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Digital Competences in the Economy 4.0 and Their Determinants

Małgorzata Ćwiek[1], **Katarzyna Maj-Serwatka**[2]

[1] Krakow University of Economics, Department of Statistics, Rakowicka 27, 31-500 Kraków, Poland, e-mail: cwiekm@uek.krakow.pl, ORCID: https://orcid.org/0000-0002-6375-098X

[2] Krakow University of Economics, Department of Public Finance, Rakowicka 27, 31-500 Kraków, Poland, e-mail: majk@uek.krakow.pl, ORCID: https://orcid.org/0000-0003-0312-3359

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ABSTRACT

Objective: The article aims to assess the differentiation of the level of digital competences of young adults and identification of factors influencing the level of these competences among respondents disadvantaged by the digital divide.

Research Design & Methods: The article discusses the differences in the level of digital competences among young adults in Poland. The determinants of the level of digital competences among respondents at risk of digital exclusion were identified and, based on a regression tree analysis, it was indicated which of them best predict a low level of digital competences. Material from our own research conducted on a nationwide sample of 1,000 respondents was used. The catalogue of digital competences was taken from The European Digital Competence Framework (DigComp). Radar plots, box-plot plots, and regression trees were used to analyse the data.

Findings: As a result of the research, determinants of the low level of digital competences were identified, such as the type of place of residence, the level of education, and the level of social and cognitive competences. Moreover, it has been shown that the level of digital competences of people at risk of digital exclusion is only slightly differentiated by gender.

Implications/Recommendations: Reducing digital competence deficits is possible by participating in the education process. While competence gaps among young people can be reduced through formal education, in the case of professionally active people this is possible mainly through participation in informal and non-formal education. In the light of the research results, the development of digital competences requires the simultaneous development of cognitive and social competences.

Contribution: The article fills a research gap in the field of digital competences of young adults in Poland. Individual digital skills were measured and factors that differentiate their level were identified. It was also indicated which of the identified determinants best predict the risk of digital divide among young adults in Poland, which is the novel factor in the paper.

Article type: original article.

Keywords: digital competences, digital divide, labour market, survey data.

JEL Classification: I25, J24, J29, O15.

1. Introduction

The ongoing technological changes are one of the most important factors influencing the functioning of the modern digital economy. Digitalisation is universal and global, and concerns both social and economic processes, creating new challenges for a wide range of entities. The consequences of the dynamic development of technology include, among others: changing requirements in the labour market. They concern both employers, who must use these technologies on an increasingly wider scale to remain competitive, and employees, who must have the skills to work in a digital environment. Therefore, the requirements for employees in terms of the ability to use, manage and work with new technologies are increasing (Butler-Adam, 2018). Hence, in the Economy 4.0, employees must have not only skills related to the use of digital information and data, communication and cooperation in the digital world but also the creation of digital content, cybersecurity, and solving problems arising from working in a digital environment. It is also worth emphasising that the issue of digital competences is important not only in the aspect of Economy 4.0 but also in 5.0. The approach presented within this concept places people at the centre of the production process and uses progress for sustainable, intelligent development while respecting the environment (Atif, 2023; Raja Santhi & Muthuswamy, 2023).

Bearing in mind the above premises, the aim of the article is to assess differentiation of the level of digital competences of young adults and identification of factors influencing the level of these competences among respondents threatened by a digital divide. To achieve the goal, the following research questions were formulated: 1) What is the level of individual digital skills among respondents declaring different levels of general digital competences? 2) What are the determi-

nants of the level of digital competences among respondents threatened by a digital divide? 3) Which of the identified determinants best predict a low level of digital competences? To carry out the research planned in this way, material from our own research conducted on a nationwide sample of 1,000 respondents was analysed. The catalogue of digital competences was taken from The European Digital Competence Framework (DigComp). Radar plots, box-plot plots, and regression trees were used to analyse the data.

2. Literature Review

The digital transformation poses a challenge for a number of areas in modern society, including the labour market, education system, healthcare, and public administration. The consequences of digitalisation on the labour market are expressed, among other things, in employers' expectations of both the existing employees and individuals who are just entering the labour market. In the wake of the new digital world, globalisation and automation have reduced the number of routine, low-skilled jobs. Employees are required to have greater flexibility since much of the work which they have performed thus far has been automated. This implies a need for constant adaptation to shifting trends in the labour market, as well as lifelong learning and readiness to change occupations. Digital technologies accelerate the meaningful transformation of business activities, processes, competence, and models while allowing full leverage of the changes and opportunities brought about by their impact across society in a strategic and prioritised manner (Demirkan, Spohrer & Welser, 2016; Firlej, 2016).

