

MEASURING DIGITAL SKILLS IN EUROPE AND SPAIN: A CRITICAL REVIEW

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Abstract: In the current context of digital acceleration, having digital skills has become a necessity to avoid falling behind. In this regard, it is essential to understand the level of competencies of the population and take appropriate measures in relation to their evolution. Through the following study, a review of the Digital Economy and Society Index (DESI) is conducted as the main source for measuring European and Spanish digital performance, as well as the digital competencies of the population. From this review, some biases linked to the definition of the study group and the design of the survey on which it bases its results are identified. On the other hand, some limitations related to data aggregation that may mask the situation of vulnerable groups are also identified. Finally, considerations are provided on how to improve some of these aspects, such as the possibility of advancing towards a greater alignment between DESI itself and the European Framework for Digital Competence for Citizens, which serves as a conceptual model.

Keywords: Digital skills; DigComp; Digital Economy and Society Index; Digital Skills Indicator.

Título: MEDICIÓN DE LAS COMPETENCIAS DIGITALES EN EUROPA Y ESPAÑA: UNA REVISIÓN CRÍTICA.

Resumen: En el actual contexto de aceleración digital, contar con habilidades digitales se ha convertido en una necesidad para no quedarse atrás. En este sentido es fundamental conocer el nivel de competencias de la ciudadanía y tomar las medidas adecuadas en relación con su evolución. Mediante el siguiente estudio, se realiza una revisión del Índice de Economía y Sociedad Digital (DESI) como principal fuente de medición del rendimiento digital europeo y español y de las competencias digitales de la ciudadanía. A partir de esta revisión, se identifican algunos sesgos vinculados a la definición del grupo objeto de estudio y el diseño de la encuesta en la que basa sus resultados. Por otra parte, también se identifican algunas limitaciones relacionadas con la agregación de datos que puede enmascarar la situación de colectivos vulnerables. Finalmente, se aportan consideraciones sobre la manera de mejorar algunos de estos aspectos, como la posibilidad de avanzar en una mayor alineación entre el propio DESI y el Marco Europeo de Competencias Digitales para la Ciudadanía que toma como modelo conceptual.

Palabras clave: Competencias digitales; DigComp; índice de economía y sociedad digital; Digital Skills Indicator.

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1 INTRODUCTION

Having digital skills is no longer an option if we do not want to fall behind. The current society inevitably drags us into the digital world to meet a significant number of our daily needs, some of which are essential. Every day, we become more dependent on technology, its environments, and devices. This situation is further intensified by a significant number of public initiatives that have identified digital transformation as the response to social and economic recovery after the pandemic (European Commission, 2020; Government of Spain, 2021). This recognition is echoed by the European Parliament and the European Council, which already in 2006 included digital competence as one of the keys to lifelong learning in a knowledge-based society (European Union, 2006; European Union, 2018).

Moreover, considering that digital transformation has become one of the main drivers of economic development, we can argue that digital exclusion becomes one of the main social threats. A threat that can lead to the loss of opportunities in crucial areas such as employment, education, access to public resources, and even social relationships. In this way, the digital divide deepens and perpetuates pre-existing disadvantages, becoming an amplifier of social exclusion. The digital gap adds to the challenges faced by the most vulnerable individuals and families, further hindering their full participation in society (Foessa Foundation, 2021). In the same vein, the European Anti-Poverty Network [EAPN] (2022) points out that the digital gap is a determining factor in the increase of social inequalities, affecting specific vulnerable groups more intensely. It is a "gap of gaps" that not only reflects social inequalities in the digital world but accentuates existing ones and may jeopardize other groups not considered vulnerable before (Vera-Baceta, Navarro & Gómez-Hernández, 2022).

These circumstances must be carefully considered, especially in contexts like Spain, where it is estimated that approximately one in three individuals between 16 and 74 years old lacks basic digital skills. This figure surpasses the European average – 46.08% (Eurostat, 2023). The pandemic has also revealed digital knowledge gaps in families,

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hampering their children's learning, especially in so-called "difficult performance" centers – one in ten public schools in Spain – where more than 50% of students have low socio-economic resources (Trujillo-Sáez et al., 2020). Likewise, Trujillo-Sáez (2021), in a technical report for the European Commission, points out that addressing only the shortage of digital devices oversimplifies the problem. There is a strong component linked to the digital competence of families comparable to what was detected in the 1970s with literacy competence and its transmission from parents to children, now transferred to the digital context (Torres-Menárguez, 2021). This reality complicates the balance between digital acceleration, seen as an escape route from various current crises, and a society struggling to adapt to the intense changes it provokes.

In this context, having measurement instruments that provide a detailed picture of the population's digital competencies is especially important. A challenging task that, precisely due to its complexity, offers few alternatives. Among them, the Digital Economy and Society Index [DESI], developed by the European Union Statistics Office [Eurostat], is considered the reference source in defining public policies at the European level (European Commission, 2023). Specifically, its "human capital" chapter addresses the evaluation of citizens' internet usage skills, using the "Digital Skills Indicator" [DSI], which, in turn, is based on the European Framework for Digital Competence for Citizens [DigComp]. The calculation of these indicators is based on data collected through surveys conducted in various European states under the guidelines of Eurostat. In the case of Spain, the data source used is the annual survey on "Equipment and Use of Information and Communication Technologies in Homes" [TIC-H], carried out by the National Institute of Statistics [INE].



Figure 1. Elements involved in determining the level of digital skills of the citizenship within the framework of DESI.

2 OBJECTIVES AND METHODOLOGY

Having effective measurement tools for assessing the digital skills of the entire population is a fundamental step for crucial aspects such as:

- Identifying risk situations and combating digital exclusion.
- Properly guiding related public policies and establishing priorities for public investment.
- Determining the measures to be taken.

