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DIFFERENTIATION IN LEVELS OF HUMAN CAPITAL AMONG SMALL CITIES IN WARMINSKO-MAZURSKIE VOIVODSHIP

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Abstract. A very important factor in sustainable development, especially of small cities, is their endogenous capital, including human capital. Cities with a higher level and quality of human capital are able to gain advantage in productivity and competitiveness, and they can develop more rapidly owing to the "knowledge spillover". Differences in the level of human capital between cities also affect the pace of development of an entire region and country. It is therefore important to analyze the scale of such differentiation, particularly among small cities, which are struggling with problems like urban shrinkage, talent drain or peripheralisation. The aim of the research was to assess the differentiation in the level of human capital among small cities in the warmińsko-mazurskie voivodship. The study covered 39 small cities. The Perkal synthetic indicator was applied to assess the level of human capital. Based on the values of this indicator, the cities were ordered linearly and grouped, using the standard deviations method. The level of human capital in the cities included in the study was significantly varied. The highest positions in the ranking were taken: Mikołajki, Lubawa, Biskupiec, Kisielice, Zalewo and Olsztynek. These cities were classified into the group of cities with high level of human capital. The lowest values of the human capital synthetic indicator were achieved for the cities: Sępopol, Jeziorany, Korsze, Pieniężno and Reszel. These cities were classified as cities with a very low level of human capital. The research results can help to design a strategy for the socio-economic development of the voivodship and to identify areas in need of strategic intervention.

Keywords: human capital; differentiation; small cities; development; synthetic indicator

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1. Introduction

Human capital is seen in contemporary economy as a particularly valuable resource and a key factor that can ensure a lasting competitive advantage to countries, regions and companies (see Kuc-Czarnecka, 2019, pp. 425–440). Authors of numerous studies emphasise that the development of human capital is a distinguishing feature of successful cities and regions (see Romer, 1990, pp. 71–102; Cortright, 2001, pp. 1–35; Mellander & Florida, 2012, pp. 2–26; Kijek & Matras-Bolibok, 2019, pp. 695–709). Areas with a higher level of human capital gain an advantage in productivity, rate of development, and the growth in salaries and employment (see Shapiro, 2003, pp. 1–24; Fu, 2007, pp. 86–111). The sites where human capital concentrates (especially cities) develop more rapidly owing to the effect of knowledge spillover, facilitated by dense interaction between units possessing much human capital (see Lucas, 1988, pp. 3–42; Glaeser, 2003, pp. 83–98).

The use of endogenous development potential, including human capital, is especially important for small cities, which are an important element of the country's settlement network and constitute local poles of development (Szarek-Iwaniuk, 2019, p. 2; Farelnik et al., 2020, pp. 19, 24). By acting as local centres, they organise the space and affect the quality of living of both their residents and the population living in the surrounding countryside (Heffner, 2016, p. 11). However, small cities struggle with many economic, social and spatial problems. The contemporary challenges for small towns are the outflow of population, peripheralization, small economic potential, poor absorption of innovations and aggregation of negative social phenomena (Drobniak, 2019, p. 49; Farelnik et al., 2021, pp. 141–142). In this situation, the chances of a city for development increasingly often depend on the level and quality of gathered human capital as well as on the opportunities for its creation and development.

The level of human capital in Poland is differentiated regionally. The warmińsko-mazurskie voivodship is one of the Polish provinces with the lowest level of human capital (see Bizon, 2014, pp. 295–310; Nazarczuk & Cicha-Nazarczuk, 2014, pp. 189–200; Wierzbicka, 2017, pp. 329–343). Because of the low level of entrepreneurship in this region, there is a constant outflow of the highest quality human capital to regions which offer employment and higher enumerations. This process is particularly prevalent in the case of small cities.

The aim of the research was to assess the differentiation in the level of human capital among small cities in the warmińsko-mazurskie voivodship. An effort was made to find answers to two research problems: *What is the scale of this differentiation?* and *Which cities in the region have the lowest level of human capital?*

The study covered all small cities in the warmińsko-mazurskie voivodship. The level of human capital possessed by the cities was assessed on the basis of 12 variables describing the cities' potential in this regard. The analysis was carried out on data from 2019. The Perkal method was applied. It enabled to determine a synthetic indicator describing the level of human capital in cities and to order them linearly. The research also employed one of the methods of grouping linearly ordered objects, that is the standard deviation method.

