CROSS PANDEMIC DIGITAL SKILLS NEED

George CĂRUȚAȘU[1]

Nicoleta Luminita CĂRUȚAȘU [2]

Beatrice Gabriela COTET[3]

Abstract

The pandemic of COVID 19 is perceived by the literacy as digital improving skills toward the change off lifestyle and workflow. Nevertheless, beyond the personal attitude regarding those changes, the digital skills perceived usefulness and use rose as a direct result. The digital skills, covered in The Digital Economy and Society Index, published by EU Commission since 2014, are divided into private life, employee and learning scope of usage. The analyses also comprise the human capital, connectivity, integration of digital technology, and digital public services. This article presents the findings of a cross-pandemic research, in the period of 2019-2022, regarding the digital skills perceived usefulness, profiling depending on the scope of usage and the intention to enhance the digital skills by assisted training. The paper presents the research results of an enquiry made among the students regarding perceived usefulness, use and training intention for digital skills enhancements. It covers the bachelor and master's degree programs, with the Computer Science, Social Sciences and Engineering as field of study. The study was made using 266 answers from the above-mentioned categories.

Keywords: digital competences, training need, digital economy, COVID pandemic

JEL Classification: M15

1. Introduction

The EU Commission defined the digital competence as "the confident, critical and creative use of ICT to achieve goals related to work, employability, learning, leisure, inclusion and/or participation in society" [14]. Furthermore, the report of DigComp states as main areas for digital competence the information and data literacy, communication and collaboration, digital content creation, safety and problem solving, with a division in specific and transversal competences [24].

However, from the organizational point of view, the Digital Economy and Society Index (DESI) 2022 [9] introduces the framework to measure the society digitization which includes the human capital, digital infrastructures, integration of digital technology, and digital public service. Nevertheless, the human capital is assessed using the Digital Skills Indicator, based on the above mentioned DigComp framework. Also, it is introducing a

---

[1] Prof. PhD, Romanian-American University, george.carutasu@rau.ro

[2] Prof. PhD, University POLITEHNICA of Bucharest, nicoleta.carutasu@upb.ro

[3] Lect. PhD, University POLITEHNICA of Bucharest, beatrice.cotet@upb.ro

scale to assess the citizen lacking digital skills: individuals with low digital skills, individuals with narrow digital skills, individuals with limited digital skills, individuals with no digital skills and not assessed. This category of citizen lacking digital skills is important for the paper objective because they are the primary target for training plan assessment. Furthermore, the individual is using digital skills in private life, as an employee an as a student.

The concept of digital competence and digital literacy is in depth analyzed in [17] where authors provide a literature review for examining in a structured fashion the usage of the above-mentioned terms in the scientific approach. In their article [18], the authors proposed instead of the digital skills the concept of digital intelligence. The composition of digital intelligence covers algorithms, and evaluation, abstraction, decomposition, and using patterns, emotional communication, cybersecurity, and digital identity. The need of digitalization for all ages categories transpired from the article [11] the authors emphasizing the age division and peculiarity for 50+ digital skills. The identification and self-assessment of the digital skills is also presented in [23], enhancing the results for a survey made among more than one thousand professionals. In addition to DigComp, the authors introduce the creative thinking as a digital skill.

The gap between the required digital skills by new emerging jobs and acquired skills during the conventional education is highly debated in literacy [12]. In the report Bridging the digital skills gap, the authors describe the situation in Canada and the development of "digital careers". Moreover, because of the rapid development of the requirements regarding new digital technologies, the formal education cannot provide digital skills enhancement for the student for not invented or not spread technologies. Nevertheless, the same report, offers a collection of educational programs and frameworks used in Canada to enhance the digital skills.

The response of the EU Commission is presented in [4] with a high regard for the appropriate approach for different target groups. In this context, it is underlined that several groups were identified: young age 16-24 years old with no or low-level education, 55+ years old individuals, unemployed or low level 25-64 years old, individuals inactive, nationals of non-EU countries, rural areas, and employees in low-skilled occupation. Even the digital skills are present during the academic period, another issue raised in the literacy is the assessment of individual skills. In [16] the authors make a systematic review of existent assessment methods for digital competence in universities. Nevertheless, the study showed that the most used form is the self-assessment using quantitative methods, being noted that more substitute forms of assessments, based on summative, diagnostic, or peer-reviewed assessments. An example of the educators' skills in Norway is presented in [22]. Also, the K-12 digital skills programs are presented in [8] with a special focus on STEM education.

