Report of the EGH subgroup on measuring ICT skills using household surveys

August 2024

Summary of proposed recommendations

A. The subgroup recommends the modified wording and organization of ICT skills indicators shown in Table 1 and detailed in Annex 1 for future data collection.

- Examples detailed in Annex 1 should be adapted to reflect the most popular local or national services.
- Countries should consider their need for a filter question on Internet use where individuals can accomplish near-equivalent tasks using widely adopted non-Internet ICT services such as mobile banking or integrated voice response (IVR).

Table 1.
Proposed ICT skills indicators, by ICT skill area. **Bold** text indicates proposed changes to wording from current recommendations.

Information and data literacy
Verifying the **truthfulness** of information found online
Finding information about goods or services
Accessing news or books in a digital format
Finding health information
Communication and collaboration
Sending **content in messages**
Making calls (telephoning over the Internet/VoIP)
Participating **on social networking platforms**
Taking part in consultations via the Internet to define civic or **social** issues
Digital content creation
Editing text documents, spreadsheets or presentations **using digital tools**
Duplicating or moving data, information and content in digital environments
Creating **content combining different digital media**
Using spreadsheet **software**
Programming or coding in digital environments
Safety
Taking security measures **to protect devices and online accounts**

Taking measures to protect privacy on your device, account or app
Problem solving
Connecting new devices
Installing software **or** apps
Using Internet **or mobile** banking
Doing an online course **or accessing online learning material**
Purchasing or ordering goods or services

B. The subgroup agreed that countries which collected sufficient data on the five skill areas should calculate overall digital skill levels for individuals using the criteria shown in Table 2.

- Countries collecting data for only three or four of the skill areas are encouraged to calculate overall skills levels for use at the national or local level.

Table 2.
Definition of overall ICT skill levels for individuals

Category	Definition
Above basic skills	Above basic skills in all five areas
Basic skills	At least basic skills in all five areas – can be basic or above basic, but not all five at above basic
4 of 5	*Basic* or *above basic* in any four areas and no skills in one area (at least basic in four of five areas).
3 of 5	*Basic* or *above basic* in any three areas and no skills in two areas (at least basic in three of five areas).
2 of 5	*Basic* or *above basic* in any two areas and no skills in three areas (at least basic in two of five areas).
0-1 of 5	No skills in four or five areas (at least basic in one or fewer of five areas).

C. The subgroup agreed that for the moment, at a global level, it is challenging to identify a reduced set of indicators that can provide near-equivalent information on ICT skills in a country compared to the full set.

- Given differences between conditions in countries and changing technologies identifying a common reduced set across countries is a challenge.
- If interested, countries are encouraged to investigate the possibility of using a reduced set of indicators by comparing results against the full set while also considering conceptual issues (e.g. criteria of having all five skills areas).

1. Background

In 2013, the Expert Group on ICT Household Indicators (EGH) added indicator HH15 to the Core list of ICT Indicators. This indicator examines the activities individuals carry out on digital devices as a proxy for digital skills to help link ICT usage and its impact. These data may be used to inform targeted policies to improve ICT skills, and thus contribute to an inclusive information society. The UN Sustainable Development Goals (SDGs) also reference ICT skills through SDG Indicator 4.4.1: *Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill*.

At its 2017 meeting, EGH agreed to create a subgroup to improve the measurement of ICT skills based on ICT household data and make proposals for a conceptual framework and dimensions of digital skills to be monitored through ICT household data. The subgroup operated from 2018 to 2020 amending the response categories of HH15, reducing redundancy and filling data gaps in the skills that are currently measured.

At its 2021 meeting, EGH decided to revive the subgroup on ICT skills to reconsider ways to aggregate indicators on skills in a meaningful way given the additional skills indicators that were added. The revived subgroup proposed several key recommendations that were accepted by EGH at its 2022 and 2023 meetings:

- To discontinue the grouping of indicators by levels (basic/intermediate/advanced).
- To include component indicators from HH9 to complement and rebalance the data, aligning with the conceptual framework and its skills areas (DigComp).
- Individuals should be assessed on the number of activities within a skill area they report having done in the last three months using the following progression:

None	Basic	Above basic
0 activities	1 activity	More than 1 activity

    - Skill levels should not be assessed in skill areas where fewer than two indicators are collected.
    - Indicators should be weighted equally within each skill area.
    - Skill areas with different numbers of components should be treated equally.

EGH prolonged the mandate of the subgroup for 2024 to build on the work of previous years and investigate how the set of ICT skills indicators could be made more robust and resilient to technological changes. It also requested the subgroup to examine further country examples and investigate whether and which indicators within each skill area could be identified as "mandatory" for calculating aggregates. Lastly, EGH requested that the subgroup also consider further conceptual and practical issues, including whether or when data availability might be sufficient to recommend assessments of overall ICT skill levels for individuals.

2. Reflections from the sub-group on measuring ICT skills

The subgroup met five times in 2024 through videoconference. The focus was three-fold. First, to examine the wording and scope of the current recommended ICT skills indicators and make proposals to improve their robustness, modernity and clarity. Second, to assess data availability in order to recommend assessments of overall ICT skill levels for individuals. Last, to consider the practical aspects of developing comparable skill aggregates given differences between countries in the questions included in their household surveys.

Members of the subgroup were invited to provide inputs that were discussed during the monthly calls. Cetic.br (Brazil) and Statistics Canada provided data-driven analyses related to identifying a common reduced set of skills indicators (more information in Annex 4 and Annex 5). Members from a consortium led by the University of Cape Town organized a workshop in London on digital skills in low- and middle-income countries. This workshop included sessions where attendees provided feedback on the improved ICT skills indicators.

An additional input to the subgroup was from the preliminary results of ITU's data collection from its annual short questionnaire (see

Annex 3). As part of its normal data collection cycle, ITU sent a questionnaire to countries to collect ICT household survey data in March 2024 where, for the first time, data on aggregates for each skill area were requested. The ITU received and validated data from this questionnaire through June 2024 with 41 countries providing data on ICT skills aggregates for at least one skill area (of 61 countries with any data on ICT skills indicators). Of these, 19 were Eurostat countries providing data calculated according to the DSI 2.0 methodology. Results based on the other 22 countries which followed the 2023 EGH recommendations helped to inform the subgroup on how countries can provide these data.

A. Updating indicators

The subgroup examined each of the existing ICT skills indicators to assess whether they could be improved keeping in mind three overarching goals:

- Maintain comparability over time by avoiding major changes.
- Maintain relevance by modernizing indicator wording and using mobile-friendly language where warranted.
- Maintain specificity by keeping indicators comprehensible to respondents and avoiding overly vague wording.

The changes ranged from minor wording changes to improve clarity and modernize terms to more substantive changes which adjust the conceptual emphasis of indicators. The changes also focused on examples included in the indicators, the subgroup recommends that countries **adapt examples to include the most popular local or national services**. Some details will be explained below, the complete set of changes can be found in Annex 1.

Another consideration of the subgroup was the perspective shared from lower-income countries. In some of these countries, **technologies such as integrated voice response (IVR) are widely used and may allow individuals with low literacy and without access to the Internet to demonstrate near-equivalent ICT skills**. In such cases, adjustments to surveys may include consideration of whether to include filters on Internet use or include reference to locally available services that do not require an Internet connection (e.g. mobile banking services, IVR programs). Such services may be considered for the following indicators:

- Internet or mobile banking
- Finding health-related information
- Finding information about goods or services
- Sending content in messages

While outside the scope of this year's work, the subgroup also recognized the importance of devising **simple and clear survey questions** based on cognitive interviews to ensure consistent responses from all segments of population [2]. The indicators, as defined in this report, may in some cases need to be divided into separate questions to ease the cognitive response burden.

Last, the subgroup agreed that adding new indicators (such as using mapping tools, using spam blockers, creating files/folders) would be out of scope for this year's revision. While new indicators could be considered in future iterations of the subgroup, this year's subgroup **recommends stability for several years before further changes**.

Minor changes in wording

For many indicators, some minor changes in wording were required to clarify the meaning of the indicator or modernize some of the terminology.

