

Developing Digital Skills among European Adults: Trends and Challenges for Human Capital Management Strategies

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DOI: 10.25019/STR/2025.007

Abstract

This article analyzes the most significant trends and challenges in the development of adults' digital skills across the European Union, with a particular focus on Romania. The main objective of the paper is to identify, based on statistical data provided by official European and national institutions, the current state of digital skill development among the population, with an emphasis on highlighting the socio-demographic factors that influence it, especially age, gender, education level, occupational status, development region, etc. The study employs a comparative statistical methodology, using recent data from Eurostat, the National Institute of Statistics, and other official institutions. The data highlight significant differences between member states: while in the Netherlands and Finland over 80% of citizens possess at least basic digital skills, Romania records the lowest level in the EU, with only half the EU-27 average of 56%. These differences are further emphasized by factors such as education: individuals with higher levels of education had a higher percentage of basic digital skills than those with lower levels of education. At the European level, differences are also pronounced across age categories: older people have fewer digital skills than younger people. Gender has a varying influence depending on the age group: among young people, women are more digitally competent than men; however, this trend reverses among older respondents. Digital skill levels also varied markedly by labor market status: the highest proportions were found among students and employed individuals. In the context of accelerating technological transformations, the article contributes to the debate on the need to adapt education and professional training strategies to ensure the inclusion of all social groups and prevent the deepening of inequalities. The study emphasizes the necessity of public policies that support the equitable development of digital skills, with a focus on including vulnerable groups and reducing the digital divide in the context of the European digital transition.

Keywords

Digital skills, digitalization; digital society; human capital

Introduction

Digital transformation has reshaped economies, institutions, and everyday life, turning adults' digital competences from a desirable asset into a fundamental requirement for participation, employability, and resilience. At the European level, institutions and bodies have placed lifelong learning and upskilling at the core of their agendas, while international organizations such as the OECD, UNESCO, and the World Bank have emphasized the role of digital literacy as a driver of inclusion, equity, and sustainable development. In this context, digital competences are increasingly acknowledged not only as a cornerstone of economic competitiveness and social cohesion, but also as a condition for resilience in the face of technological change. Understanding how different groups acquire and use digital skills, and how these patterns shape opportunities for learning and employment, is therefore essential for both policy and practice.

Beyond the European perspective, the article also considers Romania, where structural challenges and contextual specifics mirror broader continental patterns. The national case provides relevant insights into how socio-demographic factors such as education, labor-market status, and territorial divides influence adults' engagement with digital competences, illustrating how European-level dynamics are reflected and, at times, amplified in a national context. Against this background, the objective of the

paper is to provide a consolidated overview of the main trends and challenges in the development of adults' digital skills, identify the socio-demographic factors that structure inequalities - age, gender, education, labor-market status, and region - and situate them within both a European and a national perspective.

Brief overview of adult learning and digital skills development – a theoretical perspective

Education represents an expansive and dynamic field of inquiry, encompassing a wide array of theoretical frameworks, disciplines, and practical applications. In the context of today's fast-paced technological evolution, defining clear boundaries or comprehensive thematic categories within the educational domain has become increasingly challenging. The multiplicity of perspectives and the speed at which new paradigms emerge make it nearly impossible to exhaustively enumerate all relevant topics, let alone to provide a detailed analysis within a single framework.

A core component of education is the process of learning itself, which continues to evolve in both form and substance. Even at this level, conceptual debates and applied methodologies remain in constant flux. Frequently, they can only be approached at a superficial level, while deeper exploration is constrained by the ephemeral nature of available resources—resources that often become obsolete before they can fully address the complexities under investigation.

Recent developments in digital intelligence (DI) and artificial intelligence (AI) have profoundly reshaped education, science, and society, leading to what Emmert-Streib (2021, p. 293) defines as a “digital society” – an asymptotic stage of the digital economy characterized by the omnipresence of AI in our lives. In education, DI entails the development of advanced digital skills, the integration of AI into teaching processes, and the adoption of new pedagogical paradigms, such as those proposed within the DP4SET framework (Huang, Adarkwah, Liu, Zhuang, & Chang, 2024, p. 279), which emphasize student-centered learning, the provision of quality digital resources, and active collaboration between teachers and AI.