The evaluation of the digital skills is a continuous process where several scales are used. The ECDL (European Computer Driving License tests were used in [20] to assess the real level of digital skills in Poland for students enrolled in pedagogical studies. The students had also filled a self-assessment for general competences, office suite, and the ability to use new hardware and software. The study revealed that between self-assessed perceived competence and the tested one exists a gap, indicating a lower level of digital competences of the enrolled students.

Nevertheless, according to [13], even between the age cohorts exists differences between the perceived level of digital skills and the usefulness in learning activities. Moreover, in the study the authors used also DigComp as framework, using simple task to perform the assessment of three different age cohorts. The results indicate that the digital skills are developed over time with higher enhancement for the student in secondary school. Anyway, the study indicates a flatten dispersion for the group in case of determining the competence level for higher competence level.

The present study aims to envisage the evolution of the digital skills perceived by the students, both technological and economic fields of study, during the period of 2018-2022. The origin of this inquiry was to determine if it existed a market for extracurricular courses and to determine the perceived value for the students.

Instead of starting with the peer-reviewed assessment of the digital skills of the students which was passed to academic staff during the ordinary examination, we assessed the perceived usefulness and actual use of technology in the student's life, dividing it into private life, as an employer and as a student.

The study used a questionnaire available on-line, the students being assisted during the response. The paper structure includes the methodology of the research, experimental, debates and comparisons with similar research, and conclusions.

2. Determining the cross-pandemic students' digital skills need

As a theoretical model for the research an adapted TAM (Technology Acceptance Model) was used, illustrated in Fig. 1. The model is inspired by [6]. Subsequentially, our previous research [3], which covered only pre-pandemic and pandemic time, showed that- a good correlation exists between the perceived usefulness, usage of technology, attitudes toward using on technology, intention to participate on short term (six months) at an extracurricular level for a training program.

Additional, to our previous research, our objectives were stated below:

GO.1 Determining if the pandemic of COVID 19 influenced the digital skills perceived usefulness and use in private life, as an employee and in the learning process:

SO1.1 Determining the perceived usefulness of digital skills depending on the scope of use,

SO1.2 The correlation between the perceived of use and the intention to enhance digital skills.

GO.2 Identification of cross-pandemic student training attitude regarding digital skills enhancement,

SO 2.1 Digital skills for which respondents have indicated that they are intended to participate in extra-curricular courses,

SO2.3 Specify a value threshold for which respondents are willing to pay for the training or improvement of specified digital skills
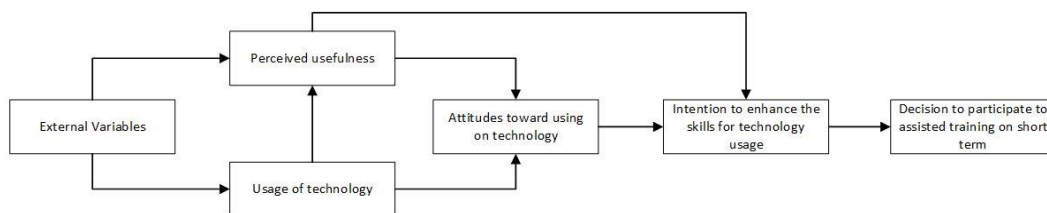
Figure 1. Adapted TAM for decision to participate to assisted training

The experiment took place in the period 2019-2022, in a form of an assisted answering questionnaire [7]. The respondents were distributed according to the Tab.1. As it can be seen, most of the respondents were enrolled to a study program (95.48%), especially to bachelor (74.18%). Also, the most respondents are male (78,19) in the age category of 16-30 years, with residence in the urban are. The distribution of the target group corresponds to the data recorded to the universities, both technical and computer science field of study being renowned by gender inequity. The study comprises student from Romanian-American University, and University POLITEHNCIA of Bucharest. The envisaged study programs were Computer Science for Business Management and Industrial Engineering.

