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A Global Framework of Reference on Digital Literacy Skills for Indicator 4.4.2

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Introduction

The objective of the Digital Literacy Global Framework (DLGF) project is to develop a methodology that can serve as the foundation for Sustainable Development Goal (SDG) thematic Indicator 4.4.2: "Percentage of youth/adults who have achieved at least a minimum level of proficiency in digital literacy skills".

To achieve this objective, we have built on the European Commission's Digital Competence Framework for Citizens (DigComp 2.0) as the initial framework and conducted four empirical studies to develop the proposed framework:

1) a synthesis of existing regional, national and sub-national frameworks to identify competences relevant for the global context, and in particular, analysing the extent to which existing, well-developed and all-encompassing frameworks would be relevant (i) for all countries, whether economically rich or poor, and (ii) over time;
2) an analysis of digital literacy competences demonstrated in information and communications technology (ICT) use in major socio-economic sectors, with a focus on developing countries;
3) an in-depth consultation to seek expert views on the appropriateness and use of a global framework; and
4) an online consultation to seek experts' feedback on the proposed framework. We have made particular efforts to include examples and expert views from countries in the following regions: Asia, the European Union (EU), high-income.

1. Definitions of digital literacy

The importance of digital literacy is evidenced by the many national and regional efforts to develop and implement digital literacy frameworks and strategic plans to bolster citizens' digital literacy. However, the reasons for countries to adopt and develop frameworks vary. For example, the Republic of Korea intends to enhance the digital literacy of public officials to increase the efficiency, transparency and delivery of services to citizens through public administration (Young, 2016). Oman, on the other hand, adopted the Microsoft Digital Literacy Curriculum to bridge the digital divide, bolster its ICT industry and build young citizens' employment capacity (Sultanate of Oman Information Technology Authority, 2008).

Likewise, definitions for digital literacy also differ. Some consider digital literacy as a new literacy comprising multiple dimensions and represented in new, multimodal social practices. For instance, Ala-Mutka (2011) defined digital literacy for DigComp as an emergent literacy from other literacies and, as such, is greater than the sum of the other literacies, which include information literacy, media literacy, Internet literacy, and computer or ICT literacy (i.e. hardware and software knowledge and skills). Similarly, in Kenya's Basic Education Curriculum Framework, digital literacy encompasses traditional literacies and computer literacy.

The proposed DLGF is intended to serve for monitoring, assessment and further development of digital literacy, taking into consideration different levels of development. Hence, the resulting framework needs to be operationalisable to serve this purpose. In reviewing related frameworks collected from government and non-government agencies, we find that the following notions recurred constantly: "access", "manage", "understand", "integrate", "communicate", "evaluate" and "create". Hence, we propose the following definition for digital literacy:

Digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy and media literacy.

Our observations during the various stages of our empirical work show that there is a general acceptance that competence in digital literacy requires the person to have the necessary *knowledge* and *skills*, but views differ regarding *attitudes*. We hold the view that attitudes are necessary for a person to have the commitment and motivation to achieve competent performance, and should be included in the DLGF.

2. Mapping of ICT and digital literacy frameworks and examples of competences

As mentioned, DigComp 2.0 was selected as the reference digital literacy framework for this project. It has been synthesized from other, major digital literacy frameworks and undergone a long consultation and development process, thus presenting a comprehensive view on competence areas and competences from economically-advanced countries. The DigComp 2.0 framework (Vuorikari et al., 2016) is presented in **Table 1**.

Table 1. DigComp 2.0 competence areas and competences

Competence area	Competences
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 in citizenship through digital technologies 2.4 Collaborating through digital technologies 2.5 Netiquette 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 licenses 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 technologies 5.4 Identifying digital competence gaps

In order to ensure that the proposed global framework is relevant to countries at different levels of development, we began the study with two mapping exercises, one on cross-national and selected national ICT and digital literacy frameworks and the other on digital literacy competences required in use cases of digital technology in some major economic sectors. These are reported in this section.

3.1 Mapping of cross-national and selected national ICT and digital literacy frameworks

We conducted a systematic search for digital literacy frameworks in the targeted regions and countries using country names in combination with search terms, including digital, literacy, competences, skills, ICT, computer and information. A key limitation to the search results is our searches being constrained to information in the English language. Nonetheless, we were able to find information about specific digital literacy frameworks being adopted in 47 countries *(see **Appendix 1**)*. **Table 2** shows the distribution of the 47 countries across geographical regions and the income level of the country according to the World Bank income levels. **Figure 1** presents the geographic locations of the countries for which the frameworks have been collected.

Table 2. Distribution of the 47 countries across geographical regions and income levels

Geographical region	Income level of country				Total
	High	Upper-middle	Lower-middle	Low	
1. Asia	1	3	7		**11**
2. European Union	1	1			**2**
3.High-income countries outside the European Union	2				**2**
4. Latin America	1	4			**5**
5. Middle East and North Africa	4	4	4		**12**
6. Sub-Saharan Africa		4	6	3	**13**
7. Other		1	1		**2**
Total	**9**	**17**	**18**	**3**	**47**

Figure 1. A map of the geographic locations of the countries for which the frameworks have been collected

Note: Some countries have more than one framework belonging to the same framework type. Only one icon is shown for each framework type collected for that country. A limitation of the map generation software is that some icons overlap with each other. Appendix 1 provides an accurate list of the distribution of frameworks analysed across countries.

There are several important observations based on an examination of the collected frameworks listed in Appendix 1:

1. The framework information we have collected are not exhaustive of those adopted in these 47 countries.
2. In a number of cases, the countries have multiple frameworks in use, likely for different purposes.
3. There are two types of frameworks, frameworks developed at the national or sub-national level and frameworks adopted from the training courses and assessment frameworks used by commercial enterprises. It should be noted that the enterprise frameworks do not have an official status as a national framework. However, these are often adopted by national entities (e.g. Colombian police force) for the purpose of human resource development and qualification requirements for jobs.
4. 11 countries have developed their own national frameworks, and of these 7 have in addition adopted enterprise frameworks. On the other hand, 36 of the sampled countries have only adopted enterprise frameworks.
5. We found a total of three different enterprise frameworks adopted by the 43 countries that use them, in decreasing order of popularity:
    a. International Computer Drivers Licence (ICDL)[1]—adopted in 31 countries;
    b. Certiport Internet and Computing Core Certification (IC³)[2]—adopted in 13 countries; and
    c. Microsoft Digital Literacy Standard Curriculum[3]—adopted in 11 countries.
6. Some countries adopt multiple enterprise frameworks, nine having adopted two (Colombia, Egypt, Indonesia, Oman, Qatar, Rwanda, South Africa, Thailand, United Arab Emirates (UAE)) and two having adopted all three frameworks (Malaysia and Viet Nam).

Our findings thus show that multinational commercial enterprises have a major role in influencing the digital literacy competences that are being taught and assessed, particularly in developing countries. The enterprise courses and examinations are sometimes delivered by international organizations or businesses, and sometimes by national providers in collaboration with them.

While the content coverage found in the digital literacy frameworks varies, there are generally five types of content: purpose of the framework, competence areas and competences, learning domains (such as knowledge, skills and attitudes), how the tasks are to be performed and the digital tools to be used. In proceeding further to map the frameworks to competence areas and competences, we find that the language used in some of the frameworks are too general to warrant accurate mapping.

We have selected six of the national frameworks (Costa Rica, India, Kenya, Philippines, Chile and British Columbia (Canada)) that are most clearly written with regard to the competency areas, as well as the three enterprise frameworks to map against the DigComp 2.0 framework. The salient features of these nine frameworks are presented through fact sheets, which can be found in **Appendix 2a to 2i**.

[1] https://icdl.org/
[2] https://certiport.pearsonvue.com/Certifications/IC3/Digital-Literacy-Certification/Overview
[3] https://www.microsoft.com/en-us/digitalliteracy/overview.aspx

In conducting the mapping, we have adopted a low-inference approach to reduce the researcher's subjective judgement. Under this principle, when the source framework and DigComp use the exact same words, a direct 1:1 mapping was performed. For competences in source documents that do not use words found in the DigComp framework, a codebook was developed to manage and organize synonymous words to code competences. In cases where the source document description of a competence is so general that it can be interpreted to map onto more than one competence, these are not mapped based on the low-inference principle.

In the mapping process, we have identified two areas of digital literacy competences that may not most appropriately capture the contexts and concerns reflected in the frameworks if the mapping were to be confined only to those competence areas and competences in the DigComp framework:

1. *Devices and software operations (CA0)*—This relates to basic operations of the digital devices, such as turning them on and off, understanding basic concepts of hardware and software, and operations on a graphical user interface.
2. *Career-related competences (CA6)*—These refer to competences in the use of digital technologies that are important productivity tools for particular business sectors. Examples include competences in using Learning Management Systems for teachers, computer-aided design (CAD) and computer-aided manufacturing (CAM) applications for architects, engineers and construction workers, health information systems for medical practitioners, and social media for marketing professionals. Career-related competences are included in two of the three enterprise frameworks, the ICDL and the Microsoft Digital Literacy Standard Curriculum.

These two competence areas, labeled as 0 and 6, are defined in **Appendix 3** and added to the DigComp framework for the mapping exercise. In conducting the mapping, each statement/description of competences in the framework are mapped (coded) to one of the competences in the extended framework. **Table 3** presents the results of the mapping exercise.

3.2 Differences in mapped competences across frameworks

The results show that competences related CA0 is referenced in all except one of the frameworks, while CA6 is referenced in one of the national and two of the enterprise frameworks. Table 3 also reveals that the three enterprise frameworks have similar coverage of competences, but there is a much wider diversity in national frameworks. The diversities in coverage reflect the very different nature of these frameworks. The three enterprise frameworks serve relatively similar purposes in framing the courses and certification programmes that they offer. The narrowest coverage is found in the national frameworks from Chile and India, both of which are used as guides for high-stake examinations on digital literacy. The other four national frameworks serve as guides for K-12 curricula development and hence include more specific descriptions of competences.

Nonetheless, as there are many other contextual and cultural factors influencing the implementation of curriculum frameworks, it is not possible to conclude that these frameworks are comparable in terms of their execution or impact. Furthermore, there is no evidence that the competences included in the national frameworks differ on the basis of the country's economic development. Hence, based on the mapping results, one would not be able to get much insight about the possible differences in terms of the relative importance of the various competences.

Table 3. Mapping of selected digital literacy frameworks onto the extended DigComp framework

Digital literacy frameworks	0	1	1.1	1.2	1.3	2	2.1	2.2	2.3	2.4	2.5	2.6	3	3.1	3.2	3.3	3.4	4	4.1	4.2	4.3	4.4	5	5.1	5.2	5.3	5.4	6	Total
Kenya Basic Education Curriculum Framework	5			2		4			3					5		2	3			2			2			2	2	6	**38**
Philippines ALS-K to 12 LS 6	7		19	1	6		3	4		1	4	2		19	4	3		4	1	6	5					3	6		**98**
India Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA)	1		4		2	1	1	1	1					1															**12**
Costa Rica Student Performance Standards in Digital Technology-enhanced Learning	15		4	4	4		4	6	1	10	5			11		1	10	8	3	2	1			1	1	3	13		**107**
Chile SIMCE TIC Matrix of ICT Skills for Learning			2	2	2		1								3	1				1	1						1		**14**
British Columbia Digital Literacy Framework	8	1	13	4	1	5	3	2	4	2	7	5		6	3	5	4	1	3	4	8	1	4	5	2	3	2		**106**
IC3 Global Standard 5	16		16	1	14		5	3			2	1		14	2	1	1	1	5	4	3			1		1	3		**94**
ICDL Competences	21		22	5	19	1	5	2		4	3	1		41	10	2	3	2	8	6	3	1				2	12	4	**177**
Microsoft Digital Literacy Standard Curriculum Version 4	15		13	1	5		1				1			10	3	1			5	2	1						7	2	**67**
Total no. of instances mapped	**88**	**1**	**93**	**20**	**53**	**11**	**23**	**18**	**9**	**17**	**22**	**9**	**0**	**107**	**25**	**16**	**21**	**16**	**25**	**27**	**22**	**2**	**6**	**7**	**3**	**14**	**46**	**12**	

Note: Underscored competence areas (0 and 6) are proposed additions to the existing DigComp 2.0 competence areas and competences.

3.3 Relative importance of the different competences

The numbers in each cell in Table 3 represent the number of discrete performance standards/ objectives/learning outcomes/skills in the given framework coded to one of the specific competences. A comparison of the frequency of coverage across competences shows the most popularly-valued competences to be hardware and software operations (CA0), information and data literacy (CA1), interacting through digital technologies (competence 2.1 or C2.1 for short), developing digital content (C3.1), copyright and licenses (C3.3), protecting personal data and privacy (C4.2), and identifying digital competence gaps (C5.4). Each of these competences are included in eight of the nine frameworks. In particular, it is observed that *developing digital content* (C3.1, N=107) and *browsing, searching and filtering data, information and digital content* (C1.1, N=93) have the highest number of specific mappings, most of which are contributed by the three enterprise frameworks. These are technical competence for individuals working with productivity software most often done on a desktop.

The least-mapped competences are *protecting the environment* (C4.4, N=2) and *identifying needs and technological responses* (C5.2, N=3). Within the communications and collaboration area, *engaging in citizenship through digital technologies* (C2.3, N=9) is the least mapped. These indicate that the competences associated with broader social concerns and higher levels of problem-solving receive lower attention and are less specified compared to basic technical skills.

3.4 Proficiency levels and assessment

The DigComp 1.0 competence framework proposed three proficiency levels, which was later expanded to eight proficiency levels in DigComp 2.1 (DigComp 2.1 contains no conceptual updates to DigComp 2.0 competence areas and competences but it includes updates to proficiency levels and examples of use), defined systematically and accompanied by examples. However, none of the digital literacy frameworks we collected provide such comprehensive proficiency level descriptions. In frameworks that serve as the basis for K-12 curriculum development, grade levels in formal schooling are often used as proxies for defining proficiency levels. Other frameworks may use broad descriptors such as initial, intermediate and advanced (e.g. in the Chilean SIMCE TIC framework).

4. Mapping of digital literacy competences in examples of digital technology use

To provide meaningful guidelines for the provision of training, monitoring and assessment of digital literacy associated with employment, decent jobs and entrepreneurship in disparate contextual settings, we were inspired by the examples for employment and learning found in the DigComp 2.1 framework, which are grounded in specific contexts. We have decided to gather an additional form of empirical input to inform the digital literacy framework development: collecting examples of digital literacy use in everyday contexts in a wide range of countries outside of Europe, particularly those within the specified geographical regions.

Our examples were selected from six sectors: four are major economic and/or employment sectors (agriculture, energy, finance and transportation) that are important in low-income countries, and two involve technology use for empowerment of communities suffering from systemic economic, social and political vulnerabilities (low-skilled and low-literate women in poor communities and displaced populations such as refugees).

4.1 Methodology for searching and selecting examples

We used search engines to identify examples through news and media reports in the six sectors in low- and middle-income countries. Two kinds of systematic searches were carried out:

- Google searches for mainstream media and government websites in the English language; and
- YouTube searches for videos in any language.

Often, initial results were followed by a snowball process to search for further information from associated sources such as App store pages and company websites. Selection criteria for the use cases to be included in the competence mapping process are the clarity and richness of information available in English about the case.

The initial round of search resulted in a total of 59 examples of use from countries outside Europe, covering all World Bank national income classifications (high-, upper-middle-, lower-middle- and low-income countries), with priority given to examples from lower-middle- and low-income countries *(see **Appendix 4** for details).* From these, we further selected 20 that have sufficiently detailed information for mapping onto the extended DigComp digital literacy competences. These 20 examples *(see **Table 4**)* come from 14 countries in four regions (Asia, Latin America, Middle East and North Africa, and sub-Saharan Africa). While each use case is listed with a country based on the search results, the type of scenarios is not necessarily confined to a particular country. For example, GoFundMe operates in many countries, even though the use case we found was for supporting agricultural developments in Somalia.

Table 4. List of the 20 use cases selected for mapping on to DigComp competences

Region	National income	Country	Example	Sector
Asia	High	China, Hong Kong	Android Pay / Apple Pay	Finance
	High	Singapore	Grab / Grab Pay	Finance; transport
	Lower-middle	India	IFFCO Kisan	Agriculture
	Lower-middle	India	RML Farmer	Agriculture
	Lower-middle	India	RML Trader	Agriculture
	Lower-middle	Indonesia	Go-Jeck	Finance; transport
	Lower-middle	Pakistan	Easypaisa	Finance
	Lower-middle	Philippines	FarmHelp	Agriculture
	Upper-middle	China	Alipay / Tenpay	Finance
Latin America	Low	Haiti	MonCash	Finance
Middle East and North Africa	Lower-middle	Syrian Arab Rep.	Gherbtna	Migration
	Lower-middle	Syrian Arab Rep.	Tarjemly Live	Migration
Sub-Saharan Africa	Low	Rwanda	Tigo Cash	Finance
	Low	Somalia	GoFundMe	Finance
	Low	Somalia	Whatsapp	Finance
	Lower-middle	Kenya	M-Farm	Agriculture
	Lower-middle	Kenya	M-Kopa	Energy
	Lower-middle	Kenya	M-Pesa	Finance
	Lower-middle	Nigeria	Arnergy	Energy
	Lower-middle	Zambia	3-2-1 Service	Empowerment

To more easily understand the convergence of geography and sectors, we graphically present these examples on Google Maps in Figure 2. Examples of use are shown by country and by sector.

Figure 2. A map of the geographic locations of the examples of digital literacy use identified by sector and country

Note: Only one icon is shown where countries have more than one example of digital literacy use in the same sector. Due to the limitation of the map generation software, some icons on the map overlap with each other. Table 4 provides the full list of all examples collected and the respective sectors to which they belong.

The mapping of examples of use to DigComp competences is more complex compared to the mapping of the digital literacy frameworks, comprising of two processes. First, we have to identify the operations that the user may need to perform in the task. For example, in using mobile phone or smart phones for agriculture-related tasks and operations, there are 10 types of functions that the user needs to master:

1. Turn on/off and charge the device
2. Send and receive text messages
3. Set or change App language
4. Share location data
5. Create a public profile
6. Search for, choose, download and approve privacy policy of an application
7. Intra-app finance transactions
8. Search for goods and services and compare price information
9. Buyer and seller interaction
10. Top up account through an agent.

The 15 functions identified in the 20 use cases *(see **Appendix 5**)* fall into two categories:

1) general functions such as turning on/off and charging the device, sending and receiving text messages, searching for goods and services, and comparing price information; and
2) financial transactions such as topping up one's account through an agent.

It should be pointed out that there are differences in the specific functions that are found to be operating in the six sectors *(see **Appendix 6**).* It should also be pointed out that the above list of functions does not cover all uses in the six sectors we mapped. For example, there are cases of migrants learning to programme and create media products, and women with low levels of literacy learning to build structures, such as toilets, from watching instructional videos. We have not included these due to a lack of details. The purpose of the current mapping exercise is to demonstrate the methodology rather than to achieve exhaustive coverage, which is not possible.

One important observation is that all of the examples can be completed using a phone or a tablet. They do not require the use of a computer but require a network-enabled device, which can be a mobile phone or a smartphone connected to the Internet. Furthermore, the digital literacy competence levels required for achieving the same function depend on the specific devices used. For example, the process of searching for goods and services in order to compare prices differ greatly depending on whether a mobile phone or a smartphone is used. In mapping the same function on these two types of devices, we find that, even though the type of competence is the same, the range of operations available on an application designed for the smartphone is much wider, and consequently, the understanding of the competence and the proficiency level required on a smartphone can be higher.

We observe in developing countries a wide gap between digital literacy assessment practices and how digital literacy competence is exhibited in the examples we collected. Assessments conducted by the three enterprise frameworks and in the context of some national frameworks (e.g. Chile and India) use standalone desktop computers, while everyday use scenarios requiring digital literacy competence, particularly those in developing countries, use almost exclusively mobile devices. Desktop computers are primarily used for workplace productivity, often in the context of white-collar jobs. The most popular devices that are used by the majority of adults are mobile devices, such as mobile phones, smart phones, and tablets. Furthermore, irrespective of the device used, non-networked devices have very limited uses for everyday purposes, except in schools and training institutions.

The mapping of the examples to DigComp 2.0 competences listed in Table 1 (extended by an additional competence area, labelled as "0" for devices and software operations) was carried out for the 15 types of functions identified in the 20 cases *(see Appendix 5).* The full results of the mapping are presented in **Appendix 7**. While large differences do not exist in digital literacy skills through everyday transactions using a mobile phone which has no Internet connectivity, important differences do exist between mobile phone and smart phone users that have implications for digital literacy: smart phone users can demonstrate three competences in digital operations which are not available to mobile phone users *(see Appendix 7).*

Another important finding is that, irrespective of the kind of device used, the functions required of users only covered 16 of the 22 competences listed. The six "missing" DigComp competences are also identified in some of the digital literacy frameworks we mapped *(see Table 3),* including the U.S. National Educational Technology Standard (ISTE, 2016). The absence of these six competences in this mapping exercise suggests that they are not necessary or useful in everyday operations in a wide range of economic and developmental contexts. Furthermore, basic technical and interactive competences seem more necessary, and adding a competence area on devices and software operations indicates the importance of this area outside of developed countries. Ultimately, we find that the technology and infrastructure available, as well as the sector, determine the digital literacy competences and proficiency levels that are important for that context.

5. Pathways for digital literacy development and assessment: An example application of a Digital Literacy Global Framework

In developing the draft Digital Literacy Global Framework (DLGF) and in mapping the examples, the project team found that the specific digital literacy competences and proficiency levels that are important depend on their specific country and economic sector contexts. The opportunities for a person to develop his/her digital competences also depend on their particular context. Nonetheless, in order to advance the use of digital technology to enhance social and economic development, the necessary infrastructure and access need to be available in the community, in addition to the individual having the required level of digital literacy.

Hence, in order that the DLGF can be a useful resource to guide digital literacy development and assessment for diverse country and sector contexts, the project team has developed a *pathway mapping methodology* to guide countries, sectors, groups and individuals to develop strategies and plans for advancing their own digital literacy development goals and pathways. A pathway for digital literacy development can be developed through comparing case examples for specific targeted contexts to identify the difference in digital literacy competences required for acceptable performance between the popular current use and the

use scenario to aspire to. Using this mapping methodology, stakeholders at different levels of the system in different country/sector/personal contexts can customise their own digital literacy development plan.

We propose that designing curricula and assessments around case examples may be a more effective approach to address different country contexts. Defining digital literacy levels and assessments at the practical level by case examples, and not at the conceptual level in frameworks, results in a non-linear and contextualised approach.

Appendix 8 presents a detailed pathway mapping methodology and includes two sample pathways based on agriculture *(see **Appendix 9**)* and e-government *(see **Appendix 10**)*. Each pathway comprises competences and contexts using examples for countries at different levels of development. A pathway may involve more than one technology type or sector, which shows how digital literacy competences for employment, decent jobs and entrepreneurship are closely linked with a set of inter-related sectors and technologies. We find three possible types of progression in competences in such pathways: i) increasing the proficiency level for acceptable performance within the same competence where more sophisticated digital devices or software systems are used; ii) the development of new competences; and iii) changes in the relative importance of specific competences due to changes in application areas or technology advances.

6. Rounds of consultation leading to a proposal for a Digital Literacy Global Framework skills

Based on findings from the two mapping exercises reported above, we then conducted two consultation stages to arrive at a final proposal for the DLGF. **Appendix 11** summarises the proposed DLGF we used for the in-depth consultation. The resulting, modified framework used in the online consultation is presented in **Appendix 12**. Detailed methodological notes for both consultation stages can be found in **Appendix 13**, and detailed findings from the analysis of the in-depth consultation and the online consultation can be found in **Appendices 14** and **15** respectively.