Digital technologies allow us to obtain large data streams that require further research to create value which could provide a competitive edge for enterprises (Kraus *et al*., 2021). Big data (BD) is universal and therefore it is suitable for extensive use – both to identify customer needs and risk management, to design products and services, as well as to manage quality. Data analysis can also serve as a source of information about internal corporate processes and a starting point for their improvement (Urbinati *et al*., 2019). Hence, now more than ever enterprises have a growing need for people with specialist knowledge of information and communications technology (ICT). Debortoli, Müller and vom Brocke (2014) have distinguished between BD and traditional business analysis and developed a competency classification for BD and business intelligence (BI). The authors are certain that BI mainly requires skills associated with the use of appropriate software while working with BD which must go hand in hand with coding skills and knowledge of statistics. Research into this trend has also been conducted by Dubey and Gunasekaran (2015), who demonstrated the potential to enhance organisational value by possessing the appropriate hard and soft skills necessary to use BD and business analytics.

In turn, the consequences of BD or other megatrends (artificial intelligence, blockchain, advanced robotisation) for the education system imply a need for a new perspective on the competences transferred as part of the education process (Ćwiek & Maj-Waśniowska, 2020). This indicates several reasons to justify the inclusion of ICT in education. The first concerns the potential benefits of ICT in teaching and learning, which should result in better achievement and higher levels of student motivation (Pettersson, 2018). Secondly, digital competences are absolutely necessary for the modern knowledge-based society (Maj-Serwatka & Stabryła-Chudzio, 2023). Finally, digital competences, which enable active participation in social and economic life, prevent the digital divide. The term "digital divide" originally denoted inequality of access to ICT and the Internet (Irving *et al*., 1999). The evolution of ICT infrastructure brought with it a change in the perception of the digital divide and the focus shifted from the hardware aspect to the ability to use digital resources and competences (Ćwiek, 2018).

Changes and reforms of education systems as stipulated by technological progress are a prerequisite for people graduating and starting their working lives in order to meet work-related challenges of the digital future in the era of Economy 4.0 (Schwab, 2016). Gartner (2017) observes that new technologies (mixed reality, cognitive computing, blockchain, artificial intelligence), through their impact on the labour market, force companies to look for employees with the required digital skills (Bughin *et al*., 2018).

The digital competences that employees must acquire vary depending on the nature of the work. Murawski and Bick (2017) indicate that this acquisition is conditioned by properly designed curricula and training. A dual approach to digital competences, specifically from the demand and supply sides, may be helpful in this context. In both instances, the analyses use text mining techniques, among many other methods. The former case concerns the use of job advertisements to examine the required competences for a given position and the accompanying level of remuneration. The supply-side approach, on the other hand, means an analysis of the skills declared by employees in given jobs. Regarding the competences required for individual jobs, the difference between demand and supply indicates a gap between the currently existing vs. actually required digital competences of the labour force (Oberländer, Beinicke & Bipp, 2020; Bilan, Mishchuk & Samoliuk, 2023).

However, it should be noted that digital competences are also very important not only in the context of the functioning of the private sector but also from the point of view of public administration. Research in this area was conducted by Androniceanu *et al*. (2023). The authors looked for factors that most determine human resources digital competences and identified social factors, extrinsic motivation factors, and administrative and managerial factors as the most important. Moreover, research results indicate that the main reason for the development of

digital competences is the need to ensure data security and the need to ensure the continuity of the organisation's operations through consistent application of technological tools. In turn, Andronicеanu and Georgescu (2023) studied the correlations between human development and the digital competences of citizens and employees of a public administration office in Romania. The research results indicate two interesting relationships. Firstly, a negative relationship between Internet use and human development was observed. At the same time, a positive correlation was found between human development and digital skills. What is more, digitalisation of public administration has reduced employment in this area.

Economy 4.0 means the analysis of big data, related to the continuous acquisition of information, automation of production processes, the use of blockchain technology, machine learning, and finally – artificial intelligence. Therefore, active participation in socio-economic life requires the ability to understand and use digital content. These skills include both digital as well as social and cognitive competences that are used to operate in the digital age (Martzoukou *et al*., 2020). Digital competences also support interaction and communication in personal and social life (Bughin *et al*., 2018). These are increasingly referred to as essential soft skills (Kovacs & Vamosi Zarandne, 2022). According to the European Commission (2022), in the future nine out of ten jobs will require digital skills. This means that these skills will be necessary in both your private and professional life. The importance of social competences for an individual results from the fact that they allow for building social capital and determine the ability to work in an international environment (PwC, 2017). Cognitive competences, in turn, become particularly important in the era of the Internet due to information chaos. Thanks to logical reasoning it is possible to critically select information and assess its credibility. Changes in the labour market and the growing number of jobs requiring social and cognitive skills indicate the increasing importance of soft skills in relation to analytical skills (Varga *et al*., 2017).