In this way, obtaining information that allows for the measurement and monitoring of the evolution of digital skills is key, but also a challenging task to accomplish. Currently, the available information is limited, and in many cases, it is presented in an aggregated manner through composite indicators. This method of presenting data aims to simplify and summarize complex information, although this simplification may also hinder the conduct of more precise analyses or examinations from different perspectives and criteria.

This study conducts a review of the measurement of digital skills in the Spanish and European contexts through the DESI and DSI indices, their calculation methodology, and the conceptual model on which they are based – the European Framework for Digital Competence for Citizens, DigComp. The goal is to provide a faithful picture of what is genuinely being measured, identifying the components, construction methods, possibilities for obtaining additional or complementary information beyond the general offering, and recognizing limitations and areas for improvement.

Specific objectives are established as follows:

- Conduct a focused documentary analysis of the Digital Economy and Society Index (DESI) to identify aspects related to establishing the level of digital skills for the entire population.
- Review the survey on the equipment and use of information and communication technologies in households (TIC-H), as the primary data source, to identify the variables used for calculating indicators.
- Identify elements of the European Framework for Digital Competence for Citizens (DigComp) that DESI and DSI use as a conceptual model when determining the digital skills of the population.
- Analyze the "Digital Skills Indicator," as the primary indicator of DESI in determining indicators related to digital skills and describe its calculation method.
- Identify biases and limitations related to the aforementioned indicators and processes and, where applicable, propose areas for improvement.

3 CALCULATING THE LEVEL OF DIGITAL SKILLS OF INDIVIDUALS IN EUROPE AND SPAIN

3.1 The Digital Economy and Society Index (DESI)

The DESI index is the primary tool for measuring the digital performance of Europe and its member countries. Through DESI, progress is monitored in terms of the development and adoption of technologies and the digital transformation of the economy and society. It is a composite index consisting of four key dimensions: human capital; connectivity; digital technology integration; and digital public services. Each of these dimensions contributes a maximum of 25 points to the index, resulting in a scale with a maximum score of 100 points. The chapter on "human capital" addresses the evaluation of citizens' internet usage skills and the advanced skills of ICT specialists, establishing six indicators divided into two sub-dimensions:

Dimension	Sub-dimension	Indicator
1 Human capital	1a Internet user skills	1a1 At least basic digital skills
		1a2 Above basic digital skills
		1a3 At least basic digital content creation skills
	1b Advanced skills and development	1b1 ICT specialists
		1b2 Female ICT specialists
		1b3 Enterprises providing ICT training
		1b4 ICT graduates

Table I. Structure of the "human capital" chapter of DESI.

The specific indicators related to internet user skills (section 1a of the table) are developed as follows:

Indicator	Description	Unit	Source
1a1 At least basic digital skills	Individuals with 'basic' or 'above basic' digital skills in each of the following five dimensions: information, communication, problem solving and software for content creation and safety	%	Eurostat - European Union survey on ICT usage in Households and by Individuals (I_DSK2_BAB)
1a2 Above basic digital skills	Individuals with 'above basic' digital skills in each of the following five dimensions: information, communication, problem solving and software for content creation and safety	%	Eurostat - European Union survey on ICT usage in Households and by Individuals (I_DSK2_AB)
1a3 At least basic digital content creation skills	Individuals with at least a basic level in using software for digital content creation	%	Eurostat - European Union survey on ICT usage in Households and by Individuals (I_DSK2_DCC_BAB)

Table II. Indicators on Digital Skills of Individuals – DESI.

Therefore, it is in the sub-dimension "Internet User Skills" where there is a need for some tool that allows evaluating the level of digital skills of the population. Specifically, this level is established through the "Digital Skills Indicator," an indicator that is conceptually based on the "European Framework for Digital Competence for Citizens" (DigComp) and uses European surveys on the use of ICT in households as data sources. In the case of Spain, this survey is called "Survey on Equipment and Use of Information and Communication Technologies in Homes".

3.2 (Spanish) Survey on Equipment and Use of Information and Communication Technologies in Homes

The survey on equipment and use of information and communication technologies in households (TIC-H) is a panel-type statistical operation conducted by the National Institute of Statistics of Spain (INE). It follows the methodological recommendations of Eurostat with the aim that the results obtained can be aggregated and compared at the European level.

The annual survey aims to gather information on the development and evolution of the so-called "Information Society." Specifically, the survey aims to:

- Understand the information and communication technology equipment in Spanish households (internet connection, fixed and mobile telephony, and computer equipment).
- Analyze the use and new habits of the Spanish population regarding the internet (activities performed, use of e-commerce, or interactions with electronic administration).
- Obtain comparable information among Spanish autonomous communities (this operation is a statistic for state purposes and is included in the National Statistical Plan 2021-2024).

It is the most significant Spanish source in its field, and its data is strictly comparable among European Union countries and in other international contexts. The TIC-H survey is part of the community statistics on the "Information Society," and therefore, it is subject to the Regulation of the European Parliament and of the Council 808/2004 of April 21, 2004, and the Implementing Regulation (EU) 2020/1013 of July 20, 2020.

For its execution, a three-stage sampling is used with stratification. In the first stage, census sections are stratified, in the second stage, primary family homes are stratified, and in the third stage, one person aged 16 or older is selected from each household. The sections are grouped into strata within each autonomous community based on the size of the municipality to which they belong. In the selection of units in the second stage, the relationship of primary family homes in each of the selected sections for the sample is used, obtained from the exploitation of the most updated available Continuous Register of Inhabitants. Information is collected using two different interview methods: firstly, an electronic questionnaire available on the internet, and secondly, a personal interview for households that have not completed the questionnaire online (INE, 2021).