The article is composed of the following parts: theoretical background, research methodology, results, discussion and conclusions. The theoretical background focuses on the definition of human capital and how it is measured. The role of human capital in the development of modern cities in also described. The methodology section discusses the statistical methods used in the study and the way the variables were selected. The subsequent part of the article discusses the research results concerning the differentiation in the human capital level among small cities in the warmińsko-mazurskie voivodship. In the next part, the author refers her results to studies reported by other researchers. The article ends with conclusions, including suggestions for future research.

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2. Theoretical background

The importance of human capital in explaining the wealth of nations was emphasised by such economists as W. Petty, A. Smith and J.B. Say. However, the principles of the human capital theory were expressed later, in the 1960s, by J. Mincer, T.W. Shultz and G.S. Becker. At that time, human capital was mainly equated to formal education, especially schooling and the time dedicated to learning (see Mincer, 1958, pp. 281–302; Schultz, 1961, pp. 1–16; Becker, 1964, pp. 9–49). With time, the definition of human capital was extended to include the aspect of physical health (see Grossman, 1972, pp. 223–255; Mirvis, Chang & Cosby, 2008, pp. 30–57).

The notion of human capital appeared broadly in theories of economic growth. R. Lucas (1988, pp. 3–42) in the theory of endogenous growth demonstrated that accumulation of human capital and scientific and technical knowledge is a source of long-term economic growth. N.G. Mankiw, D. Romer and D.N. Weil (1992, pp. 407–437) considered the process of human capital accumulation in the Solow's neoclassical growth model, which facilitated its better adjustment to the actually observed growth tendencies in countries. These authors demonstrated that differentiation in the GDP per capita in different countries can be to a large extent explained by differences in the level of education. Studies on the influence of human capital on the economic growth of countries and regions have been continued to this day (see Barro, 1999, pp. 237–277; Bils & Klenow, 2000, pp. 1160–1183; Badinger & Tondl, 2003, pp. 215–239; Herbst, 2007, pp. 166–203; Gennaioli et al., 2013, pp. 105–164; Karambakuwa *et al*., 2020, pp. 1143–1159). There are also discussions about the direction and strength of the relationship between these categories (see Boozer *et al*., 2003, pp. 1–48; Spagat, 2006, pp. 44–56; Mehrara & Musai, 2013, pp. 55–62).

There are indications in the literature that the development of human capital is a key feature of successful cities. Human capital enhances productivity and creativity of individuals, improves the competitiveness on the labour market, gives a stimulus to new initiatives and unleashes the spirit of enterprise and technical progress (Starosta (Ed.), 2012, pp. 42–43). In cities with high concentration of human capital, an increase in the number of jobs and productivity of companies is higher than in other cities (see Fu, 2007, pp. 86–111; Elvery, 2010, pp. 367–379). The underlying reason is that people with superior skills are able to perform tasks more quickly and effectively, meaning that they can produce more and generate a higher added value (Florida et al., 2012, p. 355). Of significance is also the effect of knowledge spillover (Shapiro, 2003, p. 13). High quality human capital accelerates the process of knowledge and innovation creation and diffusion, which affects the rate of the economic growth in a given territory (Wierzbicka, 2017, p. 331).

The following are considered as the most important factors influencing the level and quality of human capital: quality of education, attractiveness of the local labour market, including its size and diversity, migrations of people, especially young ones with high qualifications, and a variety of properties composing the attractiveness of living in a given location (quality of living). All these factors are usually shaped during the long process of the development of a given area, during which the characteristics and economic functions have arisen, as well as demographic properties and social and cultural characteristics of the local population, including the culture of entrepreneurship (Gwosdz et al., 2019, p. 39).

Nowadays, there is no consensus on the definition of human capital. In its narrow sense, it is understood as the level of education in a given economy and is equated with these characteristics of persons that are related to formal education and skills (see Florczak, 2008, p. 171; Faggian & McCann, 2009, p. 319; Cabrita, 2015, p. 22; Bean, 2016, p. 104). In a broader view, it comprises knowledge resources, skills, competences, health and even the vital energy of a society. In other words, human capital includes not only the quantitatively seen formal education but also the quality and structure of education as well as all skills and competences earned by people outside the system of education and their health condition (see Bontis et al., 1999, p. 393; OECD, 2001, p. 18;

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Kucharčíková, 2011, p. 65). Human capital is a complex and ambiguous notion, in addition to which it is intangible in nature, making it difficult to measure.