The triad of competences, i.e. social, cognitive and digital competences, are referred to as the competences of the future or meta-competences (Śledziewska & Włoch, 2020). Hence, it should be stated that digital competences are necessary to counteract the digital divide, but not all tasks performed can be automated. Flexible perception, creativity, and emotional intelligence are necessary for effective problem solving (McKinsey Global Institute, 2017). The requirements regarding these competences, which are key from the employer's perspective regardless of the field of business activity, are a source of challenges for employees in the digital economy.

Considering digitalisation and technological changes and their impact on the labour market in the era of the 4.0 Economy, numerous studies have been conducted. Hetmańczyk (2024) pointed out that due to the ongoing digitalisation processes,

multidimensional professional training of employees is necessary. Adapting employee skills to new challenges ensures the competitiveness of the economy. They are also essential to achieving the sustainable development goals. In this context, according to Bugowski and Trzaska (2023), employees' digital competences are of particular importance. Threats and challenges for the labour market due to increasing digitalisation were discussed by Kolokytha *et al*. (2018). They pointed out that technological changes intensify structural maladjustment in the labour market. On the one hand, in some countries there is a high level of unemployment, and on the other, enterprises report problems with finding employees with appropriate competences. In turn, Chinoracký and Čorejova (2019), and Sârbu *et al*. (2020) investigated the possible labour market consequences of the widespread use of new technologies.

All of the studies mentioned above point to the need to develop competences, particularly digital ones, among employees in connection with ongoing technological changes. However, these studies did not characterise employees who are most at risk of marginalisation in the labour market due to low levels of digital competences. Hence, this article fills the research gap by identifying the factors that differentiate the level of digital competences of young adults and identifying those that best predict the risk of the digital divide.

3. Data and Research Method

The assessment of the level of digital competences and the identification of the determinants of their low level were evaluated based on primary data obtained in the course of our own research. A nationwide survey using computer assisted web interview (CAWI) on an online panel was conducted by the Public Opinion Research Center in the fourth quarter of 2020. The survey covered 1,000 respondents aged 18–30, with at least secondary education, selected by quotas from panel participants. The sample is representative in terms of age, sex, and education level (Table 1).

The catalogue of competences examined in the study was taken from The European Digital Competence Framework (DigComp) (Ferrari, 2013). The digital competence survey covered 21 skills grouped in five areas: 1) information and data literacy, 2) communication and collaboration, 3) digital content creation, 4) safety, 5) problem solving.

The respondents evaluated individual skills on a Likert scale (from 1 to 5); additionally, a possible answer was that one is unable to self-assess the level of a given competence. According to the DigComp methodology, an individual fluent in these five areas who is able to use the functions of digital technologies is considered a person with digital competence.

Table 1. Characteristics of Respondents Participating in the Study

Variable	Number	Percentage
Sex		
Male	476	47.6
Female	524	52.4
Age		
18–24	399	39.9
25–30	601	60.1
Level of education		
Secondary	575	57.5
Tertiary	425	42.5

Source: the authors.

The competence level assessment is presented in the form of a radar chart. It presents the results for all respondents, as well as the results for people who assessed their general digital competences as average at best (score 3 or lower), and those who assessed their competences at a good or very good level (score 4 or 5). Due to the purpose of the article, further analysis was carried out only for people at risk of digital divide. The criterion for this risk was an assessment of general digital competences of at most level 3.

Among persons with average or low digital competences, 57% are female. 37% of people in the study group are aged 18–24, the remaining 63% are aged 25–30. Nearly 60% of all respondents threatened by the digital divide have secondary education (Table 2). The smallest number of such people is in the group of respondents with higher education who have a PhD or postgraduate studies.

Table 2. The Number of Respondents with a Low Level of Digital Competence According to the Level of Education

Level of Education	Number	Cumulative Number	Percentage	Cumulative Percentage
Vocational secondary schools	96	96	24.00	24.00
General secondary	80	176	20.00	44.00
Post-secondary	56	232	14.00	58.00
Incomplete tertiary	18	250	4.50	62.50
Bachelor's degree or equivalent	69	319	17.25	79.75
Master's degree or equivalent	73	392	18.25	98.00
PhD or postgraduate studies	8	400	2.00	100.00

Source: the authors.

The last element of the characteristics of people at risk of digital divide is their place of residence. The largest groups are residents of rural areas (42.25%), small towns with a population of up to 20,000, and towns with 20,000–49,000 inhabitants (12.25% and 11.25% respectively).

During the analysis, first of all, for the indicated group, it was checked whether variables such as sex, age, level of education, and size of place of residence affect the level of digital competences. The analysis used a synthetic variable, which is the arithmetic mean of the ratings of 21 competences included in The European Digital Competence Framework. This variable is a stimulant. Then, the direction and strength of the correlation between the examined digital competences and cognitive and social competences was checked. The inclusion of cognitive and social competences in the model results from the belief in the literature on the complementarity of these three types of skills (Śledziewska & Włoch, 2020). Finally, a regression tree was developed, which is one of the methods of data mining. They allow a recursive division of the set of observations into disjoint subsets based on a dependent variable. The condition for using this method is an appropriate scale for measuring the dependent variable (at least an interval scale). The purpose of its use is to separate high and low values of the dependent variable at each stage of division while minimising leaf variability (Łapczyński, 2010).

