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THE INFLUENCE OF DIGITAL LITERACY ON THE EMPLOYMENT RATE OF THE OLDER POPULATION

Andelka Stojanović*, Isidora Milošević, Sanela Arsić

University of Belgrade, Technical Faculty in Bor, Serbia

Abstract: Information and communication technologies (ICT) have recently become essential in shaping employees' career trajectories. The changes brought by intensive digitization condition the growing demand for specific knowledge and competencies that constitute a new literacy paradigm - digital literacy. On the other hand, digitization processes can negatively affect older people and their working performance and employability. Using data from the Eurostat database, which contains international, comparable data, this study investigated the relationship between digital literacy and the employment rate of the older population. In order to define the elements of digital literacy, the level of computer skills, the way of obtaining ICT skills, and the ability to evaluate digital content were considered. The results show that in the age group, 55-64 is a statistically significant influence of the variables describing digital literacy on the employment rate. However, this influence is not proven when testing the population aged 35-44 and 45-54.

Keywords: digital literacy, ICT, older population, employment rate

1. INTRODUCTION

The intense changes that have occurred in recent decades in the development of information and communication technologies (ICT) not only affect industry and science but also have significant social and economic consequences. Globally viewed, society faces significant challenges regarding the availability and intensity of ICT use, which causes the emergence of numerous digital divides on global, regional, and even personal levels.

One of today's particular problems is the population's aging, which is a challenge in itself. By observing the statistics, a significant increase in the older population in the world can be determined. Namely, according to the United Nations (2022), by 2050, one in six people in the world will be over age 65, which would be 16% of the population. While the aging population trend started in the world's most developed countries, aging is recently noticed in middle and low-income countries. The largest share of the older population nowadays is in Europe and Northern America, with almost 19 percent aged 65 or over (in 2022), with further growth predicted in both regions. On the other hand, Northern and sub-Saharan Africa and most of Asia are projected to have relatively small proportions of older people in 2050, although the growth rate is evident.

In light of the aging population, society and industry face numerous challenges. The increase in the share of older people forces companies to redesign products and services,

* Corresponding author: anstojanovic@tfbor.bg.ac.rs

adapt to the new needs of older users, and take advantage of the opportunities that arise from this (Sallati & Schützer, 2021).

Also, the number of older employees is increasing, which, in the context of the pronounced digitalization of business processes, poses an additional challenge to the company's management that needs to be addressed. Namely, there are significant changes in employment patterns caused by technological changes, which require redesigning business strategies and orientation towards long-life learning. Considering that younger employees, Millennials, and Generation Z grew up in an environment already changed by digitization and connected with ICT in the early stages of life, they naturally adopt new technologies faster (Picatoste et al., 2018; Olejniczak, 2022). Therefore, the expectations of these age groups are actually a similar level of interaction with technologies in a working environment and dealing with the most modern technologies available (Wirthman, 2020). In contrast, older employees are less comfortable with the intense digitalization of the working environment and must make additional efforts to acquire the necessary digital skills. During that process, older employees often face prejudices and negative attitudes (Lissitsa et al., 2017), even with a certain degree of discrimination and digital exclusion. Nevertheless, the largest share of the labor force represents mature employees who cannot just be excluded from business processes.

In most European countries, retirement occurs between 60 and 65 years of age and even up to 67 in some cases (Greece, Italy, Norway, Denmark) (Finnish Center for Pensions, 2023). For this reason, it can be said that those who belong to the population aged 55-64 today will be in employment for another ten years. Nevertheless, they have specific valuable working and life experiences and soft skills that contribute to the business's success. Given that ICT is ubiquitous, differences in the level of digital skills cause deepening inequalities to the extent that a specific part of the population is deprived of adequate social inclusion and financial security. Therefore, monitoring the current level of digital literacy and the employment rates of the older population is an important research topic for the present and future of the economy and society.