The questionnaire is structured into blocks that can be grouped into three main sections: ICT information about the household; ICT information about children aged 6 to 15, if they live in the household; and ICT information about the selected person aged 16 or older in the household. The 2021 survey includes the following blocks:

- I. Household composition.
- II. Equipment of the main residence in information and communication technology products.
- III. Household internet access.
- IV. Computer and internet use by children (10 to 15 years old).
- V. Mobile phone and internet use by the selected person.
- VI. Electronic administration.
- VII. E-commerce.
- VIII. Computer skills (in 2022 - Internet of Things).
- IX. Privacy and protection of personal data (in 2022 - ICT Recycling).
- X. Telecommuting.
- XI. Socioeconomic characteristics of the selected person.

For calculating the level of digital skills of individuals, following Eurostat guidelines, the population aged 16 to 74 who have used the internet in the last three months before the interview is considered. Those who have never used the internet or have not done so in the last 3 months are classified as "not assessable."

In the various blocks of the TIC-H survey, the selection of questions whose answers will contribute to the variables specified in Regulation (EU) 2022/1399 on the dataset designated for the calculation of the level of digital skills of individuals and other related indicators can be found. These variables (responses) are of type Yes/No (T_SINO) with values: 1 – Yes; 6 – No; 9 – "Don't know/No answer," except for the variable ULT_COM (which accepts values 1 – In the last three months; 2 – between three months and one year; 3 – more than one year ago). For evaluation purposes, this last variable is interpreted in the same way as a Yes/No variable for its value 1. In "Annex I," the survey questions used for calculating the level of digital skills of the surveyed individuals are shown by block, including the name of the variable in which it is stored according to Regulation (EU) 2022/1399 on the dataset, and including the name of the variable in the microdata file of the TIC-H survey (made available by INE).

Based on these responses, one of the most important primary indicators is established, namely the "Digital Skill Indicator" (Overall skills), whose calculation mechanisms we will see later. In any case, in order to understand its competency distribution, it is advisable to first be acquainted with the DigComp framework that serves as its conceptual basis.

3.3 The Digital Competence Framework for Citizens (DigComp)

The European Joint Research Centre (JRC) is a reference service in science and knowledge of the European Commission, responsible for providing high-level scientific and technical advice to EU institutions and member states. As part of its responsibilities, it is in charge of publishing and updating DigComp, which for over a decade has provided guidelines for understanding digital competences.

DigComp is a tool that facilitates a common language, ultimately aiming to enhance the digital competence of all citizens. Currently, various European governments use it to formulate policies supporting digital competence development, plan education and training initiatives, and improve digital skills for specific groups (Vuorikari, Kluzer & Punie, 2022). Multiple examples of application can be found, such as the case under review, the Recovery, Transformation, and Resilience Plan of Spain, or the Spanish National Digital Competence Plan (Government of Spain, 2021; Government of Spain, 2021b).

DigComp is structured into five dimensions: the first establishes competency areas; the second, specific competencies; the third, the level of mastery; the fourth, examples of knowledge, skills, and attitudes; and the fifth, examples of use:

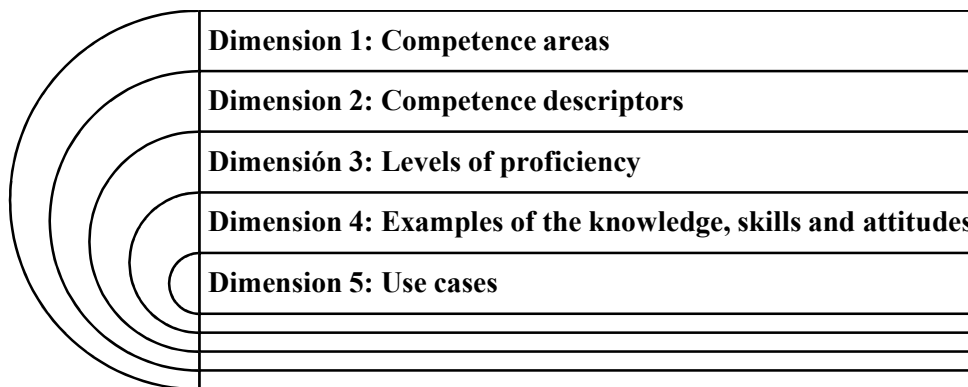


Figure 2. Dimensions of the DigComp 2.2 framework (own elaboration).

Regarding the first and second dimensions, the contents are distributed as follows:

Dimension 1: Competence Areas	Dimension 2: Competence descriptors
1. Information and data literacy	1.1. Browsing, searching and filtering data, information and digital content 1.2. Evaluating data, information, and digital content 1.3. Managing data, information, and digital content
2. Communication and collaboration	2.1. Interacting through digital technologies 2.2. Sharing through digital technologies 2.3. Engaging citizenship through digital technologies 2.4. Collaborating through digital technologies 2.5. Netiquette (online etiquette) 2.6. Managing digital identity
3. Digital content creation	3.1. Developing digital content 3.2. Integrating and re-elaborating digital content 3.3. Copyright and licences 3.4. Programming
4. Safety	4.1. Protecting devices 4.2. Protecting personal data and privacy 4.3. Protecting health and well-being 4.4. Protecting the environment
5. Problem solving	5.1. Solving technical problems 5.2. Identifying needs and technological responses 5.3. Creatively using digital technology 5.4. Identifying digital competence gaps

Table III. Competency Areas and Specific Competencies of the DigComp Framework (Vuorikari, Kluzer & Punie, 2022).