The model for regression trees is created locally by submitting models built in disjoint segments of multidimensional space:

$$f(x_i) = \sum_{k=1}^{K} \alpha_k I(x_i \in R_k), \tag{1}$$

where:

R_k – segments of space X^m,

α_k – model parameters,

m – the number of explanatory variables,

I – the indicator variable expressed as:

$$I(x_i \in R_k) = \prod_{l=1}^{L} I\left(v_{kl}^{(d)} \leq x_{il} \leq v_{kl}^{(g)}\right), \tag{2}$$

where: $v_{kl}^{(d)}$ and $v_{kl}^{(g)}$ are respectively the lower and upper limits in the l dimension of space.

Model parameters α_k are determined according to the formula:

$$\alpha_k = \frac{1}{N(k)} \sum\nolimits_{x_i \in R_k} y_i, \tag{3}$$

where: $N_{(k)}$ – the number of observations that belong to R_k segment.

In the next step, using the appropriate quality functions of division, the R segment is divided into subsequence segments. The final form of the model is selected using one of the edge trimming methods (Walesiak & Gatnar, 2012). The C&RT algo-

rithm with the minimum cost of a cross-check was used to build regression trees. The explanatory variables include: cognitive competences, social competences, size of place of residence, level of education, age and sex. Statistical analysis of the data was performed using the Statistica 13 software.

4. Results and Discussion

To achieve the research goal, the analysis was carried out in two variants. In the first variant, the opinions of all respondents were taken into account (G1), while in the second variant, the respondents were divided into two groups (G2–G3) according to the self-assessment of general digital skills. In the second variant, the first group includes people who assess their digital skills as average at best (G2 – score 1–3) and the second – people who assess their digital skills as high or very high (G3 – score 4–5). Group G2 are people threatened by the digital divide. The average ratings of 21 individual digital competences for each group are shown in Figure 1.

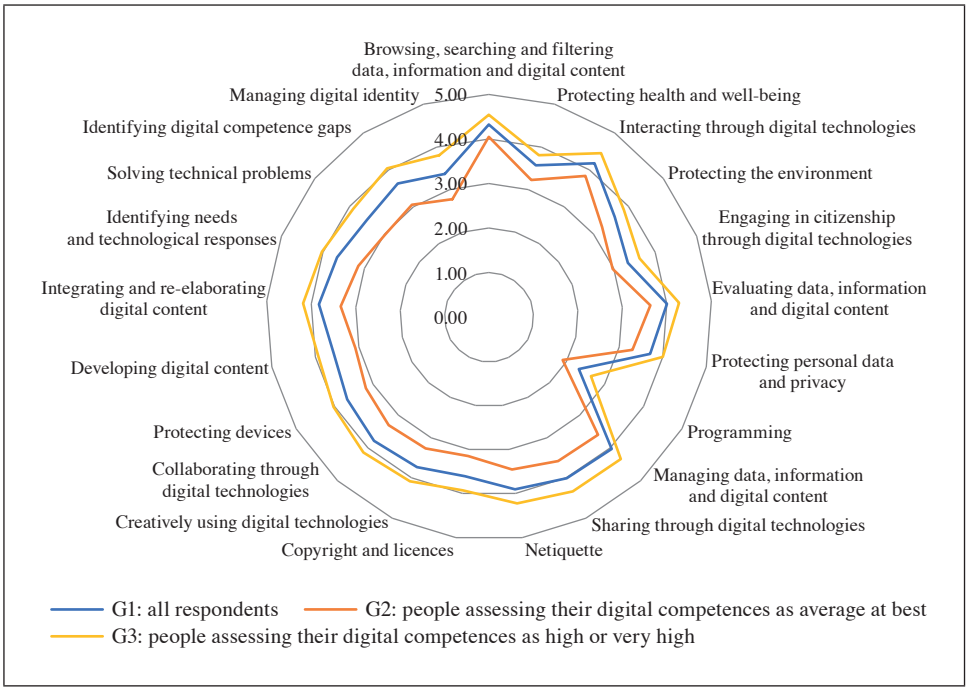

Fig. 1. Radar Chart of Average Ratings of Digital Competences in the Surveyed Groups of Respondents

Source: the authors.