In the **Information and data literacy** skill area, the following minor changes in wording were recommended:

Current indicator	Proposed indicator	Comments
Verifying the reliability of information found online	Verifying the **truthfulness** of information found online	Truthfulness more to the point (even if conceptions of truthfulness can vary).
Getting information about goods or services	**Finding** information about goods or services	Excluding unsolicited advertisements
Seeking health-related information	**Finding** health-related information	Focus on successful searches

In the **Communication and collaboration** skill area, the following minor changes in wording were recommended:

Current indicator	Proposed indicator	Comments
Participating in social networks (creating user profile, posting messages or other contributions to Facebook, Twitter, Instagram, Snapchat, etc.)	Participating **on social networking platforms** (e.g. creating user profile, **reading or** posting messages and other contributions to Facebook, **X**, Instagram, Snapchat, **TikTok**)	Emphasizing passive participation Adding additional examples (though countries can tailor locally relevant examples)
Taking part in consultations or voting via the Internet to define civic or political issues (urban planning, signing a petition etc.)	Taking part in consultations via the Internet to define civic or **social** issues (e.g. urban planning, signing a petition, **voting**)	Emphasize civic nature of consultations vs political. Voting only one example

In the **Digital content creation** skill area, the following minor changes in wording were recommended:

Current indicator	Proposed indicator	Comments
Using copy and paste tools to duplicate or move data, information and content in digital environments (e.g. within a document, between devices, on the cloud)	**Duplicating or moving data**, information and content in digital environments (e.g. within a document, between devices, on the cloud)	Copy and paste not always the primary means of duplicating and moving
Programming or coding in digital environments (e.g. computer software, app development)	Programming or coding in digital environments	Examples not informative
Using basic arithmetic formulae in a spreadsheet	Using **spreadsheet software (e.g. using basic arithmetic formulae, functions, macros)**	Emphasizing use of spreadsheets rather than arithmetic formulae only
Using software run over the Internet for editing text documents, spreadsheets or presentations	Editing text documents, spreadsheets or presentations **using digital tools (e.g. Google Docs, Sharepoint, Apple iCloud)**	Adding examples for clarity

In the **Safety** skill area, the subgroup recommended a modernization of examples of both security and privacy measures that individuals can take. For both indicators the emphasis

was placed on active measures taken. For security measures, the word "effective" was removed as this is a subjective assessment.

Current indicator	Proposed indicator
Setting up effective security measures (e.g. strong passwords, log-in attempt notification) to protect devices and online accounts	**Taking** security measures to protect devices and online accounts (e.g. **changing** passwords**, setting up two-factor authentification, avoiding unsecure links or downloads**)
Changing privacy settings on your device, account or app to limit the sharing of personal data and information (e.g. name, contact information, photos)	**Taking measures to protect** privacy on your device, account or app (e.g. to limit the sharing of personal data and information**, restrict access to social network profiles or geolocation, prevent targeted marketing**)

In the **Problem solving** skill area, the following minor changes in wording were recommended:

Current indicator	Proposed indicator	Comments
Connecting and installing new devices (e.g. a modem, camera, printer) through wired or wireless technologies	Connecting new devices (e.g. camera, printer**, wireless speakers or wireless headphones**)	Wireless speakers/headphones more frequently connected than modems. Wired or wireless technology is self-evident. Installation no longer often required
Finding, downloading, installing and configuring software and apps	Installing software **or** apps	Installing infers that the software and apps have already been found, downloaded. "Configured" is not clear to all respondents. An individual should respond that have done the activity if they have installed software or apps (not required to have installed both)

Also in the Problem solving skill area, two adjustments were made to indicators that were previously excluding certain types of activities.

Current indicator	Proposed indicator	Comments
Internet banking (includes…looking up account information; excludes electronic	**Using** Internet or mobile banking (includes electronic transactions with a bank for payment,	Removing exclusion of activities that would nearly always require online banking (addition of "mobile banking" explained below)

transactions via the Internet for other types of financial services such as share purchases, financial services and insurance)	transfers, etc. such as M-Pesa, or for looking up account information)	
Purchasing or ordering goods or services (purchase orders placed via the Internet …; excludes orders that were cancelled or not completed; includes purchasing of products such as music…)	Purchasing or ordering goods or services (via the Internet whether or not payment was made online; includes purchasing of products such as music, travel and accommodation via the Internet)	Removing exclusion of cancelled/incomplete orders. This still shows the activity or skill of interest.

Substantive changes

In the **Communication and collaboration** skill area the subgroup recommended the below change to emphasizing sending content as the important aspect of the indicator. The revised indicator also expands the concept from attached files only to sending content more generally. Attaching files is one of many ways to send messages with additional content.

Current indicator	Proposed indicator
Sending messages (e.g. e-mail, messaging service, SMS) with attached files (e.g. document, picture, video)	Sending **content** (e.g. document, picture, video **through attached files, embedded content, hyperlinks**) **in messages** (e.g. e-mail, messaging service, **MMS**)

The **Digital content creation** skill area was a particular focus of the subgroup as the current set of activities included several possibly overlapping indicators. The subgroup addressed this by making two recommendations. The first is an adjustment to the indicator "Creating electronic presentations with presentation software". The subgroup recognized that while digital skills required for office jobs remain important, the indicators should also recognise digital content created in other aspects of life. The proposed indicator (shown below) will include activities that can be performed with a smartphone as well. This also aligns with a similar existing Eurostat indicator.

A second change is recommended to drop the indicator on uploading content from the set of ICT skills indicators. The subgroup considered sharing online to be more representative of confidence than digital skills. The indicator will be retained as an indicator of activities by Internet users (HH9) as it continues to be of interest for other research outside of digital skills.

Current indicator	Proposed indicator

Creating electronic presentations with presentation software	Creating content **combining different digital media**
Uploading self/user-created content to a website to be shared	**[Removed from digital skills indicators]**

The subgroup expanded the definition further for two indicators in the **Problem solving** skill area. For Internet banking, the subgroup recognized that many individuals in some countries can do activities comparable to Internet banking using non-Internet connected mobile phones. It is therefore important that individuals that have performed similar tasks are also included when assessing comparable digital skills in a population.

For online learning, the subgroup also considered that the amount of learning material available online has expanded considerably in recent years. Enrolment in a formal course is less meaningful than it was even several years ago. While acknowledging that an additional indicator in HH9 already exists[1] the subgroup still felt it was important to expand the definition of online learning to cover informal learning despite some overlap between the indicators.

Current indicator	Proposed indicator
Internet banking (includes…)	**Using** Internet **or mobile** banking (includes…)
Doing an online course (in any subject)	Doing an online course **or accessing online learning material (e.g. video tutorials, webinars, learning apps)**

Cross-cutting issues

Finally, the subgroup also identified significant overlap between the two indicators below. To simplify and avoid confusion for respondents, the subgroup recommended dropping one indicator. This indicator should be removed from surveys as it does not provide additional information.

Skill area	Current indicator	Proposed indicator
Digital content creation	Using copy and paste tools to duplicate or move data, information and content in digital environments	Duplicating or moving data, information and content in digital environments
Problem solving	Transferring files or applications between devices	**[Removed]**

[1] Consulting wikis (Wikipedia etc.), online encyclopaedias or other websites for formal or informal learning purposes

B. Overall skills aggregate

Definition

Another objective of the group was to review the possibility of assessing overall ICT skills for individuals. Ideally such a measure would inform policy on digital skills by identifying the breadth of digital skills in a population. Data on overall ICT skills can provide an indication of the gaps that a population needs to bridge to achieve basic levels of ICT skills. DSI 2.0 is used in European countries to provide such information [1] and the subgroup agreed that this definition was suitable as well as an international recommendation. The subgroup agreed that the **overall ICT skills aggregates can only be calculated for countries reporting aggregates for all five skill areas**. The agreed definitions are provided in Table 2 (see *Summary of proposed recommendations*).

ITU Short Questionnaire results

The results of the ITU short questionnaire collected in 2024 (Annex 3) show how data comprehensiveness can make implementing an overall ICT skills aggregate measure challenging. Of the 21 countries providing data on ICT skills aggregates only 10 reported data on all five skill areas. According to the definition above, it would not be possible to calculate overall ICT skill levels for the 11 countries reporting aggregates for fewer than five skill areas. Of note, the *Safety* skill area was the least reported skill area with only 12 of the 21 countries reporting skills aggregates. As noted in previous subgroup reports this is a skill area with newer indicators than the others and increases in data availability in the future are possible and **strongly recommended**.

Other considerations

Based on data availability reported by the ITU, the subgroup recognized that many countries will not be able to provide data on overall ICT skill levels immediately. Until comprehensive data are collected for all five skill areas, data would not be internationally comparable. However, there are many countries which collect data for three or four of the five skill areas. The subgroup agreed that in these cases, countries could still gain valuable information about their populations by calculating overall ICT skill levels using similar criteria, but for the subset of skill areas that they collect. For example, in a country only collecting data for four skill areas, an individual with *basic skills* in all four skill areas collected would be considered to have *basic skills*. This modified ICT skill level calculation **could be used at the national level to gain valuable insights even if it is not internationally comparable**.

C. Common reduced set of indicators

Motivation

The current proposed set of indicators consists of 20 activities. The subgroup agreed that the recommended set provides depth and breadth to assessments of digital skills in a population. Nevertheless, there are good reasons why a smaller set of indicators could be preferable in certain circumstances – two are elaborated below.