The literature most often distinguish three methods for measuring human capital: the cost-, income- and education-based ones. The cost-based method involves determination of the outlays into the creation of human capital, that is the costs incurred by teaching and educating people. The income-based method means mainly the determination of the present value of future earnings by individuals, because it rests on the assumption that differences in earned salaries reflect the ultimate productivity of work. The education-based approach consists of identifying the level of education of the society. According to this method, education is the key element in the formation of human capital (see Oxley et al., 2008, pp. 283–344; Robinson et al., 2008, pp. 53–67; Roszkowska, 2012, pp. 38–44). The literature also provides many examples of studies in which these methods were employed (see Botev et al., 2019, pp. 3–54; Broxterman & Yezer, 2020, pp. 1–7). It is worth underlining, however, that the application of any of these methods commands the availability of many data, which in the case of regions or cities may be either inaccessible or difficult to access. Hence, evaluation of the level of human capital is often based on synthetic indicator, which are determined from the available partial indicators that are its approximations (Grześkowiak, 2017, p. 8). Among the indicators used most often are ones that identify the level of formal education, e.g. gross enrolment ratio, share of persons with a specific education level, average number of years in education, average results of examinations, etc. Other popular indicators are connected with occupational activity (e.g. employment rate, unemployment rate, entrepreneurship), mobility (e.g. migration balance, length of residing in the same location) and health (e.g. expenditure on health care, average longevity) (see *Guide…*, 2016, pp. 1–150; Gwosdz et al., 2019, pp. 27–34).

However human capital is defined, its role in the knowledge-based economy is growing steadily. Human capital is 'a carrier' of knowledge and innovation, which are pivotal to the ability of national, regional or local economies to compete successfully and to develop. Human capital is also perceived as a very important factor in the sustainable development of cities, regions, and countries.

3. Research methodology

The evaluation of the level of human capital and its differentiation was performed for all small cities in the warmińsko-mazurskie voivodship. According to the classification applied in Poland, small cities are the ones with population of up to 20,000 (compare Runge, 2012, pp. 83–101; Gaczek et al., 2019, pp. 7–10). In 2019, there were 39 such cities in the warmińsko-mazurskie voivodship.

The Perkal method was applied to analyse the differences in the human capital level owned by these cities. This approach enables to order analysed multi-dimensional objects according to a synthetic measure, which is a function of the input variables (Parysek & Wojtasiewicz, 1979, p. 26). The Perkal method is often used to assess the level of the socio-economic development of cities (see Kwiatek-Sołtys, 2011, pp. 363–370; Konecka-Szydłowska, 2012, pp. 135–146), regions (see Churski, 2014, pp. 63–77; Miśkiewicz-Nawrocka & Zeug-Żebro, 2017, pp. 69–83; Borkowski, 2020, pp. 195–216) and states (see Kruk & Waśniewska, 2017, pp. 337–352; Krasnodębski & Paluch, 2018, pp. 1722–1737). The choice of variables used to develop the Perkal's synthetic indicator was based on formal, subject-related and statistical considerations.

At the stage of considering the subject-related and formal aspects, an effort was made to select such variables that would most faithfully describe the level of human capital in cities. However, the limited availability of data from small cities created a considerable challenge. Hence, the variables chosen, while being highly relevant for the subject matter, were universal, measurable, available and complete (compare Balcerzak & Pietrzak, 2017, pp. 5–18). In total, 16 potential variables were enrolled in the study.

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At the next stage, which comprises the selection statistical data, the variation of the variables was taken into consideration, as well as the degree to which they correlate with the other variables. The variables for which the variability coefficient was below the adopted threshold value, i.e. 0.1, were discarded from the set of potential variables. Likewise, the variables for which the value of the Pearson correlation coefficient was higher than the adopted threshold value of 0.8 were removed from the set (compare Bal-Domańska et al., 2020, pp 790–795). In total, 4 variables were discarded. The final set of variables used to create the synthetic indicator of human capital contained 12 variables (both simulants – S and destimulans – D):

- X_1 – number of business entities per 1,000 working age population – S,
- X_2 – number of working persons per 1,000 population – S,
- X_3 – share of registered unemployed persons in the working age population – D,
- X_4 – share of non-working age persons in the total population – D,
- X_5 – permanent residence migration balance per 1,000 population – S,
- X_6 – birth rate per 1,000 population – S,
- X_7 – gross primary school enrolment rate – S,
- X_8 – number of students per 1 class in primary schools – D,
- X_9 – average primary school leaving exam results in mathematics – S,
- X_{10} – average primary school leaving exam results in English – S,
- X_{11} – average mid-secondary school exam results in mathematics – S,
- X_{12} – average mid-secondary school exam results in English – S.