Five competency areas are established, where the first three refer to specific activities and uses, and the fourth and fifth are transversal, as they apply to any type of activity carried out through digital means. In particular, the specific competencies related to the "problem-solving" domain could be present in each of the other competency areas, but they are indicated as a specific competency area to emphasize their importance in technological appropriation and digital practice.

On the other hand, the third dimension establishes four general levels of mastery – basic, intermediate, advanced, and highly specialized – further subdivided into eight gradual levels of proficiency – two for each general level (numbered as 1 and 2) – based on three parameters: the level of complexity of the tasks performed; the degree of autonomy with which the user can interact with technologies; and the cognitive domain used. Therefore, each level represents a step in the acquisition of competence according to its cognitive challenges, the difficulty of the tasks to be carried out, and the independence that the person has in completing them.

Overall Levels	Granular Levels	Complexity of tasks	Autonomy	Cognitive Domain
Foundation	1	Simple task	With guidance	Remembering
	2		Autonomy and with guidance when needed	
Intermediate	3	Well-defined and routine tasks, and straightforward problems	On my own	Understanding
	4	Tasks, and well-defined and non-routine problems	Independent and according to my needs	
Advanced	5	Different tasks and problems	Guiding others	Applying
	6	Most appropriate tasks	Able to adapt to others in a complex context	Evaluating
Highly specialised	7	Resolve complex problems with limited solutions	Integrate to contribute to the professional practice and to guide others	Creating
	8	Resolve complex problems with many interacting factors	Propose new ideas and processes to the field	

Table IV. Main keywords that feature the proficiency levels (Vuorikari, Kluzer & Punie, 2022).

Finally, the fourth dimension of the framework includes examples of knowledge, skills, and attitudes applicable to each of the 21 specific competencies – a total of 257 – and the fifth dimension relates examples of use in applying the competency to different objectives that help us understand its applicability in a contextualized manner.

3.4 Digital Skills Indicator (DSI)

The DSI is an indicator that was first tested in 2014 and aims to determine the level of digital skills of the population based on a set of variables obtained from various surveys on the use of ICT in Europe. In the case of Spain, as we have indicated, the TIC-H survey.

The indicator was revised between 2019 and 2022 within the activities of the "Information Society" working group of Eurostat in order to modernize and adapt it to the underlying theoretical framework of DigComp, which is also updated to version 2.2. The DSI is used for calculating the Digital Economy and Society Index (DESI) to meet the requirements of the "human capital" chapter in its sub-dimension "internet user skills," which, as we have seen, establishes the following indicators: people with at least basic skills, people with skills above basic, and people with at least basic skills in content creation (Vuorikari et al., 2022).

DSI uses the DigComp framework as a conceptual model to identify what people need to be digitally competent, while also guiding the grouping of sets of variables that will determine the level of digital skills for each person. Specifically, DSI performs intermediate assessments for each of the five competence areas established in DigComp: information and data literacy, communication and collaboration, digital content creation, security, and problem-solving. For each of these, it defines the level of specific competence on a scale of three levels: no skills, basic skills, and skills above basic. This value is established based on the response given to the reference questions in the TIC-H survey. In "Annex II," you can find a summary table redistributing the TIC-H survey questions according to the competence area of DigComp they help evaluate, including the variable name as stored according to Regulation (EU) 2022/1399 on dataset, and the variable name in the TIC-H microdata file.

All these variables, as mentioned earlier, generate "0" values for negative responses and "1" for affirmative responses, allowing the construction of a matrix that counts the affirmative answers. Based on the number of affirmative responses, the evaluation criteria are established as follows (example from the year 2021):

Competence Areas	Number of questions with affirmative answers		
	No Skills	Basic skills	Skills above basic
Information and Data Literacy	0	1	2+
Communication and Collaboration	0	1	2+
Digital Content Creation	0	1, 2	3+
Safety	0	1, 2	3+
Problem Solving	0	1, 2	3+

Table V. DSI evaluation criteria for each competency area (own elaboration).

For example, in a questionnaire where a person has answered affirmatively to question 19.a. "Read news, newspapers, or magazines online," linked to the competency area "information and data literacy," they would have, at least, the consideration of having a "basic level" for that area.

Based on the partial evaluation of each competency area, the overall level of digital competence is determined based on the following criteria:

- **No skills (Level 0):** Individuals without skills in four out of the five competency areas or without skills in all five despite stating that they have used the internet in the last three months.
- **Limited skills (Level 1):** Individuals without skills in three out of the five competency areas but have some skills in the other two.
- **Reduced skills (Level 2):** Individuals without skills in two out of the five competency areas but have some skills in the other three.
- **Low skills (Level 3):** Individuals without skills in one out of the five competency areas but have some skills in the other four.
- **Basic skills (Level 4):** Individuals with a basic level in all five competency areas (some may be "basic," and others may be "above basic," without reaching "above basic" in all five areas).
- **Advanced skills (Level 5):** Individuals with an advanced level in all five areas.