The variation in indicators collected by countries can result in challenges with comparability. As noted in the 2023 subgroup report, countries often do not include all indicators in their household surveys although this is recommended. Hence the requirement for calculating an aggregate measure: **at least two indicators within a skill area.** However, as these activities can vary between countries, skills aggregates for different countries can be based on a different set of indicators – with no overlap in some cases. Where this occurs, the comparability of this measure will depend on the similarity of the underlying likelihood that an individual will have done each activity within a skill area.

Another motivation for a reduced set is where questions on ICT activities are being included in multi-purpose surveys, there may be limitations on the number of questions that can be added. In certain countries, where digital skill levels are low, the inclusion of a long set of questions, where a respondent is likely to say 'no', may result in respondent frustration. This was cited as a challenge in the previous round of UNICEF's Multiple Indicator Cluster Surveys (MICS)[2] where the previously recommended set of 9 questions on digital skills was asked for the first time.

Identifying candidate indicators

Given this background, the subgroup attempted to mitigate these issues by identifying a common and reduced set of required indicators for the calculation of skills aggregates – two indicators per skill area.

One set of inputs on the topic addressed the issue of whether a reduced set of indicators could reasonably replicate the results of aggregating using the full set of indicators. Brazil provided an interesting analysis providing evidence that using a data-based approach such a set of indicators could be identified (see Annex 4). It noted that this type of analysis should be done **for each country,** as underlying conditions are likely to vary between countries. Taking inspiration from the Brazil analysis, Canada also provided their own data-driven analysis using a different method. They also eventually arrived at a reduced set, which reasonably replicated the results of the full set. However, the specific indicators that best replicated the results for Canada differed in most skill areas from those derived for Brazil (see Annex 5). Annex 5

A similar data-driven approach was presented where a reduced set of 10 items was selected using Eurostat data from 27 EU countries [1, p.20-21]. The method based on Item Response Theory (IRT) modeling to select items that maximize the information

[2] Sixth round of MICS (MISC6)

content and reliability of the shortened scale. However, due to differences in indicators and the cultural contexts, the results yield little insights for the use at a global level.

Such data-driven approaches show that a reduced set of indicators is a reasonable proposition. However, given the lack of capacity in many countries, for the moment the subgroup does not recommend at a global level using such a data-driven approach to identifying this reduced set of indicators.

A complementary approach taken by the subgroup was to identify the common required set based on their perceived importance in measuring digital skills and without a goal of replicating the results of the full set. This expert-driven approach was used in an exercise conducted in the London Digital Skills workshop. In this exercise participants (a group of ~20 researchers generally focusing on conditions in low- and middle-income countries) were asked which two activities in each skill area would be most important to retain in a reduced set of digital skills indicators. While participants shared very interesting perspectives during the exercise, no clear choices emerged in most skill areas.

Last, the share of ITU member states providing data on these indicators since 2021 was considered, however, the subgroup emphasized that the recommendations should be for the best indicators in any common reduced set of indicators regardless of data availability. This recognizes that informative indicators, that are not widely collected today, could be collected in the future. The subgroup's recommendations should encourage more countries to collect the current ICT skills indicators with their improved modifications rather than be influenced by current levels of data availability.

Table *3* shows the data availability along with a comparison of the other different methods. Based on these four sources of information and discussion during its meeting, the subgroup noted the following:

- In the *Communication and collaboration* skill there was **no consensus** – all four indicators are possible selections.
- In the *Digital content creation* skill area there was **no consensus** – all five indicators are possible selections. However, the indicator *Duplicating or moving data, information and content in digital environments* was recommended by three of the four sources.

- ***Finding information about goods/services* was recommended in all cases** in the *Information and data literacy* skill area. While there was no consensus for the second indicator, *Accessing news or books in a digital format* was the next most recommended.
- **No consensus** was found for the *Problem solving* skill area.
- For **Safety,** the existing 2 indicators are recommended.

Table 3.
Proposed reduced sets of indicators, various sources.

	Indicator 1	**Indicator 2**	**Indicator 3**	**Indicator 4**	**Indicator 5**	**Indicator 6**	**Indicator 7**
Comm. and collab.	Making calls over the internet (E-L) **[58%]**	Sending content in messages (L-C) **[36%]**	Participating on social networking platforms (B-C) **[61%]**	Taking part in consultation or voting via Internet (B) **[45%]**	Using instant messaging (E)		
Digital content creation	Duplicating or moving data... (L-B-C) **[47%]**	Creating content combining different digital media (L) **[55%]**	Editing…using digital tools (L-C) **[15%]**	Using spreadsheet software (E) **[55%]**	Programming or coding... (B) **[55%]**	Uploading self/user-created content (B)	Using word processing software (E)
Information and data literacy	Finding information about goods or services (E-B-L-C) **[58%]**	Accessing news or books.. (E-L-C) **[55%]**	Finding health info (L) **[58%]**	Verifying the reliability of information (B) **[50%]**			
Problem solving	Installing software or apps (E-L) **[58%]**	Internet or mobile banking (L-C) **[61%]**	Doing an online course … (L) **[57%]**	Connecting new devices (B) **[18%]**	Purchasing or ordering goods or services (B-C) **[60%]**	Changing settings of software, app or device (E)	
Safety	Taking measures to protect privacy **[27%]**	Taking security measures **[16%]**	Limited access to profile … (E)	Checked that the website where you provided personal data was secure (E)			

E = Eurostat recommended indicators
B = Brazil recommended indicators (data-driven based on model)
C = Canada recommended indicators (data-driven)
L = Most recommended indicators from London Digital Skills Workshop (concept-based)
[xx%] = Data availability (share of ITU members with data since 2021)
Gray = Only two indicators in Safety skill area
Red = Not included in ITU digital skills indicators

ITU Short Questionnaire results

Another point to consider is that of those who provided validated data on skills aggregates in the ITU Short Questionnaire using the EGH recommendations[3], most collected nearly all indicators in skill areas for which they reported aggregates. This is a self-selected group, but still may show that there may be fewer concerns about comparability. Variations on this same pattern were observed across skill areas for countries providing aggregate ICT skills data.

- *Communication and collaboration*: 11 of 19 provided data for all activities in the skill area and 17 provided data for at least three of the four activities in the skill area.
- *Digital content creation*:16 of 20 provided data for at least five of the six activities
- *Problem solving*: 15 of 20 provided data for at least five of the six activities and
- *Information and data literacy:* all 17 countries providing ICT skills aggregate data for had provided data for at least three of the four activities in this skill area.

3. Conclusions

It is recommended to **close the subgroup** as its work has been completed. However, the subgroup recognizes that the digital skills required to fully benefit from digital technology will continue to evolve. Consequently, it is likely that this topic should be revisited in the future. To balance the need for relevance and stability, the subgroup recommends a pause in EGH's work on this topic for at least three years to provide stability. Digital skills should remain open as a discussion topic in the EGH Forum.

To communicate these changes, the ITU will also request the Interagency Working Group on SDGs (IAEG-SDG) to implement an update to the metadata for SDG 4.4.1 and consider the most efficient way to update the Manual for measuring ICT access and use by households and individuals with these new recommendations.

Annex 1: Mapping of current indicators to recommended indicators

Current indicator	Proposed indicator

[3] Analysis excludes 19 European countries which reported data using the DSI 2.0 methodology

Information and data literacy	
Verifying the reliability of information found online	Verifying the **truthfulness** of information found online
Getting information about goods or services	**Finding** information about goods or services
Reading or downloading newspapers, magazines or electronic books in a digital format	**Accessing news or books** in a digital format **(e.g. reading online news, watching news videos online, reading e-books on an e-reading device)**
Seeking health-related information (on injury, disease, nutrition etc.)	**Finding** health information
Communication and collaboration	
Sending messages (e.g. e-mail, messaging service, SMS) with attached files (e.g. document, picture, video)	Sending **content** (e.g. document, picture, video **through** attached files, **embedded content, hyperlinks**) **in messages** (e.g. e-mail, messaging service, **MMS**)
Making calls (telephoning over the Internet/VoIP using Skype, WhatsApp, Viber, iTalk, etc.; includes video calls via webcam)	Making calls (telephoning over the Internet/VoIP using Skype, WhatsApp, Viber, iTalk, etc.; includes video calls via webcam)
Participating in social networks (creating user profile, posting messages or other contributions to Facebook, Twitter, Instagram, Snapchat, etc.)	Participating **on social networking platforms** (**e.g.** creating user profile, **reading or** posting messages and other contributions to Facebook, **X**, Instagram, Snapchat, **TikTok**)
Taking part in consultations or voting via the Internet to define civic or political issues (urban planning, signing a petition etc.)	Taking part in consultations via the Internet to define civic or **social** issues (**e.g.** urban planning, signing a petition, **voting**)
Digital content creation	
Using software run over the Internet for editing text documents, spreadsheets or presentations	Editing text documents, spreadsheets or presentations **using digital tools (e.g. Google Docs, Sharepoint, Apple iCloud, etc.)**
Using copy and paste tools to duplicate or move data, information and content in digital environments (e.g. within a document, between devices, on the cloud)	**Duplicating or moving** data, information and content in digital environments (e.g. within a document, between devices, on the cloud)
Creating electronic presentations with presentation software (including text, images, sound, video or charts)	Creating **content combining different digital media** (including text, images, sound, video or charts)