6.1 In-depth consultation methodology

The first stage consisted of an in-depth consultation with digital literacy experts to validate the draft DLGF *(see Appendix 11)*, which was an extension of DigComp 2.0 based on the two mapping exercises reported earlier. As DigComp is a framework developed to serve the needs of countries in Europe which are economically developed, it is important that the final proposed framework covers countries at all levels of development. During the in-depth consultation, experts were invited to review the draft executive summary of the DLGF *(see **Appendix 16**),* followed by an online interview *(see **Appendix 17**)* to seek their feedback on the relevance of digital literacy in their local contexts and the suitability of the proposed DLGF.

Of the 97 invited participants, 15 experts completed the consultation, representing a coverage of at least two countries from each six regions: Africa, Asia, the European Union, high-income nations outside of the European Union, Latin America, and the Middle East and North Africa *(information about these 15 experts can be found in **Appendix 18**.)* The interviews with the experts were transcribed and analysed to address the research questions about the relevance of digital literacy and frameworks in the expert's context, specific comments on the suitability and comprehensiveness of the proposed DLGF, as well as comments on the usefulness and operationalisability of the proposed pathways mapping methodology.

6.2 In-depth consultation findings

The interviewed experts generally welcomed the development of a DLGF. Also there is general agreement about the relevance of competence areas in the DigComp 2.0 framework. However, responses towards CA0 (hardware and software) varied, some experts considered it irrelevant or redundant, while others saw its value in the immediate and medium term within their own contexts. CA6 (career-related competences) was considered too specialised by some experts although not much feedback was received on this point possibly due to it not being initially specified in the DLGF consultation document.

A lot of useful feedback was received through the interviews. An expert in the European Union recommended making the language of the proposed competence areas and competences more consistent with the language used in DigComp by removing references to proficiency levels and specific digital technologies and making use of Bloom's taxonomy action verbs in the descriptions. Following this advice, competences in the relevant specialised field were included in CA6 and the labels and competences for CAs 0 and 6 were rewritten to align with the DigComp style.

When asked if there were any missing digital literacy competences to be added to the framework, the most cited missing competence (n=3) was computational thinking, which has increasingly gained wide global attention. While some may consider computational thinking to be part of programming (competence 3.4), most of the current focus is on algorithmic thinking as an integral part of problem-solving competences in the digital world and not necessarily involving programming in specific computer languages. After discussions with experts, the project team decided to add computational thinking to the proposed framework as competence 5.5 for the online consultation.

The experts considered the proposed pathway mapping methodology to be helpful to their countries and sectors in identifying pathways for digital literacy development most suited to specific contexts and needs. They provided further examples of digital literacy applications in education, finance and e-government. They also foresaw difficulties and opportunities in implementing the pathway mapping methodology. While recognising the relevance of this methodology for high-income/urban contexts and small state contexts alike, its usefulness depends very much on the relevance and credibility of the case examples. Therefore, for the purpose of the online consultation stage, an illustrative digital literacy pathway for e-government using a case example contributed by experts from Mauritius was added as a more relevant pathway for urban and high-income contexts.

6.3 Online consultation methodology

The second consultation stage was conducted as an online survey to solicit input from a larger number of stakeholders from different countries. For the online consultation, respondents were asked to review a short video presentation[4] on the proposed DLGF before completing a 22-item survey *(see **Appendix 19**)* on the competence areas and competences in the proposed DLGF, the pathway mapping methodology and background information about the respondent. To facilitate continuity and continued partnership in the validation process, experts invited to the in-depth consultation were also invited to the online consultation. To reach a broader group of stakeholders, the online consultation was promoted through social media and

[4] https://youtu.be/2OG4teOvtDA

research information management systems (RIMs). The survey was open from 8 March 2018 to 8 April 2018 and received 31 complete responses. The list of participants in the online consultation is found in **Appendix 20**. To capture and analyse diverse contexts, experts were categorised according to geographical region and country income level. The profile of respondents according to World Bank income classifications is as follows:

- High-income countries: 12
- Upper-middle-income countries: 9
- Lower-middle-income countries: 2
- Multinational, multi-income (either international or listed affiliation with more than one country and the countries are in different income groups): 8

The profile of respondents according to geographic regions is:

- Africa: 3
- Asia: 7
- European Union (including Central Asia and former Soviet Union): 7
- Latin America: 4
- Multi-region (listed affiliation with countries in more than one region): 8
- N/A (Australia and unclassified): 2

6.4 Online consultation findings

The online consultation survey results indicate that a majority of respondents agreed or strongly agreed that all of the proposed competence areas and competences should be included in the DLGF, including the proposed additional competence areas CA0 and CA6, and their competences. Out of the seven proposed competence areas, CA6 received the least support.[5] All of the lower-middle-income country respondents either agreed or strongly agreed to the inclusion of both CA0 and CA6. All disagreement or strong disagreement came from respondents in high-income or multi-national or multi-income, multi-country contexts. Based on the open-ended survey responses received, we changed the label of competence 0.2 to clarify the focus on software, and we use the more contemporary term “devices” to replace “hardware” in the labels of CA0, competences 0.1 and 0.2.

With regard to the proposed addition of competence 5.5, computational thinking, 45% and 26% of respondents respectively strongly agreed and agreed with the importance of its inclusion in the DLGF. All lower-middle-income country respondents (n=2) strongly agreed. All disagreement (n=4) came from respondents in high-income (n=3) or upper-middle-income (n=1) countries. The open-ended survey responses show that opposition to the inclusion of computational thinking was associated with the respondent’s view that this is already included in competence 3.4 on programming.

[5] 21 out of 31 responses either agreed or strongly agreed with the importance of the inclusion of CA6 and its competences in the DLGF.

16% and 61% of respondents respectively strongly agreed and agreed to the statement that the pathway mapping methodology provides a useful method to make use of the DLGF in a local or national context. However, only 10% and 42% of respondents strongly agreed and agreed respectively to the statement that the steps are easy to follow. The open-ended responses reveal that the small number of contexts presented in the examples limited the respondent's ability to fully understand the pathway mapping methodology.

6.5 Summary

Based on the findings from both the in-depth and online consultations, the project team proposes a final version of the DLGF to the UIS for consideration. The proposed framework is summarised in **Table 5**, followed by a description of the competence areas and competences to add to what is currently covered in DigComp 2.0.

Table 5. Proposed competence areas and competences for the Digital Literacy Global Framework

Competence areas and competences	Description
0. Devices and software operations**	To identify and use hardware tools and technologies. To identify data, information and digital content needed to operate software tools and technologies.
0.1 Physical operations of digital devices**	To identify and use the functions and features of the hardware tools and technologies.
0.2 Software operations in digital devices**	To know and understand the data, information and/or digital content that are needed to operate software tools and technologies.
1. Information and data literacy	To articulate information needs, to locate and retrieve digital data, information and content. To judge the relevance of the source and its content. To store, manage and organise digital data, information and content.
1.1 Browsing, searching and filtering data, information and digital content	To articulate information needs, to search for data, information and content in digital environments, to access them and to navigate between them. To create and update personal search strategies.
1.2 Evaluating data, information and digital content	To analyse, compare and critically evaluate the credibility and reliability of sources of data, information and digital content. To analyse, interpret and critically evaluate the data, information and digital content.
1.3 Managing data, information and digital content	To organise, store and retrieve data, information and content in digital environments. To organise and process them in a structured environment.
2. Communication and collaboration	To interact, communicate and collaborate through digital technologies while being aware of cultural and generational diversity. To participate in society through public and private digital services and participatory citizenship. To manage one's digital identity and reputation.
2.1 Interacting through digital technologies	To interact through a variety of digital technologies and to understand appropriate digital communication means for a given context.
2.2 Sharing through digital technologies	To share data, information and digital content with others through appropriate digital technologies. To act as an intermediary, to know about referencing and attribution practices.
2.3 Engaging in citizenship through digital technologies	To participate in society through the use of public and private digital services. To seek opportunities for self-empowerment and for participatory citizenship through appropriate digital technologies.
2.4 Collaborating through digital technologies	To use digital tools and technologies for collaborative processes and for co-construction and co-creation of resources and knowledge.

Competence areas and competences	Description
2.5 Netiquette	To be aware of behavioural norms and know-how while using digital technologies and interacting in digital environments. To adapt communication strategies to the specific audience and to be aware of cultural and generational diversity in digital environments.
2.6 Managing digital identity	To create and manage one or multiple digital identities, to be able to protect one's own reputation, to deal with the data that one produces through several digital tools, environments and services.
3. Digital content creation	To create and edit digital content. To improve and integrate information and content into an existing body of knowledge while understanding how copyright and licenses are to be applied. To know how to give understandable instructions for a computer system.
3.1 Developing digital content	To create and edit digital content in different formats, to express oneself through digital means.
3.2 Integrating and re-elaborating digital content	To modify, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant content and knowledge.
3.3 Copyright and licences	To understand how copyright and licences apply to data, information and digital content.
3.4 Programming	To plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.
4. Safety	To protect devices, content, personal data and privacy in digital environments. To protect physical and psychological health, and to be aware of digital technologies for social well-being and social inclusion. To be aware of the environmental impact of digital technologies and their use.
4.1 Protecting devices	To protect devices and digital content, and to understand risks and threats in digital environments. To know about safety and security measures and to have due regard to reliability and privacy.
4.2 Protecting personal data and privacy	To protect personal data and privacy in digital environments. To understand how to use and share personally identifiable information while being able to protect oneself and others from damages. To understand that digital services use a “Privacy policy” to inform how personal data is used.
4.3 Protecting health and well-being	To be able to avoid health-risks and threats to physical and psychological well-being while using digital technologies. To be able to protect oneself and others from possible dangers in digital environments (e.g. cyber bullying). To be aware of digital technologies for social well-being and social inclusion.
4.4 Protecting the environment	To be aware of the environmental impact of digital technologies and their use.

Competence areas and competences	Description
5. Problem-solving	To identify needs and problems and to resolve conceptual problems and problem situations in digital environments. To use digital tools to innovate processes and products. To keep up to date with the digital evolution.
5.1 Solving technical problems	To identify technical problems when operating devices and using digital environments, and to solve them (from trouble-shooting to solving more complex problems).
5.2 Identifying needs and technological responses	To assess needs and to identify, evaluate, select and use digital tools and possible technological responses to solve them. To adjust and customise digital environments to personal needs (e.g. accessibility).
5.3 Creatively using digital technologies	To use digital tools and technologies to create knowledge and to innovate processes and products. To engage individually and collectively in cognitive processing to understand and resolve conceptual problems and problem situations in digital environments.
5.4 Identifying digital competence gaps	To understand where one's own digital competence needs to be improved or updated. To be able to support others with their digital competence development. To seek opportunities for self-development and to keep up-to-date with the digital evolution.
5.5 Computational thinking**	To process a computable problem into sequential and logical steps as a solution for human and computer systems.
6. Career-related competences**	To operate specialised digital technologies and to understand, analyse and evaluate specialised data, information and digital content for a particular field.
6.1 Operating specialised digital technologies for a particular field**	To identify and use specialised digital tools and technologies for a particular field.
6.2 Interpreting and manipulating data, information and digital content for a particular field**	To understand, analyse and evaluate specialised data, information and digital content for a particular field within a digital environment.

Note: In the competence areas and competences column, text in bold indicates competence areas and plain text indicates competences.

** Added competence areas and competences which are not in the DigComp 2.0 framework.

i) Competence area 0 - Devices and software operations

Results from the consultation showed general agreement that a digital literacy framework should include competences needed for basic operations of devices and software, particularly in the context of low-income and developing countries . While competence 5.1 in DigComp 2.0 (solving technical problems) also involves the operation of devices and software, it refers to higher levels of understanding and skills involved in the problem-solving process.[6]

The proposed addition of CA0 (Devices and software operations) comprises two additional competences, 0.1 Physical operations of digital devices and 0.2 Software operations in digital devices.

ii) Competence 5.5 - Computational thinking

It is important to include computational thinking in the proposed framework as it is increasingly important that people have an understanding of the algorithmic, computational nature of problem-solving involving digital technology. Computational thinking is different from, though related to, the programming competence 3.4 under digital content creation. We propose to include computational thinking under CA5, problem-solving, to highlight that it is distinct from the ability to construct software programmes using set computer languages.

iii) Competence area 6 - Career-related competences

Some frameworks which target adults include career-specific competences, such as the use of digital technology in engineering (e.g. computer-aided design/computer-aided manufacturing equipment) and in education (e.g. use of Learning Management Systems). As the objective of our proposed framework is to serve as the foundation for thematic Indicator 4.4.2 of SDG 4.4, we believe career-specific competences should be included and aligned with the proposed Digital Literacy Pathway Mapping Methodology. Obviously, which career-specific knowledge, skills and attitudes should be included depends on the specific socioeconomic context, which also change over time. CA6, Career-related competences, is an addition to DigComp 2.0, comprising competences 6.1 (Operating specialised digital technologies for a particular field) and 6.2 (Interpreting and manipulating data, information and digital content for a particular field). One advantage of the openness and flexibility for this competence area is that countries can identify the competences required for economic growth and development in targeted fields and in specific contexts.

7. Recommendations for the next steps

Results from research and the consultation processes show that there is wide recognition of the value of a global framework to guide the development of digital literacy. The majority of experts consulted agree on the proposed competence areas and competencese in the draft framework. Priorities in the field of digital literacy will differ depending on socioeconomic contexts and the level of development of a country. The project team has proposed recommendations on how the proposed framework can guide digital literacy development in different country contexts and serve as the basis for the development of indicators for SDG 4.4.2.

[6] Defined as “to identify technical problems when operating devices and using digital environments, and to solve them (from trouble-shooting to solving more complex problems)”.

7.1 Digital literacy assessment instruments and indicators

There are numerous instruments that have been developed by national, regional, international and commercial agencies for assessing digital literacy or digital competence. Based on our mapping of cross-national and national lCT and digital literacy frameworks in Section 3, we found that the competences described in these frameworks can all be mapped to the DigComp 2.0 framework. Hence, we are confident that these instruments can be mapped to the proposed DLGF.

The digital literacy assessment instruments that exist have been developed to serve different purposes, from certification to evaluation of individuals or population groups, to research, etc. Carretero, Vuorikari and Punie (2016) conducted a comprehensive review of 22 assessment instruments and catergorised them into four major categories: performance assessment, knowledge-based assessment, self-assessment and secondary data-gathering and analysis. Performance assessment requires the individual to demonstrate how he/she performs certain tasks, while knowledge-based assessment requires the individual to explain how he/she would perform certain tasks. Self-assessments are subjective evaluations of one's own competence and may not really reflect a person's competence in real-life situations. Secondary data-gathering and analysis may provide some information about competence at the group or population level but not at the individual level. For certification or comparison of digital literacy achievements (such as in the International Computer and Information Literacy Study 2013 and 2018), performance assessment is the instrument of choice.

However, there is not a one-size-fits-all assessment of digital competence that can serve all purposes and contexts, and performance assessments may not necessarily provide indicators that are relevant for every context. For instance, the European Computer Driving License (ECDL) and International Computer Driving License (ICDL), which are used in many developing countries, assess digital competence using standalone desktop computers which are not connected to the Internet. But digital technology use in these countries, as shown in case examples in Section 4, involve almost entirely of networked mobile devices such as mobile phones, smart phones and tablets. Therefore, assessment indicators and instruments need to be mapped to the DLGF framework and include the context of usage and assessment purpose for them to be relevant and useful. As an example, assessments on a standalone desktop computer cannot address whether a farmer can use his/her mobile phone to conduct trading transactions for his produce but can be used to assess programming skills unrelated to network operations.

7.2 Development of global digital literacy indicators should be supported by cost-effective cross-national R&D programmes

Context-sensitive and fit-for-purpose digital literacy indicators and assessment instruments can possibly be most effectively generated through a process of research and consultation that identify examples of DLGF implementation suited to the needs of the target stakeholders through the pathway mapping methodology described in Section 5 at country/sector levels. The proposed DLGF could serve as a lever for scaffolding inter-organizational coordination and collaboration in the enhancement of digital literacy development. In particular, collaboration on the implementation of the pathway mapping methodology to generate digital literacy training and assessment programs may provide a fertile context for collaboration among entities in diverse socio-political and economic contexts without the prior establishment of a common DL framework among the collaborating agencies.

7.3 Proficiency levels and case examples for digital literacy frameworks

Thematic Indicator 4.4.2 focuses on a minimum level of proficiency in digital literacy skills. DigComp 1.0 differentiates four levels of proficiency and DigComp 2.1 differentiates eight levels of proficiency along three aspects (complexity of tasks, autonomy and cognitive domain). Most digital literacy frameworks reviewed in this report do not specify proficiency levels for competences and therefore do not provide minimum levels.

We recommend that digital literacy frameworks should include descriptions of proficiency so that they can provide better information on performance, which is necessary for the development of training programmes, monitoring and assessment. The three aspects of proficiency in DigComp 2.1 are useful in providing a clear framework for conceptualising proficiency levels.

Proficiency level specifications are only meaningful to the extent that these can be clearly understood by the targeted stakeholders. Furthermore, while different levels of proficiency can be defined in a general framework, what serves as an adequate level of proficiency differs according to the context. Our mapping exercises demonstrate that not all competences may be necessary. Hence, the development of proficiency level specifications should also be prioritised according to the context. The findings show that some competences are more relevant to a broader range of socioeconomic conditions and the minimum proficiency level can be determined based on the specific context. We recommend using a case example mapping methodology to identify the required levels of proficiency for adequate performance in select examples for targeted stakeholders. We further recommend that cross-national collaboration be forged in the development of proficiency levels and case examples of use.

7.4 Indicators for digital literacy to monitor progress towards SDG 4.4

To meet SDG 4.4 to "substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship", data need to be available in order to track progress and establish baselines. The aim of this project is to propose a definition and a global competence framework for digital literacy skills to underpin the development of Indicator 4.4.2. The framework would serve as a guide to monitor, assess and further develop digital literacy across countries at all stages of development. The associated indicators should also serve different national contexts and be developed through cross-national collaborations.

8. Conclusion

Experts and stakeholders across diverse economic and regional contexts have generally agreed on the proposed Global Framework for Digital Literacy and pathway mapping methodology. Our findings show that the DigComp 2.0 framework is a valuable and suitable basis for the development of a global digital literacy framework.

Countries have approached digital literacy in varying ways conceptually and in practice. The DigComp 2.0 competence framework addresses contexts in European countries, which are typically high-income and technologically-developed. . To cater for different country needs on a global scale, the proposed framework has added competences, such as CA0, Devices and software operations, and CA6, Career-related competences, as well as competence 5.5, Computational thinking.

The proposed framework and pathway mapping methodology can serve as a foundation for thematic Indicator 4.4.2 and the development of digital literacy frameworks, curricula and assessments across different countries and regions. We hope that the report will provide a solid foundation for further development of digital literacy to contribute towards the achievement of SDG 4.4.

Appendix 1. List of collected digital literacy frameworks

#	Country	Region	Income level	Fwk type	Framework provider	Framework
1	Algeria	Middle East and North Africa	Upper-middle	2	Enterprise	ICDL
2	Bermuda	High-income countries outside the EU	High	2	Enterprise	ICDL
3	Botswana	Sub-Saharan Africa	Upper-middle	2	Enterprise	ICDL
4	Canada	7 High-income countries outside the EU	High	1	National	British Columbia's Digital Literacy Framework
4	Canada	High-income countries outside the EU	High	1	National	USE, UNDERSTAND & CREATE: A Digital Literacy Framework for Canadian Schools
5	Chile	Latin America	High	1	National	ICT SIMCE competences
5	Chile	Latin America	High	2	Enterprise	ICDL
6	Colombia	Latin America	Upper-middle	2	Enterprise	ICDL
6	Colombia	Latin America	Upper-middle	2	Enterprise	ICDL-ECDL e-citizen programme
7	Costa Rica	Latin America	Upper-middle	1	National	Student performance standards in learning with digital technologies
7	Costa Rica	Latin America	Upper-middle	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2007
8	Egypt	Middle East and North Africa	Lower-middle	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2007
8	Egypt	Middle East and North Africa	Lower-middle	2	Enterprise	ICDL
9	Fiji	Other	Upper-middle	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 4
10	Georgia	Other	Lower-middle	2	Enterprise	ICDL
11	Hungary	European Union	High	1	National	Digital Education Strategy
12	India	Asia	Lower-middle	1	National	National Digital Literacy Mission
12	India	Asia	Lower-middle	1	National	The Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA)
13	Indonesia	Asia	Lower-middle	1	National	SiBerkreasi
13	Indonesia	Asia	Lower-middle	2	Enterprise	ICDL

13	Indonesia	Asia	Lower-middle	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 5
14	Iran	Middle East and North Africa	Upper-middle	2	Enterprise	ICDL courses
15	Iraq	Middle East and North Africa	Upper-middle	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2008
16	Jordan	Middle East and North Africa	Lower-middle	1	National	Queen Rania Foundation for Education and Development (QRF) (Formerly Jordan Education Initiative)
17	Kazakhstan	Asia	Upper-middle	2	Enterprise	ICDL
18	Kenya	Sub-Saharan Africa	Lower-middle	1	National	Digischool: the Digital Literacy Programme
18	Kenya	Sub-Saharan Africa	Lower-middle	1	National	ICT Authority Strategic Plan 2013-2018
18	Kenya	Sub-Saharan Africa	Lower-middle	1	National	Presidential Digitalent Programme Curriculum
18	Kenya	Sub-Saharan Africa	Lower-middle	1	National	The Kenya National ICT Masterplan
18	Kenya	Sub-Saharan Africa	Lower-middle	2	Enterprise	ICDL
19	Rep. of Korea	Asia	High	1	National	Baeumnara
20	Kyrgyzstan	Asia	Lower-middle	2	Enterprise	ICDL
21	Lesotho	Sub-Saharan Africa	Lower-middle	2	Enterprise	ICDL
22	Libya	Middle East and North Africa	Upper-middle	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2007
23	Malaysia	Asia	Upper-middle	1	National	MANAGEMENT, TECHNICAL AND IT skills programs
23	Malaysia	Asia	Upper-middle	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2007
23	Malaysia	Asia	Upper-middle	2	Enterprise	ICDL-Malaysia's National Competency Standard (NCS) for ICT User (ICDL courses)
23	Malaysia	Asia	Upper-middle	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 6
24	Mauritius	Africa	Upper-middle	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2007
25	Mexico	Latin America	Upper-middle	2	Enterprise	ICDL
26	Mongolia	Asia	Lower-middle	2	Enterprise	ICDL
27	Morocco	Middle East and North Africa	Lower-middle	2	Enterprise	Microsoft

28	Namibia	Sub-Saharan Africa	Upper-middle	2	Enterprise	ICDL
29	Nigeria	Sub-Saharan Africa	Lower-middle	2	Enterprise	ICDL
30	Oman	Middle East and North Africa	High	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2009
30	Oman	Middle East and North Africa	High	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 4
31	Panama	Latin America	Upper-middle	2	Enterprise	ICDL
32	Philippines	Asia	Lower-middle	1	National	National ICT Competency Standards (NICS) of the Philippines
32	Philippines	Asia	Lower-middle	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 7
33	Qatar	Middle East and North Africa	High	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2010
33	Qatar	Middle East and North Africa	High	2	Enterprise	ICDL
34	Romania	European Union	Upper-middle	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2007
35	Rwanda	Sub-Saharan Africa	Low	2	Enterprise	ICDL
35	Rwanda	Sub-Saharan Africa	Low	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 4
36	Saudi Arabia	Middle East and North Africa	High	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2011
37	South Africa	Sub-Saharan Africa	Upper-middle	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 4
37	South Africa	Sub-Saharan Africa	Upper-middle	2	Enterprise	ICDL
38	Sudan	Sub-Saharan Africa	Lower-middle	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2012
39	Swaziland	Sub-Saharan Africa	Lower-middle	2	Enterprise	ICDL
40	Syrian Arab Rep.	Middle East and North Africa	Lower-middle	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2013
41	Tajikistan	Asia	Lower-middle	2	Enterprise	ICDL
42	UR Tanzania	Sub-Saharan Africa	Low	2	Enterprise	ICDL
43	Thailand	Asia	Upper-middle	2	Enterprise	ICDL-Thai national qualification framework for Digital Literacy Standards (mapped to ICDL modules)
43	Thailand	Asia	Upper-middle	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 8
44	UAE	Middle East and North Africa	High	2	Enterprise	ICDL

44	UAE	Middle East and North Africa	High	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 5
45	Viet Nam	Asia	Lower-middle	2	Enterprise	Certiport Internet and Computing Core Certification (IC³) 2007
45	Viet Nam	Asia	Lower-middle	2	Enterprise	ICDL
45	Viet Nam	Asia	Lower-middle	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 9
46	Zambia	Sub-Saharan Africa	Lower-middle	2	Enterprise	ICDL
47	Zimbabwe	Sub-Saharan Africa	Low	2	Enterprise	ICDL

Note: Each number in the # column refers to a different country.