Analysing the presented radar chart, it can be noticed that regardless of group affiliation, respondents rate the same competences as the highest and lowest, which results in a similar arrangement of lines on the chart, but with the difference that the assessment of people threatened by the digital divide is shifted towards the middle of the chart. If we compare the self-assessment of competences by respondents from the first and second groups, the smallest differences are visible for 1) browsing, searching and filtering data, information and digital content and 2) protecting health and well-being (0.28 and 0.34, respectively). The largest differences were observed for managing digital identity and identifying digital competence gaps (0.60 and 0.57, respectively). It is worth emphasising that in the case of people in the G1 group, only one digital skill was rated at a level below 3 (programming). The vast majority of other competences were rated above 3.5. In the G2 group, however, respondents rated the vast majority of skills as less than 3.5. Interestingly, if we compare the average competence ratings of respondents from the G2 and G3 groups, the smallest and largest differences were noted in the case of the same skills as when comparing G1 and G2 groups. However, this time the discrepancies in assessments are much greater. The smallest differences for the previously mentioned competences were 0.50 and 0.58, respectively, while the largest were 1.03 and 0.99, respectively. This means that the differences mentioned are almost twice as large, which demonstrates a wide range in the respondents' level of competences.

The conclusions reached by van Laar *et al*. (2020) and De Haan (2010) seem important in this context. The authors indicate that the differences in the level of digital skills in knowledge-based societies are one of the causes of social inequality. Moreover, the progressive development of new technologies and the information society deepens these gaps. Professionally inactive people with lower education, as well as the elderly and members of ethnic minorities are particularly vulnerable to the risk of digital divide (De Haan, 2010).

In the next step, it was checked whether the digital competences of people threatened by digital divide depend on features such as gender, level of education and the size of the respondents' place of residence. For this purpose, a synthetic variable was introduced to describe the respondents' digital competences, which is the arithmetic mean of the assessments of individual 21 competences. The distribution of the synthetic variable in the mentioned cross-sections is shown in Figure 2.

Analysing the obtained distributions, it can be seen that women and men rated their digital skills at a similar level. Opinions on the impact of gender on the level of digital competences are divided in the literature on the subject. Its absence was pointed out by, among others, Guillén Gámez and Perrino Peña (2020) and Rodríguez, Cantabrana and Cervera (2021).

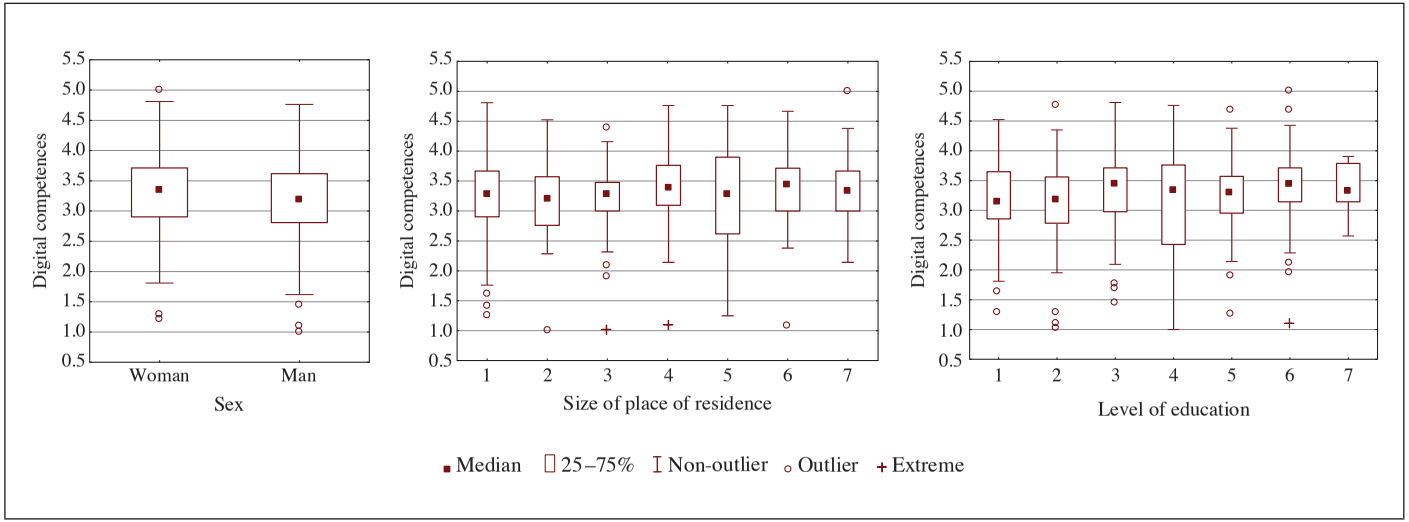

Fig. 2. Distributions of the Synthetic Variable Describing Digital Competences by Gender, Size of Place of Residence and Level of Education

Notes: Size of place of residence: 1 – village, 2 – town up to 20,000 inhabitants, 3 – town with 20,000–49,000 inhabitants, 4 – city with 50,000–99,000 inhabitants, 5 – city with 100,000–199,000 inhabitants, 6 – city with 200,000–500,000 inhabitants, 7 – city with over 500,000 inhabitants. Level of education: 1 – vocational secondary schools, 2 – general secondary, 3 – post-secondary, 4 – incomplete tertiary, 5 – bachelor's degree or equivalent, 6 – master's degree or equivalent, 7 – PhD or postgraduate studies.