The procedure of the determination of the synthetic human capital indicator was preceded by the process of data normalisation. The normalisation of variables was accomplished with the classical standardisation procedure, which ensures the elimination of variability as a basis for differentiating between objects (Walesiak, 2014, p. 368). Standardisation of variables was carried out as follows (Kruk & Waśniewska, 2017, p. 343):

for the stimulants $$z_{ij} = \frac{x_{ij} - \bar{x}_j}{s(x_j)}, \qquad i = 1, 2, \ldots, n; j = 1, 2, \ldots, m, \tag{1}$$

for the destimulants $$z_{ij} = -\frac{x_{ij} - \bar{x}_j}{s(x_j)}, \qquad i = 1, 2, \ldots, n; j = 1, 2, \ldots, m, \tag{2}$$

where:
z_{ij} – standardised value of *j*-th variable in *i*-th object,
x_{ij} – value of *j*-th variable in *i*-th object,
$\bar{x}_j$ – arithmetic mean of the value of *j*-th variable
s_{x_j} – standard deviation of *j*-th variable.

Standardised variables were submitted to the procedure of synthetisation. The Perkal synthetic indicator for the analysed cities was derived from the formula (Kruk & Waśniewska, 2017, p. 344):

$$s_i = \frac{1}{m} \sum_{j=1}^{m} z_{ij} \qquad i = 1, 2, \ldots, n, \tag{3}$$

where:
s_i – value of the Perkal indicator in *i*-th object,
z_{ij} – standardised value of *j*-th variable in *i*-th object,
m – number of variables.

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The Perkal synthetic indicator can take values within the range [-3; 3]. It served to order linearly the analysed cities and to group them according to the level of human capital they own.

The division of cities into groups was conducted with the help of the standard deviation method. The range limits were set based on the arithmetic mean value of the Perkal indicator for all cities $(\bar{s})$ and the level of the standard deviation of this indicator *S*(*s*) (Panek & Zwierzchowski, 2013, pp. 118–119). The set of the cities was divided into four groups:

1. With a very high level of human capital – the Perkal indicator in the range of $s_i \geq \bar{s} + S(s)$;
2. With a high level of human capital – the Perkal indicator in the range $\bar{s} + S(s) > s_i \geq \bar{s}$;
3. With a low level of human capital – the Perkal indicator in the range $\bar{s} > s_i \geq \bar{s} - S(s)$;
4. With a very low level of human capital – the Perkal indicator in the range $s_i < \bar{s} - S(s)$.

Both the linear ordering and the grouping of the cities were carried out on the basis of data of 2019, acquired from the Local Data Bank.

4. Results

The cities turned out to be significantly diverse with regard to values of the tested variables describing the level of human capital. This is confirmed by such information as the minimum and maximum value of standardised variables (Table 1).

Table 1. Variables describing the level of human capital in cities – basic descriptive statistics