Appendix 2a. British Columbia Digital Literacy Framework fact sheet

Name of the framework or initiative	British Columbia Digital Literacy Framework
Institution or provider of the course (in the case of an academic article: author/s of the paper)	British Columbia Ministry of Education
Brief outline (summarising the salient points of the framework/initiative)	A recently introduced curriculum framework for K-12 students based on ISTE NETS•S standards. without levels but with school-based assessment
Webpage	https://www2.gov.bc.ca/gov/content/education-training/k-12/teach/teaching-tools/digital-literacy
Reference (listing references to paper, books, articles, reports that present the framework or initiative or which came out of the reported project)	USE, UNDERSTAND & CREATE: A Digital Literacy Framework for Canadian Schools - Overview
Type of initiative (specifying the nature of the case, i.e. if the case is a project, a digital literacy initiative, a school curriculum, an academic paper, etc.)	Regional digital literacy curriculum framework
Objective of the case	Preparing young Canadians to be digital citizens and to make good choices when using digital media
Context of the framework or initiative (institutional frame the framework/initiative belongs to or funding body)	British Columbia implemented the new curriculum in public and independent schools from September 2016.
Literacy focus and approaches (type of literacy it develops, e.g. media literacy, ICT literacy)	Digital literacy
Vision (explicit understanding of Digital Competence and its aims, definition of Digital Competence or related competences)	The Ministry of Education has defined digital literacy as "the interest, attitude and ability of individuals to appropriately use digital technology and communication tools to access, manage, integrate, analyze and evaluate information, construct new knowledge, create and communicate with others". Digital literacy comprises six dimensions: 1. Research and Information Literacy: Students apply digital tools to gather, evaluate, and use information; 2. Critical Thinking, Problem Solving, and Decision Making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources; 3. Creativity and Innovation: Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology; 4. Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior; 5. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others; 6. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations.
Target group (group/s that the framework or initiative is intended for)	Primary and secondary mainstream school students
Structure of the case study (listing the phases in a project)	The framework is based on the National Educations Technology Standards for Students (NETS•S) standards developed by the International Society for Technology in Education (ISTE).

Material (available material or supporting documents for disseminating/explaining the framework/initiative)	
Methods (methodology foreseen for the implementation of the framework/initiative)	
Tools (available material for the implementation of the framework)	
Implementation level (statement of the implementation of a framework and its level; e.g. compulsory school, primary/secondary, etc.)	Grade levels K-12
Width of implementation (regional, national, international)	Regional
Competence components (summary of the competences and sub-competences envisaged by the framework/initiative)	Six dimensions: 1. Research and Information Literacy (dimension): 1A: Information Literacy (sub-dimension): (10 learning outcomes sequenced by grade level); 1B: Information Processing And Management: (6 learning outcomes). 2. Critical Thinking, Problem Solving, and Decision Making: 2A: Specialized And Advanced Skills For Learning: (7). 3. Creativity and Innovation: 3A: Specialized And Advanced Skills for Creative Expression: (7). 4. Digital Citizenship: 4A: Internet Safety: (3); 4B; Privacy And Security: (11); 4C: Relationships And Communication: (9); 4D Cyberbullying: (7); 4E: Digital Footprint And Reputation: (5); 4F: Self-image And Identity: (8); 4G: Creative Credit And Copyright: (6); 4H: Legal And Ethical Aspects: (4); 4I: Balanced Attitude Towards Technology: (10); 4J: Understanding And Awareness of the Role of ICT in Society: (4); 5. Communication and Collaboration: Technology Mediated Communication And Collaboration: (11); 6. Technology Operations and Concepts: 6A: General Knowledge And Functional Skills: (12); 6B: Use in Everyday Life: (6); 6C: Informed Decision Making: (6); 6D: Seamless Use Demonstrating Self-Efficacy: (4); 6E: Learning About And With Digital Technologies: (10).
Levels (description of the envisaged proficiency levels)	
Assessment of competences (if and how competences are measured or assessed)	Exit profiles with example of use guidelines at key educational levels between K-12. School-based assessment of competences.

Appendix 2b. Chile SIMCE TIC fact sheet

Name of the framework or initiative	Chile SIMCE TIC
Institution or provider of the course (in the case of an academic article: author/s of the paper)	Enlaces - Centro de Educación y Tecnología - Ministerio de Educación
Brief outline (summarising the salient points of the framework/initiative)	SIMCE TIC (Information and Communication Technologies) is a nationwide assessment administered to second-year high school students. It assesses the ICT skills for learning levels achieved by Chilean school system students. It also leads to discussion on the individual and contextual factors that may influence achievement on SIMCE TIC.
Webpage	http://www.enlaces.cl/evaluacion-de-habilidades-tic/simce-tic/?lang=en
Reference (listing references to paper, books, articles, reports that present the framework or initiative or which came out of the reported project)	
Type of initiative (specifying the nature of the case, i.e. if the case is a project, a digital literacy initiative, a school curriculum, an academic paper, etc.)	National ICT skills assessment framework
Objective of the case	The test assesses the ICT skills development level of Chilean students.
Context of the framework or initiative (institutional frame the framework/initiative belongs to or funding body)	The Ministry of Education and ENLACES developed ICT programs and policies. An ICT competences assessment for SIMCE program was made in 2010.
Literacy focus and approaches (type of literacy it develops, e.g. media literacy, ICT literacy)	ICT skills for learning
Vision (explicit understanding of Digital Competence and its aims, definition of Digital Competence or related competences)	The SIMCE TIC test comprises three dimensions for ICT skills for learning: 1. information; 2. communication; and 3. ethics and social impact.
Target group (group/s that the framework or initiative is intended for)	Approximately 10,000 second-year high school students take the test.
Structure of the case study (listing the phases in a project)	Two OECD reports, iSkills – ETS (USA), Key Stage 3 ICT (England), ICT Literacy (Australia) informed the development of ICT skills for learning. Chilean documents informed the implementation strategy.
Material (available material or supporting documents for disseminating/explaining the framework/initiative)	
Methods (methodology foreseen for the implementation of the framework/initiative)	First delivered in 2011, with second delivery in 2013. Unknown deliveries since.
Tools (available material for the implementation of the framework)	The test is taken in November with schools and examiners agreeing on a date and time. The test is computer-based, and schools need to provide the infrastructure for Ministry of Education computers.
Implementation level (statement of the implementation of a framework and its	Secondary level

level; e.g. compulsory school, primary/secondary, etc.)	
Width of implementation (regional, national, international)	National
Competence components (summary of the competences and sub-competences envisaged by the framework/initiative)	3 dimensions with 12 skills: 1. Information (dimension): 1A Information as a Source (Sub-dimension): Define the information required; Search for information; Select information; Assess information; Organize digital information (5 ICT skills); 1B Information as Output: Integrate information; Understand information; Analyze information; Represent information; Create new information (5). 2. Comunicación: Communication: Know how to transmit information to others (1). 3. Ethics and social impact: Social Impact: Responsible use of ICTs (1)
Levels (description of the envisaged proficiency levels)	Initial; intermediate; and advanced. Advanced level students have also met initial and intermediate performance levels.
Assessment of competences (if and how competences are measured or assessed)	Virtual desktop software with commonly used productivity software. Students perform tasks related to an ecology project. 32 items make up the test. 3 types of questions: closed questions, action questions, and open questions. These questions are presented during a simulated chat between the test-taker and three virtual friends.
Further information (notes on the relevant aspects that have not been covered in the previous fields)	Results from 2011 and 2013 are public and reported nationally, regionally, and by school administration type.

Appendix 2c. Costa Rica Student Performance Standards in Digital Technology-enhanced Learning fact sheet

Name of the framework or initiative	Costa Rica Student Performance Standards in Digital Technology-enhanced Learning
Institution or provider of the course (in the case of an academic article: author/s of the paper)	Omar Dengo Foundation (ODF); Ministry of Public Education (MPE)
Brief outline (summarising the salient points of the framework/initiative)	Performance standards in digital technology-enhanced learning from pre-K to grade-level 12
Webpage	http://www.fod.ac.cr/estandares/docs/descargas/SPSCR.pdf
Reference (listing references to paper, books, articles, reports that present the framework or initiative or which came out of the reported project)	
Type of initiative (specifying the nature of the case, i.e. if the case is a project, a digital literacy initiative, a school curriculum, an academic paper, etc.)	National performance standards in digital technology-enhanced learning
Objective of the case	Costa Rican educational system expectations for student capability with digital technology as an exit profile at each education level The performance standards should inform classroom teaching and learning practice.
Context of the framework or initiative (institutional frame the framework/initiative belongs to or funding body)	The initiative to develop these performance standards was led by the Ministry of Public Education and the Omar Dengo Foundation, along with support organizations such as CRUSA foundation and ISTE
Literacy focus and approaches (type of literacy it develops, e.g. media literacy, ICT literacy)	Performance standards with digital technologies
Vision (explicit understanding of Digital Competence and its aims, definition of Digital Competence or related competences)	These performance standards clearly define student digital technology capability at each educational level. "The performance standard profiles are accompanied by a series of useful teaching guidelines for designing projects and learning opportunities, so that students can adopt digital technologies as tools for developing their capacities to reason, collaborate, participate, use knowledge for creating, define and solve problems and develop responsibly and safely in digital technology- mediated contexts."
Target group (group/s that the framework or initiative is intended for)	Pre-K to grade-level 12 students
Structure of the case study (listing the phases in a project)	These standards were constructed from 2006-2008 by the Ministry of Public Education and the Omar Dengo Foundation. Financial support from the CRUSA Foundation and technical support from Dr. Don Knezek, CEO of the International Society for Technology in Education (ISTE).
Material (available material or supporting documents for disseminating/explaining the framework/initiative)	
Methods (methodology foreseen for the implementation of the framework/initiative)	Education authorities will lead teacher adoption of the performance standards. Educators, school directors and parents may use the performance standards as a reference and an accountability mechanism.
Tools (available material for the implementation of the framework)	

Implementation level (statement of the implementation of a framework and its level; e.g. compulsory school, primary/secondary, etc.)	Pre-K to grade-level 12
Width of implementation (regional, national, international)	National
Competence components (summary of the competences and sub-competences envisaged by the framework/initiative)	3 dimensions: 1. Problem-Solving and Investigation (dimension): 6 sub-dimensions; 2. Productivity: 7 sub-dimensions; 3. Citizenship and Communication: 7 sub-dimensions. Each dimension contains properties of creativity, logical reasoning, collaboration, ethics and proactivity
Levels (description of the envisaged proficiency levels)	No explicit levels within a performance standard but performance standards are grouped as exit profiles by educational level
Assessment of competences (if and how competences are measured or assessed)	

Appendix 2d. India Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA) fact sheet

Name of the framework or initiative	India Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA)
Institution or provider of the course (in the case of an academic article: author/s of the paper)	India state governments and implementation agencies, and certifying agencies
Brief outline (summarising the salient points of the framework/initiative)	A scheme to make digitally literate one person in every eligible rural by 31 March 2019.
Webpage	https://www.pmgdisha.in
Reference (listing references to paper, books, articles, reports that present the framework or initiative or which came out of the reported project)	
Type of initiative (specifying the nature of the case, i.e. if the case is a project, a digital literacy initiative, a school curriculum, an academic paper, etc.)	National digital literacy
Objective of the case	To realize the government's Digital India vision, to train rural people to use digital devices for specific functions, to build up the nation and to reduce the digital divide amongst people groups
Context of the framework or initiative (institutional frame the framework/initiative belongs to or funding body)	The Ministry of Electronics & Information Technology will supervise the project. NGOs, Industry, Government authorized centres, Common Services Centres (CSCs) and authorized educational institutions will train people.
Literacy focus and approaches (type of literacy it develops, e.g. media literacy, ICT literacy)	Digital literacy
Vision (explicit understanding of Digital Competence and its aims, definition of Digital Competence or related competences)	"Digital literacy is a person operating digital devices (like Tablets, Smart phones etc.) sending and receiving emails & browsing Internet for information and undertaking digital payment etc." 5 modules and eight competences compose digital literacy.
Target group (group/s that the framework or initiative is intended for)	A nominated, digitally illiterate person between 14 to 60 years from every eligible rural household.
Structure of the case study (listing the phases in a project)	
Material (available material or supporting documents for disseminating/explaining the framework/initiative)	YouTube videos; brochures; banners; user guides; leaflets and handbooks. Various training locations including CSCs, Adult Literacy Centres, NIELIT Centres, RSETI, NGOs involved in IT Literacy, etc.
Methods (methodology foreseen for the implementation of the framework/initiative)	The government will reveal beneficiaries through the online scheme portal. Training centers will register and train nearby people. Learners self-study with continuous assessment and daily attendance requirement. Learners will take a high stakes exam after meeting minimum work hour and assessment requirements. Certificates issued to learners. Cost of training released to training centers after learner certification.
Tools (available material for the implementation of the framework)	A 20-hour course, with five modules to be completed between 10 and 30 days, in the official languages of India. Free to learners. Households can nominate one person for the course to register at training center.
Implementation level (statement of the implementation of a framework and its level; e.g. compulsory school, primary/secondary, etc.)	Rural households

Width of implementation (regional, national, international)	National
Competence components (summary of the competences and sub-competences envisaged by the framework/initiative)	Learning Outcomes / Competency Standards: Understand the basics (terminology, navigation and functionality) of digital devices; Use digital devices for accessing, creating, managing and sharing information; Use the Internet to browse in an effective and responsible manner; Use technology to communicate effectively; Carry out cashless transactions using digital financial tools (USSD/ UPI/ eWallet/AEPS/ Card/ PoS); Use Digital Locker; Use online citizen centric services; Appreciate the role of digital technology in everyday life, in social life and at work;
Levels (description of the envisaged proficiency levels)	
Assessment of competences (if and how competences are measured or assessed)	Continuous assessment through modules. High-stakes, online exam at a certifying centre at end of course, featuring 25, objective and true-false questions to be completed in 60 minutes.

Appendix 2e. Kenya Digital Literacy Core Competency Six of Basic Education Curriculum fact sheet

Name of the framework or initiative	Kenya Digital Literacy Core Competency Six of Basic Education Curriculum Framework
Institution or provider of the course (in the case of an academic article: author/s of the paper)	The Ministry of Education through the Kenya Institute of Curriculum development (KICD)
Brief outline (summarising the salient points of the framework/initiative)	Whole system reform through a new curriculum .
Webpage	https://www.kicd.ac.ke/images/downloads/CURRICULUMFRAMEWORK.pdf
Reference (listing references to paper, books, articles, reports that present the framework or initiative or which came out of the reported project)	Digital Literacy Program making learning fun – Gov't (newspaper article blog post); Digital literacy to be included in the primary schools teacher training curriculum (YouTube video)
Type of initiative (specifying the nature of the case, i.e. if the case is a project, a digital literacy initiative, a school curriculum, an academic paper, etc.)	National curriculum framework with digital literacy core competence
Objective of the case	"To provide bespoke, differentiated, innovative learning experiences that ensure each and every child can take their place in the world with confidence and pride as 21st century Kenyans." To improve citizens' lives and industries, for the nation, region and the world.
Context of the framework or initiative (institutional frame the framework/initiative belongs to or funding body)	The curriculum is the realization of government policy aligned with the national constitution, and national government and regional vision plans.
Literacy focus and approaches (type of literacy it develops, e.g. media literacy, ICT literacy)	Digital literacy
Vision (explicit understanding of Digital Competence and its aims, definition of Digital Competence or related competences)	"Digital literacy can be described as having the knowledge, skills and behaviours which are necessary to effectively and safely use a wide range of digital content and devices. Such devices include mobile phones, smart phones, tablets, laptops and desktops among others. All these fall within the category of network enabled devices. Digital literacy focuses mainly on network enabled devices and should not be confused with computer literacy skills. However, traditional forms of literacy and computer literacy are enhancers in the acquisition of digital literacy skills." The Business studies track in social sciences pathway offers an alternative definition, "Digital literacy is the ability to use digital technology, communications tools, and/or networks to access, understand, manage, integrate, evaluate, and create information."
Target group (group/s that the framework or initiative is intended for)	K-12 students
Structure of the case study (listing the phases in a project)	Government-stakeholder engagement; a national needs-assessment study; curriculum reform conferences; and benchmarking studies.
Material (available material or supporting documents for disseminating/explaining the framework/initiative)	
Methods (methodology foreseen for the implementation of the framework/initiative)	KICD will lead in teacher capacity building and curriculum implement capacity building.

Tools (available material for the implementation of the framework)	An online digital literacy platform with materials will support teacher professional development.
Implementation level (statement of the implementation of a framework and its level; e.g. compulsory school, primary/secondary, etc.)	K-12
Width of implementation (regional, national, international)	National
Competence components (summary of the competences and sub-competences envisaged by the framework/initiative)	Digital literacy is a core competency of basic education. It is integrated in all pre-primary education subjects. "Apply digital literacy skills for learning and enjoyment." is a learning outcome in early years education. "Apply digital literacy skills appropriately for communication and learning." is a learning outcome for Middle School. Digital literacy is incorporated into social sciences pathway and select secondary school subject essence statements. It is integrated into all subjects at vocational level and pre-vocational level. "Apply digital literacy skills for learning and enjoyment." is a learning outcome at pre-vocational level and intermediate level for special education needs.
Levels (description of the envisaged proficiency levels)	
Assessment of competences (if and how competences are measured or assessed)	Competency-based assessment, with formative assessment methods and instruments, and summative assessment at select education levels

Appendix 2f. Philippines K to 12 Basic Education Curriculum for the Alternative Learning System (ALS-K to 12) Learning Strand 6: Digital Literacy fact sheet

Name of the framework or initiative	Philippines K to 12 Basic Education Curriculum for the Alternative Learning System (ALS-K to 12) Learning Strand 6: Digital Literacy
Institution or provider of the course (in the case of an academic article: author/s of the paper)	Republic of the Philippine, Department of Education
Brief outline (summarising the salient points of the framework/initiative)	Digital literacy is a learning strand within the curriculum for ALS students for these students to develop digital literacy and basic ICT skills for effective living and working, with critical knowledge, skills and values in the digital universe.
Webpage	http://www.deped.gov.ph/sites/default/files/page/2017/LS%206%20Digital%20Literacy!!.pdf
Reference (listing references to paper, books, articles, reports that present the framework or initiative or which came out of the reported project)	
Type of initiative (specifying the nature of the case, i.e. if the case is a project, a digital literacy initiative, a school curriculum, an academic paper, etc.)	National digital literacy curriculum framework
Objective of the case	To produce 21st-century digital citizens that can use ICT and digital tools confidently, responsibly and ethically
Context of the framework or initiative (institutional frame the framework/initiative belongs to or funding body)	Many Filipinos do not attend or complete basic, formal education (Grades 1-6 and Year 1-4) for which reason the government provides the ALS to allow learners a context-sensitive opportunity to complete basic education.
Literacy focus and approaches (type of literacy it develops, e.g. media literacy, ICT literacy)	Digital literacy
Vision (explicit understanding of Digital Competence and its aims, definition of Digital Competence or related competences)	"Digital literacy is the capacity of every ALS learner to safely and responsibly generate, apply, and share digital information in multiple formats from a wide range of sources using computers or mobile devices." 21st century digital citizens need digital literacy, which comprises four, interrelated dimensions: 1. knowledge of digital concepts and operations; 2. using the internet and digital system networks; 3. practicing digital ethics; and 4. using ICT and digital devices and applications in daily life.
Target group (group/s that the framework or initiative is intended for)	ALS learners, including out-of-school children and adults, such as those in rural areas with limited infrastructure and institutional support
Structure of the case study (listing the phases in a project)	
Material (available material or supporting documents for disseminating/explaining the framework/initiative)	National curriculum frameworks
Methods (methodology foreseen for the implementation of the framework/initiative)	From 2017, ALS is Department of Education (DepEd) operated across the country. DepEd agents go to ALS areas to administer materials and assessment in community centers, homes or outdoors, and move on to other areas, with possibility for return visits and follow-up.
Tools (available material for the implementation of the framework)	

Implementation level (statement of the implementation of a framework and its level, e.g. compulsory school, primary/secondary, etc.)	Primary and secondary levels
Width of implementation (regional, national, international)	National
Competence components (summary of the competences and sub-competences envisaged by the framework/initiative)	6 content standards and performance standards: 1. (Content standard) Digital Concepts: (Performance standard) Explain basic concepts related to the use of information communication technologies (ICTs) in an increasingly digital world (12, sequenced learning competencies from simple to complex). 2. Digital Operations and Management: Demonstrate knowledge of basic hardware operations, software operations, and file management in using a computer (6 learning competencies). 3. Digital Applications: Use common office application software packages to produce documents and manage information as tools to solve problems in daily life (5 learning competencies for word processing, 7 for spreadsheet, 5 for presentation software). 4. Digital System Network: Navigate the digital global system to search for information and resources, and communicate with others in everyday life (6 learning competences). 5. Digital Devices: Make use of mobile devices as tools to access information and communicate with others (7 learning competences). 6. Digital Ethics: Demonstrate ethical practices and values in using technology in the 21st century (6 learning competences).
Levels (description of the envisaged proficiency levels)	Based on education level: Basic Level; Elementary Level (Basic / Advanced); Secondary Level (Junior Highschool /Senior Highschool)
Assessment of competences (if and how competences are measured or assessed)	Assessment standards and instruments may not be ready.

