canton of Zurich, 2021	Ratio of social assistance recipients in relation to the total population aged 15–64	0.206	0.060	0.010	0.416
Youth rate 2015–2019	Statistical Office of the Canton of Zurich, 2021	Ratio of inhabitants under 19 years of age to inhabitants 20–64 years of age	34.8	3.88	23.46	48.36
Regional structures						
Employment density 2014–2018	Statistical Office of the Canton of Zurich, 2021	Ratio of people participating in the labor market (in full-time equivalents) in relation to the number of inhabitants	0.29	0.19	0.08	1.60
SME rate 2014–2018	Statistical Office of the Canton of Zurich, 2021	Ratio of small and medium-sized companies (SMEs) in relation to the total of companies	0.08	0.04	0.00	0.21
Rate of workplaces in the 2nd sector 2014–2018	Statistical Office of the Canton of Zurich, 2021	Ratio of workplaces in the second sector in relation to the total of workplaces	0.24	0.11	0.02	0.57
Reachability of upper-secondary-level schools 2018 (-)	Federal Statistical Office, 2021	Average reachability in meters	4562.66	2888.43	612.58	13401.29
Financial spending in education 2015–2019	Statistical Office of the Canton of Zurich, 2021	Financial expenditures for education in CHF	2089.77	250.65	1583.40	3177.40
Lower secondary school: lower requirement rate 2015–2019	Department of Education of the Canton of Zurich, 2021	Ratio of students in division with lowest requirements in relation to the total of students on lower secondary level	0.04	0.05	0.00	0.19
Child care supply rate 2018	Department of Education of the Canton of Zurich, 2021	Number of places of child care supply per resident children in a municipality	0.12	0.11	0.00	0.50
Rate of public transport 2014–2018	Statistical Office of the Canton of Zurich, 2021	Ratio of public transport in total traffic on working days	0.14	0.73	0.20	0.51
Reachability of library 2018 (-)	Federal Statistical Office, 2021	Average reachability in meters	5001.56	3066.85	643.87	13509.82

5. Results

In this chapter, we present the results from the procedure presented above. First, we show the results of the reduction in indicators, the factor models and the clustering of the levels "social composition" and "regional structures". Subsequently, we combine the clustering on both levels to a typology. Finally, we test for differences between types on three education indicators.

5.1. Socioeconomic Composition

We checked the seven theoretically defined indicators for their measure of sampling adequacy. With a Kaiser–Meyer–Olkin overall MSA of 0.70 and indicators varying from 0.59 to 0.92, the indicators lent themselves to factor analysis.

Based on the results of the exploratory factor analyses with two and three factors, we omitted both the age and the youth rate, as the proportion of variation explained by the factors was less than 0.3. The remaining five indicators yield a two-factor model with a good fit (RMSEA = 0.00, TLI > 1). A factor correlation of 0.18 with oblique oblimin rotation indicates an orthogonal factor model. The factor loadings, communalities, and uniqueness using varimax rotation are shown in Table 2.

Table 2. Factor loadings of indicators of socioeconomic composition.

Indicator	Factor 1: Challenges	Factor 2: Resources	h2	u2
Foreigner rate	0.92	0.3	0.94	0.058
Land price	0.18	0.84	0.74	0.26
Social assistance rate	0.78	−0.073	0.61	0.39
Fiscal capacity	−0.046	0.91	0.83	0.17
Unemployment rate	0.88	0.066	0.77	0.23

Municipalities with a substantial foreigner rate, a high unemployment rate, and a high social assistance rate face significant socioeconomic challenges. Municipalities characterized by a wealthy population with high tax potential that can afford above-average land prices have a high level of socioeconomic resources. The population in these municipalities is less likely to receive social assistance and has a low unemployment rate.

Based on the factor scores generated using Ten Berge estimation, we then identified clusters of municipalities. Therefore, we validated multiple stability and internal validation measures and compared several clustering algorithms with two to four clusters. A solution with three clusters using partitioning around medoids gave the best agreement with the factor scores [82].