Characteristics	Frequency	Percentage
The level of the last graduate studies. according to ISCED Classification 2011		
ISCED 3 - High School Education	180	66.67%
ISCED 4 - Post-secondary Education	11	4.13%
ISCED 5 - General Higher Education	9	3.38%
ISCED 6 - Bachelor or equivalent studies	56	21.05%
ISCED 7 - Master or equivalent level	8	3.00%
ISCED 8 - PhD or equivalent level	2	0.75%
Gender		
Male	208	78.19%
Female	58	21.81%
Age category		
16-30 years	246	92.48%
31-40 years	17	6.39%
41-50 years	3	1.13%
Residence		
Urban	215	80.82%
Rural	51	19.18%
Study program enrolment		

Yes	254	95.48%
No	12	4.52%

Table 1. Target group distribution

The reason of selecting the programs was for a better understanding of digital skills division and because of Industry 4.0 concept implementation in technical academic learning programs [5]. However, the forms used to collect responses is available, and used yearly to enhance the evolution of the digital skills training need. To have a clear view over the digital skills, we proposed the index presented in Tab. 2, considering a division of them, more oriented to technologies, which later can be designed in extracurricular courses. We started with foundation level, having as base the Computer Science curriculum, with using operating systems, Office software and electronic communication. More specialized digital skills were added to identify the purpose of use: private life, as an employee or as a student. At the time of designing the digital skills index we have in mind the emerging technologies presented by leading software companies, as Microsoft [15], or Autodesk [1]. The same companies foreseen for the next period, in [19] a big push of hybrid work tools and a rapid spread of smart technology. The report of Autodesk shows that new digital skills will be needed soon, to enhance the man-to-machine collaboration, as digital twin, augmented reality, and artificial intelligence as a part of new emerging Industry 5.0 concept. It is foreseen that the index to be updated with new skills, however, now being part of the general category of Smart technologies. As a result of the presented arguments, it can be concluded that the digital skills selected cover the entire spectrum of everyday activities.

No.	Digital skill
1	Using operating systems (e.g. Windows)
2	Using the Office Software (e.g. Word, Excel, PowerPoint, etc.)
3	Electronic communications and correspondence (e.g. email, SMS, WhatsApp, Skype, Internet)
4	Social Networks and content platforms (e.g. Facebook, Instagram, YouTube, LinkedIn)
5	Online Payment Systems and Banking
6	Integrated customer or resource management systems (e.g. ERP, CRM)
7	Business planning systems (Calendar, project planner)
8	Remote Access Systems to resources and cloud computing
9	Dedicated programs for software production and content creation
10	Smart Technologies (smart home, sensors, Artificial Intelligence)

Table 2. Digital skills index

2.1. Perceived usefulness of digital skills

The perceived usefulness of digital skills was introduced in the questionnaire at the beginning as a starting point in the TAM model. Using the digital skills index the respondents were asked to indicate which of the following skills they perceive as useful for the private life, as an employee or as a student. The goal of the inquiry is to determine whether digital skills are profiled to a certain scenario. The results of the MultiChoice question were deployed in Fig. 2-4, with an overview of the usefulness in Fig. 5.

As it can be observed, almost all digital skills have gained several percentage points in the perceived usefulness in the four years, considering the pandemic as having a positive impact over students' awareness regarding the usefulness of the digital skills. However, should be underlined that more and more students evolve from digital immigrants to digital natives, the year of birth migrating from 2001 to 2004, for most of respondents. Furthermore, the Fig.5 shows a first profiling of digital skills.
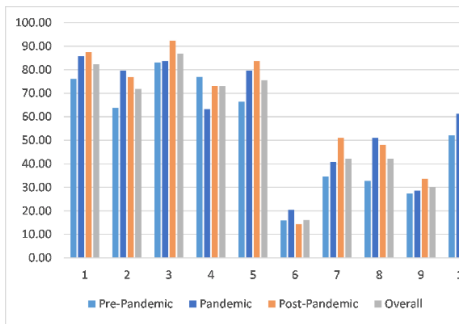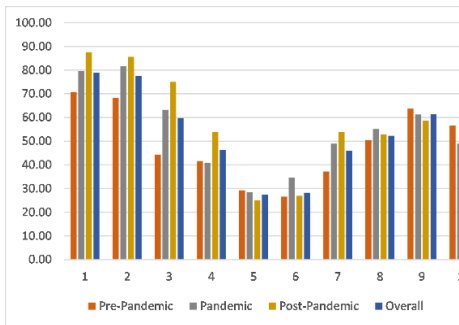