Variables describing the level of human capital in cities	Value of the variable after standardization		Range
	Minimum	Maximum	
X_1 – number of business entities per 1,000 working age population (S)	-2.049 (Wielbark)	3.411 (Mikołajki)	5.459
X_2 – number of working persons per 1,000 population (S)	-1.313 (Sępopol)	2.976 (Lubawa)	4.290
X_3 – share of registered unemployed persons in the working age population (D)	-2.267 (Sępopol)	1.625 (Lubawa)	3.893
X_4 – share of non-working age persons in the total population (D)	-1.831 (Reszel)	2.920 (Wielbark)	4.752
X_5 – permanent residence migration balance per 1,000 population (S)	-2.234 (Jeziorany)	2.589 (Barczewo)	4.823
X_6 – birth rate per 1,000 population (S)	-2.219 (Górowo Iławeckie)	1.635 (Bisztynek)	3.854
X_7 – gross primary school enrolment rate (S)	-1.504 (Wielbark)	3.987 (Kisielice)	5.491
X_8 – number of students per 1 class in primary schools (D)	-1.704 (Orzysz)	2.013 (Kisielice)	3.717
X_9 – average primary school leaving exam results in mathematics (S)	-1.901 (Pasym)	2.835 (Wielbark)	4.736
X_{10} – average primary school leaving exam results in English (S)	-1.929 (Ryn)	2.177 (Mikołajki)	4.107
X_{11} – average mid-secondary school exam results in mathematics (S)	-2.656 (Barczewo)	2.692 (Mikołajki)	5.347
X_{12} – average mid-secondary school exam results in English (S)	-1.753 (Gołdap)	3.164 (Ruciane Nida)	4.917

Source: own calculations based on date from Local Data Bank (2020)

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In this case, the variables for which the range between the cities was the biggest were: gross primary school enrolment rate and number of business entities per 1,000 people in the working age population. The variable for which the range was the smaller turned out to be the average number of students per 1 class in primary schools. The maximum value of a variable was achieved by Mikołajki on three occasions, by Lubawa, Kisielice and Wielbark for two variables each, while Barczewo, Bisztynek, Ruciane-Nida scored the highest once. The minimum value of a variable was determined twice for Sępopol and Wielbark, and once for Barczewo, Gołdap, Górowo Iławeckie, Jeziorany, Orzysz, Pasym, Reszel and Ryn. The analysis suggests quite large area of variability of the analysed characteristics, describing the level of human capital in cities. Furthermore, the cities present internal variation in terms of their level of human capital. In some aspects, they score quite high and can be said to be leaders, whereas in some other areas their position is very weak (Wielbark is a good example of such internal discrepancies).

Differences in values of particular variables translated to the position of each city in a ranking list pertaining to the level of owned human capital (Table 2).

Table 2. Results of linear ordering of cities according to the level of human capital

Position in the ranking	City	Type of municipality[1]	Value of the Perkal synthetic indicator
1	Mikołajki	r-u	1.003
2	Lubawa	u	0.740
3	Biskupiec	r-u	0.634
4	Kisielice	r-u	0.576
5	Zalewo	r-u	0.519
6	Olsztynek	r-u	0.418
7	Olecko	r-u	0.407
8	Lidzbark Warmiński	u	0.369
9	Wielbark	r-u	0.369
10	Młynary	r-u	0.285
11	Pisz	r-u	0.215
12	Dobre Miasto	r-u	0.176
13	Braniewo	u	0.151
14	Węgorzewo	r-u	0.136
15	Nowe Miasto Lubawskie	u	0.123
16	Ryn	r-u	0.118
17	Susz	r-u	0.109
18	Gołdap	r-u	0.046
19	Miłakowo	r-u	0.030
20	Bisztynek	r-u	0.019
21	Nidzica	r-u	0.004
22	Morąg	r-u	-0.032
23	Ruciane-Nida	r-u	-0.046
24	Frombork	r-u	-0.123
25	Pasym	r-u	-0.165
26	Miłomłyn	r-u	-0.235
27	Orzysz	r-u	-0.235
28	Orneta	r-u	-0.236
29	Tolkmicko	r-u	-0.264
30	Biała Piska	r-u	-0.272

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31	Pasłęk	r-u	-0.274
32	Górowo Iławeckie	u	-0.307
33	Lidzbark	r-u	-0.353
34	Barczewo	r-u	-0.389
35	Reszel	r-u	-0.521
36	Pieniężno	r-u	-0.663
37	Korsze	r-u	-0.753
38	Jeziorany	r-u	-0.780
39	Sępopol	r-u	-0.800

[1] a city in a rural-urban municipality (r-u), an urban municipality (u)

Source: own calculations based on date from Local Data Bank (2020)