At the societal level, a digital intelligence-driven economy contributes to sustainable regional development by stimulating innovation and entrepreneurship. However, its effects vary depending on a region's maturity, degree of urbanization, and stability of public policies (Wan & Wu, 2025, p. 20). AI also enhances student learning by enabling experiential and practical opportunities, particularly when integrated with other technologies such as virtual reality, 3D environments, gaming, and simulation (Rosak-Szyrocka, 2024, p. 477). Knauss (2022, p. 53) notes that the influence of technology on communication and culture requires “a broad understanding of media literacy in the sense of digital literacy.”

Within this broader context, the OECD (2023, p. 11) positions adult learning at a crossroads, marked by “persistent differences and overall stagnation”. According to the same report, meaningful improvement is possible only if learning systems are promoted across the entire adult population (OECD, 2023, p. 40). Complementing this perspective, interdisciplinary research conducted by academics from Austria, Finland, and Germany reveals that “individual, social and technical reasons” motivate adults to participate in digital skills training (Pihlainen et al., 2023). Interestingly, adults report being more motivated to acquire such skills for “staying in touch with relatives” than for “learning how to use a smartphone” (Pihlainen et al., 2023, p. 112). Some express a willingness “to learn by themselves” in order “to gain independence in their everyday life” (Pihlainen et al., 2023, p. 113), yet their efforts are often hindered by “a lack of resources in their social surroundings” or by “the difficulty of keeping themselves updated” (Pihlainen et al., 2023, p. 114). As the authors conclude, adult learning is “socio-culturally framed in many ways” and depends on the cultural, political, social, and economic environment (Pihlainen et al., 2023, p. 114).

Against this background, the present paper aims to identify, using statistical data from official European and national institutions, the current state of digital skills development among the adult population, with particular emphasis on the influence of socio-demographic factors. Previous studies

have highlighted significant generational differences in internet and social media use and attitudes, as well as a positive correlation between educational attainment and digital skill levels.

Regional disparities are equally relevant, as digital skills constitute a critical driver for economic development and improved quality of life. To monitor such competencies, Eurostat employs the Digital Skills Indicator (DSI), a composite index measuring activities across five competence areas: information and data literacy, communication and collaboration, digital content creation, problem-solving, and safety. Achieving at least a basic overall level of digital skills requires individuals to have performed at least one activity in each area; examples include sending e-mails, using spreadsheet software, managing access to personal data, fact-checking information, or changing software settings (Eurostat, 2024a).

The current state of digital skills development in the European Union – a comparative statistical overview

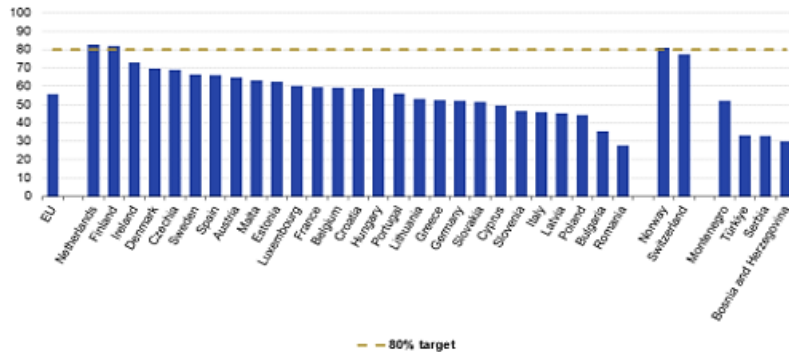
At the EU level, in 2023, 93.1% of households were connected to the internet. For this analysis, internet access refers not to the technical availability of a connection in a given location ('connectability'), but rather to the actual ability of at least one household member to access and use the internet from home ('connectivity'). However, disparities were evident based on the degree of urbanization. Households in rural areas had a lower connectivity rate (90.5%) than those in towns and suburbs (92.7%) or urban areas (94.9%) (Eurostat, 2024a, p. 88).

In 2023, according to Eurostat (2024a, p. 90), over 80% of individuals in the European Union reported using the internet daily. Usage patterns varied notably across age groups and levels of urbanization. Daily internet use was most prevalent among younger individuals: 97.1% of those aged 16–24 reported daily use, compared with only 59.2% among those aged 65–74. Geographic disparities were also observed: individuals residing in rural areas were less likely to use the internet daily (80.3%) than those living in towns and suburbs (85.7%) or urban areas (89.5%).