We characterize the three clusters as follows (see Table 3): the 91 municipalities in the first cluster account for 20 percent of the population. They face fewer socioeconomic challenges and fewer socioeconomic resources than average. Therefore, their socioeconomic composition can be labeled as "balanced". The 60 municipalities in the second cluster, where 75 percent of the population live, have above-average socioeconomic challenges. As they have only limited socioeconomic resources to address these challenges, their socioeconomic composition can be characterized as "challenging". Finally, the nine municipalities in the third cluster, accounting for five percent of the population, dispose of resources that are clearly above average. Combined with low challenges, they show a "privileged" socioeconomic composition. Two municipalities could not be categorized, due to missing data on unemployment.

Table 3. Clustering results of socioeconomic composition.

Cluster	Number of Municipalities	Proportion of Total Population
"Balanced"	91	19.5%
"Challenging"	60	75.3%
"Privileged"	9	5.1%
Not assigned	2	0.1%

5.2. Regional Structures

First, we checked the nine theoretically defined indicators for their measure of sampling adequacy. They show a Kaiser–Meyer–Olkin overall MSA of 0.70. We dropped the indicator on the rate of workplaces in the second sector, which has an MSA of 0.39. The remaining eight indicators are suited for factor analysis, as they have an overall MSA of 0.73, with individual MSAs varying between 0.66 and 0.90.

Based on the results of the exploratory factor analysis with two and three factors, we omitted the indicators on the organization of lower secondary level and on financial spending in education. For these two indicators, the proportion of variation explained by the factors was less than 0.5. The exploratory factor analysis with the remaining six indicators and three factors leads to a so-called saturated model. Because the degree of freedom within this model equals 0, the model fit cannot be assessed.

Subsequently, we checked different models in confirmatory factor analysis. We chose the model based on the loading structure of the saturated model, which has three factors with two indicators each. The selected model has a good fit (RMSEA = 0.10, RMSR = 0.027, TLI = 0.95). In models with small degrees of freedom, the RMSEA shows difficulties assessing the model fit [83]. Therefore, we rated the model adaptation based on RMSR and TLI. Interfactor correlations between 0.42 and 0.54 indicate that the factors are interdependent. The standardized factor loadings are shown in Table 4.

Table 4. Standardized factor loadings of indicators for regional structures.

Indicator	Factor 1: Labor Market	Factor 2: Institutional Accessibility	Factor 3: Extracurricular Stimulation Potential
SME rate	0.98	0	0
Employment density	0.83	0	0
Reachability of upper-secondary-level schools	0	0.88	0
Reachability of library	0	0.87	0
Child care supply rate	0	0	0.75
Rate of public transport	0	0	0.85

Municipalities with a high rate of small- and medium-sized companies (SMEs) in relation to the total of companies and a high employment density offer good labor market conditions. Municipalities characterized by good reachability of upper secondary schools and libraries share high institutional accessibility. Finally, municipalities with a good child care supply and that place great importance on local public transport endeavor to offer their residents good extracurricular stimulation potential.

Based on the estimated factor scores, we validated multiple stability and internal validation measures and compared several clustering algorithms with two to four clusters. The best fit to the factor scores was a solution with two clusters using partitioning

around medoids [82]. The first cluster comprises 85 municipalities with 16 percent of the population (see Table 5). Low scores on all three factors indicate regional structures that are assumed to be negatively related to educational participation. In the second cluster, where 75 municipalities represent 84 percent of the population, there are well-developed regional structures that promote participation in education.

Table 5. Clustering results of regional structures.