This study aims to examine the relationship between the level of digital literacy and the employment rate and to determine whether there is a significant effect on the employment of the older population. The Principal Component Analysis and Multiple Linear Regression will be applied to test models that establish digital literacy and employment rate relations. Digital literacy will be analyzed as a multifactor phenomenon based on the data retrieved from the Eurostat database.

2. LITERATURE REVIEW

At the time of the significant progress of ICT and its influence in all spheres of life and business, there were occurrences of significant notable differences and the phenomenon of the digital divide arising as a result of inequality in access and the level of use of digital technologies. Certain studies show that the impact of ICT on economic performance is not the same everywhere and depends on the country's economic development level (Mayer et al., 2020). Lucendo-Monedero et al. (2019) aimed to identify spatial inequality in the digital development of European households and individuals at the regional level. They find that the digital divide among European regions is identified in a north/west-south/east pattern. Zilian and Zilian (2020) presented empirical evidence that digital inequalities also occur in developed countries. Nevertheless, they point to the positive effects of a high socio-economic background on reducing problems caused by digitization. Galperin and Arcidiacono (2021) investigated gender digital differences and their impact on participation in the workforce and

confirmed the connection between employment and internet use. Given that digital exclusion is observed in certain age groups, digital divides based on ageism are becoming the subject of numerous research and concerns of EU institutions.

Digital divides largely contribute to the significant exclusion of deprived social groups and cause substantial negative social consequences. Also, the economic implications of fast-growing digital changes must not be ignored. Research by Abbasabadi and Soleimani (2021) dealt with the link between the expansion of digital technologies and unemployment. The results show a significant correlation between unemployment and digital technology indexes. It is further concluded that as digital technologies expand, unemployment rises to a maximum and begins to decline as technological expansion exceeds a specific value.

Technological progress has conditioned the accelerated growth of the global economy and the automation of many industrial and business processes, consequently affecting education, personal skills, competencies, but also working relationships. Additionally, the emergence of new specialized workplaces and the development of new knowledge and smart products occurred. Vu (2011) emphasizes the importance of human capital for the effective application of ICT because technologies alone do not bring improvements if employees' digital skills are not raised to an adequate level. Digital divides significantly affect the working population especially concerning more mature and older employees. Many pieces of research deal with the changes in the working environment and the employees' adaptation to the new situation. In extensive research on the effects of technological changes on employment made by Mondolo (2022) and Filippi et al. (2023), it was concluded that the impact of ICT incorporation in the working environment on older employees could be negative, positive, or even inconclusive. However, if it is about employees with a higher educational level, especially in digital literacy, who have intensively used ICT in their work, the negative impact of technology on employment is significantly reduced.

Digital literacy (or ICT literacy) refers to the necessary extension of literacy. It is defined as the ability to use information from ICT sources and to develop the skills of using digital devices and critical thinking to assess the value of information and security (Fulton & McGuinness, 2016; Nicholson, 2017). According to UNESCO (2018) definition: "Digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship. It includes competencies that are variously referred to as computer literacy, ICT literacy, information literacy and media literacy."

The importance of digital literacy is reflected in the achievement of financial inclusion for older people, given that the ability to perform financial transactions remains an essential element of daily activities and social inclusion (Bui & Luong, 2023). Digital financial literacy represents knowledge about digital financial products and services and awareness of risks and rights (Kumar et al., 2023). Digital financial literacy allows the adequate and simple management of finances and long-term financial stability. The results of the research by Bui and Luong (2023) indicate that financial literacy problems arise as a consequence of the level of education and wealth. Ciesielska et al. (2022) dealt with e-government inclusion policies for seniors, considering the two main drivers of these activities. Namely, technological and social aspects must be evaluated when considering the necessity of adapting services provided through e-government. First, the problem arises because of the older population's coherence with technology and their ability to use it. On the other hand, with aging, the need to use various social services has been increasing, and in recent times they are all offered in digital form. Therefore, the problem of digital inclusion of the older population represents an important field of social policy and a strong challenge for policymakers.