Figure 2. Private life necessary skills

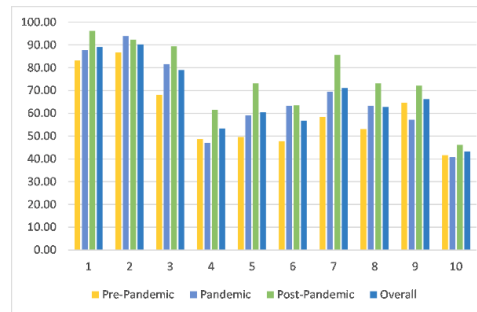Figure 3. Employee necessary digital skills

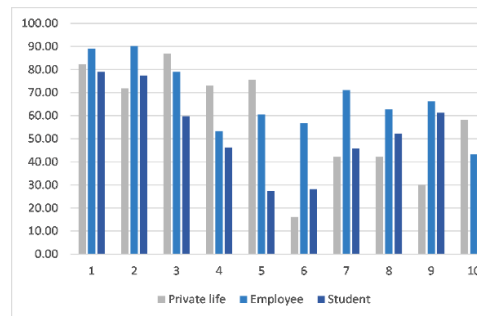Figure 4. Student necessary digital skills

Figure 5. Overall necessary digital skills

2.2. Usage of technology

Also, another point that was important in our inquiry was to determine if the respondents are using the digital skills in the aspects mention of everyday life. The MultiChoice question answers are indicated in Fig.6-9. The usage of technology variates as a direct result of the pandemic situation, registering, as it was expected, higher rated for the electronic

correspondence and online payment and banking in the private life, during the pandemic, being correlated with the increase of the e-commerce sector [21].

The usage of the digital skills as an employer increased steadily during the envisaged period, for most of the digital skills, exception being countered for integrated customer or resource management systems, case that could be explained by hybrid work reorganization and the migration to simpler solutions as business planning systems, as direct results of pandemic work fashion [10].

The digital skills used in the learning process, also registered a steadily increase for the majority, the respondents being enrolled during the pandemic period (March 2020-2022) in on-line forms of learning. The universities adapted to on-line learning systems using various solutions, to maintain the learning process [2]. The overall use of the digital skills indicates a clear profile for the scope, registering a common body of skills used for all scenarios and dedicated ones for a specific or two scenarios. As such, with over 70% usage for overall scenarios, the use of the operating systems, Office software and electronic communications using different platforms, cover the foundation of digital skills despite of scope of use. Moreover, the online payment and banking is seen as skill used in the private life only, being correlated that at work (majority of student are employed during the last year of study) they are not using as software designers or engineers the on-line banking directly.

3. Results and discussions

For the specific objective of the research SO1.1 Determining the perceived usefulness of digital skills depending on the scope of use, the inquiry shows a dependence of the perceived usefulness regarding the scope of use for a part of the digital skills, rest of them being common for all purposes. As such, the first tree skills from the index, a large majority of the respondents (over 70%), indicate a perceived usefulness despite the scope of use (Fig.9). The fundamental digital skills are using operating systems, Office software and electronic communications.
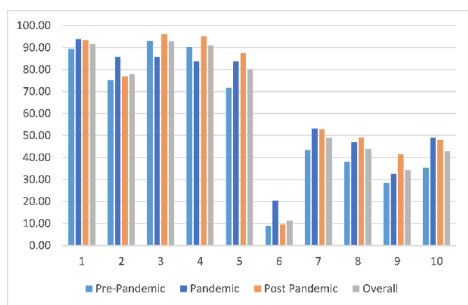