Appendix 2g. IC3 Digital Literacy Certification fact sheet

Name of the framework or initiative	IC3 Digital Literacy Certification
Institution or provider of the course (in the case of an academic article: author/s of the paper)	Certiport: A Pearson Vue business
Brief outline (summarising the salient points of the framework/initiative)	IC3 claims it is a comprehensive, global standard. "The IC3 Digital Literacy suite of products includes learning and practice solutions, assessment tools, and certifications specifically designed for a variety of ages and occupations."
Webpage	https://certiport.pearsonvue.com/Certifications/IC3/Digital-Literacy-Certification/Overview
Reference (listing references to paper, books, articles, reports that present the framework or initiative or which came out of the reported project)	IC3 has been referenced by the International Society for Technology in Education (ISTE); The American Council on Education (ACE); The National Coalition of Certification Centers (NC3); SkillsUSA; the Global Digital Literacy Council (GDLC); European Union Committee for Standardization (CEN); Oman's Information & Technology Authority; Iraq Minister of Higher Education and Scientific Research; Qatar University; The Technical and Vocational Training Corporation in Saudi Arabia; The Arab Administrative Development Organization (ARADO)
Type of initiative (specifying the nature of the case, i.e. if the case is a project, a digital literacy initiative, a school curriculum, an academic paper, etc.)	Certiport is a for-profit, certification business.
Objective of the case	IC3 teaches concepts and skills for educational and professional certification, and increased productivity, marketability and value.
Context of the framework or initiative (institutional frame the framework/initiative belongs to or funding body)	"Certiport, a Pearson VUE business, was established in 1997 and is now the leading provider of certification exam development, delivery, and program management services. "
Literacy focus and approaches (type of literacy it develops, e.g. media literacy, ICT literacy)	Digital literacy skills
Vision (explicit understanding of Digital Competence and its aims, definition of Digital Competence or related competences)	"Objective domains are a comprehensive set of specific and measurable knowledge, skills, and abilities that are the basis for the development of both the certification exams and learning products."
Target group (group/s that the framework or initiative is intended for)	Students and job seekers that want skill validation. Local employers and government tech initiatives.
Structure of the case study (listing the phases in a project)	Creation of global standard (GS): GS4 and then GS5
Material (available material or supporting documents for disseminating/explaining the framework/initiative)	
Methods (methodology foreseen for the implementation of the framework/initiative)	A sales department; over 14,000 Certiport test centers worldwide; instructors and lessons
Tools (available material for the implementation of the framework)	Course materials and practice tests: LearnKey on-demand video courseware, interactive labs and prescriptive study guides; CCI Learning pre-assessment software, courseware for instructor led classes, e-learning courses and blended training solutions; Pearson e-courses and textbooks; Teknimedia interactive online and offline computer training and assessment software; G-Metrix practice certification tests and environments

Implementation level (statement of the implementation of a framework and its level, e.g. compulsory school, primary/secondary, etc.)	
Width of implementation (regional, national, international)	International
Competence components (summary of the competences and sub-competences envisaged by the framework/initiative)	3, iterative, global standards: IC3 Global Standard 5 (Newest standard); IC3 Global Standard 4 (Predecessor standard); IC3 Spark (Youth standard); each standard comprises the same, three dimensions: 1. key applications: Covers popular word processing, spreadsheet and presentation applications and the common features of all applications (for GS5, 7 objective domains with 31 sub-domains). 2. Computing fundamentals: Covers a foundational understanding of computing (for GS5, 7 objective domains with 27 sub-domains). 3. Living online: Covers skills for working in an Internet or networked environment (for GS5, 9 objective domains with 25 sub-domains).
Levels (description of the envisaged proficiency levels)	
Assessment of competences (if and how competences are measured or assessed)	1. IC3 GS5 (each exam is 50 minutes): Living Online - 50 Questions; Computing Fundamentals - 50 Questions; Key Applications - 45 Questions. 2. IC3 GS4 (each exam is 50 minutes): Living Online - 45 Questions; Computing Fundamentals - 45 Questions; Key Applications - 43 Questions. 3. IC3 Other: GS5 Spark - 45 Questions (50 minutes); GS4 Spark - 60 Questions (50 minutes); GS4 Fast Track - 45 Questions (50 minutes)
Further information (notes on the relevant aspects that have not been covered in the previous fields)	Competitions for certification candidates

Appendix 2h. ICDL fact sheet

Name of the framework or initiative	ICDL (ECDL)
Institution or provider of the course (in the case of an academic article: author/s of the paper)	ICDL (International Computer Driving Licence) and ECDL (European Computer Driving License) are synonymous enterprise providers.
Brief outline (summarising the salient points of the framework/initiative)	The ICDL programme comprises modules for common computer application skills and competencies to meet educational and professional requirements. People take module tests and create profiles from taking modules.
Webpage	https://icdl.org/
Reference (listing references to paper, books, articles, reports that present the framework or initiative or which came out of the reported project)	ECDL mapped to DigComp competences; and A Guide to DIGCOMP for National Operators 2016
Type of initiative (specifying the nature of the case, i.e. if the case is a project, a digital literacy initiative, a school curriculum, an academic paper, etc.)	ICDL is a non-profit social enterprise that aims to raise digital competence standards around the world.
Objective of the case	
Context of the framework or initiative (institutional frame the framework/initiative belongs to or funding body)	
Literacy focus and approaches (type of literacy it develops, e.g. media literacy, ICT literacy)	Computer skills
Vision (explicit understanding of Digital Competence and its aims, definition of Digital Competence or related competences)	"Computer skills enable people of all ages to understand and use technology to improve their personal and professional lives."
Target group (group/s that the framework or initiative is intended for)	Individuals, employers and schools. Anyone who wants to improve their professional and personal life through computer skills.
Structure of the case study (listing the phases in a project)	ECDL was established between 1995 and 1996. ICDL was established in 1999. UNESCO has made it a national operator in the Middle East, the Americas and Asia. In 2003, ICDL advanced modules were created.
Material (available material or supporting documents for disseminating/explaining the framework/initiative)	
Methods (methodology foreseen for the implementation of the framework/initiative)	People can find test centers and purchase candidate registration numbers to take certification tests.
Tools (available material for the implementation of the framework)	ICDL has more than 24,000 accredited test centers in over 100 countries. It uses tutors and paper-based workbooks for introductory courses.
Implementation level (statement of the implementation of a framework and its level; e.g. compulsory school, primary/secondary, etc.)	
Width of implementation (regional, national, international)	International
Competence components (summary of the competences and sub-competences envisaged by the framework/initiative)	Each module comprises module goals, learning categories with skill sets and reference-task items.

Levels (description of the envisaged proficiency levels)	Levels by module group: 4 introductory courses before modules. Basic modules: 4; Intermediate: 13; Advanced: 4. No leveling within modules. ICDL recommends 3 profiles: Base profile: 4 basic modules; Standard profile: 4 basic and 3 intermediate modules; Expert profile: 3 advanced modules
Assessment of competences (if and how competences are measured or assessed)	High stakes, automated, certification tests at test centers with immediate feedback. One test for each module. Diagnostic tests with suggested 80% pass mark available under test conditions. Pass mark is 75% for all module tests. The ICDL portfolio comprises passed modules and their certificates.
Further information (notes on the relevant aspects that have not been covered in the previous fields)	Test centers set costs for testing and training.

Appendix 2i. Microsoft fact sheet

Name of the framework or initiative	Microsoft Digital Literacy Standard Curriculum Version 4
Institution or provider of the course (in the case of an academic article: author/s of the paper)	Microsoft
Brief outline (summarising the salient points of the framework/initiative)	Digital Literacy Standard Curriculum Version 4 comprises generic ICT skills and concepts with Windows 8 and Microsoft Office 2013 examples of use.
Webpage	https://www.microsoft.com/en-us/DigitalLiteracy/curriculum4.aspx
Reference (listing references to paper, books, articles, reports that present the framework or initiative or which came out of the reported project)	Many references with references within countries and with national institutions, including Oman Information Technology Authority: https://www.ita.gov.om/ITAPortal/MediaCenter/NewsDetail.aspx?NID=221
Type of initiative (specifying the nature of the case, i.e. if the case is a project, a digital literacy initiative, a school curriculum, an academic paper, etc.)	An ongoing enterprise framework from a for-profit business in partnership with national institutions
Objective of the case	In the case of Oman, "The Community-wide training program has been launched to contribute to Oman's transformation to a digital society by building IT skills within the community to bridge the digital divide. This program will help to strengthen local ICT industry and in create additional employment opportunities for the youth of Oman."
Context of the framework or initiative (institutional frame the framework/initiative belongs to or funding body)	National and community institutions partner with Microsoft to implement the curriculum
Literacy focus and approaches (type of literacy it develops, e.g. media literacy, ICT literacy)	ICT skills and concepts
Vision (explicit understanding of Digital Competence and its aims, definition of Digital Competence or related competences)	5 ICT skills and concepts dimensions: 1. Computer Basics; 2. The Internet, Cloud Services, and the World Wide Web; 3. Productivity Programs; 4. Computer Security and Privacy; 5. Digital Lifestyles
Target group (group/s that the framework or initiative is intended for)	People who want to learn computer technology fundamentals with basic computing concepts and skills at a basic reading level.
Structure of the case study (listing the phases in a project)	Fourth version of enterprise framework
Material (available material or supporting documents for disseminating/explaining the framework/initiative)	Microsoft digital literacy curriculum website with online and downloadable materials; national institution websites
Methods (methodology foreseen for the implementation of the framework/initiative)	Each curriculum dimension is a course comprising several lessons; each lesson focuses on a different sub-dimension. Each course has a downloadable or online launchable e-learning and assessment
Tools (available material for the implementation of the framework)	In the case of Oman, national and community institutions may leverage promotional mechanisms, individual trainers, public/private partnerships and financial subsidies to implement the framework.
Implementation level (statement of the implementation of a framework and its level; e.g. compulsory school, primary/secondary, etc.)	In the case of Oman, a community pilot program; young people; women
Width of implementation (regional, national, international)	Sub-national

Competence components (summary of the competences and sub-competences envisaged by the framework/initiative)	5 dimensions: 1. Computer Basics: 1A: Introduction to Computers (6 objectives); 1B: Common Computer Terminology (5); 1C. Computer Performance and Features (6); 1D. Computer Operating Systems (6); 1E. Career Opportunities (2); 2. The Internet, Cloud Services, and the World Wide Web: 2A: The Internet (4); 2B: The World Wide Web (7); 2C: Using E-Mail (5); 2D: Other Methods of Communicating on the Internet (4); 3. Productivity Programs: 3A. Introduction to Productivity Programs (1); 3B: Common Features and Commands (6); 3C: Introduction to Word Processors (6); 3D: Introduction to Spreadsheet Programs (5); 3E: Introduction to Presentation Programs (4); 3F: Introduction to Database Programs (5); 4. Computer Security and Privacy: 4A: Introduction to Computer Security and Privacy (5); 4B: Protecting Your Computer (3); 4C: Protecting Your Family from Security Threats (3); 4D: Keeping Your Computer Secure and Updated (2); 4E: Computer Ethics (3); 5. Digital Lifestyles: 5A: The Digital Experience (2); 5B: Introduction to Digital Audio (3); 5C: Introduction to Digital Video (3); 5D: Introduction to Digital Photography (3); 5E: Introduction to Digital TV and Enjoying Digital Media on Your Computer (4); 5F: Digital Technology and Career Opportunities (4)
Levels (description of the envisaged proficiency levels)	
Assessment of competences (if and how competences are measured or assessed)	Each course has a downloadable assessment application. Digital Literacy Certificate Test: 30-60 minutes; 30 questions; taken after the five courses or equivalent: test feedback includes links to course lessons that may need to be reviewed. People who pass can personalize and print a Digital Literacy Certificate.

Appendix 3. DigComp competence mapping codebook

Id	Competence area and competence	Code description
1	3. Digital Content Creation	To create and edit digital content To improve and integrate information and content into an existing body of knowledge while understanding how copyright and licences are to be applied. To know how to give understandable instructions for a computer system. Productivity programs seem related to C1 and C3.
2	3.3 Copyright and licences	Copyright and licences: To understand how copyright and licences apply to data, information and digital content. Related words are legal, ethics, violation and intellectual property. Rules. Regulations
3	3.1 Developing digital content	Developing digital content: To create and edit digital content in different formats, to express oneself through digital means. Synonymous with development, or creation and editing, is recording, copying and converting; editing and output formats; and editing and managing; work with; format. Knowledge representations. Expression. Adjust. Check. Print.
4	3.2 Integrating and re-elaborating digital content	Integrating and re-elaborating digital content: To modify, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant content and knowledge. Synonymous words are insert and add; templates. Co-construct content. Merge and refine. Number of sources and types. Adapt and transform. Represent various sources. Metadata in databases
5	3.4 Programming	Programming: To plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task. Functions and formulas in spreadsheets go here. Steps. Instructions. Logic. Order. Computational thinking.
6	1. Information and Data Literacy	To articulate information needs, to locate and retrieve digital data, information and content. To judge the relevance of the source and its content. To store, manage, and organise digital data, information and content. Productivity programs seem related to C1 and C3.
7	1.2 Evaluating data, information and digital content	Evaluating data, information and digital content: To analyse, compare and critically evaluate the credibility and reliability of sources of data, information and digital content. To analyse, interpret and critically evaluate the data, information and digital content. Key word is reliability; equally trustworthy; rating; information sources; triangulation; synthesize sources; compare; contrast; validity
8	1.1 Browsing, searching and filtering data, information and digital content	Browsing, searching and filtering data, information and digital content: To articulate information needs , to search for data, information and content in digital environments, to access them and to navigate between them. To create and update personal search strategies. Keyword is a keyword. Additional key words are listening and viewing; exploring; explain workings; navigate, commands, functionality; perform basic...through a graphical user interface. Find and gather. Routine. Everyday. Transactions. The DigComp definition focuses on search as a discrete function, with keywords and a portal; but the definition should encompass a more general idea of search as scanning and skimming on a graphical user interface.

9	1.3 Managing data, information and digital content	Managing data, information and digital content: To organise, store and retrieve data, information and content in digital environments. To organise and process them in a structured environment. Key words are organise and manage. Save. Structure. Classify. Genres. Schemes. Categorize. Backup. Restore. Filter. Sort. Install
10	5. Problem Solving	To identify needs and problems, and to resolve conceptual problems and problem situations in digital environments. To use digital tools to innovate processes and products. To keep up-to-date with the digital evolution. Developing solutions is a related phrase. Significant questions or investigation.
11	5.4 Identifying digital competence gaps	Identifying digital competence gaps: To understand where one's own digital competence needs to be improved or updated. To be able to support others with their digital competence development. To seek opportunities for self-development and to keep up-to-date with the digital evolution.
12	5.1 Solving technical problems	Solving technical problems: To identify technical problems when operating devices and using digital environments, and to solve them (from trouble-shooting to solving more complex problems). Related words are using internal guidance. Troubleshoot. Help menus
13	5.3 Creatively using digital technologies	Creatively using digital technologies: To use digital tools and technologies to create knowledge and to innovate processes and products. To engage individually and collectively in cognitive processing to understand and resolve conceptual problems and problem situations in digital environments. Related terms are crowdsourcing, collective intelligence and wikis. Create. Complex models. Simulations. Forecasting possibilities. Cloud computing utilization
14	5.2 Identifying needs and technological responses	Identifying needs and technological responses: To assess needs and to identify, evaluate, select and use digital tools and possible technological responses to solve them. To adjust and customise digital environments to personal needs (e.g. accessibility). Key words are helping people; different types, or options, and availability; describing or identifying benefits or uses; digital tools appropriate to specific tasks. Personal. Achieve. Self-efficacy. Combinations. Customize. Informed decision-making is problem solving. Apply. But are application, formatting and editing in office applications but developing content and not identifying needs? Competence seems cross-referenced with developing content. Help menus as a means to improve efficiency and productivity. Settings. Configurations. Cloud computing web apps. Interests. Important.
15	2. Communication and Collaboration	To interact, communicate and collaborate through digital technologies while being aware of cultural and generational diversity. To participate in society through public and private digital services and participatory citizenship. To manage one's digital identity and reputation. Keyword is community. Participate.

16	2.1 Interacting through digital technologies	Interacting through digital technologies: To interact through a variety of digital technologies and to understand appropriate digital communication means for a given context. This means references to synchronous and asynchronous ICTs like instant messaging and video chats.
17	2.6 Managing digital identity	Managing digital identity: To create and manage one or multiple digital identities, to be able to protect one's own reputation, to deal with the data that one produces through several digital tools, environments and services. Keyword is promote. Multiple audiences. Developing relationships and risking with people. Synonymous with digital footprint or trails.
18	2.3 Engaging in citizenship through digital technologies	Engaging in citizenship through digital technologies: To participate in society through the use of public and private digital services. To seek opportunities for self-empowerment and for participatory citizenship through appropriate digital technologies. DigComp examples of use are at neighborhood and city level. Real life people. Strong digital citizenship. Public domain. Government.
19	2.5 Netiquette	Netiquette: To be aware of behavioural norms and know-how while using digital technologies and interacting in digital environments. To adapt communication strategies to the specific audience and to be aware of cultural and generational diversity in digital environments. Different pressures teens face; uncomfortable Keyword is etiquette and correct. Audience and tone. Multiple audiences. Cultural awareness. Common expectations. Global. Suitable behavior. Codes of conduct. Appropriate context. Humility. Respect. Sensitive. Hosting.
20	2.2 Sharing through digital technologies	Sharing through digital technologies: To share data, information and digital content with others through appropriate digital technologies. To act as an intermediary, to know about referencing and attribution practices. Synonymous words include referencing, and citing, and bibliography. Attachments. Authors.
21	2.4 Collaborating through digital technologies	Collaborating through digital technologies: To use digital tools and technologies for collaborative processes, and for co-construction and co-creation of resources and knowledge. Related terms are crowdsourcing, collective intelligence and wikis. Working with partner. Roles.
22	4. Safety	To protect devices, content, personal data and privacy in digital environments. To protect physical and psychological health, and to be aware of digital technologies for social well-being and social inclusion. To be aware of the environmental impact of digital technologies and their use. For general competences, involving fraud, or improper use.
23	4.4 Protecting the environment	Protecting the environment: To be aware of the environmental impact of digital technologies and their use.

24	4.1 Protecting devices	Protecting devices: To protect devices and digital content, and to understand risks and threats in digital environments. To know about safety and security measures and to have due regard to reliability and privacy. Related terms are guidelines and measures. Hacking. Scams. Malware. Depending on their means and what they are after, predators may be related to 4.1, 4.2 and 4.3. Watermarks. Updates.
25	4.2 Protecting personal data and privacy	Protecting personal data and privacy: To protect personal data and privacy in digital environments. To understand how to use and share personally identifiable information while being able to protect oneself and others from damages. To understand that digital services use a "Privacy policy" to inform how personal data is used. Depending on their means and what they are after, predators may be related to 4.1, 4.2 and 4.3. Seals of approval; guarding; collecting information and personalizing; thefts, scams and access; promotion; marketing Related to digital footprint or trails. Users.
26	4.3 Protecting health and well-being	Protecting health and well-being: To be able to avoid health-risks and threats to physical and psychological well-being while using digital technologies. To be able to protect oneself and others from possible dangers in digital environments (e.g. cyber bullying). To be aware of digital technologies for social well-being and social inclusion. Depending on their means and what they are after, predators may be related to 4.1, 4.2 and 4.3. Related words are uncomfortable, appropriate, safe, good and rules; peer pressure and different pressures. Risking with people and in relationships. Bullying; cruelty; teasing; escalation; anonymity; emotional words like anger and fearful High-risk; illegal. Hurt. Better. Worse. Positive attitude. Realistic. Distractions. Confidence. Related to digital footprint or trails. Beauty; health; perceptions; ideals; distortions; stereotypes; pressure; self
27	6. Career-related competences	Contains the phrase career opportunities in descriptor or header. Or sets of competences for specific careers.
28	0. Hardware and software operations	Turning on and off hardware. Conceptualization of hardware or technology without practical experience, or graphical user interface. Understanding concepts outside the other competence areas. Recognize. Peripheral devices.

Note: Codes, that is, competence areas and competences, are listed in ascending order of a unique code ID found in the ID column. Code descriptions include DigComp descriptors for each DigComp competence, and key words or phrases that emerge from coding other frameworks and that are assigned to specific competences to maintain low-inference coding.

Appendix 4. List of examples of use grouped by country and sector

Country	National income	Agriculture	Empowerment	Energy	Finance	Migration	Transportation	Total
Afghanistan	Low	0	1	0	0	0	0	1
Bangladesh	Lower-middle	1	0	0	1	0	0	2
Botswana	Upper-middle	0	1	0	0	0	0	1
Brazil	Upper-middle	0	0	0	0	0	1	1
Burkina Faso	Low	0	1	0	0	0	0	1
Cambodia	Lower-middle	0	1	0	0	0	0	1
China	Upper-middle	0	0	0	1	0	3	4
Dem. Rep. of the Congo	Low	0	1	0	0	0	0	1
Ghana	Lower-middle	2	1	1	1	0	0	5
China, Hong Kong	High	0	0	0	1	0	0	1
India	Lower-middle	4	1	0	1	0	1	7
Indonesia	Lower-middle	0	0	0	2	0	1	3
Japan	High	0	0	0	0	0	0	0
Kenya	Lower-middle	2	0	1	3	0	0	6
Madagascar	Low	0	1	0	0	0	0	1
Malawi	Low	0	1	0	0	0	0	1
Mali	Low	0	1	0	0	0	0	1
Mozambique	Low	0	1	0	0	0	0	1
Nigeria	Lower-middle	1	1	2	0	0	0	4
Pakistan	Lower-middle	0	0	0	1	0	0	1
Philippines	Lower-middle	1	0	0	0	0	0	1
Rwanda	Low	0	0	0	1	0	0	1
Senegal	Low	1	0	0	0	0	0	1
Singapore	High	0	0	0	1	0	3	4
Somalia	Low	0	0	0	1	0	0	1
South Africa	Upper-middle	0	0	0	0	0	0	0
Sudan	Lower-middle	1	0	0	0	0	0	1
Syrian Arab Rep.	Lower-middle	0	0	0	0	2	0	2
UR Tanzania	Low	0	1	0	0	0	0	1
Uganda	Low	1	1	0	0	0	0	2
United Arab Emirates	High	0	0	0	0	0	1	1
Zambia	Lower-middle	0	1	0	0	0	0	1
Total		**14**	**15**	**4**	**14**	**2**	**10**	**59**

Note: Examples of use are listed in the table by country in alphabetical order. Numbers in sector cells indicate the number of examples of use found for that country.

Appendix 5. Summary of the different functions available on mobile and smartphones.

Function	On mobile phone	On smartphone
G1: turning on/off device, charging	G1	G1
G2: sending & receiving text	G2	G2
G3:login, user account & password management, locking devices	G3M	G3S
G4: searching for goods & services & comparing prices	G4M	G4S
G5: setting or changing app language		G5S
G6: sharing location data		G6S
G7: creating & setting public profile		G7S
G8: Searching, understanding & approving privacy policy statements		G8S
T1: buyer & seller interaction connected through intermediary	T1M	
T2: Topping up account through an agent	T2M	
T3: Evaluating price & service provider information. Rate service.		T3S
T4: Intra-app finance transactions		T4S
T5: Inter-app finance transactions		T5S

Note: It is possible that given a higher number of examples or the inclusion of more economic sectors for this study, we could find new functions beyond the current list.

In examining the functions, a user may need to manipulate in these 20 use examples, we find three situations in terms of device dependence:

1. There is no substantive difference between these two types of devices for functioning – there are two functions that fall into this category: turning on/off and charging the device (GG1) and sending and receiving text messages (G2).

2. The same function can be performed on both types of devices, but the functionality and proficiency levels required are different – there are also two functions that fall into this category: device and account management (G3M & G3S, login, user account and password management, locking devices), and searching and comparing information (G4M & G4S).

3. Some functions are only available for a specific type of device. Two of the functions are only used by mobile phone users: buyer and seller interaction connected through an intermediary, and topping up one's account through an agent. These are two financial transactions that have to be conducted through an intermediary even though digital communication devices are being used, as the devices are not Internet enabled. There are four generic functions (G5S, G6S, G7S, G8S) and three financial transactions (T3S, T4S, T5S) that are only available through an Internet-enabled device such as a smartphone.

Appendix 6. Functions operating in the examples collected in each of the six sectors

SECTOR	G1	G2	G3M	G3S	G4M	G4S	G5S	G6S	G7S	G8S	T1M	T2M	T3S	T4S	T5S
Agriculture	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓	
Empowerment	✓	✓			✓										
Energy	✓	✓	✓	✓						✓		✓		✓	
Finance	✓	✓	✓	✓		✓	✓		✓	✓		✓		✓	✓
Migration	✓	✓		✓		✓	✓	✓	✓	✓			✓	✓	✓
Transport	✓			✓		✓	✓	✓	✓	✓			✓	✓	✓

Note: Green colour represents functions available on mobile phones. Orange colour indicates functions only available on smartphones. It is possible that given a higher number of examples for this study, we could find more functions operating in a sector beyond the current list.