In 2023, nearly two-thirds of the EU population (63.9%) reported using internet banking services. Adoption rates varied significantly across regions, with relatively low usage observed in several eastern and southern parts of the EU: the lowest participation rates were recorded in Bulgaria, Romania, and southern Italy, while the highest were in Denmark. In the same year, approximately one-fifth of individuals aged 16–74 in the EU (19.9%) reported having sold goods or services online within the previous three months. Age differences were notable: younger individuals were more inclined to engage in online sales compared to older age groups: 28.7% of individuals aged 25–34 sold goods or services via the internet, a proportion nearly four times higher than that of individuals aged 65–74 (7.4%) (Eurostat, 2024a, pp. 95,97).

Eurostat measures individuals' digital skills through the Digital Skills Indicator (DSI). The DSI is a composite indicator that covers activities across five competence areas: information and data literacy, communication and collaboration, digital content creation, problem-solving, and safety skills. To achieve a level of at least basic overall digital skills, individuals must have performed at least one activity related to each area; for example, relevant activities include sending e-mails, using spreadsheet software, managing access to personal data, fact-checking, or changing software settings (Eurostat, 2024b).

The European Union has set a target that at least 80% of Europeans should have basic digital skills by 2030. In 2023, 56% of EU citizens aged 16–74 years had at least basic overall digital skills, representing 24 percentage points below the 2030 target set by the European Union (Eurostat, 2025). Two member states had already achieved the 80% benchmark in 2023: the Netherlands (83%) and Finland (82%). They are followed by Ireland (73%), Denmark (70%), and Czechia (69%). Conversely, the lowest shares of individuals with at least basic digital competencies were observed in Romania (28%) and Bulgaria (36%). (Eurostat, 2025).



**Figure 1. Individuals with at least basic digital skills, 2023
(% of individuals aged 16-74)**

Source: Eurostat, 2024b

With the exception of online communication (where the difference is only 4% and 12%, respectively), in the other four areas of digital competence, the proportion of the Romanian population aged 16–74 with at least basic skills is 14–28% lower than the EU average and 27–43% lower than that of the Netherlands, the top-performing EU country in this regard (Cibian et al., 2022, p. 27).

**Table 1. Persons with at least basic overall digital skills in the five areas, 2021
(% of individuals aged 16-74)**

Digital competence areas	Romania	UE-27	Netherlands
Information and data literacy skills	66	80	93
Communication and collaboration skills	82	86	94
Digital content creation skills	41	66	83
Safety skills	44	68	87
Problem-solving skills	51	79	94

Adapted from Cibian et al., 2022, p. 27.

Socio-demographic variables, such as age, gender, and education level, significantly influence the level of digital competence. For instance, only 28% of individuals aged 65 to 74 demonstrated at least basic digital skills. In contrast, 70% of so-called “digital natives” aged 16 to 24, as well as individuals in the 25–34 age group, possessed such competencies as illustrated in Figure 2 (Eurostat, 2024b).

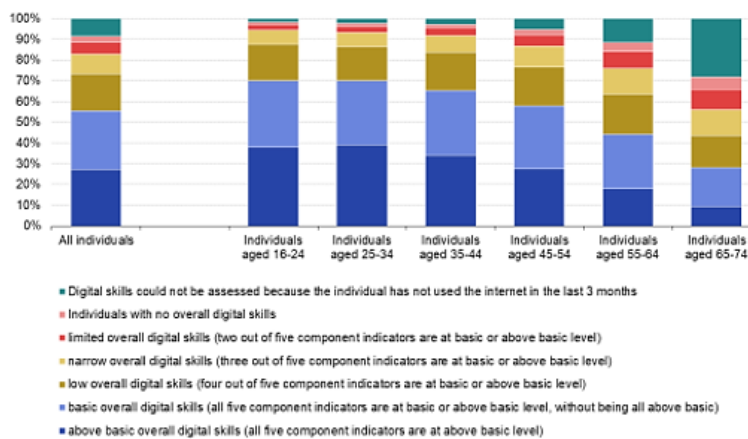


Figure 2. Digital skill levels by age group, EU, 2023 (% of individuals)

Source: Eurostat, 2024b

In the majority of EU Member States, the proportion of individuals possessing at least basic digital skills was higher among men than among women (Figure 3). The most notable gender gaps were observed in Austria (8 percentage points), France (7 percentage points), and Greece (6 percentage points). However, in eight EU countries, this trend was reversed, with women exhibiting higher levels of basic digital competence than men. The largest such gender difference in favor of women was recorded in Lithuania, at 5 percentage points (Eurostat, 2025).