Cluster	Number of Municipalities	Proportion of Total Population
"Unfavorable"	85	16.0%
"Favorable"	75	83.6%
Not assigned	2	0.4%

5.3. Typology

In the next step, we developed a typology with six types by combining the clustering of both levels. Municipalities could be assigned to all six types. As one type only contains one municipality (privileged situation and favorable structures), we merged it with its similar neighboring type five. Table 6 gives an overview of the resulting five types, their characteristics, and their proportion of the total population.

Table 6. Description of the five types.

Type	Number of Municipalities	Proportion of Total Population	Characterization
1	69	11.0%	Balanced situation, unfavorable structures
2	21	8.4%	Balanced situation, favorable structures
3	13	4.5%	Challenging situation, unfavorable structures
4	46 (incl. City of Zurich)	70.5% (27.2%)	Challenging situation, favorable structures
5	9	5.1%	Privileged situation, favorable structures
-	4	0.5%	Missing values

The majority of the population lives in one of the 46 municipalities of type four, including the City of Zurich. These municipalities face socioeconomic challenges but offer favorable regional structures. In addition to the City of Zurich, type four also contains other urban centers such as the City of Winterthur (see Figure 1). With a challenging socioeconomic situation and poorly developed regional structures, the 13 municipalities of type three have the most unfavorable socio-spatial conditions. These municipalities are found at the very edge of the canton. Comparable to type three, the 69 mostly small rural municipalities of type one have not (yet) set up any favorable regional structures. However, the socioeconomic composition is less challenging than in type three. Type two, with its 21 municipalities spread throughout the canton, is characterized by a high level of socioeconomic challenges and average resources. These municipalities provide favorable regional structures, especially with regard to institutional accessibility and extracurricular stimulation potential. Finally, type five, with nine municipalities, accounting for five percent of the population, clearly stands out from the other types due to its very privileged socioeconomic composition and favorable regional structures. These municipalities are almost exclusively located on the lower Lake Zurich.