Using basic arithmetic formulae in a spreadsheet	Using spreadsheet **software (e.g. using basic arithmetic formulae, functions, macros)**
Programming or coding in digital environments (e.g. computer software, app development)	Programming or coding in digital environments
Uploading self/user-created content to a website to be shared (text, images, photos, videos, music, software, etc.)	**[Removed from digital skills indicators]**
Safety	
Setting up effective security measures (e.g. strong passwords, log-in attempt notification) to protect devices and online accounts	**Taking** security measures **to protect devices and online accounts** (e.g. **changing** passwords, avoiding unsecure links or downloads, setting up two-factor authentication)
Changing privacy settings on your device, account or app to limit the sharing of personal data and information (e.g. name, contact information, photos)	**Taking measures to protect** privacy on your device, account or app (**e.g.** to limit the sharing of personal data and information**, restrict access to social network profiles or geolocation, prevent targeted marketing**)
Problem solving	
Connecting and installing new devices (e.g. a modem, camera, printer) through wired or wireless technologies	Connecting new devices (e.g. camera, printer, **wireless speakers or wireless headphones**)
Finding, downloading, installing and configuring software and apps	Installing software **or** apps
Internet banking (includes electronic transactions with a bank for payment, transfers, etc. such as M-Pesa, or for looking up account information; excludes electronic transactions via the Internet for other types of financial services such as share purchases, financial services and insurance)	**Using** Internet **or mobile** banking (includes electronic transactions with a bank for payment, transfers, etc. such as M-Pesa, or for looking up account information)
Doing an online course (in any subject)	Doing an online course **or accessing online learning material (e.g. video tutorials, webinars, learning apps)**
Purchasing or ordering goods or services (purchase orders placed via the Internet whether or not payment was made online; excludes orders that were cancelled or not completed; includes purchasing of products	Purchasing or ordering goods or services (via the Internet whether or not payment was made online; includes purchasing of products such as music, travel and accommodation via the Internet)

such as music, travel and accommodation via the Internet)	
Transferring files or applications between devices (including via cloud-storage)	**[Removed]**

Annex 2: Comparison with Digital Skills Indicator (DSI) 2.0

Background

In February 2023, select members of the ITU's ICT Data and Analytics team were granted access to Eurostat microdata for several research purposes including for pilot analysis of EGH recommendations for aggregating data on ICT skills at the individual level. The current microdata include data for years 2009-2022 for all Eurostat member states as well as code descriptions. The most recent year where data on digital skills were collected was 2021[4].

Mapping to ITU indicators

Once downloaded, Eurostat data for **2021** (the latest year with ICT skills data) were mapped to ITU indicators and aggregated using available individual and household weights. This can be summarized in the following steps:

- **Logical mapping to ITU codes** – In some cases, transformation of Eurostat codes was necessary to create yes/no options required for aggregation under the ITU definitions[5]. While most were clear correspondence, partial correspondence was also used in several cases, most notably for editing where the Eurostat definition is focused on editing photos/videos/audio and the ITU definition on editing documents/presentations.
- **Summarizing microdata** – Data were aggregated by multiplying the mapped individual responses against individual weights and summing these weighted responses across selected variables, grouping by country.

Structural comparison

The table below shows the difference in the structure of the two recommendations. Notably, *Information and data literacy* is nearly perfectly aligned between the two. Other skill areas show differences:

[4] This analysis is based on data from Eurostat, *Information and Communications Technologies (ICT) usage by Households and Individuals*, 2021, released 8 Feb 2024. The responsibility for all conclusions drawn from the data lies entirely with the author(s).

[5] For example, using the response code for "in the last three months" for the Eurostat question *When did you last buy or order goods or services for private use over the internet?*

- *Communication and collaboration* – EGH recommendation excludes three indicators that are included in DSI 2.0: *Using instant messaging* (IUCHAT1), *Expressing civic/political opinions* (IUPOL2), *Sending/receiving emails* (IUEM) while including a different indicator: *Sending content in messages*. Likely results in higher assessed skills using DSI 2.0 – more indicators plus sending content in messages is a subset of sending messages.
- *Digital content creation* - EGH recommendation excludes two indicators that are included in DSI 2.0: *Using word processing software* (CWRD1), *Using advanced features of spreadsheet software* (CXLSADV1). Likely results in higher assessed skills using DSI 2.0 – more indicators (though advanced spreadsheets is a subset of using spreadsheet software).
- *Problem solving* - EGH recommendation excludes three indicators that are included in DSI 2.0: *Changing settings of software, app, or device* (CCONF1), *Selling goods/services* (IUSELL), *Looking for a job* (IUJOB). It also excludes purchasing goods/service between 3 and 12 months ago. The EGH recommendation include a different indicator: *Connecting and installing new devices*. Effect is unclear as selling goods/services and looking for a job are unlikely to increase the numbers of positive responses.
- *Safety* - EGH recommendation excludes one indicator included in DSI 2.0: *Checked the website where you provided personal data was secure* (MAPS_CWSC). This is subset of the missing EGH recommended indicator for *Taking security measures to protect devices and online accounts*. It is not sufficient to covering this indicator. All other DSI safety indicators are related to EGH recommended indicator *Taking measures to protect privacy on your device, account or app*. Since only one of two ITU indicators is collected in the skill area, **the aggregate cannot be calculated under the EGH recommendation.**

Table 4.
DSI 2.0 structure compared to 2023 EGH recommendations

Skill area	Common indicators	DSI 2.0 only	EGH only
Info. and data literacy	4 / 4	**TICXND:** Did not check the truthfulness of the information or content you found on the internet news sites or social media because already knew that information, content or source was not reliable	
Comm. and collab.	3 / 4	**IUCHAT1:** Using instant messaging, i.e. exchanging messages, for example, via Skype, Messenger, WhatsApp, Viber, Snapchat **IUPOL2:** Expressing opinions on civic or political issues on websites or in social media **IUEM**: Sending / receiving e-mails	Sending content in messages

Digital content creation	5 / 5	**CWRD1:** Using word processing software **CXLSADV1:** Using advanced features of spreadsheet software to organise, analyse, structure or modify data	
Safety	1 / 2 (5 DSI indicators related to privacy)	**MAPS_CWSC:** Checked that the website where you provided personal data was secure	Taking security measures to protect devices and online accounts **USLCOOK:** Use software that limits the ability to track your activities on the internet on any of your devices
Problem solving	4 / 5	**CCONF1:** Changing settings of software, app or device **IUSELL:** Selling goods or services via a website or app **IUJOB:** Looking for a job or sending a job application **IBUY=2:** Bought or ordered goods or services for private use over the internet between 3 months and a year ago	Connecting and installing new devices

Data comparison

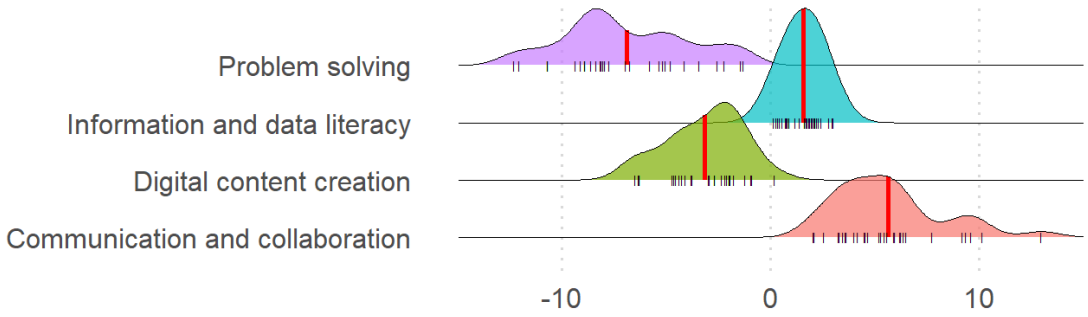
In addition to mapping 2021 Eurostat indicators to ITU codes, the DSI 2.0 indicators were also imported from the 2021 Eurostat microdata for comparison. This comparison shows that skill levels using the DSI 2.0 methodology and the EGH recommendations are quite similar for individuals with *at least basic* skills in Eurostat countries. As expected, based on the structural differences, the *Information and data literacy* skill area yields the most similar results with no differences more than 2 percentage points (all DSI greater than EGH). Only the *Problem solving* skill area showed some additional discrepancy with the share of individuals with *at least basic skills* 10 percentage points higher using DSI 2.0 in one country (Romania). This was an exception with most shares in countries remaining 0-2 percentage points higher under DSI 2.0.