The top-scoring city was Mikołajki, a small town in the District of Mrągowo, with a population of 3,787. The Perkal synthetic indicator for this city was 1.003, which indicates a high level of human capital found in this city. The distinguishing asset of this city among all the 39 cities is the highest level of entrepreneurship. There are 252 business entities per 1,000 population in Mikołajki, in comparison to an average 158 businesses in all the analysed set of cities. Mikołajki is also distinguished by the highest average results achieved by primary school leavers in the English (64% versus 49% for the total set of cities) as well as the highest average result obtained from the mathematics exam taken by mid-secondary school pupils (52% versus 36% for the total number of the cities). The second position was scored by Lubawa, situated in the District of Iława. This is an urban municipality, with a population of 10,388. It was the highest number of working persons per 1,000 population (512 versus 219 for all cities) and the lowest percentage of registered unemployed persons in the working age population (2.4% versus 5.6% for all cities). The third position is occupied by Biskupiec, a city in the District of Olsztyn, populated by 10,634 people. An advantage of this city is one of the highest, and positive permanent residence migration balance per 1,000 residents (1.9 relative to the average for all cities being -4.1). Another upside is quite good results achieved by schoolchildren passing the middle secondary school examination in mathematics (44% versus 36% for all cities). Moreover, values of most variables describing the level of human capital were higher in this city than their average counterparts for all the cities. This observation is supported by the fact that values of as many as 10 variables, following standardisation, were positive.

Sępopol was assessed as having the lowest level of human capital among the analysed set of cities. It is a very small town, with a population of 1,941, situation in the District of Bartoszyce. The weakness of this town lies in the lowest number of working persons per 1,000 population (90 versus the average for all cities equal 219) and the highest share of registered unemployed persons in the working age population (10.1% versus the 5.6% average). Sępopol is also characterised by one of the poorest examination results achieved by mid-secondary school pupils in English (47% versus 61% for all cities). Another city with very low human capital is Jeziorany, located in the District of Olsztyn. Jeziorany has the highest negative balance of migration for permanent residence per 1,000 population (-13.5 versus the average for all cities equal -4.1) and one of the lowest birth rates per 1,000 population (-8.9 versus the average of -3.3). Significantly, the value of the Perkal synthetic indicator in as many as 21 cities was positive and higher than the average value for all the set. In 18 cities, this indicator obtained negative values. The range between the highest value of the Perkal indicator, which was scored by Mikołajki, and the lowest one, determined for Sępopol, was 1.803.

The subsequent step in this analysis was grouping the cities. Consequently, four groups of cities were distinguished (Table 3).

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Table 3. Results of grouping cities using the standard deviation method

Group	City	Level of human capital	Average value of the Perkal indicator in the group
1	Mikołajki, Lubawa, Biskupiec, Kisielice, Zalewo, Olsztynek	very high $s_i \geq 0.416$	0.648
2	Olecko, Lidzbark Warmiński, Wielbark, Młynary, Pisz, Dobre Miasto, Braniewo, Węgorzewo, Nowe Miasto Lubawskie, Ryn, Susz, Gołdap, Miłakowo, Bisztynek, Nidzica	high $0.416 > s_i \geq 0.0$	0.171
3	Morąg, Ruciane-Nida, Frombork, Pasym, Miłomłyn, Orzysz, Orneta, Tolkmicko, Biała Piska, Pasłęk, Górowo Iławeckie, Lidzbark, Barczewo	low $0.0 > s_i \geq -0.416$	-0.225
4	Reszel, Pieniężno, Korsze, Jeziorany, Sępopol	very low $s_i < -0.416$	-0.704

Source: own calculations based on date from table 2

The first one, with a very high level of human capital, contains 6 cities: Mikołajki, Lubawa, Biskupiec, Kisielice, Zalewo and Olsztynek. The average value of the Perkel indicator for this group was 0.648, at the standard deviation of 0.204. The second group included 15 cities with high human capital. The average value of the Perkal indicator here was 0.171, and the standard deviation was 0.133. Thus, this was a far more numerous group, but less diverse than the first one. The third group, with a low level of human capital, consisted of 13 cities. The average value of the Perkel indicator was -0.225, at standard deviation of 0.108. This group turned out to be even less diverse than the second one. The fourth group, composed of cities with the lowest level of human capital, gathered 5 cities: Reszel, Pieniężno, Korsze, Jeziorany and Sępopol. The average value of the Perkel indicator was -0.704, and the five cities diverged from this value by an average of 0.115. In brief, the group of cities with the highest level of human capital proved to be the most diverse one.