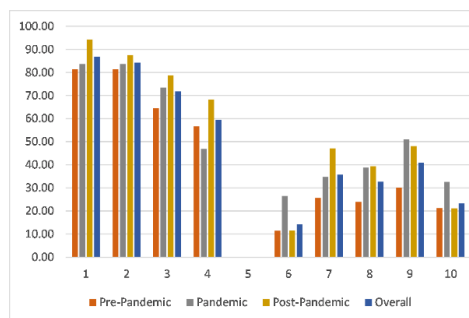Figure 6. Student use of digital skills
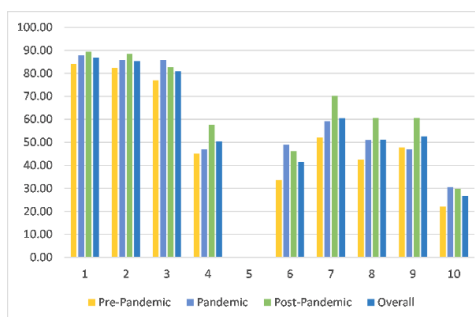

Figure 8. Student use of digital skills

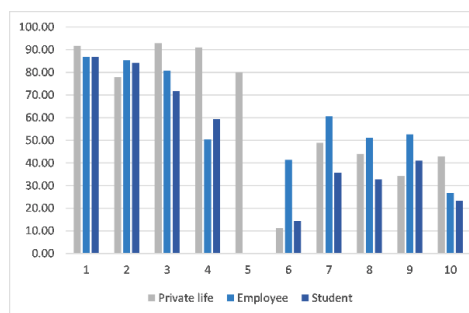Figure 7. Employee use of digital skills

Figure 9. Overall use of digital skills

Specific for the scenario as an employee, as it was expected, we found the integrated customer or resource management systems and business planning systems. The respondents appreciate that social networks and content platforms is more often perceived as useful in the private life. For both scenarios, as an employee and the private live, the on-line payment and banking systems (75.56% overall private life and 60.53% overall as an employee). The Smart technologies are placed between the private life and student activity (58.27% overall private life and 46.62% overall as a student), considering that the perceived usefulness of smart technologies is not yet linked with the employee posture, because the lack of exposure of workers of such technologies or low awareness of the implied technologies. The last skills, Remote Access Systems and dedicated programs for software production and content creation are seeing as dedicated for employee and student scenarios, this perceive coming before the pandemic period and sustained after (Fig.3-4).

Regarding SO1.2 The correlation between the perceived of use and the intention to enhance digital skills, in the Fig. 9 is presented the declared intention of the future to acquire or to enhance a specific digital skill. As it can be seen, specific to pandemic time, the interest for enhancing the fundamental skills is higher with almost 10%, a slightly increase for the employee specific scenario and a drop for the skills perceived as being useful in the learning process. However, with an overall value of 59.48% for all the digital skills, we can assume that is positive corelation between perceived usefulness and intention to acquire or to enhance digital skills, with a steady increase of the intention during the period of report (53.98% pre-pandemic, 59.81% pandemic and 63.16% post pandemic).
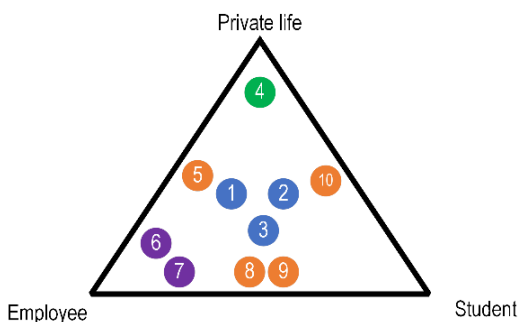