Next, a practical case is presented as an example to illustrate the process:

Competence Areas	Variable storing the response value TIC-H	Questions with "Yes" response (valor 1)	Total questions with "Yes" response	Partial assessment	Final assessment
Literacy in information and data	IUIF	1	3	Above basic level	Level 3 Low skills (Individuals with no skills in one of the five competency areas but possess some skills in the other four)
	IHIF	1			
	IUNW1	0			
	TICXND/TICXND/TICCSFOI/TICIDIS/TICNIDIS	1			
Communication and collaboration	IUEM	1	1	Basic level	
	IUPH1	0			
	IUCHAT1	0			
	IUSNET	0			
	IUPOL2	0			
Content creation	CWRD1	1	2	Basic level	
	CXLS1/CEPVA1/CXFER1	0			
	CPRES2	1			
	CXLSADV1	0			
	CPRG2	0			
Safety	MAPS_RPS	0	0	No skills	
	MAPS_RRGL	0			
	MAPS_LAP	0			
	MAPS_RAAD	0			
	MAPS_CWSC	0			
Problem solving	PCOOK1	0	2	Basic level	
	CINSAPP1	0			
	CCONF1	1			
	IBUY	1			
	IUSELL	0			
	IUBK	0			
	IUOLC/IUOLM	0			
IUJOB	0				

Table VI. Example of an assessment of a questionnaire based on the DSI model (author's own elaboration).

In this example, the evaluated person would have a competence level above basic in the "Information and Data Literacy" area, a basic level of competence in the areas of "Communication and Collaboration," "Content Creation," and "Problem Solving," and would not have skills in the "Security" competency area. According to the general DSI evaluation criteria, these partial results would assign this person an overall level 3 of competences, corresponding to "low skills" (below basic).

4 CONCLUSIONS AND DISCUSSION

As mentioned earlier, in digital transformation processes, monitoring the level of digital skills of individuals is crucial to ensure that no one is left behind. However, establishing monitoring mechanisms at the European level is a complex challenge addressed through the DESI index and its "Digital Skills Indicator".

On the one hand, having an interoperable and comparable data infrastructure at the European level is inherently valuable. In this regard, DSI is a very useful tool for analyzing digital skills due to its proven robustness and reliability as a measurement instrument overall, the psychometric quality of the items it encompasses, and its ability to make comparisons between countries.

However, the challenge of reaching a consensus on collecting minimal data may end up providing insufficient information when delving into specific aspects. Additionally, presenting aggregated data may obscure specific aspects of the reality it measures.

On the other hand, in the case of Spain, some considerations can be made about the TIC-H survey regarding its use in determining the digital skills of the Spanish population. TIC-H, as mentioned, is based on the study of "households," and in its selection, biases are observed that can affect the representativeness of the diversity of the population, particularly among the most disadvantaged groups in our society. It should be noted that the sample only includes individuals who belong to a household, aged 16 to 74, and have used the internet in the last 3 months. Apart from the segmentation itself, other limitations may arise related to the willingness of certain individuals to participate and respond, or the difficulty in delving into qualitative aspects that could provide a deeper understanding of the reasons behind certain patterns. Another aspect that can affect the survey is linguistic or cultural bias if differences in the language and culture of the respondents are not adequately taken into account.

Regarding the relationship between DSI and its conceptual framework DigComp, it is important to note that, for the purposes of DSI, the focus is on the activities that people carry out using digital technologies. It is assumed that individuals who have performed certain activities possess the corresponding skills. In contrast, the DigComp framework focuses on skills (the ability to carry out processes to complete tasks and solve problems), not on knowledge components or attitudes.

Referring to the established levels of digital skills, while respecting the self-diagnostic nature of the survey, it might be beneficial to delve into a reformulation of the questions along the lines of the conceptual reference framework—in this case, the specific version DigComp 2.2 and the tasks proposed for each of the established specific competencies. For example, by using the specific tasks in the framework for an A2 level (which completes a basic level). "Annex III" includes a comparative table of the questions from the TIC-H survey used for DSI calculation and the specific tasks by competency area outlined in DigComp for an A2 level (Basic). In some cases, the DSI may not accurately reflect the competency levels. For instance, the fact that a person responds in the TIC-H survey that they have searched for goods or services online would already indicate a basic level of competency in the information and data literacy domain.

Regarding the determination of proficiency levels, even considering the type of evaluation possible through surveys like TIC-H, the proposed reformulation in terms of content would also allow aligning the segmentation carried out by DSI, both by competency area (below basic, basic, above basic) and, in general, with DigComp 2.2 segmentation (basic, intermediate, advanced, and highly specialized). This alignment enables a more detailed evaluation in later phases or different contexts. In this regard, there seems to be a discrepancy between the requirements for identifying a basic level of competencies according to DSI's evaluation criteria and an assessment aligned with the reference model's criteria.

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APPENDIX I. Questions from the TIC-H survey used for calculating the level of digital skills of surveyed individuals by survey block.