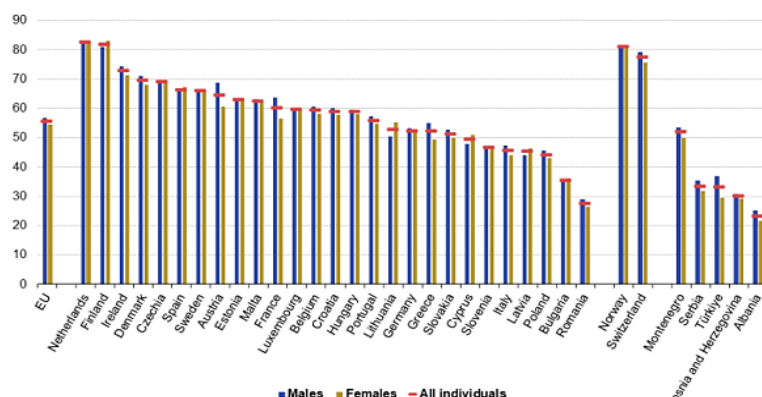


Figure 3. Individuals with at least basic overall digital skills, by sex, 2023
(% of individuals aged 16-74)

Source: Eurostat, 2025

Although men reported slightly higher overall levels of digital competence (57% demonstrating at least basic digital skills, compared to 54% of women in the EU-27), the gender gap varied considerably across age groups. In the younger age groups (16-24, 25-34, and 35-44 years), a greater proportion of women had at least basic digital skills than their male peers. Conversely, among individuals aged 45 and above, this pattern was reversed, with men consistently showing higher levels of digital competence (57% of women and 58% of men for the age group 45-54 years, and 42% of women and 47% of men for the age group 55-64 years possess at least basic digital skills). The gender disparity tended to increase progressively with age in the older cohorts (Eurostat, 2024b). Detailing, according to Eurostat (2025) and presented in Figure 4, among individuals aged 16-24, 72% of women and 68% of men possess at least basic digital skills. A similar trend is observed in the 25-34 age group, where 71% of women and 69% of men demonstrate basic or above-basic digital competencies. In contrast, the lowest levels of digital proficiency are found among individuals aged 65-74, with only 34% of men and 23% of women exhibiting at least basic digital skills. This age group also displays the most significant gender disparity, with the proportion of women possessing at least basic digital skills being 10 percentage points lower than that of men.

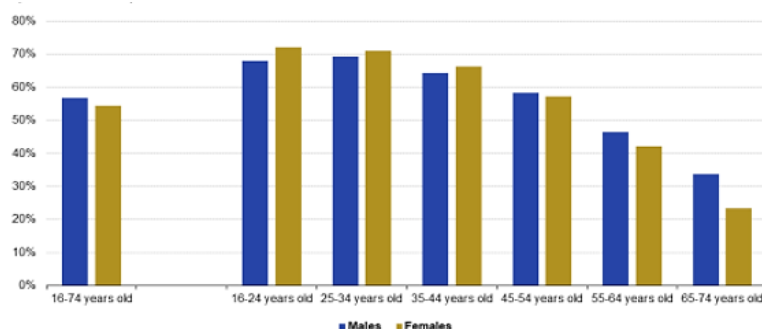


Figure 4. Individuals with at least basic digital skills, by sex and age, EU, 2023
(% of individuals)

Source: Eurostat, 2024b

Among the 56% of European Union citizens aged 16 to 74 who possessed at least basic digital skills, 28% demonstrated basic overall digital skills, while 27% exhibited above-basic digital proficiency. A clear correlation was observed between educational attainment and digital competence: the higher the level of education, the greater the proportion of individuals with at least basic digital skills. Among those with tertiary education, 80% had at least basic digital skills (32% at the basic level and 48% at the above-basic level) (Eurostat, 2025).

Compared to 51% among those with medium formal education, and only 34% among those with no formal education or with a low level of educational attainment as detailed in Figure 5. The most pronounced disparities between individuals with high and low levels of formal education, in terms of the proportion possessing at least basic digital competencies, were recorded in Ireland (74 percentage points), Portugal (66 percentage points), Greece (63 percentage points), and Malta (59 percentage points). Conversely, the smallest gaps were observed in Estonia (12 pp), Finland (14 pp), and Lithuania (22 pp). In Romania, among those with tertiary education, 64% had at least basic digital skills, compared to 24% among those with medium formal education and only 13% among those with no formal education or low educational attainment (Eurostat, 2024b).