Figure 10. Digital skills profiling

1 Using operating systems (e.g., Windows)

2 Using the Office Software (e.g., Word, Excel, PowerPoint, etc.)

3 Electronic communications and correspondence (e.g., email, SMS, WhatsApp, Skype, Internet)

4 Social Networks and content platforms (e.g., Facebook, Instagram, YouTube, LinkedIn)

5 Online Payment Systems and Banking

6 Integrated customer or resource management systems (e.g., ERP, CRM)

7 Business planning systems (Calendar, project planner)

8 Remote Access Systems to resources and cloud computing

9 Dedicated programs for software production and content creation

10 Smart Technologies (smart home, sensors, Artificial Intelligence)

For SO 2.1 Digital skills for which respondents have indicated that they are intended to participate in extra-curricular courses, our inquiry found that the decision to acquire or enhance the digital skills in the next six months is dependent on the skills, the respondents (Fig.10) showed more interest (over 50%) in enhancing digital skills for new technologies (Remote access systems, dedicated programs for software production and smart technologies) for all reporting period, with a special interest, during pandemic for fundamental skills (using operating systems and Office software). An exception is made by on-line payment and banking systems for which the respondents didn't show any interest. To ease the identification of the digital skills for which the respondent intent to participate on short term is presented Fig. 11. The chart clearly indicates a higher conversion rate (average 79.28% decision/perceived usefulness) for new emerging digital skills (Remote access systems, dedicated programs for software production and smart technologies). For fundamentals skills the conversion rate is lower, with average value of 42.54%, but with a grater base of respondents that appreciates the perceived usefulness of the digital skills. However, this aspect might be explained by the early development of such digital skills during the high school or secondary school. With smaller percentage of the decision versus total respondents came in the last, the digital skills specific for the employee scenario. In this case, the integrated customer and resource management systems had 35.71% plan to participate to an assisted training program and 34.21% for business planning systems. For the last research secondary objective, SO2.3 Specify a value threshold for which respondents are willing to pay for the training or improvement of specified digital skills the questionnaire offer the possibility to the respondents to indicate a perceived value for an assisted training. The results are presented in Fig.12. The evolution of the perceived value during pandemic is indicating an increase of the category which are disposed to pay up to 350 EUR with a rise of 12.54% in comparison with the pre-pandemic and post pandemic period.

Nevertheless, the second question regarding the perceived value, was the collection of the opinion regarding 200 EUR as a price for an assisted training program to enhance or to acquire digital skills. The answers were recorded using Likert scale. 72.56 % of the respondents offer a positive opinion (Partially agree, Agree, Strongly Agree), regarding the threshold of 200 EUR as a attendance fee for an assisted training.
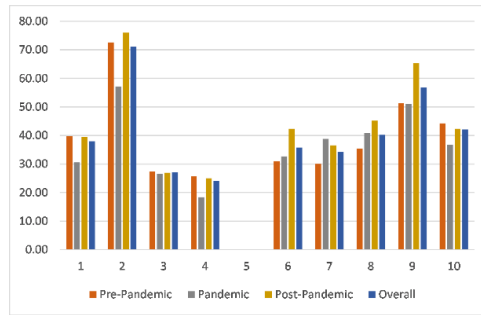
Figure 11. Decision to acquire or enhance of
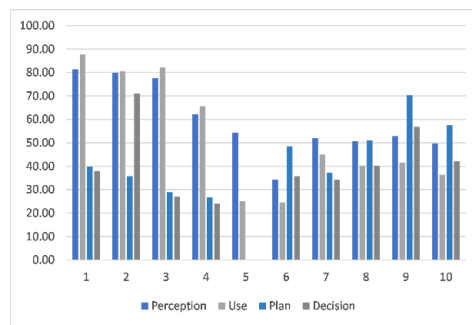digital skills in the next six months
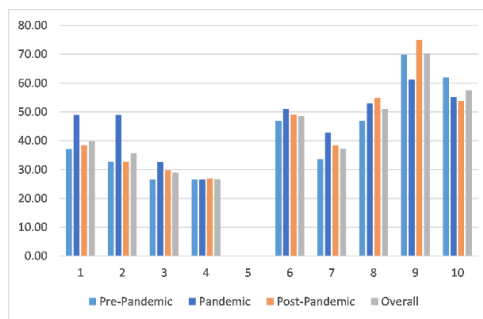

Figure 12. Perception-Use-Plan-Decision (6M)

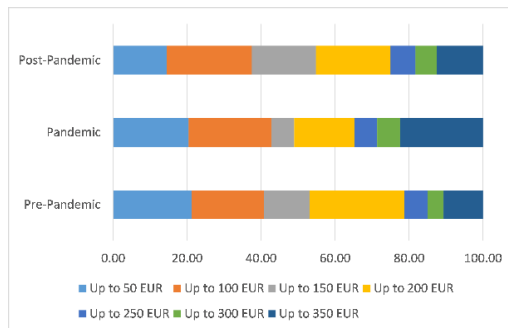Figure 13. Plan to acquire or enhance of digital skills

Figure 14. Perceived value of the assisted training

4. Conclusions

The paper presents the research results of an enquiry made in the period 2019-2022 among the students regarding perceived usefulness, use and training intention for digital skills enhancements.