Figure 1
Distribution of percentage point differences between DSI 2.0 and EGH recommendations, at least basic skills, 2021

Note: Percentage point differences expressed as (DSI – EGH). The horizontal axis shows the percentage point differences, the black tick marks indicate the differences, the height of the waves indicate the density of the distribution. The red vertical lines mark the group average values.

However, these differences were greater when comparing shares of individuals with *above basic* skill levels – partly due to different criteria for attaining *above basic* skills. Again, the *Information and data literacy* skill area yields the most similar results with no differences more than 2 percentage points (all DSI greater than EGH). Other skill areas showed larger discrepancies. To be assessed as having *above basic* skills in the *Problem solving* and *Digital content creation* skill areas DSI requires that individuals have **three** activities as opposed to two in the EGH recommendations. As a result of this and structural differences the EGH shares of individuals with *basic skills* averaged over seven percentage points higher than the same for DSI in *Problem solving* skill area. Smaller but still meaningful differences were observed for the *Digital content creation* and *Communication and collaboration* with DSI share of individuals greater for *Communication and collaboration* and lower for *Digital content creation* (where DSI requires three activities for *above basic* skills).

Figure 2
Distribution of percentage point differences between DSI 2.0 and EGH recommendations, *above basic skills*, 2021



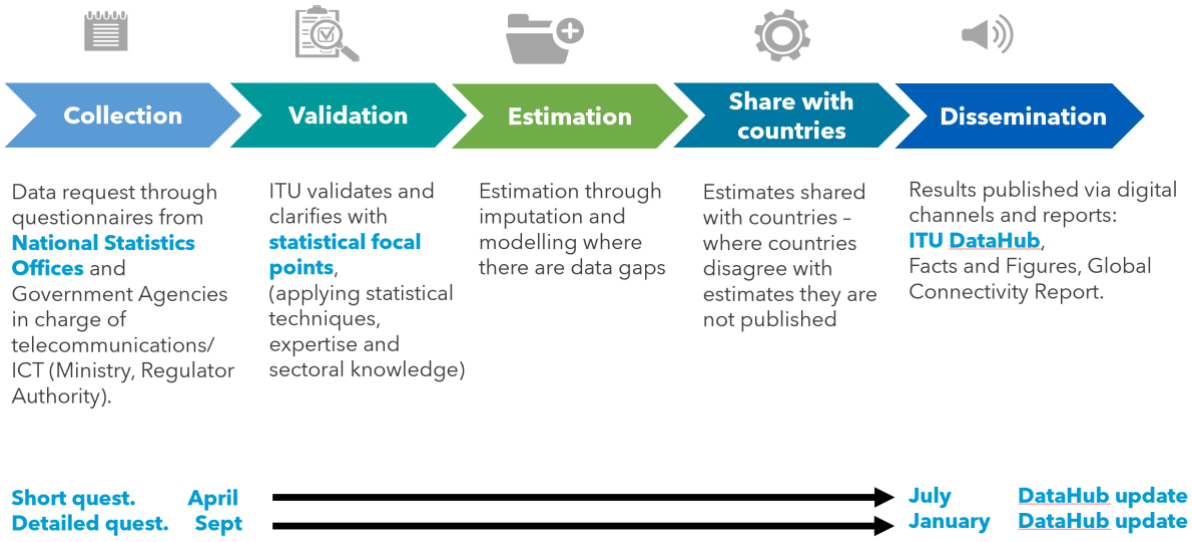
Note: Percentage point differences expressed as (DSI – EGH). The horizontal axis shows the percentage point differences, the black tick marks indicate the differences, the height of the waves indicate the density of the distribution. The red vertical lines mark the group average values.

Annex 3: Preliminary results from ITU household short questionnaire

Background

As part of its normal data collection cycle, ITU sends questionnaires twice a year to countries to collect data. A short questionnaire requesting data on key ICT indicators only (including ICT skills) is sent in March and a detailed questionnaire requesting data on all core indicators as well as socio-economic disaggregations is sent in September (see Figure 3).

Figure 3.
ITU data collection/dissemination cycle

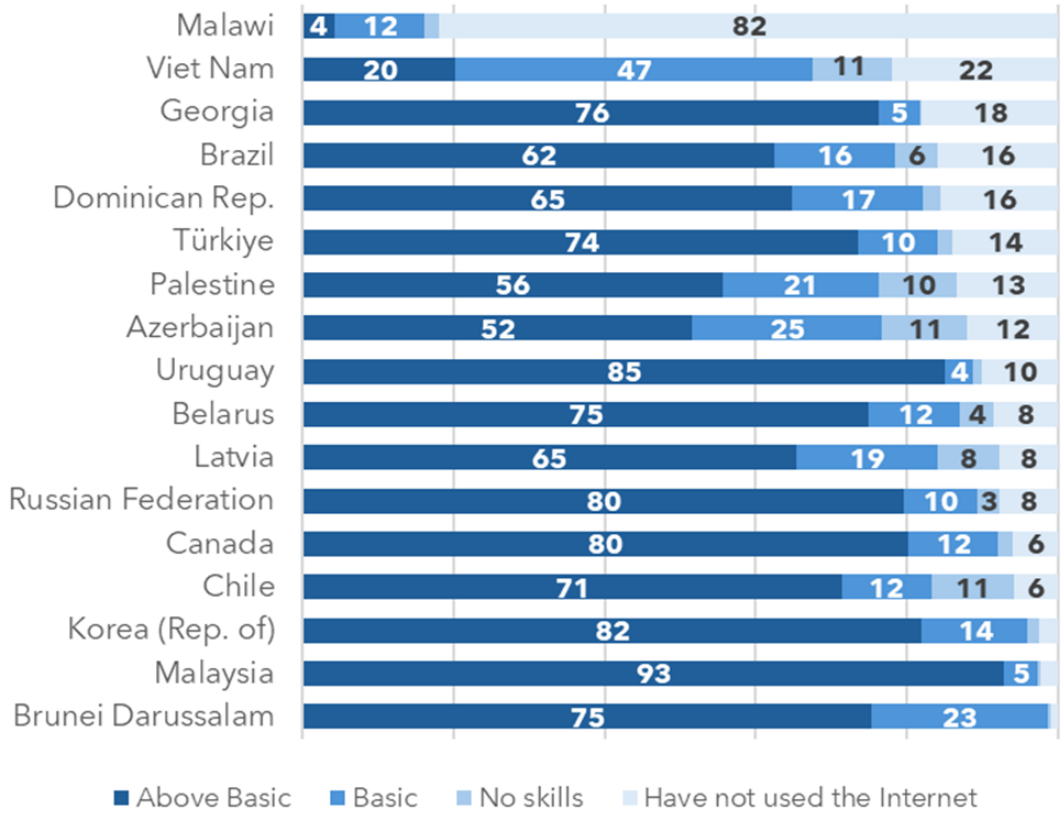


In March 2024, data on aggregates for each skill area were requested for the first time through the ITU short questionnaire. The ITU received and validated data from this questionnaire through June. Of 83 countries submitting questionnaires, 72 provided updated data and 61 provided data on at least one ICT skills indicator. ITU provided documentation of the new EGH recommendations in the questionnaire for calculating ICT skill levels for individuals and provided guidance during the validation process. Ultimately, 40 provided data on skill levels for at least one skill area. 19 were Eurostat countries providing data calculated according to the DSI 2.0 methodology (see Annex 2 for information on comparability between these methods). Results based on the other 21 countries which followed the 2023 EGH recommendations helped to inform the subgroup on how countries can provide these data and are shown below.

Communication and collaboration

Results show that communication and collaboration skills are the most highly developed among individuals using the Internet (Figure 4). In nearly every country, the share of those using the Internet and having no communication and collaboration skills is very low. However, there is much variation between countries. For example, Uruguay reports a high skill level with nearly all Internet users at the above basic skill level. This is somewhat higher than countries with similar levels of Internet use. In Viet Nam on the other hand, Internet use is only slightly lower than the other countries reporting data, but skill level data show knowledge gaps should be addressed.