On the other hand, Peng's (2017) study deals with the issue of the effect of computer skills on an employee's workplace and employability. The results indicate that digital literacy reduces the possibility of changing the employee's workplace due to digitization and additionally facilitates reemployment if the employee is transferred. Lee et al. (2022) deal with older employees' productivity and conclude that employees with well-developed ICT skills that they use when performing their work affect positively their wages. This is especially emphasized for those employed whose jobs, besides ICT skills, require a high level of education. Furthermore, the research proves that the decline in productivity accompanying the aging process can be reduced by constantly training employees to improve their digital skills.

Based on the literature review, it can be concluded that age-based digital inequality affects the socio-economic performance of the older population. Furthermore, there is a lack of research in the literature that directly examines the relationship between the level of digital literacy and the level of employment of the older population, which is the focus of this paper.

3. DATA AND METHODOLOGY

3.1. Data

Data from the Eurostat database from 2021 was used to achieve the research goals. The Eurostat database was created through the cooperation of the Statistical Office of the European Union, National Statistical Institutes, and other national authorities in the EU Member States, forming the European Statistical System (ESS). The EU survey on the use of Information and Communication Technologies (ICT) in households and by individuals is conducted annually with the aim of collecting data on the availability and use of ICT. The sample in this study consists of three age levels: 35-44, 45-54, and 54-65, which will be used to test the assumption that digital literacy's impact on employment depends on the age group. The data series on 37 European countries is collected, creating a sample of 111 data lines. A series of statistical analyses are further applied to test the assumption that digital literacy measures influence employment.

3.2. Construction of digital literacy measures

Following the previous definitions of digital literacy, measures in this paper consist of two components: Level of computer skills and Evaluating data, information, and digital content. In addition, the Way obtaining ICT skills was taken as a factor influencing the employment rate. The Level of computer skills measure consists of nine indicators presented in Table 1. Evaluating data, information, and digital content consists of six indicators, while Way obtaining ICT skills consists of five indicators, shown in Table 1.

Table 1. Defined indicators (Eurostat)

Measurement	Indicator	Label
Level of computer skills (LCS)	Individuals who have written code in a programming language (3 months)	CS1
	Individuals who have copied or moved files between folders, devices or on the cloud (3 months)	CS2
	Individuals who downloaded or installed software or apps (3 months)	CS3
	Individuals who changed the settings of software, app or device (3 months)	CS4
	Individuals who used word processing software (3 months)	CS5
	Individuals who have created files integrating elements such as text, pictures, tables, charts, animations or sound (3 months)	CS6
	Individuals who used spreadsheet software (3 months)	CS7
	Individuals who used advanced features of spreadsheet software to organise, analyse, structure or modify data (3 months)	CS8
	Individuals who edited photos, video or audio files (3 months)	CS9
Evaluating data, information and digital content (EDIDC)	Individuals have seen untrue or doubtful information or content on the internet news sites or social media (3 months)	ED1
	Individuals have checked the truthfulness of the information or content they found on the internet news sites or social media (3 months)	ED2
	Individuals have checked the truthfulness of the information or content found on the internet by checking the sources or finding other information on the internet (3 months)	ED3
	Individuals have checked the truthfulness of the information or content found on the internet by following or taking part in discussion on internet regarding the information (3 months)	ED4
	Individuals have checked the truthfulness of the information or content found on the internet by discussing the information offline with other persons or using sources not on internet (3 months)	ED5
	Individuals have checked the truthfulness of the information or content found on the internet (3 months) by using the following methods: I_TICCSFOI, I_TICIDIS or I_TICNIDIS	ED6
Way obtaining ICT skills (WODS)	Individuals carried out free online training	OS1
	Individuals carried out training paid by themselves	OS2
	Individuals carried out free training provided by public programs	OS3
	Individuals carried out training paid or provided by the employer	OS4
	Individuals carried out on-the-job training	OS5

3.3. Methods

Principal Component Analysis (PCA) represents the basis of any multivariate analysis, which purpose is investigating relationships between variables. PCA can be used for simplification, data reduction, modeling, outlier detection, variable selection prediction, etc. (Esbensen & Geladi, 1987). The basic premise of PCA is that certain measures in a data set are more meaningful for explaining a particular phenomenon while others create noise. It is used when the research focuses on the minimum number of factors that describe the maximum share of the total variance represented in the original set of variables (Hair et al., 2014).