The common digital skills, which correspond to the foundation digital skill, have a large use rate among the respondents. In this case are situated: using operating systems, office software and electronic communications and correspondence. In the private life, the specific digital skills are social networks and content platforms, online payment and banking systems, and smart technologies. Furthermore, as employee, the respondents indicate as necessary to perform their activity Online payment and banking systems, integrated customer and resource management systems, business planning systems, remote access systems to resources, dedicated programs for software production. In addition of foundation digital skills, in the student life they considered as useful remote access systems to resources, dedicated programs for software production, and smart technologies. The use rate threshold of 0.5 is enhancing that all digital skills defined in the study, are used by at least 50% at least for one scope.

Distinction between the use of the digital in the private life, as an employee or in the learning process, makes possible a deeper analysis to emphasize the influence of the intention of training in a certain skill on the respondent attitude regarding the private life or the professional development. The study revealed that all digital skills perceived usefulness rose from 2019 to 2022 with an average of 9.18%, starting with an average value of 53.59% in 2019.

It covers the bachelor and master's degree programs, with the Computer Science, Social Sciences and Engineering as field of study. The study was made using 266 answers from the above-mentioned categories. The study revealed that all digital skills perceived usefulness rose from 2019 to 2022 with an average of 9.18%, starting with an average value of 53.59% in 2019.

Also, the trends for declared use of digital skills also indicate a rose from the 2019 average value of 48.55% to 52.88 in 2022. It should be noted that all digital skills grown in this period. Nevertheless, even was expected that the training behaviour wasn't change significantly in this period, the average intention to participate for a training session, is 38.23% in 2019 and 39.90 in 2020. However, the decision to participate in the next 6 months is almost steadily between 35.75% and 39.90%. The self-estimation of the training session price was also very slow rising, from 165.93 EUR to 174.52 EUR in 2022.

References

[1] Adobe, *Experience Index 2020 Digital Trends, 2020*. From https://www.adobe.com/content/dam/www/us/en/offer/digital-trends-2020/digital-trends-2020-full-report.pdf accessed on 2021-01-11.

[2] Carutasu, G. Tabusca, A., Botea, L. *Pandemic Response to On-Line Education at Romanian-American University*, in UNDER THE PRESSURE OF DIGITALIZATION: CHALLENGES AND SOLUTIONS AT ORGANIZATIONAL AND INDUSTRIAL LEVELS, FIRST EDITION, pp. 26–31, 2021.

[3] Carutasu, G., Cotet, G. B., Carutasu, N. L. *Pandemic impact over digital skills training needs*, in 15th International Technology, Education and Development Conference, pp. 515–524. doi: 10.21125/inted.2021.0130, 2021.

[4] Centeno, C., Karpinski, Z., Brancati, C. U., *Supporting policies addressing the digital skills gap – Identifying priority groups in the context of employment*, JRC Research Reports, 2022, from https://ideas.repec.org/p/ipt/iptwpa/jrc128561.html accessed on 2020-09-20, 2022.

[5] Cotet, G. B., Carutasu, N. L., Chiscop, F. *Industry 4.0 Diagnosis from an iMillennial Educational Perspective,* Education Sciences, vol. 10, no. 1, p. 21, doi: 10.3390/educsci10010021, 2020.

[6] Davis, F. D. *Perceived usefulness, perceived ease of use, and user acceptance of information technology,* MIS Q, vol. 13, no. 3, pp. 319–339, 1989, doi: 10.2307/249008, 1989.

[7] Digital Skills Survey Microsoft Form. from https://forms.office.com/Pages/DesignPage.aspx?auth_pvr=OrgId&auth_upn=carutasu.ge orge%40profesor.rau.ro&lang=ro-RO&origin=OfficeDotCom&route=Start#FormId=-Z8cEsEFkUaq9d4D2Z6YXXMzsv2cIeFEi-QEs2MOcz9UMkNBSUkzSzlWSlVSQ1cyNFY0UExDVFRPQS4u, accessed on 2022-10-07, 2022.

[8] Dornian, K., Moshirpour, M., Behjat, L. *K-12 Digital Skills Programs as Preparation for Engineering Study: A Systematic Literature Review*, ASEE Annual Conference and Exposition, Conference Proceedings, vol. 2020-June, doi: 10.18260/1-2—34889, 2020.