Appendix 7. Mapping of the functions involved in the examples analysed to the DigComp competences

	0	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	2.6	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4
G1: turning on/off device, charging	✓																					
G2: sending & receiving text		✓	✓	✓	✓	✓	✓	✓			✓						✓			✓		✓
G3M: login, user account & password management, locking devices	✓														✓							
G3S: login, user account & password management, locking devices	✓														✓							
G4M: searching for goods & services & comparing prices		✓	✓	✓			✓										✓					
G4S: searching for goods & services & comparing prices		✓	✓	✓			✓										✓					
G5S: setting or changing app language																				✓		
G6S: sharing location data	✓					✓										✓	✓					
G7S: creating & setting public profile						✓				✓	✓					✓						
G8S: searching for, understanding & approving privacy policy statements	✓	✓	✓													✓				✓		
T1M: buyer & seller interaction connected through intermediary			✓		✓																	
T2M: Topping up account through an agent		✓			✓															✓		
T3S: Evaluating price information, costs, and service provider profiles. Rate service provider.		✓	✓	✓						✓												
T4S: Intra-app finance transactions	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓				✓	✓				✓		
T5S: Inter-app finance transactions	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓				✓	✓				✓		

Note: Green colour represents functions available on mobile phones. Orange colour indicates functions only available on smartphones.

Since the DL competence required in the use examples in the six selected sectors relate only to the functions that are independent of the sector, the mapping of the use examples to competences are not carried out directly, but between the functions listed in Table 6 and the DigComp competences listed in Table 1 (extended by an additional competence area, labelled as "0" for hardware and software operations). The following are examples of such mapping to illustrate how this process is conducted:

- G1 (turning on/off & charging device) requires competence in hardware and software operations.
- G4M & G4S (searching for goods & services & comparing prices) requires all three competences under the Information and data literacy area, and competences 2.3 (Engaging in citizenship through digital technologies) and 4.3 (Protecting health and well-being).
- G7S (creating & setting public profile) requires competences in 2.2 (sharing through digital technologies), 2.6 (managing digital identity), 3.1 (developing digital content), and 4.2 (protecting personal data and privacy).
- Both T4S and T5S (intra-app and inter-app financial transactions respectively) require the same set of competences, but to different levels of proficiency in terms of the complexities involved in accessing, evaluating and managing the information (1.1, 1.2 & 1.3) and in identifying needs and technological responses (5.2) in the decision-making process.

Appendix 8. Pathway mapping methodology examples and guide

Introduction

In developing the draft Digital Literacy Global Framework (DLGF), the project team found that the specific digital literacy competences and proficiency levels that are important to adults depend importantly on their specific country and economic sector contexts. Furthermore, their priorities for advancing their digital competence also depend on the broader developmental priorities they found themselves in. Hence, in order that the DLGF can be a useful resource to guide digital literacy development and assessment for diverse country and sector developmental contexts, the project team has developed a *pathway mapping methodology* to guide countries, sectors, groups and individuals to develop strategies and plans for advancing their own digital literacy development goals and pathways. Here, we provide a brief description of the methodology.

A pathway for digital literacy development can be developed through comparing use case examples for specific targeted contexts to identify the difference in digital literacy competence required for adequate performance between the popular current use example and the use example to aspire to. The ability to advance the use of digital technology to enhance social and economic development depends not only on the availability of the necessary infrastructure and technology access in the community, but also a higher level of digital literacy. Using this mapping methodology, stakeholders at different levels of the system in different country/sector/personal contexts can customize their own digital literacy development plan.

Use Case Example Comparison Tables for Two Economic Areas

Tables 1 and 2 compare the dimensions, competences and proficiency required for adequate performance for use cases. Table 1 compares three use case examples in agriculture, showing different levels of sophistication in the deployment of technology to enhance the productivity and profit of farmers. Table 2 compares two use cases in government, showing different levels of sophistication in the deployment of technology to enhance the productivity of entrepreneurs and bidders in government systems. The examples in both tables are numbered for a progression or pathway.

Table 1 shows the pathway of progression in competences required of the farmer if he/she wants to move from a less to a more sophisticated use of technology in the farming case examples. We can see a pathway in terms of digital technology used, from a basic mobile phone, to a smart phone, to an automated watering system that can be remotely monitored and activated. We can also see a pathway in software required from user-end software to back-end software.

Table 2 shows the different competences required of a person if he/she wants to move/extend his/her business from one country to another, in order to be able to use the relevant e-government services. E-government systems differ in terms of the nature of the services offered, the connectivity of the system across different government departments, and whether specific digital devices are needed for identification verification. We can see a pathway in terms of the complexity of the task, from registering to have a login to use a government service to using a specific government service, which includes the registering and signing into the service. We can also see a pathway in terms of the complexity of the software features and functionalities provided by the e-services portal.

Table 8.1. A comparison of three use case examples in agriculture

	Use case example	**1. A farmer in India makes better farming and trading decisions using a mobile phone service.**	**2. A farmer in Uganda conveniently buys and sells product through a smart phone app.**	**3. A farmer makes a data-driven irrigation system through Arduino**
	Economic area of use case	Agriculture	Agriculture	Agriculture
	Role(s) of the person(s) using the digital technology	Farmer	Farmer	Farmer
	Digital technology used	Mobile phone with voice call and SMS capability	A smartphone with Internet connectivity	Arduino program; USB plug; moisture sensors; wires and transmitters; power supply; (water) tank supply sensor; relay; clock; LCD display; laptop
	Software applications (if applicable)	Not applicable	Agro Market Day	Arduino program
Competence area	**Competences**	Adequate performance level	Adequate performance level	Adequate performance level
0. Devices and software operations	**0.1 Physical operations of digital devices**	The farmer can input a simcard, charge his mobile phone and turn it on. The farmer can carry his phone while working.	The farmer can input a simcard, charge his smart phone and turn it on. The farmer can carry his phone while working. The farmer knows how to take a picture with the smart phone camera.	The farmer can properly power the system and read its setting on an LCD display, or on a laptop. The farmer can plug in Arduino into a powered laptop via USB. The farmer can place sensors at appropriate depth in soil and locations in field, and place watering devices at appropriate height and location.
	0.2 Identifying software to operate digital technologies		The farmer can set up the smart phone operating system settings and is aware of Internet connectivity.	
1. Information and data literacy	**1.1 Browsing, searching and filtering data, information and digital content**	The farmer can receive four to five personalized SMS messages each day about weather, market prices and farming practices. The farmer can navigate the mobile phone interface to find relevant messages.	The farmer is able to search for and download the Agro Market Day app from the Android store. The farmer can search for a particular product in the app and view listings. The farmer can also browse agricultural news and access prices from several markets.	

	1.2 Evaluating data, information and digital content	The farmer can compare prices in different markets and decide on a market to sell his product on a particular day.	The farmer can compare prices in different markets. A farmer can evaluate recommendations for where to buy genuine agricultural tools and inputs (herbicides; pesticides; fertilizers; etc.) and make purchase decisions.	The farmer can compare Arduino and clone specifications to determine which type to purchase.
	1.3 Managing data, information and digital content	The farmer can organize and delete the SMS messages on the phone.	The farmer can organize information on multiple prices for multiple products in multiple marketplaces to buy and to sell.	The farmer can organize code so that others can read it and comprehend it. A farmer can keep track of times and dates of irrigation.
2. Communication and collaboration	**2.1 Interacting through digital technologies**	The farmer can call other farmers and show information to other farmers.	A buyer can call a seller and arrange time, date and location for transaction. The farmer with the smartphone can cooperate with the farmer without a smartphone and a buyer to transact.	The farmer can reach out to the Arduino online community to learn to program and to troubleshoot programs, and to Arduino farming community to learn appropriate ways to physically connect an irrigation system and to program it.
	2.2 Sharing through digital technologies		A farmer with a smartphone can cooperate with a farmer without a smartphone to post produce advertisements on the app for the farmer without a smartphone.	
	2.3 Engaging in citizenship through digital technologies			
	2.4 Collaborating through digital technologies			
	2.5 Netiquette			
	2.6 Managing digital identity			
3. Digital content creation	**3.1 Developing digital content**		The farmer takes pictures of his product, and uploads that with price, location and a phone number to the app.	
	3.2 Integrating and re-elaborating digital content			
	3.3 Copyright and licences			

	3.4 Programming			The farmer can define constants on the programming interface, pins, the maximum dryness, and the water delay and water post-delay. The farmer can program a loop to read sensor value, compare it, and to take action with water and delay if the soil is too dry. The farmer can reprogram the system to irrigate based on time, or to irrigate based on fertilizer not water.
4. Safety	**4.1 Protecting devices**		The farmer is able to register the app and log in with a phone number and password.	
	4.2 Protecting personal data and privacy		The farmer does not disclose password or sensitive information about himself or a fellow farmer.	
	4.3 Protecting health and well-being			
	4.4 Protecting the environment			
5. Problem solving	**5.1 Solving technical problems**			The farmer can refer to sample code in Arduino to learn to program. The farmer can reach out to the Arduino online community to learn to program and to troubleshoot programs, and to Arduino farming community to learn appropriate ways to physically connect an irrigation system and to program it.
	5.2 Identifying needs and technological responses		A farmer without a smartphone identifies the approach to cooperate with a farmer with a smartphone and Agro Market Day to post advertisements of the farmer's product. A farmer decides on whether to post an advertisement for product or to go to a market based on prices at marketplaces.	
	5.3 Creatively using digital technologies			
	5.4 Identifying digital competence gaps			
	5.5 Computational thinking			
6. Career-related competences	**6.1 Operating specialized digital technologies for a particular field** **6.2 Interpreting data, information and digital content for a particular field**			

Table 8.2. A comparison of two use case examples in e-government

	Use case example	**1. An entrepreneur registers for a Dubai MyID single sign-on to access required government online services to do business**	**2. A supplier submits a bid through the Government of Mauritius e-Procurement System**
	Economic area of use case	Government	Government
	Role(s) of the person(s) using the digital technology	Entrepreneur	Bidder for government supplier
	Digital technology used	Emirates ID card; kiosk or PC or laptop with smart-card reader; mobile or smart phone; Internet connectivity	PC or laptop; Internet connectivity
	Software applications (if applicable)	Internet browser; government service apps	Compatible Windows operating system; Office software; compatible Internet browser; Java; Adobe Acrobat Reader; digital signature certificate; anti-virus software
Competence area	Competences	Adequate performance level	Adequate performance level
0. Devices and software operations	0.1 Physical operations of digital devices	The entrepreneur can visit a kiosk within the city to register or if the entrepreneur doesn't want to visit a kiosk, the entrepreneur can turn on a computer, and attach a smart card reader. The person can insert the Emirates ID into the kiosk or the smart card reader. He/she can place finger on sensor for scanning.	The bidder can turn on a computer.
	0.2 Identifying software to operate digital technologies	The entrepreneur can respond to prompts for Emirates ID card insertion and fingerprint scanning. The person is aware of Internet connectivity, proper and successful card insertion and appropriate and successful fingerprint scanning.	The bidder can check the prerequisite hardware and software system requirements against the bidder's hardware and software system. The person can respond to the website and web browser prompts and to unblock content, to allow pop-up windows, and to install a Java utility on the bidder's system. He/she is aware of different file types, and can decompress a file comprising documents. The person recognizes required personal information on the form.
1. Information and data literacy	1.1 Browsing, searching and filtering data, information and digital content	The entrepreneur can open a web browser, and input the registration webpage address in the appropriate box in the browser. The person can	The bidder can open a web browser, and go to the Government of Mauritius e-Procurement System website. From the landing page, the person can scan and skim the content in the How to?, FAQ, Help Desk,

		identify and interpret icons and buttons, input boxes and forms on the interface. He/she can advance to the next screen in the registration process. The person can browse and select relevant government services. At a government service login, he/she can click on the MyID icon.	and Standard Bidding Docs sections of the website to find relevant information on successfully making a bid. He/she checks an email account, including its SPAM folder, to find an email from the e-Procurement system. The person opens the email and clicks on a link to confirm the registration. He/she can interpret action icons in the IFB interface. The person can search for, and select relevant invitations for bids (IFBs) from the user account dashboard. He/she can click on Proceed to go to the next screen in the IFB preparation page sequence. The person can identify drop down menus, text boxes, adding rows and importing data on forms.
	1.2 Evaluating data, information and digital content		The bidder can preview invitations and bid templates.
	1.3 Managing data, information and digital content	The entrepreneur can note down his Emirates ID PIN to register for MyID. The person can note down hi MyID username and password to access government online services.	The bidder uploads specific file types and multiple files from his system into an e-Procurement system field. The person can prepare a bid by downloading IFB documents individually or in a compressed file to a location on the person's system. He/she can receive and read email updates on the IFB. The person identifies and notes down applicable fees for the IFB.
2. Communication and collaboration	2.1 Interacting through digital technologies		
	2.2 Sharing through digital technologies		
	2.3 Engaging in citizenship through digital technologies		
	2.4 Collaborating through digital technologies		
	2.5 Netiquette		
	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	An entrepreneur can keep a physical Emirates ID card and set and recall a PIN to access information from the card. The person can enter username and	The bidder inputs personal information and security information, including Captcha and security

		password in a form on a separate page to access a government service, and then close the sign on page.	questions, on the form through single text boxes. The person logs in with a username and password.
	4.2 Protecting personal data and privacy	The entrepreneur can register a new account by selecting and inputting an existing email address and a password twice in text boxes. The person can select and input an existing mobile phone number and Emirates ID number in the form. The entrepreneur can select and input personal information, including physical address, and fingerprint scan.	The bidder can read the Terms of Use and accept the terms by clicking a check box. At the user account dashboard, the person registers his organization by first clicking on My Registration. He/she identifies required information on a form and decides whether or not to input optional information on the form. The person saves the form and encrypts data. He/she can choose and attach digital certificates to the template. The person submits the bid and identifies and notes down the hash values of the bid. The He/she can revise the bid application until the closing date for bid submission by clicking on decrypt.
	4.3 Protecting health and well-being		
	4.4 Protecting the environment		
5. Problem solving	5.1 Solving technical problems	The entrepreneur can follow and meet format input requirements for the password, mobile phone number and ID.	The bidder can meet the type or format of acceptable input by clicking the information button beside the input field and seeing a green check mark or a red check mark beside the field.
	5.2 Identifying needs and technological responses	On the registration webpage, the entrepreneur can identify the options to change language and to find more information, including kiosk locations through Google maps, and contact information telephone number and email address.	The bidder can search the system website and other websites to find and follow relevant information on how to navigate the system interface.
	5.3 Creatively using digital technologies		
	5.4 Identifying digital competence gaps		
	5.5 Computational thinking		
6. Career-related competences	6.1 Operating specialized digital technologies for a particular field 6.2 Interpreting data, information and digital content for a particular field		

Three possible types of progression in competences are observed in pathways of increasing sophistication in technology use:

1. *Increasing proficiency level for adequate performance within the same competence*. This could arise from the use of more sophisticated digital devices. In the three examples of Table 1, under competence 0.1 concerning the physical operations of digital technologies, the farmer in example 1 needs to use a mobile phone, which may have fewer physical features and pairing possibilities with other digital devices than a smartphone which the farmer uses in example 2. The use of the data-driven irrigation system in example 3 requires the farmer's organization and use of many individual parts. Increasing proficiency level for adequate performance within the same competence could also arise from the use of more sophisticated software on digital devices. In the two examples of Table 2, under competence 0.2, while the entrepreneur in example 1 uses more digital technologies, the bidder in example 2 uses a software system with more sophisticated requirements and capabilities, including interacting with different types of files on the e-Procurement System and the bidder's system.

2. *The need to develop new competences*. For instance, in Table 1, example 1 does not require competences 0.2 (basic knowledge of account management), 2.2 (sharing information on the internet), and 5.2 (identify needs and technological responses that are immediately useful).

3. The immediate importance of specific competences may be less important because of the application area, and necessarily because of the sophistication of the technology used. For instance, in Table 1 example 2, since the application focus is to help the farmer make more efficient and profitable sales, competence 3.1 (developing digital content) becomes an immediately important competence. In Table 2 example 2, since the application focus is to help the bidder make bids within the e-procurement system, competence 1.2 (evaluating data, information and digital content) becomes an immediately important competence.

The proposed pathways can be adapted for different developmental contexts and ICT availability. These can be further elaborated for different roles in a specific economic sector. For example, agricultural development in some African countries will definitely benefit if farmers and traders with mobile phones can use the RML Farmer app and Trader app effectively, with support from community knowledge workers in agriculture with smart phones. This model of integrating DL development with local/national developmental state and priorities would be immediately meaningful and motivating for those involved, and bring tangible benefits.

Limitations

It is important to note several limitations to this pathway mapping methodology. First, by using cases to develop a pathway, individual users may view a use case as too particularistic or irrelevant, dismissing a case, and not drawing salient analytical generalizations from the case to the user's experience. Second, the example pathways in this report are illustrations of the methodology and not an attempt to capture all different contexts and use case scenarios. We do not know what pathways may be developed with all possible use cases, job areas and sectors. Third, the pathway mapping methodology is clearly not conducive to traditional forms of DL assessment, which generally has been decontextualized, high-stakes, desktop-based assessment, when that type of assessment may be a meaningful approach to advance DL development in some contexts. Fourth, the methodology may suffer looser interpretation of competences,

adequate performance for competences and other DL-concepts as it is implemented in multi-stakeholder, multi-level contexts.

DLGF and pathway mapping methodology to scaffolding inter-organizational coordination and collaboration

While the pathway mapping methodology focuses on identifying the specific competences required for different digital technology use scenarios in the immediate, medium and longer term, the results of the mapping have different implications for different stakeholders in the use context. The stakeholder can be individuals, communities, institutions, NGOs, national or international organizations. For instance, Table 3 shows different possible decisions and implications for the illustrative agriculture pathway in this report based on stakeholder group. Taking the agriculture pathway as an example, the implications for an individual farmer is different from an NGO serving farmers in supporting them to increase their productivity through technology use, and different for policy makers in the Ministry of Agriculture.

Table 8.3. Pathway mapping decisions and implications for different agriculture stakeholders

Farmer	NGO serving farmers	Policy makers (ministry)
Decisions • Cost and benefit • Affordability • Infrastructure availability	Decisions • Focal applications to promote for maximum return on investment • Mode of dissemination/support	Decisions • Strategic development focus • Infrastructure development • Policies and regulations
DL implications • Literacy level • Opportunity to learn • Reaching out to user communities	DL implications • Capacity to research new developments • Identify gaps in DL competences • Identify partners and technologies to leverage	DL implications • Business intelligence network • Training / certification guidelines • Incentives and support to relevant NGOs and individual farmers

One important use of the global framework and pathway mapping methodology is to serve as a scaffolding framework for different organizations that serve the same target community to coordinate and collaborate to better support the target community that they serve. This can take the form of multi-level collaboration such as between national, sub-national and individual levels; or multi-stage collaboration such as between the many groups that serve refugees at different stages of refugee migration from displacement to re-settlement; and intra-level collaboration such as between empowerment programs for underserved communities.

The first step in this collaborative process is to identify the targeted use case scenarios. Once the use case scenarios are selected, the mapping can be done by identifying the hardware and software technologies to be used, the key actions, interactions and transactions required, and then the DL competence for performing those operations. Taking as an example intra-level collaboration between NGOs that server farmers in the same context, NGOs may work together to convince farmers that digital technology and DL are relevant to their everyday work, to research existing practices and available digital technologies for use cases, and develop the modes and use case media for training farmers.

Frequently Asked Questions (FAQ) about the DLGF and Pathway Mapping Methodology

About DLGF

1. Does the numbering of competence areas and competences indicate a progression?
    a. No, the numbering of the competence areas and the number sequencing of competences within a competence area do not indicate a progression. They are just used to provide a convenient way for referencing.

2. How can my organization make use of the digital literacy global framework?

The DLGF is intended to serve as a framework of reference for different stakeholders, and the specific use differs according to the purpose. Some examples include:

    a. To create educational programs for a target population, for example to meet the needs of developing digital literacy programs for the implementation of a national digital strategy.
    b. For further research and development in order to improve the digital literacy of a target population/sector
    c. As a reference tool to compare against existing digital literacy frameworks/curricula. You can read about the mapping of selected digital literacy frameworks onto the extended DigComp framework in the draft DLGF report. You can read about a specific example of a curriculum being mapped to DigComp here.
    d. As a reference tool to develop a digital literacy implementation plan. You can read about specific implementation examples of a digital literacy framework in the DigComp Gallery of Implementation within European Union member states.

3. How does digital literacy relate to digital citizenship, if at all?
    a. Digital literacy serves as the competence needed for citizens to exercise their rights and responsibilities in the digital world, which is not confined to geopolitical boundaries. As Ferrari (2013) states, “The competences and competence areas that are here defined can be seen as components of e-citizenship, thereby addressing the issue of digital divide. It is in fact recognized that participation in the digital domain is no longer a question of "have" or "have not", but rather an issue of competence” (p. 7).

4. Are there overlaps in the competences listed in the DLGF?
    a. Yes, some competences overlap and are interconnected**.** (For cross-references between competences, please see Annex II of Ferrari’s (2013) *DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe,* or section 4.2 of Vuorikari, Punie, Carretero and Van den Brande’s (2016) *DigComp 2.0: The Digital Competence Framework for Citizens Update Phase 1: The Conceptual Reference Model*) The goal of this project is to propose a global competence framework of digital literacy skills that is sensitive to different developmental contexts. The categorization prioritizes the recognizability and ease of use of the framework by different stakeholders. A consequence of this context-sensitivity is making visible competence areas and competences that might otherwise be missed by stakeholders, particularly those in developing contexts, if embedded within other competence areas and

competences. Thus, it was seen necessary to have additional, standalone competence areas 0 and 6, and competence 5.5 computational thinking.

5. Why is the language used to describe the competence areas and competences so broad? Would it not be better if more specific language is used?
    a. Broad or generic language in the description of competence areas and competences is appropriate for the global framework to ensure that it is relevant for diverse contexts and remain so over time. Stakeholders can make adaptations to generate their own DL frameworks as appropriate for their own contexts by using more specific language.

6. Where can I find more information about the terms used in each competence?
    a. Please refer to the DLGF competence descriptors and glossary on the project website.

About pathway mapping methodology

1. Is it your plan to establish a pathway mapping model for every potential sector in every potential job-related area?
    a. No, the example pathways are illustrations of the methodology. There are many different contexts and use case scenarios, and the project will not attempt to develop a collection. The methodology is to be adopted by relevant stakeholders who will develop their own pathway for their respective sectors and job-related areas.

2. Do all the use case examples come from large states?
    a. No, the use case examples on the website come from large and small states. The use case examples on the website are illustrative as proof of concept that any state can develop use cases and adopt the methodology.

3. Who should use the pathway mapping methodology?
    a. Anyone can select their own use cases as considered relevant and use this method to serve the purpose for which they wish to conduct the mapping. On the other hand, we can see that the most likely adopters of this methodology are those involved in the provision of DL training and those in positions serving policy makers.