Source: the authors.

Slightly greater differences are visible in the case of respondents' assessment of the size of their place of residence. The highest median rating is observed for residents of the cities with 50,000–99,000 and 200,000–500,000 inhabitants. However, for residents of villages and cities with 100,000–199,000 inhabitants, the greatest range of answers is visible, which means the greatest differences in the assessment of the level of digital competences. It is also worth emphasising that the self-assessment of competences of residents of the largest cities, i.e. those with more than 500,000 inhabitants, does not differ significantly from the assessment of competences of residents of smaller cities. This result is different from the results of Eurostat research, which indicate that urban residents have a higher average level of digital competences (Eurostat, 2023). However, it should be remembered that the results of our own research concern only the group of people under threat from the digital divide, while the results of Eurostat research concern the general public.

Taking into account the level of education, it is clearly visible that the discrepancies in the self-assessment of digital competences are the largest. The highest median grade was recorded for respondents with post-secondary education and a master's degree or equivalent. The greatest differences in the assessment of skills occurred in the case of people with incomplete tertiary education (the range of non-outlier values ranges from 1 to 4.7). However, the smallest difference is visible in the case of respondents with PhD or postgraduate studies. It should be noted, however, that the maximum self-assessment is much lower than in the case of other respondents and is below 4.0. Research by Rozkrut (2018) indicates greater activity of people with higher education in the context of using ICT. Eurostat research also shows a clearly higher level of digital competences among people with higher education (Eurostat, 2022).

Due to the purpose of the research, it was necessary to take into account the level of social and cognitive competences of the respondents in the analyses. The relationship between the level of digital competences and social and cognitive competences is presented in Table 3.

Table 3. Correlation Matrix between the Assessment of Digital Competences and Social and Cognitive Competences

Variable	Social Competences	Cognitive Competences	Digital Competences
Social competences	1.0000	0.5821*	0.4064*
Cognitive competences	0.5821*	1.0000	0.4815*
Digital competences	0.4064*	0.4815*	1.0000

*$p < 0.05$.

Source: the authors.