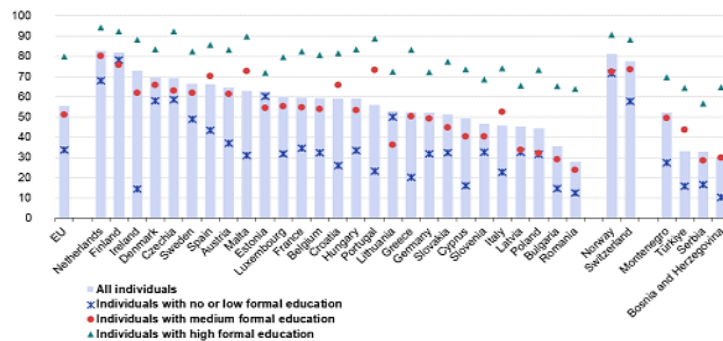


Figure 5. Individuals with at least basic digital skills, by education level, 2023
(% of individuals aged 16-74)
Source: Eurostat, 2024b

Digital skill levels also varied markedly by labor market status (Figure 6). The highest proportions were found among students (75%) and employed individuals (65%), including employees, the self-employed, and contributing family workers. In contrast, lower levels were recorded among the unemployed (48%) and those retired or otherwise economically inactive (excluding students; 31%). (Eurostat, 2025).

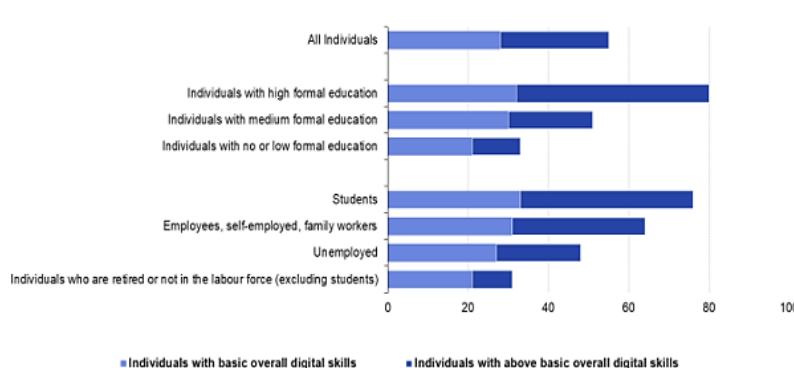


Figure 6. Individuals with at least basic overall digital skills, by education attainment level and by status in the labor market, EU, 2023 (% of individuals aged 16-74)
Source: Eurostat, 2025

A statistical approach to the development of the current digital skills of the population in Romania

According to the latest available statistical data, in 2024, 88.6% of households in Romania had internet access at home, an increase of 2.9 percentage points from 2023 (85.7%). In urban areas, 92.5% of households are connected to the internet, which is 9.3 percentage points higher than the 83.2% share of households in rural areas. Out of the total number of households by territorial profile, as of 2024, internet connectivity has become increasingly widespread among households in the Bucharest-Ilfov (95.2%), West (92.0%), and North-West (90.2%) regions (with over 9 out of 10 households having home internet access), followed by the Centre region (89.9%) (INS, 2024, p. 13).

Regarding the **frequency of Internet use**, in 2024, the proportion of people aged 16-74 who use or have ever used the internet reached 94.7% (13.5 million people). According to internet use frequency in the three months prior to the survey, 74.0% of users accessed the internet several times a day, 19.5% once a day or almost daily, 5.6% at least once a week, and 0.9% less than once a week (INS, 2024, p. 17).

When analyzed by occupational status, the highest proportion of individuals aged 16–74 who reported using the internet several times per day in 2024 was among employees (61.1%), followed by students (11.2%) and retirees (10.9%), as illustrated in Table 2. The motivation to access information is evident among both men and women. However, a slight gender gap persists in internet usage: 95.1% of men and 94.2% of women reported having used the internet at least once in their lifetime; both figures reflect increases compared to 2023 of 1.9 and 2.2 percentage points, respectively (INS, 2024, p. 17).