Appendix 9a. Agriculture example of use 1

1. Title of example: A farmer in India makes better farming and trading decisions using a mobile phone service.

2. Media upload to use example photos and articles:

3. Links to use example videos, articles and photos:
https://www.youtube.com/playlist?list=PLwiNLdOPoX8oDxwa5p0yTgnyUpdCUXhZo
http://rmlglobal.com/rmldirect.html

4. Brief description of use example (up to 150 words): Farmers' decisions on which crops to plant, and where to sell their produce have significant impact on their profits. An Indian farmer uses a mobile phone service to increase his agricultural yields and profits. He receives four to five text messages daily about short and long-term weather forecasts, market prices of different produce, and effective farmer practices. He can make decisions on which crops to grow. He can also sell his produce directly using the market information obtained, without using the services traditionally provided by middlemen who take crops to the market, thus increasing his income. He can also personalize his texts to receive information about particular crops and particular markets. He often shares information with fellow farmers in person or by forwarding texts using his mobile phone, which he carries all the time.

5. Economic area of this use example: Agriculture

6. Role(s) of the person(s) using the digital technology: Farmer

7. Digital technology used: Mobile phone with voice call and SMS capability

8. Software applications (if applicable): Not applicable

9. Purpose(s) for digital technology use: A farmer with adequate digital literacy and access to the RML service can make better decisions at each crop cycle, including what to grow and where to sell his crops. He will have an advantage over other farmers.

10. Key actions/interactions/transactions in use example:

10a. Actions (without involving other parties): A farmer charges his mobile phone and turns it on. The farmer can carry his phone while working. A farmer uses RML service on his mobile phone to receive SMS information about weather, market prices and farming practices. The farmer receives four to five personalized SMS messages each day. The farmer can compare prices in different markets and decide on a market to sell his product on a particular day. The farmer can organize and delete the SMS messages on the phone.

10b. Interactions (with other parties): The farmer can call other farmers and show information to other farmers.

10c. Transactions (materials/money exchanged with others): Not applicable

11. Additional comments and use example implications: Agricultural competition is fierce in India as there are millions of farmers, and millions more people are expected to become farmers. Digital literacy and technology for each farmer can help boost national income, increase agricultural yields and entice more young people to become farmers. India has cheap voice and text plans and needs sufficient basic mobile phone infrastructure for all.

12. Example competences and proficiency levels

Digital literacy competences related to the use example have been identified below, and beside each identified competence is a brief description of adequate performance for the competence.

Competence area	Competences	Adequate performance level
0. Devices and software operations	0.1 Physical operations of digital devices	A farmer can input a simcard, charge his mobile phone and turn it on. The farmer can carry his phone while working.
	0.2 Identifying software to operate digital devices	
1. Information and data literacy	1.1 Browsing, searching and filtering data, information and digital content	The farmer can receive four to five personalized SMS messages each day about weather, market prices and farming practices. The farmer can navigate the mobile phone interface to find relevant messages.
	1.2 Evaluating data, information and digital content	The farmer can compare prices in different markets and decide on a market to sell his product on a particular day.
	1.3 Managing data, information and digital content	The farmer can organize and delete the SMS messages on the phone.
2. Communication and collaboration	2.1 Interacting through digital technologies	The farmer can call other farmers and show information to other farmers.
	2.2 Sharing through digital technologies	
	2.3 Engaging in citizenship through digital technologies	
	2.4 Collaborating through digital technologies	
	2.5 Netiquette	
	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 technologies	
	5.4 Identifying digital competence gaps	
	5.5 Computational thinking	
6. Career-related competences	6.1 Operating specialized digital technologies for a particular field 6.2 Interpreting data, information and digital content for a particular field	

Appendix 9b. Agriculture example of use 2

1. Title of example: A farmer in Uganda conveniently buys and sells product through a smart phone app.

2. Media upload to use example photos and articles:

3. Links to use example videos, articles and photos:
https://www.youtube.com/playlist?list=PLwiNLdOPoX8q5nbnco2_yv2EaFMcAzYuV
https://play.google.com/store/apps/details?id=com.agromarketday&hl=en
http://www.agromarketday.com

4. Brief description of use example (up to 150 words): Ugandan farmers depend on market days at specific times and places to sell product. Market days create additional costs for farmers in terms of storing product for market days, transporting product to markets, and using middlemen to bring product to markets. Besides, a farmer may not be able to sell all his product on a market day. A smartphone app that connects buyers and sellers directly to decide on price, place, date and time of delivery, eliminates middlemen and physical markets, and may impact farmers' profits. The farmer takes pictures of his product, and uploads that with price, location and a phone number to the app. A buyer scrolls through product listing in the application and if he wants to buy a particular product, he calls the seller to arrange the transaction. The farmer can also post product advertisements for fellow farmers who do not have smart phones.

5. Economic area of this use example: Agriculture

6. Role(s) of the person(s) using the digital technology: Farmer

7. Digital technology used: A smartphone with Internet connectivity

8. Software applications (if applicable): Agro Market Day

9. Purpose(s) for digital technology use: A farmer with adequate digital literacy and access to Agro Market Day can lower costs and reduce reliance on middlemen and physical marketplaces to buy and to sell product. By finding price information from several marketplaces and by posting advertisements, the farmer widens his marketplaces even internationally to buy and sell product. He will have an advantage over other farmers who primarily rely on physical, local marketplaces and middlemen to buy and sell product.

10. Key actions/interactions/transactions in use example:

10a. Actions (without involving other parties): A farmer charges his smart phone and turns it on. The farmer can carry his phone while working. A farmer finds and downloads the Agro Market Day app from the Android store. The farmer registers and logs in with a phone number and password. The farmer takes pictures of his product, and uploads that with price, location and a phone number to the app. A farmer can search for a particular product in the app and view listings. The farmer can also browse agricultural news, view recommendations for where to buy genuine agricultural tools and inputs (herbicides; pesticides; fertilizers; etc.), and can access price information from several marketplaces.

10b. Interactions (with other parties): A buyer can call a seller and arrange time, date and location for transaction. A farmer with a smartphone can cooperate with a farmer without a smartphone to post produce advertisements on the app for the farmer without a smartphone. The farmer with the smartphone can cooperate with the farmer without a smartphone and a buyer to transact.

10c. Transactions (materials/money exchanged with others): Buyers and sellers exchange product and money at an agreed upon date, time and location.

11. Additional comments and use example implications: The government intends agri-business to become a major export for Uganda. Digital literacy and technology for each farmer can help boost national income and exports, and entice more young people to become farmers. However, existing physical marketplace practices may discourage farmers from buying and selling, and discourage others from becoming farmers. In addition, many Ugandans are farmers but the majority of Uganda's farmers are peasants who do not own smart phones. Uganda needs sufficient smart phone saturation and Internet data infrastructure to support widespread farmer smart phone use.

12. Example competences and proficiency levels

Digital literacy competences related to the use example have been identified below, and beside each identified competence is a brief description of adequate performance for the competence.

Competence area	Competences	Adequate performance level
0. Devices and software operations	0.1 Physical operations of digital devices	The farmer can input a simcard, charge his smart phone and turn it on. The farmer can carry his phone while working. The farmer knows how to take a picture with the smart phone camera.
	0.2 Identifying software to operate digital devices	The farmer can set up the smart phone operating system settings and is aware of Internet connectivity.
1. Information and data literacy	1.1 Browsing, searching and filtering data, information and digital content	The farmer is able to search for and download the Agro Market Day app from the Android store. The farmer can search for a particular product in the app and view listings. The farmer can also browse agricultural news and access prices from several markets.
	1.2 Evaluating data, information and digital content	The farmer can compare prices in different markets. A farmer can evaluate recommendations for where to buy genuine agricultural tools and inputs (herbicides; pesticides; fertilizers; etc.) and make purchase decisions.
	1.3 Managing data, information and digital content	The farmer can organize multiple prices for multiple products in multiple marketplaces to buy and to sell.
2. Communication and collaboration	2.1 Interacting through digital technologies	A buyer can call a seller and arrange time, date and location for transaction. The farmer with the smartphone can cooperate with the farmer without a smartphone and a buyer to transact.
	2.2 Sharing through digital technologies	A farmer with a smartphone can cooperate with a farmer without a smartphone to post produce advertisements on the app for the farmer without a smartphone.

	2.3 Engaging in citizenship through digital technologies	
	2.4 Collaborating through digital technologies	
	2.5 Netiquette	
	2.6 Managing digital identity	
3. Digital content creation	3.1 Developing digital content	The farmer takes pictures of his product, and uploads that with price, location and a phone number to the app.
	3.2 Integrating and re-elaborating digital content	
	3.3 Copyright and licences	
	3.4 Programming	
4. Safety	4.1 Protecting devices	The farmer is able to register the app and log in with a phone number and password.
	4.2 Protecting personal data and privacy	The farmer does not disclose password or sensitive information about himself or a fellow farmer.
	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	A farmer without a smartphone identifies the approach to cooperate with a farmer with a smartphone and Agro Market Day to post advertisements of the farmer's product. A farmer decides on whether to post an advertisement for product or to go to a market based on prices at marketplaces.
	5.3 Creatively using digital technologies	
	5.4 Identifying digital competence gaps	
	5.5 Computational thinking	
6. Career-related competences	6.1 Operating specialized digital technologies for a particular field 6.2 Interpreting data, information and digital content for a particular field	

Appendix 9c. Agriculture example of use 3

1. Title of example: A farmer makes a data-driven irrigation system through Arduino

2. Media upload to use example photos and articles:

3. Links to use example videos, articles and photos:
https://www.youtube.com/playlist?list=PLwiNLdOPoX8oZbyD7ORWJSSld7uHUbjM5

4. Brief description of use example (up to 150 words): In the irrigation cycle, farmers need to regularly water their crops and need to manually inspect crops for moisture or use rudimentary tools to check moisture and then gauge the amount of water to add to crops. In addition, people who would like to farm part-time need time-saving automation. Climate change makes forecasting moisture levels more challenging and no existing scheduled irrigation services based on soil moisture exist in the market. Farmers can save water, money and time by building an automatic watering system based on soil conditions. A farmer needs pumps and tanks, moisture sensors planted in soil, wires and transmitters, and a program. A farmer can program when to release water or other inputs, based on time or moisture sensor data. A farmer can conserve water for others and recoup the cost of the infrastructure shortly by saving on water costs. A farmer can substitute fertilizer for water in an irrigation cycle.

5. Economic area of this use example: Agriculture

6. Role(s) of the person(s) using the digital technology: Farmer

7. Digital technology used: Arduino program; USB plug; moisture sensors; wires and transmitters; power supply; (water) tank supply sensor; relay; clock; LCD display; laptop

8. Software applications (if applicable): Arduino program

9. Purpose(s) for digital technology use: A farmer with adequate digital literacy and access to maker tools can lower costs by reducing manpower and water in the irrigation cycle. The farmer becomes less reliant on weather forecasting information. The farmer can recoup costs from an automated irrigation system within months, and save water for other people. He will have an advantage over farmers who do not have immediate and precise data on moisture levels in their soil, who rely on weather forecasts and who rely on manpower for irrigation. The farmer expands the Arduino community for rapid, open-source prototyping.

10. Key actions/interactions/transactions in use example:

10a. Actions (without involving other parties): The farmer needs to purchase appropriate parts. The farmer can follow a connection diagram to assemble irrigation system parts. The farmer needs to plug in Arduino into a laptop via USB and install software. The farmer can define constants on the programming interface, pins, the maximum dryness, and the water delay and water post-delay. The farmer can further setup pins on the programming interface. The farmer can program a loop to read sensor value, compare it, and to take action with water and delay if the soil is too dry. The farmer can refer to sample code in Arduino to learn to program. The farmer can place sensors at appropriate depth in soil and locations in field, and place watering devices at appropriate height and location. The farmer can properly power the system and

read its setting on an LCD display, or on a laptop. The farmer can reprogram the system to irrigate based on time, or to irrigate based on fertilizer not water.

10b. Interactions (with other parties): The farmer can reach out to the Arduino online community to learn to program and to troubleshoot programs, and to Arduino farming community to learn appropriate ways to physically connect an irrigation system and to program it.

10c. Transactions (materials/money exchanged with others):

11. Additional comments and use example implications: Building an automated irrigation system is constrained by the supply of irrigation system parts, and reliable energy to power the system. Automated irrigation seems to work best on small plots and requires greater network connectivity and infrastructure investment to monitor a large field.

12. Example competences and proficiency levels

Digital literacy competences related to the use example have been identified below, and beside each identified competence is a brief description of adequate performance for the competence.

Competence area	Competences	Adequate performance level
0. Devices and software operations	0.1 Physical operations of digital devices	The farmer can properly power the system and read its setting on an LCD display, or on a laptop. The farmer can plug in Arduino into a powered laptop via USB. The farmer can place sensors at appropriate depth in soil and locations in field, and place watering devices at appropriate height and location.
	0.2 Identifying software to operate digital technologies	
1. Information and data literacy	1.1 Browsing, searching and filtering data, information and digital content	
	1.2 Evaluating data, information and digital content	The farmer can compare Arduino and clone specifications to determine which type to purchase.
	1.3 Managing data, information and digital content	The farmer can organize code so that others can read it and comprehend it. A farmer can keep track of times and dates of irrigation.
2. Communication and collaboration	2.1 Interacting through digital technologies	The farmer can reach out to the Arduino online community to learn to program and to troubleshoot programs, and to Arduino farming community to learn appropriate ways to physically connect an irrigation system and to program it.
	2.2 Sharing through digital technologies	
	2.3 Engaging in citizenship through digital technologies	
	2.4 Collaborating through digital technologies	
	2.5 Netiquette	
	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	The farmer can define constants on the programming interface, pins, the maximum dryness, and the water delay and water post-delay. The farmer can program a loop to read sensor value, compare it, and to take action with water and delay if the soil is too dry. The farmer can reprogram the system to irrigate based on time, or to irrigate based on fertilizer not water.
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	The farmer can refer to sample code in Arduino to learn to program. The farmer can reach out to the Arduino online community to learn to program and to troubleshoot programs, and to Arduino farming community to learn appropriate ways to physically connect an irrigation system and to program it.
	5.2 Identifying needs and technological responses	
	5.3 Creatively using digital technologies	
	5.4 Identifying digital competence gaps	
	5.5 Computational thinking	
6. Career-related competences	6.1 Operating specialized digital technologies for a particular field 6.2 Interpreting data, information and digital content for a particular field	

Appendix 10a. e-Government example of use 1

1. Title of example: A supplier submits a bid through the Government of Mauritius e-Procurement System

2. Media upload to use example photos and articles:

3. Links to use example videos, articles and photos:
https://www.youtube.com/playlist?list=PLwiNLdOPoX8obaNhK0R1vXoZ5Pv2fa_uu
https://eproc.publicprocurement.govmu.org/login

4. Brief description of use example (up to 150 words): The government of Mauritius's public bodies require suppliers. Previously, the process of procurement through invitations for bids, bidding and awarding and reporting was offline and was time-consuming and not cost effective. The government of Mauritius has required its public bodies to post all procurement needs in an e-procurement system and its possible suppliers to view and make bids through the system, saving time, reducing costs and increasing transparency. With a compatible system, a bidder to become a government supplier can create a user account and register his organization in the e-procurement system. The bidder can search and view all government invitations for bids, download and upload documents and digital certificates to make bids, and complete bid forms in the e-procurement system. The person can also review and revise bids after submission.

5. Economic area of this use example: Government

6. Role(s) of the person(s) using the digital technology: Bidder for government supplier

7. Digital technology used: PC or laptop; Internet connectivity

8. Software applications (if applicable): Compatible Windows operating system; Office software; compatible Internet browser; Java; Adobe Acrobat Reader; digital signature certificate; anti-virus software; https://eproc.publicprocurement.govmu.org/login

9. Purpose(s) for digital technology use: The Government of Mauritius has been keen to move towards e-procurement in line with its philosophy of sustainable of sustainable procurement. In addition, e-procurement reduces procurement costs and time for the government and is a transparent mechanism for possible suppliers to view all public body procurement needs, reports and awards.

10. Key actions/interactions/transactions in use example:

10a. Actions (without involving other parties): The bidder needs to turn on a computer, open a web browser, and go to the Government of Mauritius e-Procurement System website. From the landing page, the person can scan and skim the content in the How to?, FAQ, Help Desk, and Standard Bidding Docs sections of the website to find relevant information on successful making a bid. He/she can also search YouTube and other websites to find relevant information. The person needs to check the prerequisite hardware and software system requirements against the person's hardware and software system. In addition, he/she needs to respond to the website and web browser prompts and to unblock content, to allow pop-up windows, and to install a Java utility on the bidder's system.

The bidder needs to create a user account for his organization in the e-Procurement system first by clicking on Sign up, reading the Terms of Use and accepting the terms by clicking a check box. The person recognizes required information on a form and provides it. He/she inputs personal information and security information, including Captcha and security questions, on the form through single text boxes.

The bidder checks an email account, including its SPAM folder, to find an email from the e-Procurement system. The person opens the email and clicks on a link to confirm the registration.

The bidder logs in with a username and password. At the user account dashboard, the person registers his organization by first clicking on My Registration. He/she identifies required information and provides it through text boxes, check boxes and dropdown menus. The person can receive guidance on the type or format of acceptable input by clicking the information button beside the input field and seeing a green check mark or a red check mark beside the field. He/she can save information by clicking on the Save button. The bidder uploads required documents.

The bidder can search for, and select relevant invitations for bids (IFBs) from the user account dashboard. The person can preview invitations and bid templates. He/she can interpret action icons in the IFB interface.

The bidder can prepare a bid by downloading IFB documents individually or in a compressed file to a location on the bidder's system. The person can decompress a file comprising documents. He/she can receive and read email updates on the IFB. The person identifies and notes down applicable fees for the IFB. He/she can click on Proceed to go to the next screen in the IFB preparation page sequence.

The bidder can complete required fields for the IFB in a template, through drop down menus, text boxes, adding rows and importing data. The person can receive guidance on successful field input by clicking the information button beside the input field and seeing a green check mark or a red check mark beside the field. He/she uploads specific file types and multiple files into a field. The person saves the form and encrypts data. He/she can choose and attach digital certificates to the template.

The bidder submits the bid and identifies and notes down the hash values of the bid. The person can revise the bid application until the closing date for bid submission by clicking on decrypt.

10b. Interactions (with other parties)

10c. Transactions (materials/money exchanged with others)

11. Additional comments and use example implications: Besides the e-procurement system, the Government of Mauritius provides over a hundred, searchable e-services through its government portal. Mauritius has also implemented the IC3 curriculum for systematic, digital literacy competence training for students in schools and other citizens in community centres. It has used the IC3 curriculum to provide training for specific government e-services. It appears to be operationalizing explicit digital literacy competences and digital literacy use cases.

12. Example competences and proficiency levels

Digital literacy competences related to the use example have been identified below, and beside each identified competence is a brief description of adequate performance for the competence.

Competence area	Competences	Adequate performance level
0. Devices and software operations	0.1 Physical operations of digital devices	The bidder can turn on a computer.
	0.2 Identifying software to operate digital technologies	The bidder can check the prerequisite hardware and software system requirements against the bidder's hardware and software system. The person can respond to the website and web browser prompts and to unblock content, to allow pop-up windows, and to install a Java utility on the person's system. He/she is aware of different file types, and can decompress a file comprising documents. The person recognizes required personal information on the form.
1. Information and data literacy	1.1 Browsing, searching and filtering data, information and digital content	The bidder can open a web browser, and go to the Government of Mauritius e-Procurement System website. From the landing page, the person can scan and skim the content in the How to?, FAQ, Help Desk, and Standard Bidding Docs sections of the website to find relevant information on successfully making a bid. He/she checks an email account, including its SPAM folder, to find an email from the e-Procurement system. The person opens the email and clicks on a link to confirm the registration. He/she can interpret action icons in the IFB interface. The person can search for, and select relevant invitations for bids (IFBs) from the user account dashboard. He/she can click on Proceed to go to the next screen in the IFB preparation page sequence. The person can identify drop down menus, text boxes, adding rows and importing data on forms.
	1.2 Evaluating data, information and digital content	The bidder can preview invitations and bid templates.
	1.3 Managing data, information and digital content	The bidder uploads specific file types and multiple files from his system into an e-Procurement system field. The person can prepare a bid by downloading IFB documents individually or in a compressed file to a location on the bidder's system. He/she can receive and read email updates on the IFB. The person identifies and notes down applicable fees for the IFB.
2. Communication and collaboration	2.1 Interacting through digital technologies	
	2.2 Sharing through digital technologies	
	2.3 Engaging in citizenship through digital technologies	
	2.4 Collaborating through digital technologies	
	2.5 Netiquette	
	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	The bidder inputs personal information and security information, including Captcha and security questions, on the form through single text boxes. The person logs in with a username and password.
	4.2 Protecting personal data and privacy	The bidder can read the Terms of Use and accept the terms by clicking a check box. At the user account dashboard, the person registers his organization by first clicking on My Registration. He/she identifies required information on a form and decides whether or not to input optional information on the form. The person saves the form and encrypts data. He/she can choose and attach digital certificates to the template. The person submits the bid and identifies and notes down the hash values of the bid. He/she can revise the bid application until the closing date for bid submission by clicking on decrypt.
	4.3 Protecting health and well-being	
	4.4 Protecting the environment	
5. Problem solving	5.1 Solving technical problems	The bidder can meet the type or format of acceptable input by clicking the information button beside the input field and seeing a green check mark or a red check mark beside the field.
	5.2 Identifying needs and technological responses	The bidder can search the system website and other websites to find and follow relevant information on how to navigate the system interface.
	5.3 Creatively using digital technologies	
	5.4 Identifying digital competence gaps	
	5.5 Computational thinking	
6. Career-related competences	6.1 Operating specialized digital technologies for a particular field 6.2 Interpreting data, information and digital content for a particular field	

Appendix 10b. e-Government example of use 2

1. Title of example: An entrepreneur registers for a Dubai MyID single sign-on to access required government online services to do business

2. Media upload to use example photos and articles:

3. Links to use example videos, articles and photos:
https://www.youtube.com/playlist?list=PLwiNLdOPoX8rXV6DFOayh-Pk8uYin7QbE
https://myid.dubai.gov.ae/

4. Brief description of use example (up to 150 words): Entrepreneurs in Dubai need to use government services. Previously, when engaging government services online, entrepreneurs would waste time to create a username and password for each government service and to recall a username and password for a service. The government of Dubai has established MyID, a single sign-on comprising one username and password to access over 600 government services on websites and apps. By using a MyID, entrepreneurs can save time and conveniently access required government services, for instance, to obtain a business licence, obtain a tenancy contract and register company vehicles. An entrepreneur registers for a MyID with his fingerprint, and a physical Emirates ID card with a PIN code to access information on the ID. The person registers at a kiosk or at a computer with a smart card reader. He/she inputs email address, password, mobile phone number and ID number on the registration form.

5. Economic area of this use example: Government

6. Role(s) of the person(s) using the digital technology: Entrepreneur

7. Digital technology used: Emirates ID card; kiosk or PC or laptop with smart-card reader; mobile or smart phone; Internet connectivity

8. Software applications (if applicable): Internet browser; government service apps

9. Purpose(s) for digital technology use: The government of Dubai has a Smart Dubai vision to make Dubai the happiest city on Earth, and the MyID is an initiative to realize this vision through technological innovation. The government of Dubai also facilitates entrepreneurship, reduces paper reliance and physical visits to government departments.

10. Key actions/interactions/transactions in use example:

10a. Actions (without involving other parties): An entrepreneur needs to keep a physical Emirates ID card and set and recall a PIN to access information from the card. The person needs to visit a kiosk within the city to register or if the person doesn't want to visit a kiosk, the person needs to turn on a computer, attach a smart card reader, open a web browser, and input the webpage to register. He/she needs to insert the Emirates ID properly into the kiosk or the smart card reader. On the registration webpage, the person identifies the options to change language and to find more information, including kiosk locations through Google maps, and contact information telephone number and email address. He/she registers a new account by inputting an existing email address and a password twice in text boxes. The person inputs an

existing mobile phone number and Emirates ID number in the form, and meets format input requirements for the password, mobile phone number and ID. He/she needs to advance to the next screen in the registration process, and input personal information, including physical address, and fingerprint scan. The person needs to note down his MyID username and password to access government online services. At a government service login, he/she can click on the MyID icon and enter username and password in a form on a separate page, and then close the page.