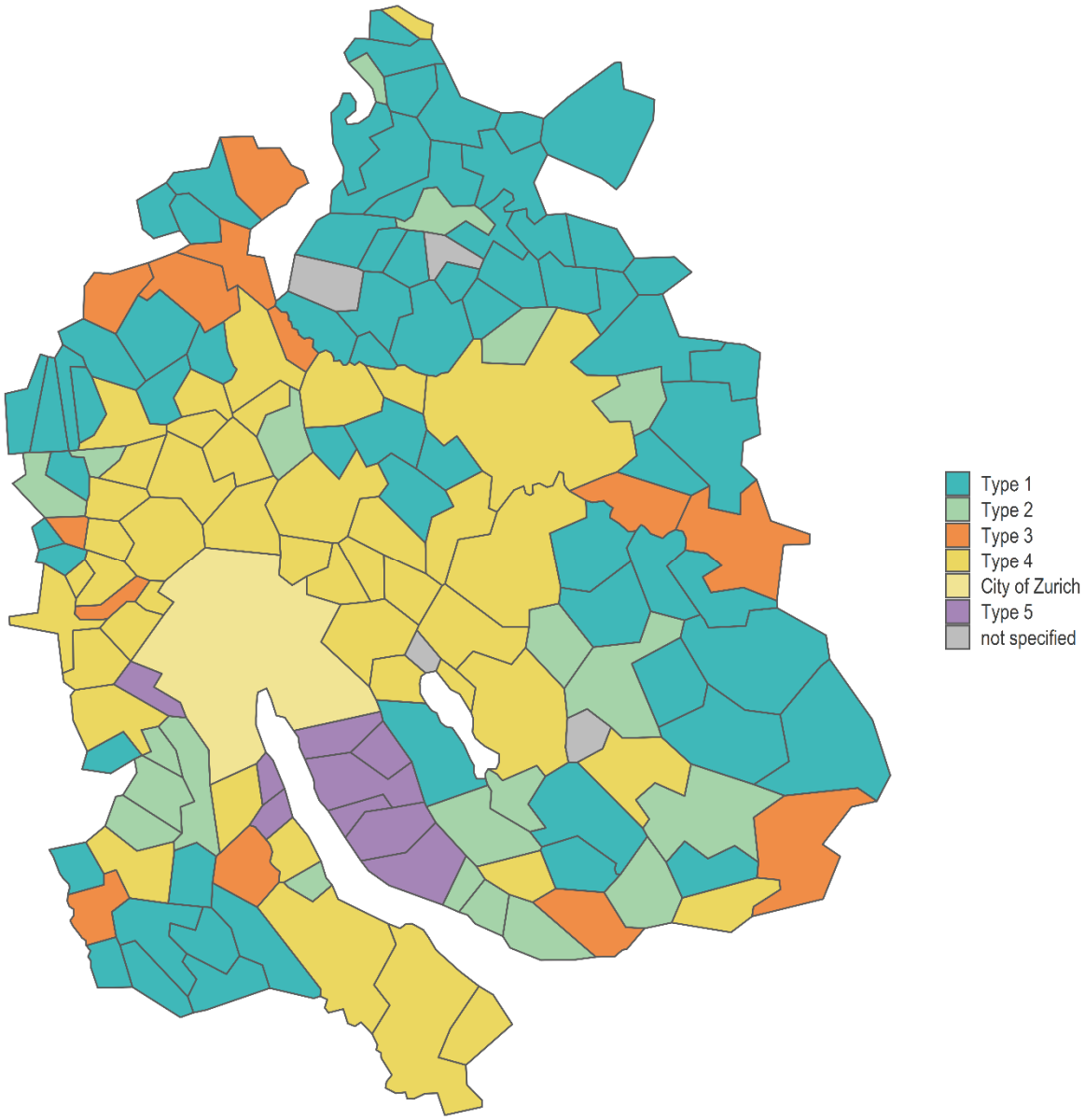

Figure 1. Geographical distribution of the five types.

Each municipality is weighted equally in the typology, regardless of its number of inhabitants. Because the City of Zurich makes up 27 percent of the population, we took a closer look at where its factor scores were located in comparison to the other municipalities of type four. It shows that the City of Zurich is correctly assigned to type four. However, compared to other municipalities of type four, the population of the City of Zurich can be characterized by a very high level of socioeconomic resources due to very high land prices. The largest city in the canton also offers particularly favorable regional structures, especially with regard to child care supply and public transport. Because we assume that these peculiarities of the socio-spatial context are reflected in varying participation in education, we approach the City of Zurich as a special case of type four.

5.4. Relevance for Participation in Education

The typology claims to reveal patterns of differences between municipalities in educationally relevant contextual conditions. In the Introduction, we referred to the spatial categorizations of the FSO [9]. To test their relevance for education, we examined differences among the FSO categories with regard to the three indicators of educational participation

by using ANOVA. With an explained variance of $R^2 < 0.18$, the categorizations show little overall discriminatory power.

Given this benchmark, we tested the differences in educational participation between the categories of our typology. The City of Zurich was treated as a separate sixth type. In two of the three indicators, the typology explains significant variance. It explains differences in the rate of tertiary degree ($F(5152) = 29.11$, $p < 0.001$), with an R^2 of 0.47 and median rates varying between 30 and 62 percent (see Figure 2). Figure 2 also reveals that it makes sense to consider the City of Zurich separately from the other type-four municipalities due to different rates of tertiary degree. With regard to the rate of persons without an upper secondary degree, the ANOVA shows significant differences ($F(5152) = 40.29$, $p < 0.001$), with an R^2 of 0.56. The median rate of persons without an upper secondary degree varies between 11 and 21 percent. For the rate of persons with a Federal Vocational Baccalaureate Certificate, the median varies between 0.15 and 0.19. No significant results were shown ($F(5152) = 1.81$, $p > 0.05$). The differences between the types are nevertheless of practical relevance because Cohen'd pointed to small to medium effect sizes [84]. Overall, depending on the education indicator, the typology shows a medium to a very good degree of distinction with respect to the educational participation of the population.