Table 2. Structure of people aged 16-74 who used the internet several times a day, in the last 3 months, by occupational status, in 2024

<i>Socio-Occupational Category</i>	<i>Percentage (%)</i>
Employees	61.1%
Pupils, students	11.2%
Pensioners	10.9%
Other inactive persons	8.5%
Self-employed workers (including business owners)	6.5%
Unemployed	1.8%

Adapted from INS, 2024, p. 17

In 2024, **the most common purposes for internet use** in the three months preceding the survey were primarily communication-related (Table 3). These included participation in social networks (82.0% of individuals), making voice or video calls over the internet (78.0%), and using instant messaging services (69.0%). Internet use for information-seeking purposes also showed high levels of engagement. Notably, 61.7% of individuals reported searching for information about goods or services, while 49.8% accessed news content through online newspapers, magazines, or news websites (INS, 2024, p. 19).

Table 3. Share of people aged 16–74 who used the internet in the last 3 months, by some access purposes, by gender, in 2024

<i>Activity</i>	<i>Female (%)</i>	<i>Male (%)</i>
Expressing opinions on civic or political issues on websites or social media	16.8	18.1
Internet banking (banking operations via the internet), including mobile banking services	29.0	31.7
Searching for health-related information (e.g., injuries, diseases, nutrition, health improvement, etc.)	42.9	26.1
For entertainment – listening (e.g., online radio, music online, YouTube) or downloading music	44.1	48.4
Sending or receiving e-mails	48.1	48.5
Reading online news sites/newspapers/magazines	47.3	52.2
Finding information about goods or services	62.3	61.0

Using instant messaging (e.g., Skype, Messenger, WhatsApp, Viber, Snapchat)	70.1	67.9
Making voice or video calls via the internet (e.g., Skype, Messenger, WhatsApp, FaceTime, Viber, Snapchat, Zoom, MS Teams, WebEx)	77.1	78.8
Participating in social networks: creating a user profile, posting messages or other contributions on Facebook, Twitter, Instagram, Snapchat, TikTok, etc.	82.7	81.3

Adapted from INS, 2024, p. 19

Among individuals aged 16–74 who used the internet in the three months prior to the survey, 11.5% engaged in online learning activities for educational, professional, or personal purposes. When analyzing participation in online learning by educational attainment, the highest proportion was observed among individuals with a higher level of education (22.2%). This was followed by those with a low to medium level of education (9.3%), while individuals with a medium level of education accounted for the lowest share (8.9%) (INS, 2024, p. 21). Other authors (Cibian et al., 2022, p. 22) also observed that individuals with lower levels of education primarily use the internet to access social networks and make audio/video calls. As educational levels increase, so does the diversity of online information and communication activities, regardless of age or occupation.

Among individuals who accessed the internet in the past 12 months, 19.4% interacted with public authorities or public services for personal purposes, an increase of 4.1 percentage points from 2023. Of these, 74.0% visited the websites of authorities or public services to obtain information about services, benefits, rights, operational programs, etc.; 41.7% sought information regarding their personal situation (such as health or pension information); and 19.7% aimed to obtain information from public databases or registers (e.g., availability of books in public libraries, cadastral registers, or business registers). These online interactions with public authorities or services are predominantly conducted in urban areas (23.8% in urban areas compared to 13.5% in rural areas). At the territorial level, the interest in online interaction with public authorities or services is highest in the Bucharest-Ilfov region (32.6%) and the North-West region (21.7%), while it is lower in the North-East (14.5%) and South-East (15.5%) regions (INS, 2024, p. 22).

The proportion of individuals aged 16–74 who used **online services to order or purchase goods and services** (relative to those aged 16–74 who used the internet in the past 12 months) has steadily increased over recent years, reaching a peak of 72.9% in 2024, which is 4.8 percentage points higher than in 2023. In 2024, nearly three out of four men (71.9%) accessed the internet to order or purchase goods or services, while the proportion of women engaging in such activities was slightly higher by 2.0 percentage points, at 73.9%. By area of residence, a significant gap of 9.8 percentage points persists between urban and rural areas: 77.1% in urban areas, compared to 67.3% in rural areas. When analyzed by age groups, online shopping participation is highest among younger individuals aged 16–34 years (84.8%), followed by adults aged 35–54 years (78.5%), and notably, 51.0% among older adults aged 55–74 years (INS, 2024, p. 25).

Educational attainment is a key individual characteristic influencing online purchasing behavior. Among internet users aged 16–74 in the last 12 months, 92.5% of those with higher education reported purchasing goods and services online, followed by 72.5% of those with medium education levels. Regarding occupational status, greater engagement with online commerce is observed among employees and students, with 84.2% and 82.6%, respectively, of internet users aged 16–74 within these groups having purchased online in the last 12 months. At the opposite end, pensioners showed the lowest participation rate in online shopping, with only 43.7% reporting ordering or purchasing goods and services online in 2024 (INS, 2024, p. 25).