PCA was conducted on the entire sample to interpret the aligning of the defined indicators to each measure, explain the variability, and determine the reliability of the proposed measurement scales. Also, regression factor scores were determined for each measure. They represent the distance of every entity's position on the factor(s) (DiStefano et al., 2009). The scores created by the regression method have a mean of 0 and a variance equal to the squared multiple correlations between the estimated factor scores and the actual factor values (IBM, 2021).

In the continuation of the analysis, the obtained factor scores were used in the multiple regression analysis. The employment rate in certain age groups was used as a dependent variable (data retrieved from Eurostat, Labor force survey), while factor scores for three digital literacy measures were used as independent variables. In order to determine the influence but also the existence of differences based on age groups, three models were defined and tested.

The basic model of the regression equation for predicting the effect of the examined variables on the employment rate has the form:

$$\text{Employment rate} = b_0 + b_1 \cdot \text{Level of computer skills} + b_2 \cdot \text{Evaluating data, information and digital content} + b_3 \cdot \text{Way obtaining ICT skills}$$

4. RESULTS

The summary statistic of the examined variables is presented in Table 2. The results of PCA and the reliability of measurement scales are also shown in Table 2. The results indicate that the collected data are adequate for conducting factor analysis, considering that all Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO test) values exceed the recommended threshold value of .6. Furthermore, high % of variance explained values indicate a high share of explained changes with examined variables. In addition, high values of factor loadings give considerable weight to the selected factors. Finally, the reliability of the measurement scales was confirmed by Cronbach's Alpha coefficient, whose values exceed the recommended values of .7.

Table 2. Statistics of the examined variables

Measurement	Label	Min	Max	Mean	Std. Deviation	KMO Test	% of variance explained*	Factor loadings	Cronbach's Alpha
Level of computer skills	CS1	.13	13.45	4.40	3.33	.894	81.960	.830- .959	.960
	CS2	4.46	97.01	54.84	19.30				
	CS3	9.62	85.04	45.98	19.17				
	CS4	1.36	68.50	32.19	17.24				
	CS5	2.96	83.78	48.22	19.18				
	CS6	2.02	70.40	34.38	16.29				
	CS7	.73	84.37	37.33	18.09				
	CS8	.64	57.71	20.15	12.43				
	CS9	1.37	63.21	26.95	14.15				
Evaluating data, information and digital content	ED1	9.36	81.29	47.03	15.62	.858	82.917	.727- .975	.940
	ED2	2.22	51.27	21.34	10.59				
	ED3	1.92	48.87	18.54	10.32				
	ED4	.64	38.84	6.95	5.92				
	ED5	.64	38.84	10.53	7.13				
	ED6	2.22	50.49	20.84	10.37				
Way obtaining ICT skills	OS1	.33	49.02	11.68	8.49	.643	69.193	.683- .941	.806
	OS2	.00	12.02	2.38	2.22				
	OS3	.12	10.71	2.74	2.29				
	OS4	.48	36.76	9.59	8.64				
	OS5	.70	53.54	12.16	10.63				

*variance based on Eigenvalues

Based on the values of factor loadings as part of PCA, factor scores were obtained for each examined element in the sample, and these values were further used in the regression analysis.

Multiple regression analysis with three independent variables was conducted on three models considering different age groups. In Model I, where the 55-64 age group was taken as the selection variable, the results indicate that the model explained 32.8% of the variability of the dependent variable, i.e., the employment rate of this age group. The values of $F=4.391$ and $Sig=.012 < .05$ show the significance of explaining this variability, presented in Table 3. On the other hand, when considering the results of Models II and III for the age categories 45-54 and 35-44, respectively, it can be concluded that there is no statistically significant influence of the level of digital literacy on the employment rate in these cases.