10b. Interactions (with other parties):

10c. Transactions (materials/money exchanged with others):

11. Additional comments and use example implications:

12. Example competences and proficiency levels

Digital literacy competences related to the use example have been identified below, and beside each identified competence is a brief description of adequate performance for the competence.

Competence area	Competences	Adequate performance level
0. Devices and software operations	0.1 Physical operations of digital devices	The entrepreneur can visit a kiosk within the city to register or if the entrepreneur doesn't want to visit a kiosk, the entrepreneur can turn on a computer, and attach a smart card reader. The person can insert the Emirates ID into the kiosk or the smart card reader. He/she can place finger on sensor for scanning.
	0.2 Identifying software to operate digital devices	The entrepreneur can respond to prompts for Emirates ID card insertion and fingerprint scanning. The person is aware of Internet connectivity, proper and successful card insertion and appropriate and successful fingerprint scanning.
1. Information and data literacy	1.1 Browsing, searching and filtering data, information and digital content	The entrepreneur can open a web browser, and input the registration webpage address in the appropriate box in the browser. The person can identify and interpret icons and buttons, input boxes and forms on the interface. He/she can advance to the next screen in the registration process. The person can browse and select relevant government services. At a government service login, he/she can click on the MyID icon.
	1.2 Evaluating data, information and digital content	
	1.3 Managing data, information and digital content	The entrepreneur can note down his Emirates ID PIN to register for MyID. The person can note down hi MyID username and password to access government online services.

2. Communication and collaboration	2.1 Interacting through digital technologies	
	2.2 Sharing through digital technologies	
	2.3 Engaging in citizenship through digital technologies	
	2.4 Collaborating through digital technologies	
	2.5 Netiquette	
	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	An entrepreneur can keep a physical Emirates ID card and set and recall a PIN to access information from the card. The person can enter username and password in a form on a separate page to access a government service, and then close the sign on page.
	4.2 Protecting personal data and privacy	The entrepreneur can register a new account by selecting and inputting an existing email address and a password twice in text boxes. The person can select and input an existing mobile phone number and Emirates ID number in the form. He/she can select and input personal information, including physical address, and fingerprint scan.
	4.3 Protecting health and well-being	
	4.4 Protecting the environment	
5. Problem solving	5.1 Solving technical problems	The entrepreneur can follow and meet format input requirements for the password, mobile phone number and ID.
	5.2 Identifying needs and technological responses	On the registration webpage, the entrepreneur can identify the options to change language and to find more information, including kiosk locations through Google maps, and contact information telephone number and email address.
	5.3 Creatively using digital technologies	
	5.4 Identifying digital competence gaps	
	5.5 Computational thinking	
6. Career-related competences	6.1 Operating specialized digital technologies for a particular field 6.2 Interpreting data, information and digital content for a particular field	

Appendix 11. Proposed digital literacy competence areas and competences from in-depth consultation

Competence area	Competences
0. Fundamentals of hardware and software	0.1 Basic knowledge of hardware such as turning on/off and charging, locking devices 0.2 Basic knowledge of software such as user account and password management, login, and how to do privacy settings, etc.
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 in citizenship through digital technologies 2.4 Collaborating through digital technologies 2.5 Netiquette 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 licenses 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 technologies 5.4 Identifying digital competence gaps
6. Career-related competences	6. Career-related competences refers to the knowledge and skills required to operate specialized hardware/software for a particular field, such as engineering design software and hardware tools, or the use of learning management systems to deliver fully online or blended courses.

Note: Underscored competence areas and competences are proposed additions to the existing DigComp 2.0 competences.

Appendix 12. Proposed digital literacy competence areas and competences from online consultation

Competence areas and Competences*	Descriptions
0. Hardware and software operations**	
0.1 Physical operations of digital technologies**	To identify and use the functions and features of the hardware tools and technologies
0.2 Identifying data, information and digital content to operate digital technologies**	To know and understand the data, information, and/or digital content that are needed to operate software tools and technologies
1. Information and data literacy	
1.1 Browsing, searching and filtering data, information and digital content	To articulate information needs, to search for data, information and content in digital environments, to access them and to navigate between them. To create and update personal search strategies.
1.2 Evaluating data, information and digital content	To analyse, compare and critically evaluate the credibility and reliability of sources of data, information and digital content. To analyse, interpret and critically evaluate the data, information and digital content.
1.3 Managing data, information and digital content	To organise, store and retrieve data, information and content in digital environments. To organise and process them in a structured environment.
2. Communication and collaboration	
2.1 Interacting through digital technologies	To interact through a variety of digital technologies and to understand appropriate digital communication means for a given context.
2.2 Sharing through digital technologies	To share data, information and digital content with others through appropriate digital technologies. To act as an intermediary, to know about referencing and attribution practices.
2.3 Engaging in citizenship through digital technologies	To participate in society through the use of public and private digital services. To seek opportunities for self-empowerment and for participatory citizenship through appropriate digital technologies.
2.4 Collaborating through digital technologies	To use digital tools and technologies for collaborative processes, and for co-construction and co-creation of resources and knowledge.
2.5 Netiquette	To be aware of behavioural norms and know-how while using digital technologies and interacting in digital environments. To adapt communication strategies to the specific audience and to be aware of cultural and generational diversity in digital environments.
2.6 Managing digital identity	To create and manage one or multiple digital identities, to be able to protect one's own reputation, to deal with the data that one produces through several digital tools, environments and services.
3. Digital content creation	
3.1 Developing digital content	To create and edit digital content in different formats, to express oneself through digital means.
3.2 Integrating and re-elaborating digital content	To modify, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant content and knowledge.
3.3 Copyright and licences	To understand how copyright and licences apply to data, information and digital content.
3.4 Programming	To plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.

4. Safety	
4.1 Protecting devices	To protect devices and digital content, and to understand risks and threats in digital environments. To know about safety and security measures and to have due regard to reliability and privacy.
4.2 Protecting personal data and privacy	To protect personal data and privacy in digital environments. To understand how to use and share personally identifiable information while being able to protect oneself and others from damages. To understand that digital services use a "Privacy policy" to inform how personal data is used.
4.3 Protecting health and well-being	To be able to avoid health-risks and threats to physical and psychological well-being while using digital technologies. To be able to protect oneself and others from possible dangers in digital environments (e.g. cyber bullying). To be aware of digital technologies for social well-being and social inclusion.
4.4 Protecting the environment	To be aware of the environmental impact of digital technologies and their use.
5. Problem solving	
5.1 Solving technical problems	To identify technical problems when operating devices and using digital environments, and to solve them (from trouble-shooting to solving more complex problems).
5.2 Identifying needs and technological responses	To assess needs and to identify, evaluate, select and use digital tools and possible technological responses to solve them. To adjust and customise digital environments to personal needs (e.g. accessibility).
5.3 Creatively using digital technologies	To use digital tools and technologies to create knowledge and to innovate processes and products. To engage individually and collectively in cognitive processing to understand and resolve conceptual problems and problem situations in digital environments.
5.4 Identifying digital competence gaps	To understand where one's own digital competence needs to be improved or updated. To be able to support others with their digital competence development. To seek opportunities for self-development and to keep up-to-date with the digital evolution.
5.5 Computational thinking**	To process a computable problem into sequential and logical steps as a solution for human and computer systems.
6. Career-related competences**	
6.1 Operating specialized digital technologies for a particular field**	To identify and use specialized digital tools and technologies for a particular field
6.2 Interpreting data, information and digital content for a particular field**	To understand, analyse and evaluate specialized data, information and digital content for a particular field within a digital environment

Notes: * In competence areas and competences column, text in bold indicates competence areas and plain text indicates competences.
The competence areas, competences and their definitions in this table are as defined in the DigComp 2.1 framework except for those indicated by **.

Appendix 13. Methodological notes from DLGF consultation stages

In-depth consultation

The first consultation stage in developing the proposed extensions to DigComp 2.0 was an in-depth consultation with a select and representative group of experts from different parts of the world. The objective of the first consultation stage was to validate the methodological approach for extending DigComp 2.0 from a high-income country, Euro-centric framework to a proposed global framework; and to enrich the proposed global framework, particularly with more use examples.

The in-depth consultation comprised a preview phase and an interview phase. For the preview phase, we developed a draft executive summary of the DLGF for participants to read. Participants were asked to take notes and if possible to send their comments and questions to the research team before the interview phase. For the interview phase, we developed an interview protocol comprising 11 questions about 1) DL requirements and conditions for youths and adults in participants' local contexts, and about DL frameworks in the local contexts; 2) views on the proposed DLGF framework competence areas and competences; 3) views on the proposed pathway mapping methodology in the framework to guide countries, sectors, groups and individuals to develop strategies and plans for advancing their own DL development goals and pathways. The interview questions were piloted for clarity and for a 45-minute timing. They were sent to experts for their preview upon confirmation of in-depth consultation participation. The interviews were conducted over VOIP software and video-recorded with the option of only audio-recording.

An expert list was developed of 97 possible candidates for the in-depth consultation. Experts constitute the categories of UIS GAML members, associates recommended from the UIS GAML members and the project team, authors and other participants in developing the DL frameworks collected for the mapping of DL frameworks, people and companies associated with the use examples collected for the project, authors of DL research literature collected for the mapping of use examples. The sample of expert participants were further categorized by country and region to target for the in-depth consultation at least two experts from two countries from six regions: Africa; Asia; EU; High-income nations outside the EU; Latin America; and Middle East and North Africa. Contact information of emails and social media handles for the experts was found through online searches when necessary. A letter explaining the consultation stage and inviting experts to participate was sent to candidates, and a reminder letter was sent to candidates with no response to the initial letter. Of the 24 people who had agreed to participate, 13 interviews were conducted with 15 people. The list of interviewees for the in-depth consultation can be found in the Appendix.

The contents of experts' responses were analyzed per interview question, and by country, to identify consensus, and recurring and outlying concerns which the project team could evaluate and address in further developing the proposed framework's competence areas and competences, and the pathway mapping methodology, for the global level. The findings of the analysis can be found in the Appendix.

Online consultation

The second consultation stage in developing the proposed extensions to DigComp was an online consultation with the objective to finalize the proposed extensions to DigComp in view of revisions based on the in-depth consultation responses, and through a large number of experts from different countries.

For the online consultation, we developed a short presentation on the proposed DLGF, and a 22-item survey, to seek experts' feedback on the competence areas and competences in the proposed DLGF, the pathway mapping methodology, and some information about each expert and the expert's organization. Experts could refer to the presentation and resources on the website when completing the survey. Regarding survey items for the CAs and competences in the proposed DLGF, experts were asked to respond through five-point Likert scale items about the clarity of the competences and CAs in general, and the importance of including each CA and its competences, including the proposed CA0 and CA6 extensions to the existing DigComp 2.0 CAs. Experts were asked to respond specifically to the importance of the proposed computational thinking competence. They were also asked to respond to the proposed definition of digital competence, comprising knowledge, skills and attitude. Each Likert scale item included an open response section for additional comments. Furthermore, through an open response item, experts were given an opportunity to suggest any missing competence to the proposed framework. Regarding the pathway mapping methodology, experts were asked to respond through five-point Likert scale items about the usefulness and ease of use of the pathway mapping methodology and use cases in the respondent's context. Through an open response item, experts were given an opportunity to suggest any use cases for pathway mapping from their local context. Regarding experts' organizational information, experts were asked multiple choice questions about the nature of their organizations, and their organizations' interest in using the DLGF. Through open response items, experts were also asked about their roles in their organizations and the countries which their organizations represent.

To facilitate continuity and continued partnership in the validation process, expert participants of the in-depth consultation were invited by email to participate in the online consultation. The expert candidates who were invited to the in-depth consultation were also invited by email to participate in the online consultation. To reach a broader and more numerous group of stakeholders beyond the in-depth consultation sample, the online consultation was promoted through the social media of Twitter and Facebook, and the research information management systems (RIMs) of Academia.edu, LinkedIn and Researchgate. The online consultation was promoted through the research teams' personal social media and RIM accounts, and the UIS GAML social media account. To reach DL experts and practitioners, within Facebook, the online consultation invitation was posted to groups directly related to the DL frameworks found in this report, and found through a Facebook group search using the term, "digital literacy". It was also posted on Facebook to ICT in education practitioner groups known to the research team. Within Twitter, the online consultation invitation was posted to the digital literacy hashtag and related hashtags found within tweets with the digital literacy hashtag. It was also posted on Twitter to ICT in education practitioner hashtags known to the research team. DL experts known to the research team or UIS GAML were personally invited to the online consultation through email. The complete list of Facebook groups and Twitter hashtags used to promote the online consultation are as follows:

Twitter hashtags:

#digitalliteracy
#educators
#medialiteracy
#elearning
#digcit
#edchat
#edtech
#adechat
#coetail
#isedchat
#aussieed
#21clhk
#learning2
#21CLTeachMeet
#techcoach
#adeedu
#DigComp
#openbadges
#coding
#DigitalDivide
#Data4SDGs
#SDG4
#dcf
#computationalthinking
#digitalcompetence
#DLCS4AL
#infolit
#medialit

Facebook groups

i. Digital literacy verified Facebook first page results
   1. Common Sense Media
   2. Digital Empowerment Foundation (India)
   3. Media Literacy Council (Singapore)
   4. Pradhan Mantri Gramin Digital Saksharta Abhiyan

ii. Digital literacy unverified Facebook first page results
   1. Digital literacy Thailand
   2. IC3 Digital Literacy Certification
   3. Digital Skills EU
   4. ICDL Thailand
   5. ECDL - ICDL Certification
   6. ICDL - Arabia
   7. ICDL - Asia
   8. ICDL - Pacific
   9. ICDL - Egypt
   10. ECDL Foundation

iii. Incidental and personal unverified Facebook pages
   1. JISC
   2. HK Flipp Educators
   3. Learning 2
   4. 21CLHK

Social media messages

- The UNESCO Institute of Statistics is seeking comments on a draft Digital Literacy Global Framework. You are invited to give your expert opinion as educators & digital literacy experts through an online consultation: http://gaml.cite.hku.hk
- Tell Us What You Think! Online consultation on global framework of reference for digital literacy skills
- We need your feedback on new framework to pave the way data on digital literacy
- Help us bridge the #DigitalDivide. Online consultation on new framework to produce #SDG4 data on digital literacy
- How should we measure digital literacy? Tell us what you think w/ online consultation
- We need data to overcome the #DigitalDivide. Tell us what you think in a consultation on a new global framework for SDG4
- How can we measure digital literacy skills globally while reflecting the unique circumstances of countries? Tell us what you think w/online consultation on a new framework for SDG4 data
- We have been reviewing how countries at all income levels measure digital literacy skills. Tell us what you think w/ online consultation
- Help us spread the word about online consultation on how to measure digital literacy skills globally to help monitor & achieve SDG4

The survey administered through Survey Monkey received 52 total responses, of which 31 are complete and 21 are incomplete. The 21 incomplete surveys are unusable in data analysis as experts either did not provide responses on the survey beyond the initial positive reply for participation or did not provide any open responses and missed complete sections of the survey. To increase the number of completed surveys, experts who did not complete the survey but had agreed to be acknowledged in the final report by leaving their names were reminded to complete the survey once by email or social media message. The survey was open from March 8, 2018 to April 8, 2018. The survey could be taken anonymously and the list of acknowledged expert participants for the online consultation is found in the Appendix.

To capture and analyze diverse contexts, experts were asked about their organizations and countries represented. Based on answers to these questions, each expert was categorized according to geographical region and country-income-level. The profile of respondents according to World Bank income classifications is:

- High-income country experts: 12
- Middle-upper income country experts: 9
- Middle-lower income country experts: 2
- Multinational, multi-income country experts (either wrote international, or listed more than one country and the countries are in different income groups): 8

In terms of region classifications, the profile of experts is:

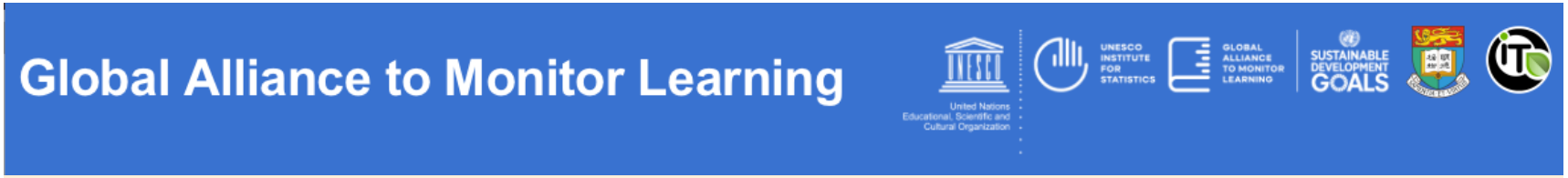
- Africa experts: 3
- Asia experts: 7
- European Union (including Central Asia and former Soviet Union) experts: 7
- Latin America experts: 4
- Multi-region (listed countries in more than one region): 8
- N/A (Australia, and unclassified): 2

Limitations and areas for further research

The online consultation sampling methods have several limitations in reaching experts from diverse developmental contexts: first, the survey was administered and promoted exclusively in English language; second, the use of online promotion methods do not account for experts in regions and countries, such as in lower-middle income or low-income countries, where there may be insufficient ICT infrastructure to reliably access the social media, the RIMs and the survey; third, the use of the specific social media and RIMs do not account for experts in regions and countries where such social media and RIMs may be unavailable or not used widely; and fourth, the online consultation invitation posting to DL-related groups and hashtags, and to RIMs may be accessed primarily by DL researchers and practitioners in mainstream education and training.

In general, the project's sampling methods for DL frameworks, use case examples and consultation experts have the limitation of selecting for English-language frameworks and use cases, and English-speaking experts. For the proposed framework to be validated as global-level may involve reaching out to a greater number of non-English-speaking experts, especially as these experts may be found in developing contexts. Furthermore, the sampling methods in this project required extensive use of networked technologies that do not account for non-digital frameworks and use case examples, and for experts without reliable access to connectivity. We recommend scaling the discussion on the proposed framework and changing the mode of discussion, not least by engaging non-English speaking experts in face-to-face mode, such as in focus groups.

Appendix 14. In-depth consultation findings for proposed Digital Literacy Global Framework



Developing a global framework of reference on digital literacy

Findings from the In-depth Consultation by Interview Question

Global Alliance to Monitor Learning

Digital Literacy Global Framework (DLGF)

1. With reference to youths (15-24 age range) and adults in the context of the regions that you are professionally active in, is digital literacy important for them in their everyday life, including employment?

1. Digital literacy necessary for basic computer software (Mauritius, Mexico, Morocco, Tunisia)
2. Internet connectivity is a must (all respondents)
3. Popular economic areas referred to by respondents:
    1. Education (Australia x2; Brazil; Canada; Czech Republic; Mauritius; Mexico; Morocco; West and Central Africa)
    2. Service (China; Mexico)
4. Urban and rural areas (all respondents but Philippines)
5. Digital literacy importance gap between youth and elderly (Czech Republic, Mauritius, Tunisia)
6. Digital literacy is important if people could get electricity and connectivity, but people don't use ICTs because they can't use ICTs (West and Central Africa).

Global Alliance to Monitor Learning

Digital Literacy Global Framework (DLGF)

2. Looking ahead to the next 3 to 5 years, do you think there will be increased demands on the DL competences of youths and adults in your country because of advances in technology, economic development, or workplace and social changes?

1. Forces that will bring new DL demands:
    1. E-commerce (Brazil; Mauritius)
    2. Economic expansion (Brazil; China; Morocco; Philippines)
    3. ICT infrastructure (Brazil; Mexico)
    4. Policy (Brazil; Czech Republic; Morocco; Tunisia)
    5. Youth practices with technology (West and Central Africa)
2. Competences that will become more important:
    1. Robotics and maker culture (Canada; Czech Republic)
    2. Programming (Brazil; Canada)
    3. Digital security and safety (Brazil; Mauritius)

Global Alliance to Monitor Learning

Digital Literacy Global Framework (DLGF)

3. DL frameworks can be used for different purposes, such as to guide training provisions, and staff selection in employment situations, or to engage in entrepreneurial innovations. Are you aware of any digital literacy frameworks used in the regions that you are professionally active in or familiar with? (Besides Digcomp)

1. Existence of ICT competence frameworks or ICT competence components of broader frameworks (Brazil; Canada; China; Mauritius; Morocco; Philippines)
    1. Enterprise frameworks: ICDL; IC3 (Mauritius)
    2. Implementation of more than one framework (Brazil; Canada)
2. Adoption or development of frameworks
    1. Government (Brazil; Canada; China; Mauritius; Morocco; Philippines)
    2. Private sector (Mauritius)
3. Demographic groups or sectors targeted by DL frameworks:
    1. Education (Brazil; Canada; China; Mauritius; Morocco; Philippines)
    2. Public at large (Brazil; Mauritius)

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Digital Literacy Global Framework (DLGF)

3 (cont[d.]) DL frameworks can be used for different purposes, such as to guide training provisions, and staff selection in employment situations, or to engage in entrepreneurial innovations. Are you aware of any digital literacy frameworks used in the regions that you are professionally active in or familiar with? (Besides Digcomp)

1. Areas where DL frameworks were implemented:
    1. Curriculum and assessment (Brazil; Canada; Mauritius; Morocco)
2. Inadequacies of DL frameworks in guiding digital literacy development:
    1. Implementation problems: No national vision or mandate for digital literacy development; cannot break silo-centric approach to DL development (Canada; Tunisia)
    2. Not grounded in people's basic, ICT infrastructure needs (West and Central Africa)
    3. Obsolete or irrelevant frameworks (Mauritius; Morocco)

Global Alliance to Monitor Learning

Digital Literacy Global Framework (DLGF)

4. We will go through the competences in Table 1 and ask you to rate each competence regarding its importance for future development in the country and sector contexts that you are knowledgeable about. (0: not relevant; 1: low relevance; 2: relevant and most people have attained this competence; 3: relevant and most people have not attained this competence.)

- 0: competences 0.1, 0.2 (Canada; China -- people should have attained these competences before entering sector)
- 1: competences 2.5 (Australia ID13); 3.2 (Mexico); 3.4 (Philippines); 4.1 (Australia ID13); 4.3 (Mexico); 4.4 (Australia ID13); 5.1 (Australia ID13); 5.2 (Mexico; Morocco); 5.2 (Australia ID13); 5.4 (Mexico; Morocco); Competence areas 5 and 6 (Morocco)
- 2-3: most competences for most countries

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Digital Literacy Global Framework (DLGF)

4. (Cont'd.) We will go through the competences in Table 1 and ask you to rate each competence regarding its importance for future development in the country and sector contexts that you are knowledgeable about. (0: not relevant; 1: low relevance; 2: relevant and most people have attained this competence; 3: relevant and most people have not attained this competence.)

Demographic reasons given for challenges in rating relevance of competences due to differences related to:

- Age (Brazil)
- Formal/informal economic sectors (Mexico)
- ICT Infrastructure diversity (West and Central Africa)
- Region (Brazil)
- Socio-economic status (Brazil; Czech Republic)
- Underdevelopment of public and private sector initiatives to develop DL (Tunisia)

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Digital Literacy Global Framework (DLGF)

4. (Cont'd.) We will go through the competences in Table 1 and ask you to rate each competence regarding its importance for future development in the country and sector contexts that you are knowledgeable about. (0: not relevant; 1: low relevance; 2: relevant and most people have attained this competence; 3: relevant and most people have not attained this competence.)