The share of people who ordered or purchased goods or services online, out of the total number of people aged 16–74 who used the internet in the last 12 months, also varies by development region, from the lowest values 69.6% in the Center region or 69.7% in the South-East region, to the highest value 82.0% in the Bucharest-Ilfov region (INS, 2024, p. 25).

Regarding the share of people aged 16–74 who used the internet in the last 3 months, by devices used or systems connected to the internet, for personal purposes, by level of education, it can be observed,

in comparison between the years 2016 and 2023 (INS, 2025), that there has been a significant increase in the preference for using mobile phones or smartphones (from 70% in 2016 to 98% in 2023), at the expense of a decline in the use of tablets (from 26.5% in 2016 to 20% in 2023) and laptops (from 36.5% in 2016 to 30.4% in 2023), but especially due to the sharp drop in computer usage — from 67.6% in 2016 to just 22.4% in 2023. The use of other devices has also been observed in recent years (e.g., SMART TVs, smart speakers, game consoles, e-book readers, smartwatches): 17.1% in 2023.

According to a recent national report on digital exclusion and inclusion (Fundatia EOS România, 2022), over 10 million Romanians lack basic digital skills, placing them at risk of exclusion from the digital society. The data reveal significant disparities: 42.4% of rural households were not connected to fixed internet; 64.5% of unemployed individuals did not use the internet to search for jobs; 91.1% of people living in rural areas did not access e-government or online local administration services; 94% of companies had not provided ICT training to their employees; more than 50% of individuals with internet access used only their mobile phones; 68.1% of those with low educational attainment had never made online purchases; 71.4% of pensioners had not bought goods or services online; 62.5% of economically inactive persons had not searched for information about goods or services online; 88% had not verified the authenticity of information found online, and 83% had never interacted with authorities or public services via the internet.

Conclusions

The relevance of this study lies in highlighting the importance of digital literacy as a key factor for economic competitiveness and social cohesion in an increasingly digital world. In the context of accelerating technological transformations, the article contributes to the debate on the need to adapt education and professional training strategies to ensure the inclusion of all social groups and prevent the deepening of inequalities. The study emphasizes the necessity of public policies that support the balanced development of digital skills, with a focus on including vulnerable groups and reducing the digital divide in the context of the European digital transition. This paper examined recent trends and structural challenges in the development of adults' digital skills across the European Union, with a focused lens on Romania. Three broad conclusions emerge.

First, the development of adults' digital competences in Europe remains uneven. While connectivity levels are generally high, the ability to translate access into meaningful skills varies substantially across countries and within societies. Comparative evidence highlights strong divides by age, education, labor-market status, and place of residence, indicating that digital inclusion is not simply a matter of infrastructure but of broader opportunity structures and learning conditions.

Second, the socio-demographic structure of inequality is consistent and cumulative. Younger cohorts and tertiary-educated adults exhibit markedly higher digital competence, while older adults and those with lower formal education remain at a disadvantage. Labor-market attachment matters: students and employed individuals outperform the unemployed and the inactive (excluding students). Gender gaps are generally small overall but vary by age group, often reversing sign across the life course. Territorial inequalities persist: rural residents report lower connectivity and narrower use cases, reflecting opportunity structures and access conditions that shape skill development.

Third, Romania concentrates many of the EU's structural vulnerabilities. National data show near-universal basic connectivity but persistent usage and skills gaps by education, labor-market status, and urban–rural profile. Online learning participation remains modest and heavily skewed towards higher-educated adults. Everyday uses cluster around communication and entertainment among lower-educated groups, while more complex, transactional, and information-seeking activities are concentrated among higher-educated and employed cohorts. E-government and e-commerce uptake has advanced but still reflects pronounced divides, with stronger engagement among urban, higher-educated users and lower participation among retirees and the inactive.

Taken together, these patterns suggest a risk of cumulative disadvantage: socio-economic, territorial, and educational factors interact to depress both opportunities to learn and incentives to invest in more advanced competences. Without targeted measures, the gap between frontrunners and laggards—both

across and within countries—may widen as digitalization deepens and AI-enabled services diffuse across workplaces and public services.

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Received: September 24, 2025

Revised: October 23, 2025

Accepted: November 5, 2025