[9] European Commission, *Digital Economy and Society Index – DESI, 2021.* from: https://digital-strategy.ec.europa.eu/en/library/digital-economy-and-society-index-desi-2021 accessed on 2022-09-05, 2021.

[10] Fink, L. *Conducting Information Systems Research in the Midst of the COVID-19 Pandemic: Opportunities and Challenges*, Information Systems Management, vol. 37, no. 4, pp. 256–259, Oct. 2020, doi: 10.1080/10580530.2020.1814460, 2020.

[11] Hämmerle, V., Reiner, J., Ruf, E., Lehmann, V., Misoch, S. (2022) *Beyond the Digital Divide: Digital Skills and Training Needs of Persons 50+*, in ICT4AWE 2022 - 8th International Conference on Information and Communication Technologies for Ageing Well and e-Health, pp. 276–282. doi: 10.5220/0011068200003188, 2022.

[12] Jackman, J. A., Gentile, D. A., Cho, N. J., Park, Y. Addressing the digital skills gap for future education, Nat Hum Behav, vol. 5, no. 5, pp. 542–545, doi: 10.1038/S41562-021-01074-Z, 2021.

[13] Jin, K. Y., Reichert, F., Cagasan, L. P., de la Torre, J., Law, N. Measuring digital literacy across three age cohorts: Exploring test dimensionality and performance

differences, Comput Educ, vol. 157, p. 103968, doi: 10.1016/J.COMPEDU.2020.103968, 2020.

[14] Joint Research Centre, Institute for Prospective Technological Studies, Ferrari, A.*, DIGCOMP: a framework for developing and understanding digital competence in Europe*, https://data.europa.eu/doi/10.2788/52966, 2013.

[15] Microsoft, *2019 Manufacturing Trends | Microsoft Dynamics 365, 2020.* From https://info.microsoft.com/ww-landing-DynOps-Manufacturing-Trends-eBook.html accessed on 2021-01-11.

[16] Sillat, L. H., Tammets, K., Laanpere, M., *Digital Competence Assessment Methods in Higher Education: A Systematic Literature Review*, Education Sciences, vol. 11, no. 8, p. 402, doi: 10.3390/EDUCSCI11080402, 2021.

[17] Spante, M., Hashemi, S. S., Lundin, M., Algers, A. *Digital competence and digital literacy in higher education research: Systematic review of concept use*, Cogent Education, vol. 5, no. 1, pp. 1–21, doi: 10.1080/2331186X.2018.1519143, 2018.

[18] Stiakakis E. and Barboutidis, G. *Exploring the construct of the new way of thinking in the digital environment," Behaviour & Information Technology*, doi: 10.1080/0144929X.2021.1949042, 2021.

[19] Teevan, J. et al., *Microsoft New Future of Work Report 2022*, From https://www.microsoft.com/en-us/research/publication/microsoft-new-future-of-work-report-2022. accessed on 2022-10-06, 2022

[20] Tomczyk, Ł., Vázquez Toledo, S., Latorre Cosculluela, C. *Declared and Real Level of Digital Skills of Future Teaching Staff*, Education Sciences, vol. 11, no. 10, p. 619, doi: 10.3390/EDUCSCI11100619, 2021.

[21] Tran, L. T. T. *Managing the effectiveness of e-commerce platforms in a pandemic*, Journal of Retailing and Consumer Services, vol. 58, p. 102287, doi: 10.1016/J.JRETCONSER.2020.102287, 2021.

[22] Tveiterås, N. C., Madsen, S. S. *From Tools to Complexity? A Systematic Literature Analysis of Digital Competence Among Pre-service Teachers in Norway*, Lecture Notes in Educational Technology, pp. 345–389, doi: 10.1007/978-981-19-1738-7_18/COVER, 2022.

[23] van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., de Haan, J., *Determinants of 21st-century digital skills: A large-scale survey among working professionals*, Comput Human Behav, vol. 100, pp. 93–104, doi: 10.1016/J.CHB.2019.06.017, 2019.

[24] Vuorikari, R., Kluzer, S., Punie, Y. *DigComp 2.2: The Digital Competence Framework for Citizens*, EUR 31006 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-48882-8, doi:10.2760/115376, JRC128415, 2022.