TIC-H Survey Block	TIC-H Survey Question	Variable EU Regulation *	Variable TIC-H **
Section V. Use of mobile phone and internet by the selected person	18.a. Internet service used: Receiving or sending emails	IUEM	SERV18_1
	18.b. Internet service used: Making or receiving video calls through the internet (using apps like WhatsApp, Skype, Messenger, FaceTime...)	IUPH1	SERV18_2
	18.c. Internet service used: Participating in social networks (creating a user profile, sending messages, or making other contributions to Facebook, Twitter, Instagram, TikTok...)	IUSNET	SERV18_3
	18.d. Internet service used: Using instant messaging (e.g., via WhatsApp, Skype, Messenger...)	IUCHAT1	SERV18_4
	19.a. Internet service used: Reading news, newspapers, or current magazines online	IUNW1	SERV19_1
	19.b. Internet service used: Searching for information on health topics (e.g., injuries, diseases, nutrition...)	IHIF	SERV19_2
	19.c. Service used on the internet: Searching for information about goods or services	IUIF	SERV19_3
	20.a. Internet service used: Expressing opinions on civic or political issues on websites or social media platforms (e.g., Facebook, Twitter, Instagram...)	IUPOL2	SERV20_1
	20.b. Internet service used: Participating in online consultations or votes on civic or political issues (e.g., consultations on urban planning, signing a petition...)	IUVOTE	SERV20_2
	21. Internet service used: Searching for a job or applying for a position (excluding the use of email)	IUJOB	SERV21_1
	22.a. Internet service used: Selling goods or services (transaction or deal conducted online) through a website or app (e.g., Amazon, Vinted, FNAC, Marketplace, eBay...)	IUSELL	SERV22_1
	22.b. Internet service used: Online banking (including mobile banking)	IUBK	SERV22_2
	23.a. Internet service used: Taking an online course (or partially online)	IUOLC	SERV23_1
	23.b. Internet service used: Using online learning materials other than a complete online course (e.g., audiovisual material, electronic texts)	IUOLM	SERV23_2
Section VII. E-commerce	28. When was the last time you bought a product or service online? (Have you made a purchase online in the last 12 months?)	IBUY	ULT_COM (1,2)
Section VIII. Computer Knowledge	43.a. Tasks related to computers, mobile phones, or other devices: Copying or moving files (e.g., documents, data, images, videos) between folders, devices (e.g., email, Messenger, WhatsApp, USB, cable), or in the cloud	CXFER1	TMOR1
	43.b. Tasks related to computers, mobile phones, or other devices: Downloading or installing software or applications (apps)	CINSAPP1	TMOR2
	43.c. Tasks related to computers, mobile phones, or other devices: Changing the settings of software, the app, or the device (e.g., adjust language, colors, text size, toolbar/menu)	CCONF1	TMOR3
	44.a. Tasks related to computers, mobile phones, or other devices: Using a word processor	CWRD1	TAREAINF 1

TIC-H Survey Block	TIC-H Survey Question	Variable EU Regulation *	Variable TIC-H **
	44.b. Tasks related to computers, mobile phones, or other devices: Creating files (e.g., document, image, video) that incorporate various elements, such as text, tables, graphics, animation	CPRES2	TAREAINF2
	44.c. Tasks related to computers, mobile phones, or other devices: Using spreadsheets	CXLS1	TAREAINF3
	44.c1. Tasks related to computers, mobile phones, or other devices: Use advanced spreadsheet functions to organize, analyze, structure, or modify data (functions, formulas, macros, Visual Basic...)	CXLSADV1	TAREAINF3_1
	44.d. Tasks related to computers, mobile phones, or other devices: Using software to edit photos, video, or audio	CEPVA1	TAREAINF4
	44.e. Tasks related to computers, mobile phones, or other devices: Programming in a programming language	CPRG2	TAREAINF5
	47.a. Verifying the accuracy of information: The participant checked sources or found other information on the internet (e.g., other news sites, Wikipedia, etc.)	TICCSFOI	CHECK1
	47.b. Verifying the accuracy of information: The participant followed or participated in online discussions about information.	TICIDIS	CHECK2
	47.c. Verifying the accuracy of information: The participant discussed the information with other people or used sources outside of the internet.	TICNIDIS	CHECK3
	48.a. Verifying the accuracy of information: The participant knew that the information, content, or source was not reliable.	TICXND	NOCHECK1
Section IX. Privacy and protection of personal data	49.a. Managing access to personal information: Reading the privacy policy of websites before providing personal information	MAPS_RPS	GESINT1
	49.b. Managing access to personal information: Restricting access to your geographical location	MAPS_RRGL	GESINT2
	49.c. Managing access to personal information: Limiting access to your profile or content on social or shared storage networks	MAPS_LAP	GESINT3
	49.d. Managing access to personal information: Denying permission to use personal information for advertising purposes	MAPS_RAAD	GESINT4
	49.e. Managing access to personal information: Check that the website where personal information was provided was secure (e.g., check for a logo or certificate or the presence of an "s" after "http").	MAPS_CWSC	GESINT5
	51. Have you made any changes to the settings of your internet browser to prevent or limit the amount of cookies on any of your devices?	PCOOK1	PREVCOOK

* Name of the variable in which it is stored according to Regulation (EU) 2022/1399 on the dataset.

** Name of the variable in the TIC-H survey microdata file

APPENDIX II. TIC-H Survey Questions Used for Calculating the Digital Skills Level of Surveyed Individuals According to DigComp Competence Areas.

Competence Areas	Questions TIC-H survey	Variable EU Regulation*	Variable TIC-H **
Literacy in information and data	19.a. Internet service used: Reading news, newspapers, or current magazines online	IUNW1	SERV19_1
	19.b. Internet service used: Searching for information on health topics (e.g., injuries, diseases, nutrition...)	IHIF	SERV19_2
	19.c. Service used on the internet: Searching for information about goods or services	IUIF	SERV19_3
	47.a. Verifying the accuracy of information: The participant checked sources or found other information on the internet (e.g., other news sites, Wikipedia, etc.)	TICCSFOI	CHECK1
	47.b. Verifying the accuracy of information: The participant followed or participated in online discussions about information.	TICIDIS	CHECK2
	47.c. Verifying the accuracy of information: The participant discussed the information with other people or used sources outside of the internet.	TICNIDIS	CHECK3
	48.a. Verifying the accuracy of information: The participant knew that the information, content, or source was not reliable.	TICXND	NOCHECK1
Communication and collaboration	18.a. Internet service used: Receiving or sending emails	IUEM	SERV18_1
	18.b. Internet service used: Making or receiving video calls through the internet (using apps like WhatsApp, Skype, Messenger, FaceTime...)	IUPH1	SERV18_2
	18.c. Internet service used: Participating in social networks (creating a user profile, sending messages, or making other contributions to Facebook, Twitter, Instagram, TikTok...)	IUSNET	SERV18_3
	18.d. Internet service used: Using instant messaging (e.g., via WhatsApp, Skype, Messenger...)	IUCHAT1	SERV18_4
	20.a. Internet service used: Expressing opinions on civic or political issues on websites or social media platforms (e.g., Facebook, Twitter, Instagram...)	IUPOL2	SERV20_1
	20.b. Internet service used: Participating in online consultations or votes on civic or political issues (e.g., consultations on urban planning, signing a petition...)	IUVOTE	SERV20_2
Digital content creation	44.a. Tasks related to computers, mobile phones, or other devices: Copying or moving files (e.g., documents, data, images, videos) between folders, devices (e.g., email, Messenger, WhatsApp, USB, cable), or in the cloud	CXFER1	TMOR1
	44.a. Tasks related to computers, mobile phones, or other devices: Using a word processor	CWRD1	TAREAINF1
	44.b. Tasks related to computers, mobile phones, or other devices: Creating files (e.g., document, image, video) that incorporate various elements, such as text, tables, graphics, animation	CPRES2	TAREAINF2