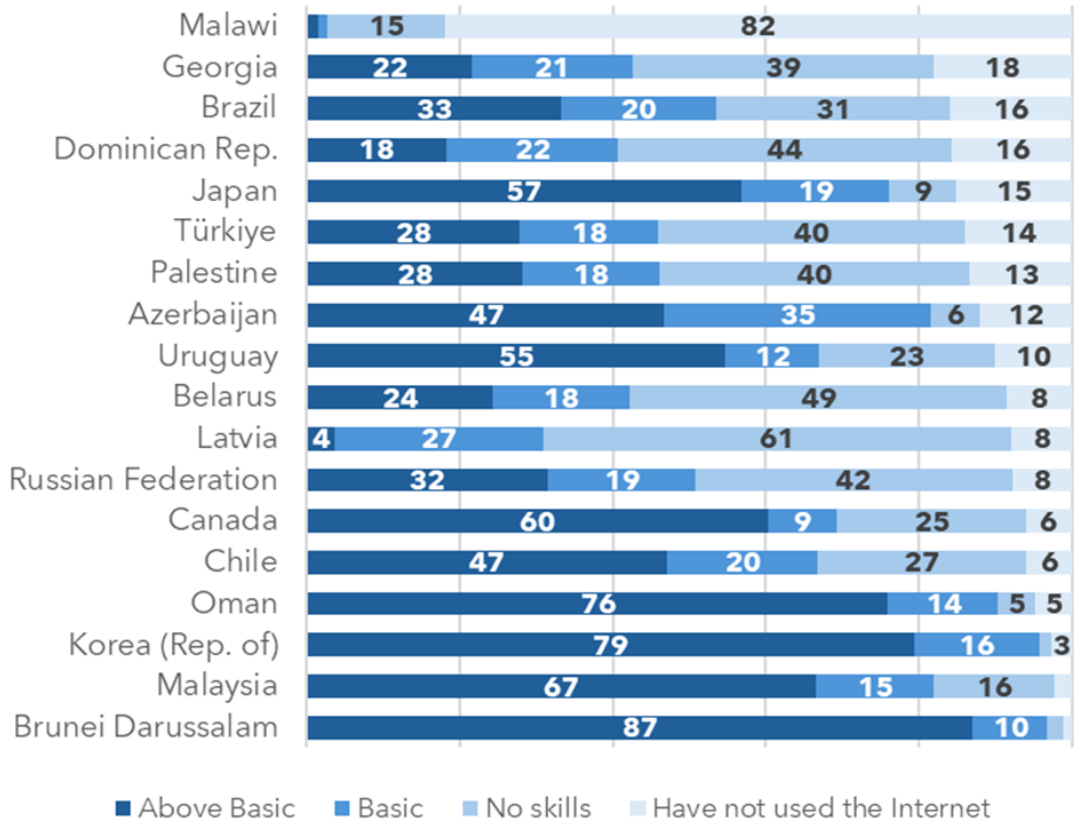
Figure 4.
Share of individuals with ICT Communication and collaboration skills, most recent year 2022 or later



Digital content creation

Digital content creation skill levels are substantially lower and skill levels vary widely among countries with similar levels of Internet use (Figure 5). Notably, there are high skill levels reported among Internet users in the Republic of Korea, Oman, and Brunei Darussalam. In Latvia, low levels of digital content creation skills are reported. This may be an issue with data comparability.

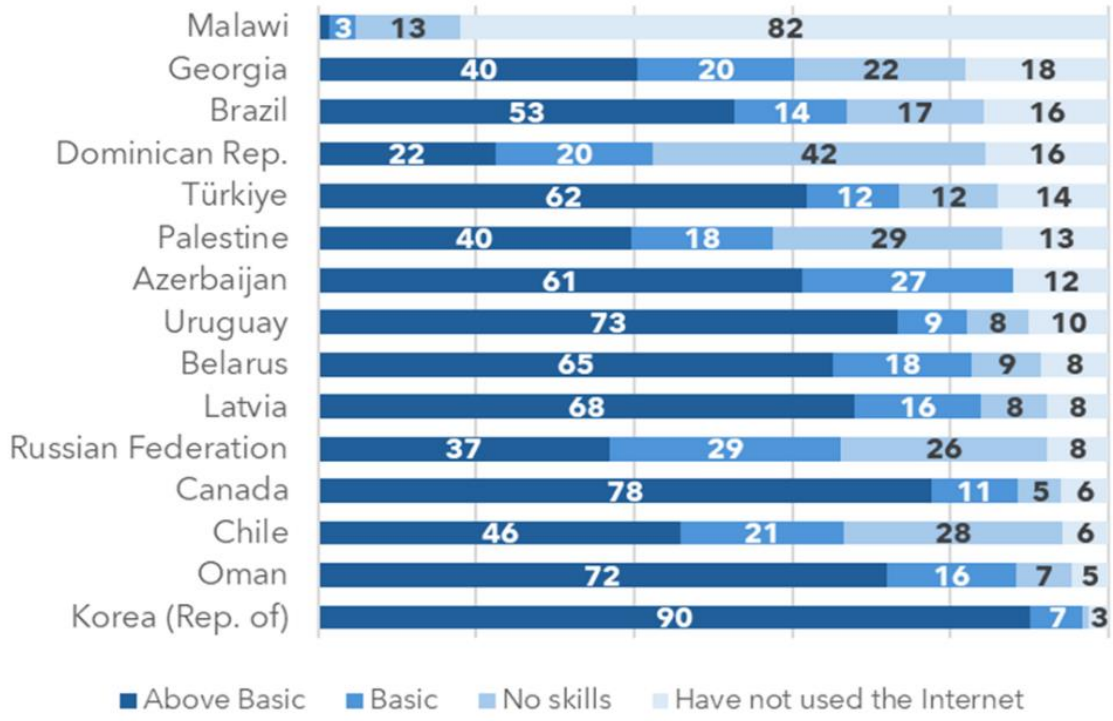
Figure 5.
Share of individuals with ICT Digital content creation skills, most recent year 2022 or later



Information and data literacy

Information and data literacy skill levels are again lower than communication skill levels and again skill levels vary widely among countries with similar levels of Internet use. There are notably high skill levels among Internet users in the Republic of Korea, Canada, and Uruguay. In many other countries the share of individuals with above basic skills is much lower. This demonstrates a need to focus digital skills education on information and data literacy skills in these countries.

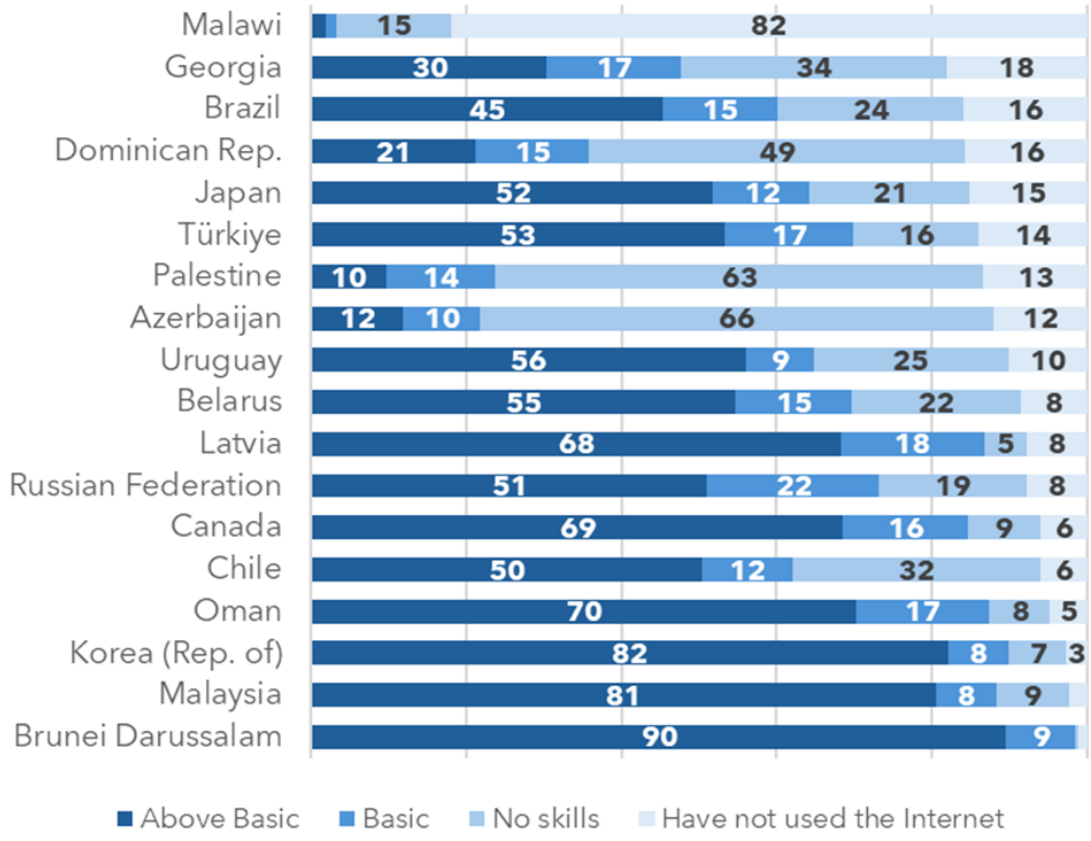
Figure 6.
Share of individuals with ICT Information and data literacy skills, most recent year 2022 or later



Problem solving

Data reported on problem solving skill levels show especially important divides between even countries with similar levels of Internet use (Figure 7). For example, high skill levels are reported among Internet users in the Republic of Korea, Malaysia, and Brunei Darussalam. Conversely, there may be a need to focus digital skills education on problem solving skills in countries like the Dominican Republic, Palestine and Azerbaijan with lower levels of above basic skills.