5. Discussion

The literature provides many examples of studies which focus on analysing the level of human capital in Poland (see Bryl, 2020, pp. 33–66; Siemiński et al., 2020, pp. 300–311), Polish regions (see Bizon, 2014, pp. 295–310; Klonowska-Matynia, 2019, pp. 32–51;), districts (see Wosiek, 2020, pp. 183–201) or cities (see Benneworth & Herbst, 2015, pp. 452–474; Wiktorowicz, 2016, pp. 85–99). Such analyses concern both the level of owned human capital and changes thereof. Many studies also deal with the influence of human capital on the economic growth of analysed regions or cities (see Herbst, 2007, pp. 166–203; Roszkowska, 2013, pp. 121–161). However, there are relatively few studies on the level of human capital in small cities, and those which are available pertain to just some of the Polish voivodships (see Konecka-Szydłowska & Dominiak, 2013, pp. 41–60). Moreover, they are often part of larger research and do not comprise all the aspects of this research problem. For example, an analysis of the level of human capital in small cities in the warmińsko-mazurskie voivodship has been made under the framework of an assessment of the socio-economic potential of the region, but it was based on just two parameters (see *Analysis of functional…*, 2019, pp. 30–34). A more complex analysis of the regional differentiation in the level of human capital in this voivodship was made for the districts (see Bartnik, 2015, pp. 7–23). The present study therefore fills in the gap in knowledge by analysing human capital in small cities.

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The author is aware that due to the limited amount of data available she was unable to take into consideration all aspects of human capital.

Interestingly, the research results obtained here are consistent with the results provided by the aforementioned, more general studies. The report in the socio-economic potential of cities in the region of Warmia and Mazury suggests that the lowest level of human capital, measured for example with results of the exams taken in the middle of secondary education, was determined in the smallest, peripheral cities (e.g. Sępopol, Pieniężno, Pasłęk, Tolkmicko, Barczewo, Biała Piska, Gołdap). This has been verified in the study presented herein. Furthermore, some consistency was also noticed between the current results and the ones obtained from a study of districts. For instance, the cities which were classified in this study as having a very high level of human capital are situated in the districts identified as possessing the highest human capital in the region (the districts of Olsztyn, Mrągowo, Iława). In turn, the cities determined to have a very low level of human capital were located in the districts characterized by the lowest level of human capital in the entire voivodship (the districts of Bartoszyce and Kętrzyn). Jeziorany was an exception. In the present study, this city occupied the second lowest position in terms of human capital, although it is situated in the District of Olsztyn, which is distinguished by a very high level of human capital. This might be explained by so-called human capital flight, that is the outflow of this city's resources to places where job opportunities are more appealing. However, the author did not analyse this issue.

6. Conclusions

The above study and its results indicate that the level of human capital in small cities located in the warmińsko-mazurskie voivodship is significantly varied. This is confirmed by a considerable range achieved by the computed Perkal synthetic indicator, which varied within <-0.800; 1.003>. The highest level of human capital was identified in Mikołajki, a small town in the District of Mrągowo. The lowest level of human capital was determined in Sępopol, one of the smallest towns in the voivodship, located in the District of Bartoszyce.

The differences between the cities in terms of their human capital are also confirmed by the results of the grouping of cities. The group of cities with very high human capital resources contained 6 out of 39 small cities analysed. The six cities differ in size, but most are situated in the north-western part of the voivodship. The group of cities with very low human capital consisted of 5 cities. They are the cities with the population of up to 5 thousand, mostly located in the northern part of the voivodship.

Recapitulating, the small cities in the warmińsko-mazurskie voivodship are characterised by the diverse level of human capital, and therefore they have different opportunities for development, based on the said capital. Significantly, their position in the economic structure of the voivodship largely depends the efficient management of knowledge on the regional level, and on the development and implementation of a proper strategy for development. Such strategy, based on the creation and use of human capital, would accelerate the process of diffusion of knowledge and innovation, and would enable a given city to attract and retain talents in its limits.

The results of the study reported above can serve as a valuable source of information and can be useful in designing strategies for the socio-economic development of the voivodship, and in identifying areas in need for strategic intervention. The planned continuation of this study will consist of an analysis of changes in levels of human capital in the same cities that have occurred in recent years. An attempt will also be made to determine whether there are any convergence or divergence processes taking place between these cities. Another key problem will be to explore and understand the causes underlying the above changes, and to identify major problem areas.

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