Competence Areas	Questions TIC-H survey	Variable EU Regulation*	Variable TIC-H **
	44.c. Tasks related to computers, mobile phones, or other devices: Using spreadsheets	CXLS1	TAREAINF3
	44.c1. Tasks related to computers, mobile phones, or other devices: Use advanced spreadsheet functions to organize, analyze, structure, or modify data (functions, formulas, macros, Visual Basic...)	CXLSADV1	TAREAINF3_1
	44.d. Tasks related to computers, mobile phones, or other devices: Using software to edit photos, video, or audio	CEPVA1	TAREAINF4
	44.e. Tasks related to computers, mobile phones, or other devices: Programming in a programming language	CPRG2	TAREAINF5
Safety	49.a. Managing access to personal information: Reading the privacy policy of websites before providing personal information	MAPS_RPS	GESINT1
	49.b. Managing access to personal information: Restricting access to your geographical location	MAPS_RRG L	GESINT2
	49.c. Managing access to personal information: Limiting access to your profile or content on social or shared storage networks	MAPS_LAP	GESINT3
	49.d. Managing access to personal information: Denying permission to use personal information for advertising purposes	MAPS_RAA D	GESINT4
	49.e. Managing access to personal information: Check that the website where personal information was provided was secure (e.g., check for a logo or certificate or the presence of an "s" after "http")	MAPS_CW SC	GESINT5
	51. Have you made any changes to the settings of your internet browser to prevent or limit the amount of cookies on any of your devices?	PCOOK1	PREVCOOK
Problem solving	21. Internet service used: Searching for a job or applying for a position (excluding the use of email)	IUJOB	SERV21_1
	22.a. Internet service used: Selling goods or services (transaction or deal conducted online) through a website or app (e.g., Amazon, Vinted, FNAC, Marketplace, eBay...)	IUSELL	SERV22_1
	22.b. Internet service used: Online banking (including mobile banking)	IUBK	SERV22_2
	23.a. Internet service used: Taking an online course (or partially online)	IUOLC	SERV23_1
	23.b. Internet service used: Using online learning materials other than a complete online course (e.g., audiovisual material, electronic texts)	IUOLM	SERV23_2
	28. When was the last time you bought a product or service online? (Have you made a purchase online in the last 12 months?)	IBUY	ULT_COM (1,2)
	43.b. Tasks related to computers, mobile phones, or other devices: Downloading or installing software or applications (apps)	CINSAPP1	TMOR2
43.c. Tasks related to computers, mobile phones, or other devices: Changing the settings of software, the app, or the device (e.g., adjust language, colors, text size, toolbar/menu)	CCONF1	TMOR3	

* Variable name as stored in accordance with the Implementing Regulation (EU) 2022/1399 on datasets.

** Variable name in the TIC-H survey microdata file.

APPENDIX III. Comparative table of the TIC-H survey questions used for calculating the DSI and the specific tasks by competency area outlined in DigComp for a competency level A2 (Basic).

Competence Areas	Questions TIC-H survey	Task DigComp overall levels foundation A2 (At basic level and with autonomy and appropriate guidance where needed, I can:)
Literacy in information and data	<p>19.a. Internet service used: Reading news, newspapers, or current magazines online</p> <p>19.b. Internet service used: Searching for information on health topics (e.g., injuries, diseases, nutrition...)</p> <p>19.c. Service used on the internet: Searching for information about goods or services</p> <p>47.a. Verifying the accuracy of information: The participant checked sources or found other information on the internet (e.g., other news sites, Wikipedia, etc.)</p> <p>47.b. Verifying the accuracy of information: The participant followed or participated in online discussions about information</p> <p>47.c. Verifying the accuracy of information: The participant discussed the information with other people or used sources outside of the internet</p> <p>48.a. Verifying the accuracy of information: The participant knew that the information, content, or source was not reliable</p>	<ul style="list-style-type: none"> – Identify my information needs. – Find data, information and content through a simple search in digital environments. – Find how to access these data, information and content and navigate between them. – Identify simple personal search strategies. – Detect the credibility and reliability of common sources of data, information and their digital content. – Identify how to organise, store and retrieve data, information and content in a simple way in digital environments. – Recognise where to organise them in a simple way in a structured environment.
Communication and collaboration	<p>18.a. Internet service used: Receiving or sending emails</p> <p>18.b. Internet service used: Making or receiving video calls through the internet (using apps like WhatsApp, Skype, Messenger, FaceTime...)</p> <p>18.c. Internet service used: Participating in social networks (creating a user profile, sending messages, or making other contributions to Facebook, Twitter, Instagram, TikTok...)</p> <p>18.d. Internet service used: Using instant messaging (e.g., via WhatsApp, Skype, Messenger...)</p> <p>20.a. Internet service used: Expressing opinions on civic or political issues on websites or social media platforms (e.g., Facebook, Twitter, Instagram...)</p> <p>20.b. Internet service used: Participating in online consultations or votes on civic or political issues (e.g., consultations on urban planning, signing a petition...)</p>	<ul style="list-style-type: none"> – Select simple digital technologies to interact. – Identify appropriate simple communication means for a given context. – Recognise simple appropriate digital technologies to share data, information and digital content. – Identify simple referencing and attribution practices. – Identify simple digital services in order to participate in society. – Recognise simple appropriate digital technologies to empower myself and to participate in society as a citizen. – Choose simple digital tools and technologies for collaborative processes. – Differentiate simple behavioural norms and know-how while using digital technologies and interacting in digital environments. – Choose simple communication modes and strategies adapted to an audience. – Differentiate simple cultural and generational diversity aspects to consider in digital environments. – Identify a digital identity, – Describe simple ways to protect my reputation online.