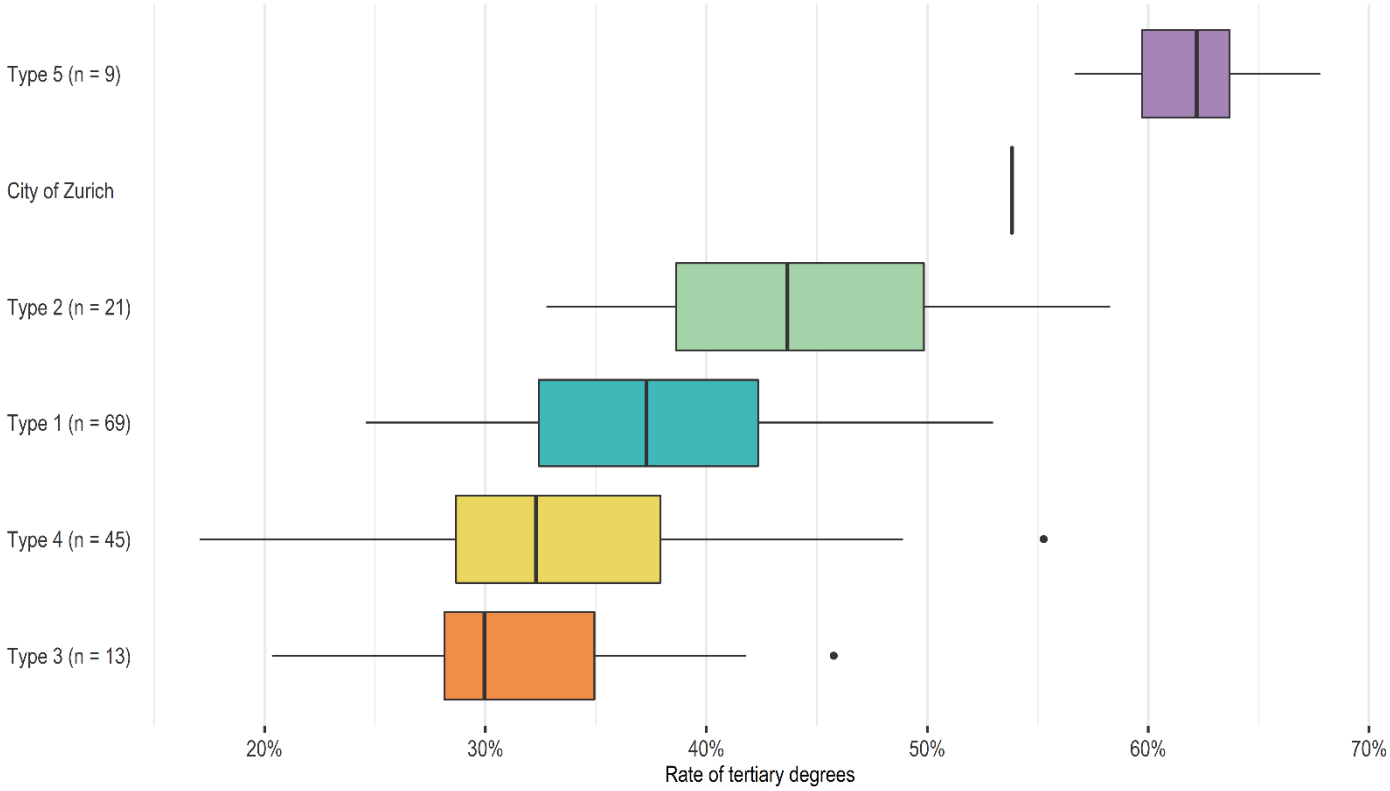

Figure 2. Distribution of the municipalities' rate of tertiary degree by type.