Table 3. Statistics of the examined variables

	Model I	Model II	Model III
Age	55-64	45-54	35-44
R ²	.328	.092	.079
F	4.391	.913	.774
Sig	.012	.448	.519

The linear regression equation for Model I has the form:

$$\text{Employment rate} = 62.918 - 1.246 \cdot \text{Level of computer skills} + 1.059 \cdot \text{Evaluating data, information and digital content} + 5.799 \cdot \text{Way obtaining ICT skills}$$

Through further analysis, considering the t values and the corresponding significance of the examined independent variables in Model I, it can be concluded that the Way obtaining ICT skills is the only influential factor ($t=2.474$ and $Sig=.02 < .05$), which is not the case for the remaining two factors Level of computer skills, and Evaluating data, information and digital content, Table 4.

Table 4. Results of multiple regression analysis

Model 1	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	62.918	2.240		28.084	.000
Level of computer skills	-1.246	4.996	-.084	-.249	.805
Evaluating data, information and digital content	1.059	4.223	.070	.251	.804
Way obtaining ICT skills	5.799	2.344	.591	2.474	.020

The obtained results provide a positive answer to the question of the impact of digital literacy on the employment rate of the elderly population. Also, it is evident that there is a difference in how digital literacy affects employability in different age groups.

5. DISCUSSION AND CONCLUSION

Significant demographic changes affecting all parts of the planet have been accelerating in recent decades, whether it is pronounced migration, changes in the birth rate, or population aging. All these changes posed to policymakers and business decision-makers the necessity of adopting new policies and strategies. Recent trends emerging in the working environment are

especially important for an aging workforce. Therefore the future of older workers must be analyzed in the context of digital changes. This paper analyzes the impact of digital literacy on the employment rate of older workers. The results indicate that the employment rate of the population belonging to the age group 55-64 depends on the level of digital literacy. The main point of influence of digital literacy is the Way obtaining ICT skills, while the remaining two factors, Level of computer skills and Evaluating data, information and digital content, do not have a statistically significant influence. By checking the influence of the same factors on the employment rates in the age groups 35-44 and 45-54, it is observed that there is no statistically significant influence of digital literacy. The obtained results are consistent with the findings of Peng (2017), Mondolo (2022), and Bui and Luong (2023), which confirm the existence of a digital age gap in many parts of the world, as well as the impact of this gap on the employment rate of the older population.

The results of previous research indicate that the reduction of older population disadvantages caused by ICT is significantly influenced by educational level. Therefore, the older population should be encouraged and empowered to increase digital literacy daily through various training (Bui & Luong, 2023). In the results of this research, a significant positive influence of the factor related to the acquisition of ICT skills through various types of training, whether provided by employers or independently undertaken by older employees, can be observed.

In the short term, ICT development can have a negative impact on the employment rate of the older population. The reasons are the need to acquire new skills and the stereotypes that older people face that their performance declines, that they are less flexible and adaptable, and that they are more difficult to train (Lissitsa et al., 2017). However, in the long term, employers' failure to deal with older employees can mean missing out on the benefits that employees with valuable work experience bring with them who have proven their values and loyalty to the company (Lam et al., 2012). Therefore, learning is considered a key element in an aging society, where the diversity of needs of the older population must be considered. Consequently, it is necessary to enable older people to learn new skills and develop such products and resources that facilitate the use of ICT. In addition to developing adequate technological solutions, it is also necessary to create appropriate policies to support the older population, thereby significantly improving their quality of life.

The limitation of the research is that the sample was selected at the state level, while for more detailed analysis, the impact of digital literacy should be observed at the personal level from the aspect of gender, education, and other demographic characteristics, which requires future quantitative research.

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