Competence Areas	Questions TIC-H survey	Task DigComp overall levels foundation A2 (At basic level and with autonomy and appropriate guidance where needed, I can:)
		<ul style="list-style-type: none"> – Recognise simple data I produce through digital tools, environments or services.
Digital content creation	<p>43.a. Tasks related to computers, mobile phones, or other devices: Copying or moving files (e.g., documents, data, images, videos) between folders, devices (e.g., email, Messenger, WhatsApp, USB, cable), or in the cloud</p> <p>44.a. Tasks related to computers, mobile phones, or other devices: Using a word processor</p> <p>44.b. Tasks related to computers, mobile phones, or other devices: Creating files (e.g., document, image, video) that incorporate various elements, such as text, tables, graphics, animation</p> <p>44.c. Tasks related to computers, mobile phones, or other devices: Using spreadsheets</p> <p>44.c1. Tasks related to computers, mobile phones, or other devices: Use advanced spreadsheet functions to organize, analyze, structure, or modify data (functions, formulas, macros, Visual Basic...)</p> <p>44.d. Tasks related to computers, mobile phones, or other devices: Using software to edit photos, video, or audio</p> <p>44.e. Tasks related to computers, mobile phones, or other devices: Programming in a programming language</p>	<ul style="list-style-type: none"> – Identify ways to create and edit simple content in simple formats, – Choose how I express myself through the creation of simple digital means. – Select ways to modify, refine, improve and integrate simple items of new content and information to create new and original ones. – Identify simple rules of copyright and licenses that apply to data, digital information and content. – List simple instructions for a computing system to solve a simple problem or perform a simple task.

Competence Areas	Questions TIC-H survey	Task DigComp overall levels foundation A2 (At basic level and with autonomy and appropriate guidance where needed, I can:)
Safety	<p>49.a. Managing access to personal information: Reading the privacy policy of websites before providing personal information</p> <p>49.b. Managing access to personal information: Restricting access to your geographical location</p> <p>49.c. Managing access to personal information: Limiting access to your profile or content on social or shared storage networks</p> <p>49.d. Managing access to personal information: Denying permission to use personal information for advertising purposes</p> <p>49.e. Managing access to personal information: Check that the website where personal information was provided was secure (e.g., check for a logo or certificate or the presence of an "s" after "http")</p> <p>51. Have you made any changes to the settings of your internet browser to prevent or limit the amount of cookies on any of your devices?</p>	<ul style="list-style-type: none"> – Identify simple ways to protect my devices and digital content. – Differentiate simple risks and threats in digital environments. – Follow simple safety and security measures. – Identify simple ways to have due regard to reliability and privacy. – Select simple ways to protect my personal data and privacy in digital environments, – Identify simple ways to use and share personally identifiable information while protecting myself and others from damages. – Identify simple privacy policy statements of how personal data is used in digital services. – Differentiate simple ways to avoid health risks and threats to physical and psychological well-being while using digital technologies. – Select simple ways to protect myself from possible dangers in digital environments. – Identify simple digital technologies for social well-being and social inclusion. – Recognise simple environmental impacts of digital technologies and their use.
Problem solving	<p>21. Internet service used: Searching for a job or applying for a position (excluding the use of email)</p> <p>22.a. Internet service used: Selling goods or services (transaction or deal conducted online) through a website or app (e.g., Amazon, Vinted, FNAC, Marketplace, eBay...)</p> <p>22.b. Internet service used: Online banking (including mobile banking)</p> <p>23.a. Internet service used: Taking an online course (or partially online)</p> <p>23.b. Internet service used: Using online learning materials other than a complete online course (e.g., audiovisual material, electronic texts)</p> <p>28. When was the last time you bought a product or service online? (Have you made a purchase online in the last 12 months?)</p> <p>43.b. Tasks related to computers, mobile phones, or other devices: Downloading or installing software or applications (apps)</p> <p>43.c. Tasks related to computers, mobile phones, or other devices: Changing the settings of software, the app, or the device (e.g., adjust language, colors, text size, toolbar/menu)</p>	<ul style="list-style-type: none"> – Identify simple technical problems when operating devices and using digital environments. – Identify simple solutions to solve them. – Identify needs, and – Recognise simple digital tools and possible technological responses to solve those needs. – Choose simple ways to adjust and customise digital environments to personal needs. – Identify simple digital tools and technologies that can be used to create knowledge and to innovate processes and products. – Follow individually and collectively simple cognitive processing to understand and resolve simple conceptual problems and problem situations in digital environments. – Recognise where my own digital competence needs to be improved or updated, – Identify where to seek opportunities for self-developments and to keep up-to-date with the digital evolution.