6. Discussion

In this paper, we developed a typology of municipalities in the Canton of Zurich useful for analyses in the field of education. For this purpose, we first defined socio-spatial indicators of the two levels, "socioeconomic composition" and "regional structures", based on theoretical approaches, and described the possible relationships between these indicators and the population's participation in education. While the first level describes the socioeconomic composition in a municipality, the second level refers to the specificity and accessibility of the institutional settings in a municipality, such as the labor market situation, the education system, and extracurricular stimulation potential. We chose indicators that are related to different educational pathways to cover different forms of educational partic-

ipation. Therefore, the indicators chosen were presumably related to a successful transition into post-compulsory education, to academic pathways, and/or career perspectives in vocational pathways. This approach based on theory addresses several shortcomings of social space analyses, in particular, the selection of indicators solely chosen due to availability and the lack of theoretical foundation [63]. In a second step, we identified factors on both levels and grouped them using clustering methods. The analyses yielded a typology that encompasses five types of municipalities. In addition, an in-depth analysis showed that the City of Zurich should be considered separately. Finally, we tested if the typology is conclusive with respect to the rate of tertiary degree, the rate of persons with a Federal Vocational Baccalaureate Certificate, and the rate of persons without a degree at the upper secondary level to verify its discrete validity.

On the first level, "socioeconomic composition", the analyses resulted in a well-fitting statistical model. Interestingly, socioeconomic resources and challenges turned out to be two independent dimensions of socioeconomic composition. In other words, privileged areas tend to have more socioeconomic resources but do not necessarily have fewer challenges. On the second level, "regional structures", the analyses showed a more complex structure of multiple interrelated factors, indicating that specificity and accessibility of institutions are difficult to operationalize. One reason for the difficulty in achieving a good-fitting model at this level could be insufficient variance because the canton sets many institutional parameters, especially in the education system. Future research would therefore have to invest in the further differentiation of these regional structures. To this end, more local data must be collected and included to better map existing regional structures and practices. Contexts with significant local responsibilities must be clearly distinguished from contexts where cantonal institutional parameters do not allow much regional flexibility.

The measurement level of the indicators is the municipality, which is plausible for aspects of the socio-spatial context such as fiscal capacity or child care supply if the level of regulation is the same. However, the influence of the immediate neighborhood on the individual may be stronger than the one of the total municipality. However, data on a lower level than that of the municipality are not yet available. A further shortcoming of the typology is that it does not take the disparities within large municipalities, such as Zurich or Winterthur, into account. This disregard makes the considerable differences between neighborhoods in larger cities disappear. However, these differences have diminished due to the rise in immigration of highly skilled workers in recent years [85]. In the future, we expect a somewhat improved data situation because statistical offices increasingly link data from different sources and thereby enrich existing data stocks. Probably, this will allow a more flexible understanding of socio-spatial conditions in the future.

Despite these shortcomings, our typology offers a distinctive framework for research in education and for cantonal administration. The typology condenses the contextual conditions into a few categories that display socio-spatial patterns of educational participation. The typology may be the basis for drawing representative samples for studies in the field of education when using stratified random sampling. In addition, explanatory models of educational disparities may be able to use the socio-spatial information of the typology. For example, in-depth analyses of the large-scale Swiss assessments of basic competencies, which focus on individual, family and classroom factors, showed that the urban–rural differentiation of the FSO has no additional explanatory value with respect to the likelihood of achieving basic competencies in the Canton of Zurich [86]. Therefore, the typology could add value to these models. The typology can also inform the actions of the cantonal administration. If the canton needs to revise its distribution of funds, the typology can identify the types of municipalities that will receive more or less funding in the recalculation. Furthermore, the typology may tell the cantonal administration whether differences between municipalities—for example, different funding of child care supply or different rates of special education—are the result of socio-spatial aspects. Based on this information, the canton may be able to adapt its actions by adjusting the institutional parameters or by providing more extensive information or support.

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