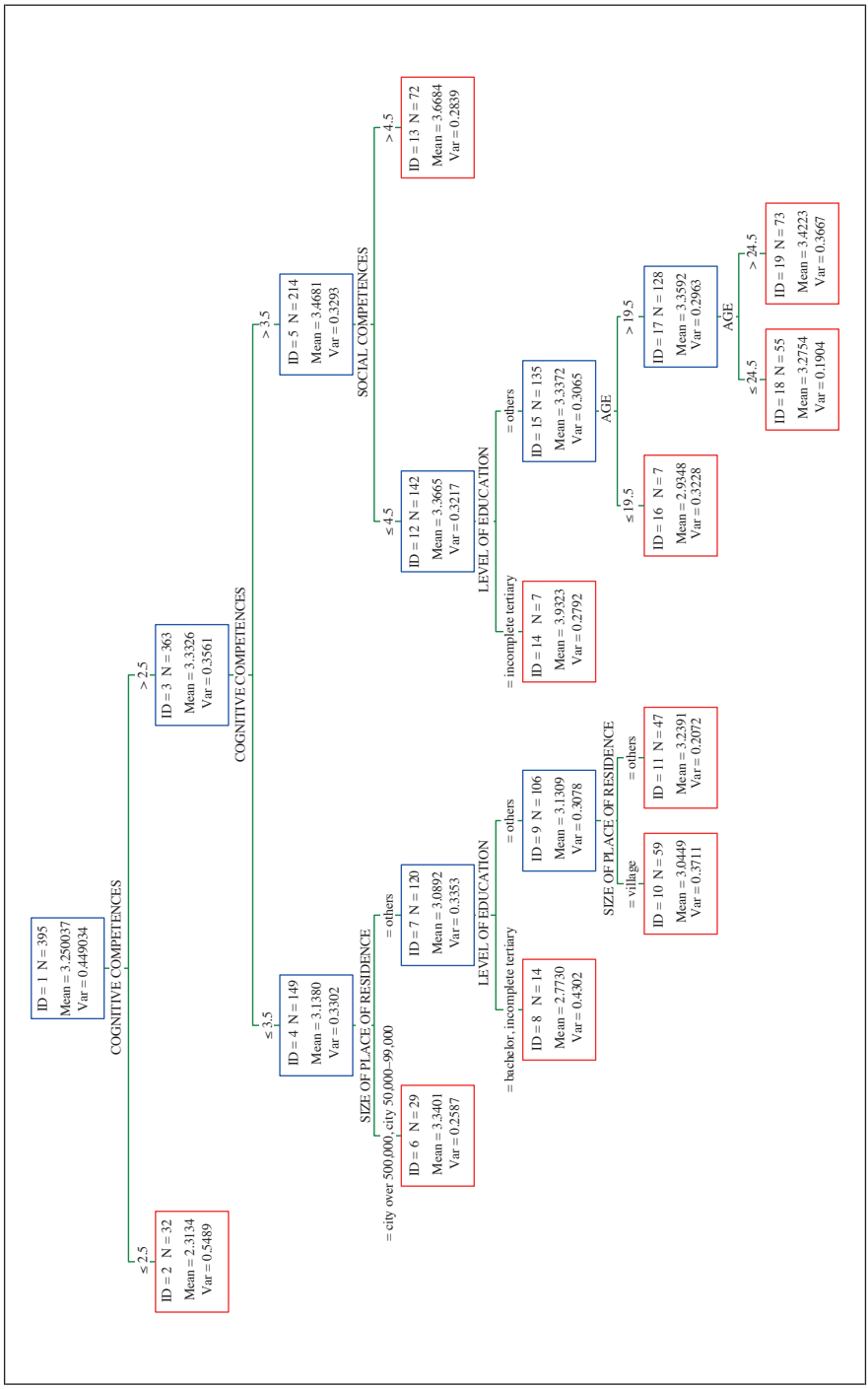

Fig. 3. Regression Tree for the Synthetic Variable Describing the Level of Digital Competences of Respondents at Risk of Digital Divide
Source: the authors.

The analysis of the results contained in Table 3 confirms the existence of a relationship between digital competences measured by the synthetic variable and cognitive and social competences. This is a moderate but statistically significant relationship, and the strength of the relationship between digital and cognitive competences is slightly greater than in the case of the correlation between digital and social competences.

To study the impact of all specified variables together on the digital competences, regression trees were used. The explained variable is a synthetic variable of digital competences. The explanatory variables include: cognitive competences, social competences, size of place of residence, level of education, age and sex. The regression tree obtained consists of nine split nodes and ten terminal nodes (Fig. 3). They were prepared for people who defined their general digital competences as level 3 at most, i.e. people threatened by the digital divide.

In the analysed tree, the first division line indicates that people with cognitive competences at a level less than or equal to 2.5 have on average 31% lower digital competences than people with cognitive competences above 2.5.

The cognitive competence level also determines the second division line. In this case, the limit value is 3.5. People with the above-mentioned competences at a level less than or equal to 3.5 have an average level of digital competence at a level of 3.14. Further dividing lines indicate that residents of cities with over 500,000 inhabitants and cities with between 50,000 and 99,000 inhabitants have higher digital competences than respondents living in smaller towns. Another division criterion is the level of education. A higher average level of the examined variable was observed in respondents who had completed master's studies and also in those with secondary education. The difference in relation to people with a bachelor's degree and incomplete higher education is 12.9%. The last dividing line in this part of the tree is related to the size of the place of residence. People living in rural areas have, on average, a lower level of digital competences than residents of other types of towns.

Returning to the second division line of the tree, it can be noticed that people with cognitive competences at a level higher than 3.5 have digital competences at a level of 3.47. In the case of these respondents, the differentiating feature is the level of social competences. Thus, people with these competences at a level of 4.5 or less have digital competences at a lower level. Among these people, the lowest level of digital competence is for people aged 19.5 or younger (average 2.93) and the highest for people aged 24.5 (average level 3.42).

What makes it disconcerting is that the age group 24 and above are people entering the labour market (often with higher education) who should possess skills that are desired by employers. Shortcomings in this area may be limited along with the acquisition of professional experience, however, they demonstrate that the education system is maladapted to the contemporary realities of socio-economic life.

This is confirmed by the results of research conducted by Google and the Polish Development Fund Group at the turn of 2018 and 2019 among 1,128 students and graduates of various universities (Włoch & Śledziewska, 2019). 31% of respondents indicated that they did not acquire digital competences at all during their studies, and 48% declared that they acquired them at a basic level. Respondents assessed the level of acquired social competences even less positively. In the case of some manifestations of these competences, such as people management, as many as 52% indicated that they had not acquired this competence at all. The respondents rated the level of their cognitive competences the best. In this case, most people indicated that they had them at a very high level (depending on individual skills, it was from 19% to 26%) (Śledziewska & Włoch, 2020). As a consequence, a significant group of employees entering the labour market, despite higher education, will require specialised training to improve their professional qualifications. According to the World Economic Forum (2018) report, this will be over 50% of employees. In the case of as many as 10%, thorough training lasting over a year will be necessary. The situation of people who do not have higher education on the labour market may be even more difficult, especially those faced with automation of their work (OECD, 2018).