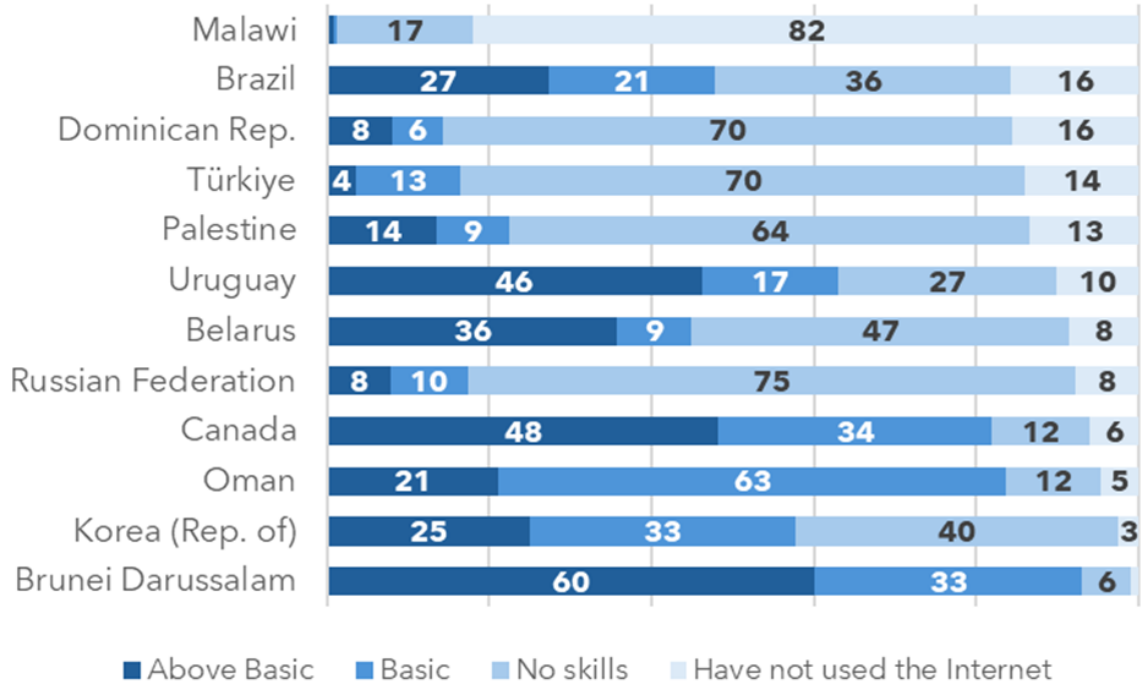
Figure 7.
Share of individuals with ICT Problem solving skills, most recent year 2022 or later



Safety

Reported ICT safety skill levels are the lowest of the skill areas on average (Figure 8). Again, skill levels vary widely among countries with similar levels of Internet use. While high skill levels among Internet users are reported in Canada and Brunei Darussalam there is a clear need to focus digital skills education on safety skills in nearly all countries reporting data.

Figure 8.
Share of individuals with ICT Safety skills, most recent year 2022 or later



Annex 4: Brazil analysis of reduced set of indicators

Introduction

This annex presents an exploration of skills data in Brazil by **Cetic.br/NIC.br** – collected through a survey conducted in 2023 – to understand which of the full spectrum of 22 skill sub-indicators[6] are the most necessary to adequately calculate the aggregate skills indicator by individuals. We do not discuss the conceptual issues related to the list of indicators but present a methodology that could be applied to different countries and to a different list of indicators if a new list is to be selected. In short, the process stablishes the road to collect a small number of essential indicators given a complete agreed-upon list. The exercise is done considering the existing list as the skills indicators to be collected by countries.

The subsequent sections outline the methodology employed, present the findings, and concluding remarks.

Methodology

In 2023 the Brazilian ICT Households Survey collected all 22 indicators listed to calculate the individuals' skills indicators. The list of indicators is shown in Figure 9 below.

[6] Based on 2023 EGH recommendations

Figure 9.
Skills indicators list

Areas and Indicators	Variable Code
Information / data literacy	
1. Verifying the reliability of information	IDL1
2. Getting information about goods or services	IDL2
3. Reading or downloading newspapers, etc	IDL3
4. Seeking health-related information	IDL4
Communication / collaboration	
1. Sending messages (e.g. email, messaging service, SMS) with attached files	ICC1
2. Making calls (Telephoning over the Internet	ICC2
3. Participating in social networks	ICC3
4. Taking part in consultation or voting via Internet	ICC4
Digital content creation	
1. Using copy and paste tools	IDC1
2. Creating electronic presentations	IDC2
3. Using basic arithmetic formula in a spreadsheet	IDC3
4. Writing a computer program	IDC4
5. Editing online text, spreadsheets, presentations	IDC5
6. Uploading self/user-created content	IDC6
Safety	
1. Changing privacy settings	ISF1
2. Setting up effective security measures	ISF2
Problem solving	
1. Finding, downloading, installing and configuring software	IPS1
2. Connecting and installing new devices	IPS2
3. Transferring files or applications between devices	IPS3
4. Electronic financial transactions	IPS4
5. Doing an online course	IPS5
6. Purchasing or ordering goods or services	IPS6

Table 5 and Source: Brazilian ICT Households 2023 survey.

Table *6* shows the results for the aggregate and disaggregate measures:

Table 5.
Proportion of individuals within each skill category (aggregated categories)

Skill Level	Percentage	Confidence interval	
No overall level	11,72	10,55	12,89
Basic level	56,01	53,93	58,08
Above basic level	16,42	14,29	18,55
No Internet use (last 3 months)	15,85	14,65	17,05

Source: Brazilian ICT Households 2023 survey.

Table 6.
Proportion of individuals within each skill category (disaggregated categories)

Skill Level	Percentage	Confidence interval	
No overall level	11,72	10,55	12,89
Limited overall level	8,25	7,49	9,00
Narrow overall level	12,31	10,66	13,95
Low overall level	14,6	13,32	15,88
Basic level	20,85	19,21	22,5
Above basic level	16,42	14,29	18,55
No Internet use (last 3 months)	15,85	14,65	17,05

Source: Brazilian ICT Households 2023 survey.

Based on this classification, we want to identify what is the minimal set of skills sub-indicators needed to reach results as close as possible to those presented in table 1.

To do that, we integrate two different methods:[7]

- Multiple correspondence analysis (MCA).
- Random Forest (RF).

a. Step 1 - Multiple correspondence analysis (MCA)

The MCA[8] method was used to identify for each skills area the variables (indicators) that contributed more to the principal axes of the MCA. The directions of the choice of variables were:

- At least two variables by skill dimension.
- After running the MCA, retain as much axes as to represent more than 85% of the total variability of the respondents.
- For the axes retained, select the variables (indicators) that contributed most for the construction of the axes.

[7] We also tried the use of ordinal linear regression (R Package *survey,* function *svyolr*) but the results were better for the RF. We choose not to present them here to be more concise.
[8] This approach utilizes sampling weights as the only required information when performing MCA on databases with complex sampling designs for R package *FactoMineR* (Lê, Josse, & Husson, 2008).

b. Step 2 – Random Forest (RF)

The RF method was used to estimate the observed overall skill (dependent variable) – based in the indicators selected on Step 1 – reduced set of select indicators (MCA choices). The process was carried out in three steps:

1) Run a RF for disaggregated skills categories considering sampling weights for the whole dataset and evaluate the results.
2) Select 200 samples of the Brazilian ICT Households survey the same way the sample was selected from the population frame [3].
3) For the samples in (2) run the RF (with weights) and evaluate the results.
4) (3) gives results in terms of identifying the empirical confidence intervals for the estimates, cross validating the observed results (avoiding overestimation).

Results

Initially we present the results of MCA. As a reminder, we retained for each skills area the indicators that contributed more to MCA axes that added up to at least 85% of the whole variability of the data – bounded by a minimum of two indicators by dimension.

a. Multiple correspondence analysis (MCA)

The tables below show the contributions of each indicator to each axe for the MAC analysis for all the skill dimensions.

Table 7.
MCA results: Information and Data Literacy

Information and Data Literacy	Factor 1	Factor 2	Factor 3	Factor 4
IDL1	23,8	**44,1**	30,2	1,9
IDL2	**26,2**	20,1	0,9	52,8
IDL3	24,4	10,5	59	6,1
IDL4	25,6	25,2	9,9	39,3
Cumulative Variance	90,5	**94,3**	97,7	100

Source: Brazilian ICT Households 2023 survey.

Table 8.
MCA results: Communication and Collaboration

Communication and Collaboration	Factor 1	Factor 2	Factor 3	Factor 4
ICC1	24,7	0,4	74	0,9
ICC2	32,1	8,3	14,5	45,1
ICC3	**34,3**	5,9	5,7	54
ICC4	8,8	**85,4**	5,8	0,0
Cumulative Variance	90,5	**94,3**	97,7	100

Source: Brazilian ICT Households 2023 survey.