Weak competences that do not meet the requirements of the labour market are a problem especially in the countries of Central and Eastern Europe, including Poland. According to Eurostat research, in 2023 only 44.3% of individuals aged 25 to 64 who are employees, self-employed or family workers have digital competences at least at the basic level. Nearly 4% of them do not have digital competences and 20% assess their skills as low (Eurostat, 2024). The issue of differences in the level of digital competences in European Union countries was also examined by Maj-Serwatka and Stabryła-Chudzio (2023).

In this context, it is worth mentioning that the crisis caused by the COVID-19 pandemic has unveiled new threats, which are related to the differences in the level of competences among young people who, as a whole, are perceived as the "owners" of high-level digital skills. The discrepancy between the belief of young adults in their exceptional digital competences and their actual digital skills has become especially prominent. At the same time, it is difficult to pinpoint the reasons for this difference. This is due to insufficient evidence of a relationship between the self-assessment of the level of digital competences and factors such as age, gender or level of education (Hecker & Loprest, 2019). It is, moreover, equally important to pinpoint that high self-assessment of digital competences may be rooted in the fact that young adults assess these competences through the prism of the ability to use social media, communicate, send information and photos, or use Internet resources, which merely encompasses skills that are part of information and data literacy and communication and collaboration (López-Meneses *et al*., 2020).

Young adults, as employees, should be aware of their digital skills, but also their shortcomings, and employers should clearly formulate expectations regarding the type and level of digital competences of employees. Such guidelines are important in the context of employee motivation and their desire to develop their skills, which in turn should be reflected in financial recognition (Bassi & Nansamba, 2019).

In the case of people with low digital competences threatened by the digital divide, it is necessary to develop them in the process of lifelong learning. In the era of digitalisation, digital competences and the need for the constant development thereof are necessary in order to counteract the digital divide, which may further become a source of social exclusion. All this is taking place in a situation where, due to lack of knowledge, individuals are unable to take advantage of the opportunities offered by the information society (Calderón, Sanmartín Ortí & Kuric, 2022). Although the work of machines will complement and support the work of people, rather than replace it (Daugherty & Wilson, 2018), the prevailing view is that advancing automation processes are skill biased (Brynjolfsson & McAfee, 2014).

5. Conclusions

The digital competence deficits identified in the article pose a particular threat to the construction and development of the digital economy. Although the formal education process and curricula increasingly pay attention to the need to develop digital skills, research results clearly indicate that these activities are insufficient. The research conducted indicates that mere graduation from studies does not guarantee the acquisition of digital competences in all five areas included in the European Digital Competence Framework methodology. However, education is mentioned as a vital element in reducing deficits in digital competence. Lythreatis *et al*. (2021) indicate that among the many factors influencing digital divide, such as: socio-demographic and socio-economic factors, social support, personal predispositions, type of technology, it is precisely education that is most closely related to the digital divide. Undoubtedly, the educational process carried out during working life is also an opportunity to reduce the competence gap and increase the level of competences, among others in the form of courses or training. Hence, formal, informal and non-formal education will largely contribute to reducing the risk of digital divide. While the competence gaps in young individuals can be limited or eliminated through formal education, in the case of the professionally active this is possible mainly through participation in informal and non-formal education.

The execution of digital development programmes and training should take into account that these measures must include competences from all five researched areas. This is due to the fact that a digitally competent person is fluent in all these areas, rather than merely being able to use digital technologies.

The conducted research allowed for the identification of practical implications. Technological changes, affecting the labour market, force a redefinition of educational policy, both in terms of its subjects, goals and content of teaching and recipients. It becomes necessary to include, in addition to traditional knowledge, new skills that will enable active participation in socio-economic life. First of all, the education system should develop digital competences, with particular emphasis on managing digital identity, which is necessary in the context of cybersecurity. In the light of the research results, the development of digital competences requires the simultaneous development of cognitive and social competences. Thanks to them, it is possible to build social capital and function in an international environment, as well as critical verification of information necessary in connection with the information noise in the era of new technologies and growing threats resulting from cybercrime.

Finally, it is also worth noting that the research conducted may constitute the basis for further in-depth analysis related to the issues raised. Particularly interesting is the issue of digital competences according to the modified DigComp 2.2, which contains examples of knowledge, skills and attitudes applicable to each of the 21 competences (Vuorikari, Kluzer & Punie, 2022). The new approach is particularly important for people who are responsible for preparing both school curricula and training programmes and courses. When it comes to the subject range, DigComp 2.2 covers topics including: disinformation in social media and news websites, datafication of Internet services and applications, interaction of people with AI systems and new technologies such as the Internet of Things and, finally sustainable growth. This last issue seems to be particularly important in the concept of Economy 5.0, which puts humans at the centre of the production process and uses progress for sustainable, intelligent development while respecting the environment (Atif, 2023; Raja Santhi & Muthuswamy, 2023). Hence, future research should take into account the issue of digital competences in Economy 5.0.

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Authors' Contribution

The authors' individual contribution is as follows: Each contributed 50%.

Conflict of Interest

The authors declare no conflict of interest.

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