Table 9.
MCA results: Digital content creation

Digital content creation	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
IDC1	**23,2**	0,2	0,0	13,1	5,5	58
IDC2	18,6	18,9	4,0	0,0	34,5	23,9
IDC3	18,7	13,6	9,7	0,0	57,5	0,6
IDC4	6,3	**57,2**	31,1	1,8	0,1	3,6
IDC5	19,1	4,2	5,4	69,5	0,1	1,6
IDC6	14,1	5,9	**49,7**	15,5	2,4	12,3
Cumulative Variance	66,8	78,1	**86,8**	91,8	96,1	100

Source: Brazilian ICT Households 2023 survey.

Table 10.
MCA results: Safety

Safety	Factor 1	Factor 2
ISF1	50,0	50,0
ISF2	50,0	50,0
Cumulative Variance	93,4	100

Source: Brazilian ICT Households 2023 survey.

Table 11.
MCA results: Problem-solving

Problem Solving	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
IPL1	19,2	2,6	1,1	18,1	58,7	0,2
IPL2	11,9	**58**	6,2	22,1	1,7	0,0
IPL3	19,1	0,3	0,6	38,8	36,9	4,2
IPL4	18	23	3,9	15,7	0,8	38,6
IPL5	11,7	0,4	85,9	2,0	0,0	0,0
IPL6	**20,1**	15,6	2,3	3,3	1,9	56,9
Cumulative Variance	82	**88**	93,1	96,1	98,4	100

Source: Brazilian ICT Households 2023 survey.

Based on the results presented on the tables above, 11 of 22 indicators were considered fundamental for the skills variability of the Brazilian respondents' dataset. The indicators retained were: 'IDL1', 'IDL2', 'ICC3', 'ICC4', 'IDC1', 'IDC4', 'IDC6', 'ISF1', 'ISF2', 'IPL2', and 'IPL6'.

b. Random Forest (RF)

Based on the retained indicators, a RF analysis was done for disaggregated categories considering full sample and replications for 200 samples of the ICT Households survey. The results are presented on tables 12 and 13.

Table 12.
Comparing RF prediction with skills indicator for disaggregated categories

Skill Level	Prediction Rate	Confidence interval	
No overall level	95,65%	91,61%	97,69%
Narrow overall level	79,24%	65,88%	84,13%
Low overall level	33,10%	27,95%	43,49%
Limited overall level	64,91%	43,46%	65,04%
Basic level	55,19%	31,47%	56,87%
Above basic level	96,34%	92,21%	98,80%

Source: Brazilian ICT Households 2023 survey.

Table 13.
Comparing RF prediction with skills indicator for aggregated categories

Skill Level	Prediction Rate	Confidence interval	
No overall level	95,65%	91,61%	97,69%
Basic level	86,35%	82,33%	90,06%
Above basic level	96,34%	92,21%	98,80%

Source: Brazilian ICT Households 2023 survey.

While, on one hand, the use of disaggregated categories captures adequately the variation inside "Basic level" users, considering the original 22 skills sub-indicators, this disaggregation is not well captured by the RF modelling of the 11 most "important" indicators. This was expected, since the lower number of indicators considered (almost half of the total number) is an obstacle for correctly classify the inner categories of "Basic level".

On the other hand, the methodology was able to achieve a good estimation for the aggregated classification of skill for the individuals. Table 14 shows the comparison of results.

Table 14.
Comparison between observed skills classification and estimated skills classification

Observed Skill Level	Estimated skill level		
	No overall level	Basic level	Above basic level
No overall level	95,6	4,4	0,0
Basic level	5,3	86,4	8,3
Above basic level	0,0	3,7	96,3

Source: Brazilian ICT Households 2023 survey.

Final remarks

The study showed that, with 11 of 22 indicators, it is possible to reliably estimate the aggregated skills indicator for Brazil. The estimation allows comparison between countries for the aggregated skills level, even for the cases that the sub-indicators selected as the most important in the analysis differ. By following these methods, other countries can replicate the study for their data sets to identify the most critical sub-indicators.

While there are relevant reasons to reduce questionnaire length by analysing the results of studies like this, since the methodologies used are data driven, it is advisable to collect the full set of sub-indicators every three years, at least, for the methodology to be verified and updated.

Annex 5: Canada analysis of reduced set of indicators

Applying Multiple correspondence analysis (MCA) to Canada

To help assess the wider applicability of the minimal set identified for Brazil, Canada replicated the MCA procedure using the 2022 Canadian Internet Use Survey (CIUS). The goals of this analysis were to examine:

- How the minimal set identified for Canada compared with the one identified for Brazil; and
- How the minimal set performed in predicting skill levels in Canada.

Before proceeding to the results of this analysis, it is important to provide a few caveats:

1. In the problem solving (PS) skill area, Canada does not collect "connecting and installing new devices," which was one of the indicators the MCA procedure selected for Brazil. Therefore, it was impossible for MCA to select an identical minimal set for PS for Canada.

2. Canada did not use RF modelling to calculate skill levels using the minimal set. Instead, we used the normal skill area calculation method, but excluded any indicators that weren't selected by MCA. This decision was made since the primary purpose of the minimal set discussion is to determine which indicators are most critical for participating in the existing skill calculations.

3. For the purposes of comparing the performance of the minimal set to the expected skill levels based on the full set, Canada first compared predictions to expectations at the skill area level, resulting in 5 observations per respondent (one per skill area). All observations were then aggregated (using survey weights) to determine the overall rate of successful predictions. We did not use the new formula Brazil created for classifying overall skill levels.

Results

Multiple correspondence analysis (MCA) results

The indicators selected by MCA for Canada were the same as Brazil for information & data literacy (IDL), communication and collaboration (CC), and safety (S), but differed for digital content creation (DCC) and PS. For consistency with Brazil, Canada also selected three indicators for DCC (Table 15).

Table 15.

Indicator	Code	Same as Brazil?
Information & data literacy		
Verifying the reliability of information	IDL1	Yes
Getting information about goods or services	IDL2	Yes

Communication and collaboration		
Participating in social networks	CC3	Yes
Taking part in consultation or voting via Internet	CC4	Yes
Digital content creation		
Writing a computer program	DCC4	Yes
Using online software for editing text, spreadsheets, or presentations[9]	DCC5	No
Uploading self/user-created content	DCC6	Yes
Safety		
Changing privacy settings	S1	Yes
Setting up effective security measures	S2	Yes
Problem solving		
Electronic financial transactions	PS4	No
Doing an online course	PS5	No

Performance of the MCA-selected minimal set

Table 16.

		Expected	
		Basic	**Above basic**
Predicted	**None**	35.3%	2.6%
	Basic	64.7%	57.5%
	Above basic	0%	39.9%

In Table 16, the denominator in each column is the weighted number of cases that scored as "basic" or "above basic" respectively when using the full set of indicators. Overall, the MCA-selected indicators performed poorly; predictions were least accurate for "above basic," with only 39.9% of cases being correctly predicted.

Exploring other potential minimal sets

With the MCA-selected indicators performing poorly, we wanted to explore if other minimal sets could perform better for Canada. By using a program to check all possible combinations (two indicators per skill area), we identified the following minimal set as performing best for Canada (Table 17).

Table 17.

Indicator	Code
Information & data literacy	
Getting information about goods or services	IDL2
Reading or downloading newspapers, etc.	IDL3
Communication and collaboration	
Sending messages (e.g. email, messaging service, SMS) with attached files[10]	CC1
Participating in social network	CC3
Digital content creation	

[9] The CIUS did not specify that this software had to be used over the Internet.
[10] The CIUS did not specify that the messages had to have attachments.

Using copy and paste tools	DCC1
Using online software for editing text, spreadsheets, or presentations[11]	DCC5
Safety	
Changing privacy settings	S1
Setting up effective security measures	S2
Problem solving	
Electronic financial transactions	PS4
Purchasing or ordering goods or services	PS6

Performance of the best-performing minimal set

Table 18.

		Expected	
		Basic	**Above basic**
Predicted	**None**	7.0%	0.1%
	Basic	93.0%	8.9%
	Above basic	0%	91.0%

The best-performing set correctly predicted over 90% of cases for both skill levels, far higher than the MCA-selected set (Table 18).

Final remarks

When using the normal method to compute skill levels, indicators selected by MCA for Canada did not provide accurate predictions. This indicates that in the absence of introducing a new calculation procedure for determining skill levels (e.g., RF modelling), MCA is not a viable method for determining a good minimal set for Canada. However, by verifying the performance of all possible minimal sets, we were able to identify another set that performed much better, demonstrating that it is possible for a minimal set to perform well using the normal calculation method.

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[11] The CIUS did not specify that this software had to be used over the Internet.