Cognitive and framework reasons given for challenges in rating relevance of competences due to differences related to:

- Broad language of competences (Brazil; Australia ID11; Australia ID13)
- People's English language proficiency (Czech Republic)
- Tacit/implicit knowledge (Mexico; Tunisia)
- Task complexity (Brazil; Czech Republic; Tunisia; Australia ID11)
- Technological complexity (Czech Republic)
- **Unconvinced by CA6 (Australia ID13)**
- Unknown or emergent technologies (Brazil; Canada)

Extended competence descriptions and competence proficiency levels may address concerns about broad language, task complexity and technological complexity

Global Alliance to Monitor Learning

Digital Literacy Global Framework (DLGF)

5. Are there any missing DL competences that you think should be included in the framework?

1. Framework is comprehensive (China; Philippines)
2. Competences should address cultural values and human heritage (Czech Republic)
3. Competences to address sex and cyberbullying (Mexico)
4. A safety competence of child protection and non-exploitation (West and Central Africa)
5. Ethics, empathy and community engagement (Canada)
6. Computational thinking (Canada; Tunisia; Australia ID11)
7. Algorithmic thinking for CA0 to replace computational thinking in CA5 (Australia ID13)

- Responses 2-5 apparently point to a need for the literacy/competence framework to include the attitude and value dimensions, in addition to knowledge and skills.
- On the other hand, while attitudes are important and should be a part of digital competence assessment, what constitutes an attitude can be confusing and attitude shouldn't be merged with knowledge and skills as competence (Australia x2).

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Digital Literacy Global Framework (DLGF)

6. Do you think a DL global framework such as the current draft should be promoted to support DL developments in the countries/sectors that you are familiar with?
a. If yes, which are the key sectors/stakeholders that would be the key beneficiaries from having such a framework, and what strategies should be used to promote it?

Stakeholders

- Auto industry (Canada; Morocco)
- Engineering and manufacturing (Morocco)
- Teachers and educators (Australia ID13; Canada, China, Mauritius; West and Central Africa)

Promotion strategies

- Through influential people in key sectors/stakeholder groups (Canada; Morocco)
- Leveraging the UNESCO brand and social media (Canada)

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Digital Literacy Global Framework (DLGF)

7. Do you have any questions about the pathway mapping methodology or the use case exemplars?

1. Micro-credentialing and digital passports: Could these pathways become micro-credentials that can be used to recognize individual or organizational efforts to achieve specific levels of digital literacy? (Canada) Are we talking here about a digital identity, digital passport so at least populations or communities or individuals that need support to identify those who have the skills and competences and those who don't? (Tunisia)
2. Do all the examples come from large states? (Mauritius)
3. Does the numbering of competence areas and competences in competence areas indicate a progression? (Philippines)
4. Is it your plan to establish a pathway mapping model for every potential sector in every potential job related area? (Canada; UK)
5. Do all the examples come from large states? (How does a small state influence the pathway? Easier to disseminate into everyday life and replicate in a small state) (Tunisia)
6. Implementation trajectory: Will nations lead the methodology implementation? How to translate the framework into national strategies, and to implement these strategies through formal and informal education? (Tunisia)
7. Do devices include mobile phones? (Tunisia)

Global Alliance to Monitor Learning

Digital Literacy Global Framework (DLGF)

7. Do you have any questions about the pathway mapping methodology or the use case exemplars?

Transcript: Is it a bottom-up process, of mapping the field according to existing notions of use? If it is, then that's fine to get a sense of whether the overarching framework is applicable and how it fits into different contexts. To me, the use case examples seem to have been selected for a socio-political purpose, which was to prove that digital technologies are relevant to fields where you wouldn't normally expect them to be; in fact, fields, literally. I can see the political and marketing purpose going on: don't just think that technology is about computer programming or office work and education. The individual cases were not ones that I could personally identify with. I work in an office in an academic research. I could see their purpose, and having a broader set of unusual cases, I can see it. I'm not sure about the next steps of it, to me it still seemed more illustrative than analytic, if that makes sense. But maybe I'm missing something from it. (Australia)

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Digital Literacy Global Framework (DLGF)

8. Do you think that this mapping methodology can in fact help stakeholders in different country and sector contexts identify their pathway for DL development that is most suited to their specific needs? If yes, how would this mapping methodology help the countries/sectors that you are familiar with?

Yes

- Facilitate international and inter-sector comparison and benchmarking (Brazil; Canada; Philippines)
- The global framework is internationally credible and contemporary (Mauritius)
- By supporting contextualization through use of video and stories (Australia ID13; Canada; Czech Republic)

No

- Depends on who is implementing the methodology for the local context (China)
- Useful more for illustrative purpose than for analytic process (Australia ID13)

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Digital Literacy Global Framework (DLGF)

9. Are there specific economic areas and/or demographic groups in your country/sector context that would likely benefit from adopting such a pathway to plan their strategic digital literacy development?

- Auto sector (Canada)
- Atypical areas but not in areas where computing is clearly prevalent and useful (Australia ID13)
- Civic organizations (Brazil)
- Education (Brazil; Canada; China; Czech Republic; West and Central Africa)
- Elderly (Czech Republic)
- Government (Brazil; Morocco; Tunisia)
- Marginalized people e.g. homeless (Canada)
- Park, marine and environment (Canada)

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Digital Literacy Global Framework (DLGF)

10. What difficulties do you foresee in popularizing/implementing a pathway mapping methodology? Do you have suggestions on how the mapping methodology can be effectively disseminated?

Difficulties

- Comparability and assessment at global level: b/c of generic competence language (Brazil); b/c of ICT infrastructure digital divides (Australia x2)
- Contextualization, generalization from or lack of awareness of use cases (Australia ID13; China; Czech Republic; Philippines; Tunisia)
- Need for training and development organization (Philippines)
- Negative attitudes (Philippines)
- Ownership (Brazil; Canada)
- Use case focus is too complex or unclear; the work in Education is much less clear cut than the use case examples in Agriculture and Finance (West and Central Africa)

Suggestions

- Collaborating and consensus building through many stakeholder groups (Brazil; Czech Republic)
- Identifying sector influencers (Canada)
- Leverage UNESCO credibility (Mauritius)
- Recommendations for use (Australia ID13; Tunisia)

Global Alliance to Monitor Learning

Digital Literacy Global Framework (DLGF)

10. What difficulties do you foresee in popularizing/implementing a pathway mapping methodology? Do you have suggestions on how the mapping methodology can be effectively disseminated? (Cont'd.)

Transcript: In terms of dissemination, I think it would have to be dynamic and engaging so video, multimedia would be the way to go. I think the challenges will be if the purpose is to generate buy-in, at one level the value is people somehow seeing some relation to their own lives in the case studies. The challenge will be that people might be saying "yes, but that's not me." "Yes, I'm a farmer but I do a different type of farming and this sort of weather monitoring is not..." I think the danger with the case study approach is that people will see it as specific, and fail to generalize from the case study to their own experience. If there are ways to support people to see that these are examples and this is the way to generalize, that would be useful. I don't know what that would look like. Practically speaking, some people will look at the cases and say, "That's great, but I can't afford it!" I'm not sure how you deal with that unless it's used as a vehicle to build ground support and industry funding for the actual infrastructure and equipment. In some cases people will not see it as relevant to them even though it would be nice if they could do it. (Australia)

Global Alliance to Monitor Learning

Digital Literacy Global Framework (DLGF)

11. Do you have one current digital literacy use case example /sector contexts and one future use case example from an important sector in your country that we could map and include as a pathway in the DLGF?

Current use cases

- Education sector: Open education resources (OER) for teachers (Brazil); ICT's for instruction (West and Central Africa)
- Financial sector: Alipay and Wechat pay (China); SBM mobile banking and MCB juice app (Mauritius)
- Government sector: Mra.mu e-tax filing and 130 government e-service (Mauritius); B3 police statement government e-service (Tunisia); Tax and civil document e-services (Morocco)

Future use cases

- Education sector: ICT's for system management of textbooks and human resources (West and Central Africa)
- Financial sector: female entrepreneurialism (Mauritius)
- Government sector: an increasing number of government e-services developed by diverse departments (Tunisia)

Summary of in-depth consultation responses to the proposed competence areas and competences

The addition of CA0, *Devices and software operations*, elicited actionable feedback from experts. Originally labeled, *Fundamentals of hardware and software* and comprising two competences, *Basic knowledge of hardware such as turning on/off and charging, locking devices*, and *Basic knowledge of software such as user account and password management, login, and how to do privacy settings, etc*., a European Union expert recommended making the language of the proposed CA and competences more consistent with the language of the DigComp CAs and competences by removing possible reference to proficiency levels and specific digital technologies, and making use of Bloom's taxonomy action verbs in writing competence descriptions. As a result, the original CA0 label was changed to *Hardware and software operations*, the 0.1 label was changed to *Physical operations of digital technologies*, and 0.2 was changed to *Identifying data, information and digital content to operate digital technologies*. The descriptions for the CA0 competences were written using low-level Bloom's taxonomy verbs to reflect the fundamental or basic nature of the CA and competences. Being more consistent with the language of DigComp would become a guiding principle of developing additional CAs and competences to the DLGF. The revised CA0 and competence labels and descriptions were advanced to the online consultation stage for validation.

In addition, the Canadian and Chinese experts consider CA0 to be unimportant to their contexts' future development, because people should have attained the competences before entering their economic sectors. Some experts find its competences to be logically better subsumed under competences within the existing DigComp framework. However, the Mauritius, Mexico, Morocco and Tunisia experts referred to a "basic" digital literacy as necessary for their country contexts, and some experts recognize the importance of making these competences explicit and visible to advance DL development. The expert for countries in Western and Central, Sub-Saharan Africa said that DL would be important for her context were electricity and connectivity accessible, and stated that people in her context do not use ICTs because people cannot use ICTs.

When asked if there were any missing DL competences to be added to the framework, the most cited missing competence (n=3) was computational thinking. When two Australian experts were asked about the possible addition of computational thinking to the one expert thought computational thinking should not be visible as it could be subsumed under competence 3.4 programming. Besides, computational thinking could be a highly specialized competence and may not fall within everyday competences. Another expert thought that computational thinking could be a fad, and recommended computational thinking with algorithmic thinking as an everyday competence for CA0. As a result, computational thinking was added to the proposed framework as competence 5.5 in CA5, Problem solving, with the aims of making it distinct from programming competence 3.4 and focusing on computational thinking's everyday application. Hence, the competence was advanced to the online consultation stage for validation.

The addition of CA6, Career-related competences, did not draw as much expert support as CA0, not least because some experts viewed the competence area as highly specialized, and out of place amongst more everyday competences. Furthermore, CA6 may not have drawn as much salient feedback because it did not contain language consistent with that of DigComp, and it did not originally comprise discrete competences, but this description under competences:

Career-related competences refers to the knowledge and skills required to operate specialized hardware/software for a particular field, such as engineering design software and hardware tools, or the use of learning management systems to deliver fully online or blended courses.

To elicit more salient feedback from experts for the online consultation stage, CA6 was developed to include discrete competences that maintain its higher-order thinking and specialized scope, first by dissecting the existing CA6 description into competence 6.1 *Operating specialized digital technologies for a particular field*, and second, adding an additional competence 6.2 *Interpreting data, information and digital content for a particular field*. The competences and their descriptions were written with language more consistent with existing Digcomp competences and used high-level Bloom's taxonomy action verbs. These competences were to be validated at the online consultation stage.

Some experts experienced difficulty in determining the importance of competences to their local contexts because of the generic language of competences. To address the issue of generic language of competences for the online consultation stage, we developed competence descriptions which build on existing descriptions and definitions from Digcomp.

Appendix 15. Online consultation findings

Q3: I am clear about the competence areas and competences in the proposed framework.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	38.71%	12
Agree (2)	45.16%	14
Neither agree nor disagree (3)	16.13%	5
Disagree (4)	0.00%	0
Strongly disagree (5)	0.00%	0
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	3.00	2.00	1.77	0.71

Q4: Competence area 0 (Hardware and software operations) and its 2 competences should be included in the DLGF and specified separately as in the proposed framework.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	35.48%	11
Agree (2)	45.16%	14
Neither agree nor disagree (3)	12.90%	4
Disagree (4)	3.23%	1
Strongly disagree (5)	3.23%	1
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	5.00	2.00	1.94	0.95

Q5: It is important for the DLGF to include Competence area 1 (Information and data literacy) and its 3 competences.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	70.97%	22
Agree (2)	29.03%	9
Neither agree nor disagree (3)	0.00%	0
Disagree (4)	0.00%	0
Strongly disagree (5)	0.00%	0
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	2.00	1.00	1.29	0.45

Q6: It is important for the DLGF to include Competence area 2 (Communication and collaboration) and its 6 competences.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	74.19%	23
Agree (2)	19.35%	6
Neither agree nor disagree (3)	3.23%	1
Disagree (4)	3.23%	1
Strongly disagree (5)	0.00%	0
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	4.00	1.00	1.35	0.70

Q7: It is important for the DLGF to include Competence area 3 (Digital content creation) and its 4 competences.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	54.84%	17
Agree (2)	25.81%	8
Neither agree nor disagree (3)	16.13%	5
Disagree (4)	3.23%	1
Strongly disagree (5)	0.00%	0
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	4.00	1.00	1.68	0.86

Q8: It is important for the DLGF to include Competence area 4 (Safety) and its 4 competences.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	58.06%	18
Agree (2)	32.26%	10
Neither agree nor disagree (3)	6.45%	2
Disagree (4)	0.00%	0
Strongly disagree (5)	3.23%	1
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	5.00	1.00	1.58	0.87

Q9: It is important for the DLGF to include Competence area 5 (Problem solving) and its 5 competences.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	51.61%	16
Agree (2)	32.26%	10
Neither agree nor disagree (3)	9.68%	3
Disagree (4)	3.23%	1
Strongly disagree (5)	3.23%	1
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	5.00	1.00	1.74	0.98

Q10: It is important for the DLGF to include computational thinking as a competence.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	45.16%	14
Agree (2)	25.81%	8
Neither agree nor disagree (3)	16.13%	5
Disagree (4)	12.90%	4
Strongly disagree (5)	0.00%	0
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	4.00	2.00	1.97	1.06

Q11: It is important for the DLGF to include Competence area 6 (Career-related competences) and its 2 competences.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	25.81%	8
Agree (2)	41.94%	13
Neither agree nor disagree (3)	12.90%	4
Disagree (4)	12.90%	4
Strongly disagree (5)	6.45%	2
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	5.00	2.00	2.32	1.17

Q12: A competence should include knowledge, skills and attitudes rather than knowledge and skills.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	45.16%	14
Agree (2)	32.26%	10
Neither agree nor disagree (3)	9.68%	3
Disagree (4)	12.90%	4
Strongly disagree (5)	0.00%	0
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	4.00	2.00	1.90	1.03

Q14: The pathway mapping methodology provides a useful method to make use of the DLGF in a local/national context.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	16.13%	5
Agree (2)	61.29%	19
Neither agree nor disagree (3)	16.13%	5
Disagree (4)	6.45%	2
Strongly disagree (5)	0.00%	0
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	4.00	2.00	2.13	0.75

Q15: I find it easy to select the appropriate use case scenarios for digital literacy for constructing the digital literacy development pathway for my own organization.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	9.68%	3
Agree (2)	48.39%	15
Neither agree nor disagree (3)	29.03%	9
Disagree (4)	12.90%	4
Strongly disagree (5)	0.00%	0
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	4.00	2.00	2.45	0.84

Q16: The steps described in the pathway mapping methodology are easy to follow.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	9.68%	3
Agree (2)	41.94%	13
Neither agree nor disagree (3)	25.81%	8
Disagree (4)	22.58%	7
Strongly disagree (5)	0.00%	0
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	4.00	2.00	2.61	0.94

Q18: What is the nature of the organization do you belong to? (Check all that applies)

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
National body (1)	29.03%	9
International agency (2)	19.35%	6
Non-Government Organization (3)	16.13%	5
Private firm (4)	12.90%	4
Other (please specify) (5)	32.26%	10
Total Respondents: 31		

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	5.00	3.00	3.00	1.59

Q19: What is/are the business nature of your organization?

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Education/training (1)	74.19%	23
Assessment (2)	12.90%	4
Technology (3)	29.03%	9
Research (4)	48.39%	15
Policy development/implementation (5)	22.58%	7
Other (please specify) (6)	3.23%	1
Total Respondents: 31		

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	6.00	3.00	2.69	1.55

Q22: My organization is interested in making use of the digital literacy global framework (DLGF), if available.

Answered: 31 Skipped: 0

ANSWER CHOICES	RESPONSES	
Strongly agree (1)	32.26%	10
Agree (2)	48.39%	15
Neither agree nor disagree (3)	19.35%	6
Disagree (4)	0.00%	0
Strongly disagree (5)	0.00%	0
TOTAL		31

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	3.00	2.00	1.87	0.71

Summary of online consultation responses to the proposed competence areas and competences

The findings from the online consultation showed that 35.48% and 45.16% of experts strongly agreed and agreed respectively with the importance of competence area 0 and its two competences being included and specified separately as in the proposed framework. All disagreement (n=1) came from a multinational or multi-income, multi-country expert and all strong disagreement (n=1) came from a high-income country expert. All lower-middle income experts either agreed (n=1) or strongly agreed (n=1). In the open responses, a high-income country expert expressed a view that hardware and software are antiquated terms, and a high-income country expert and an upper-middle income country expert suggested simplifying the competence 0.2 label to speak clearly to software. Therefore, we changed the label of CA0 from *Hardware and software operations* to *Devices and software operations*, and changed the labels of competences 0.1 and 0.2 to be consistent in the use of the term devices and to focus on software in 0.2.

As regards the proposed computational thinking competence, 45.16% and 25.18% of experts strongly agreed and agreed respectively with the importance of its inclusion in the DLGF. All lower-middle income country experts (n=2) strongly agreed. All disagreement (n=4) came from high-income country experts (n=3) and an upper-middle income country experts (n=1). In the open responses, two, high-income country experts were agreeable to the inclusion of computational thinking as a competence upon further articulation of specific skills and attitudes, and use examples for the competence that differentiates it from a programming competence. For the open responses to all questions, only high-income country experts (n=8) and a multinational or multi-income country expert (n=1) associated computational thinking with programming or coding.

With regard to the inclusion of the computational thinking competence in CA5, 51.61% and 32.26% of experts strongly agreed and agreed respectively with the importance of the inclusion of CA5 and its five competences in the DLGF. All strong disagreement (n=1) came from a high-income country expert, and disagreement (n=1) from a multinational or multi-income country expert. In the open responses, two, high-income country experts expressed concern with the inclusion of computational thinking in CA5, as a matter of their associating computational thinking with programming.

The findings from the online consultation showed that 25.81% and 41.94% of experts strongly agreed and agreed respectively with the importance of including CA6 and its two competences in the DLGF. Out of the seven, proposed CAs, CA6 showed the least number of experts (n=21) who either agreed or strongly agreed with the importance of the inclusion of the CA and its competences in the DLGF. All lower-middle income country experts (n=2) agreed. Three high-income country experts and one high-income country expert disagreed and strongly disagreed respectively; and one multinational, multi-income expert and one upper-middle income expert disagreed and strongly disagreed respectively. In the open responses, it seems some experts view the scope of the CA as too narrow, redundant or disconnected for a global framework. Some experts suggest the CA could benefit from greater specification of examples of career-related skills and roles.

To further clarify the framework after the online consultation, summaries of each competence area were developed for CA0 and CA6 which build on the existing competence area descriptions from Digcomp. A CA description is a summary of competence labels.

As regards the proposed pathway mapping methodology, 16.13% and 61.29% of experts strongly agreed and agreed respectively to the statement that the pathway mapping methodology provides a useful method to make use of the DLGF in a local/national context. However, 9.68% and 41.94% of experts

strongly agreed and agreed respectively to finding it easy to follow the steps described in the pathway mapping methodology. In open responses, experts see the limitation of the specific use context examples presented in the proposed pathway mapping methodology as a limitation in their understanding the pathway mapping methodology.

Appendix 16. Draft executive summary of Digital Literacy Global Framework (DLGF) for in-depth consultation

Hong Kong University Centre for Information Technology in Education for the Global Alliance to Monitor Learning / UNESCO Institute for Statistics

Background

Sustainable Development Goal 4 (SDG 4) represents the international education agenda for the period 2015-2030. Target 4.4, which is one of its ten targets, focuses on "*relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship*" among youth and adults. In the absence of many indicators that can compare similar and relevant job-related skills across countries at different levels of development, the monitoring framework for target 4.4 focuses on ICT and digital literacy skills. Thematic indicator 4.4.2 is the "*percentage of youth/adults who have achieved at least a minimum level of proficiency in digital literacy skills.*"

Just as with many other learning outcome indicators in the SDG 4 monitoring agenda, there is no consensus on what digital literacy skills are and how they could be monitored. To address this gap, the UNESCO Institute for Statistics (UIS), which is the custodian agency for collecting data on SDG 4 has set up the Global Alliance to Monitor Learning (GAML), under which the task force for indicator 4.4.2 has set as its first task the development of a global framework for digital literacy skills. UIS has contracted for this purpose the Hong Kong University Centre for Information Technology in Education to propose a framework and consult with stakeholders around the world. This is the executive summary of the draft digital literacy global framework, which is the document to be consulted in the first half of 2018.

Definition

In reviewing DL-related frameworks collected from government and non-government agencies, we find that these frameworks' digital literacy definitions always include the specification of competence areas and tools. For the purposes of this project, we adopt the following definition of digital literacy:

Digital literacy is the ability to define, access, manage, integrate, communicate, evaluate and create information safely and appropriately through digital technologies and networked devices for participation in economic and social life. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy, data literacy and media literacy.

Approach

We have taken as our starting point the European Commission's Digital Competence Framework for Citizens (DigComp 2.0), as it has been developed on the basis of extensive research and consultation in the EU countries. The proposed framework is underpinned by two sets of mapping to the DigComp 2.0 framework: (1) DL curriculum and assessment frameworks at cross-national, national and sub-national levels, and (2) use examples of digital literacy in major areas of social economic activity. The frameworks and use examples have been collected from countries in the following regions: Asia; Sub-Saharan Africa; Middle East and North Africa; Latin America; European Union; High-income countries outside European Union.

Mapping of Digital Literacy Frameworks

We have conducted English-language searches for DL frameworks in the targeted regions using country names in combination with search terms, including digital, literacy, competences, skills, ICT, computer and information. We have found information about specific DL frameworks being adopted in 43 countries from

high- to low-income levels according to World Bank ratings. We have selected seven national frameworks that are most clearly written with regard to the competency areas as well as three popular enterprise frameworks found in numerous countries to map to the DigComp 2.0 framework. We have developed a low-inference coding scheme to map competences from the identified DL frameworks to DigComp 2.0. The mapping results show that there are two competences referred to in these frameworks that are qualitatively different from any competences defined in DigComp 2.0, which warrant the creation of new competence areas in the global framework. The first proposed area relates to the basic operations of digital devices and is labelled *Fundamentals of hardware and software*. The second relates to specific careers or career opportunities and is labelled *Career-related competences*. Table 1 shows the DigComp 2.0 competences and areas with the proposed competences and competence areas. We found only one national framework that has a full coverage of all competences presented in DigComp 2.0. While we note the differences in the origin and intended usage of the analyzed frameworks, we do not observe any specific pattern of competence coverage that are specifically related to the state of economic development of the originating countries. We also did not find any DL framework that provided such systematic descriptions of different proficiency levels as DigComp 2.1.

Table 1. The proposed digital literacy competence areas and competences for further consultation

Competence area	Competences
0. Fundamentals of hardware and software	0.1 Basic knowledge of hardware such as turning on/off and charging, locking devices 0.2 Basic knowledge of software such as user account and password management, login, and how to do privacy settings, etc.
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 in citizenship through digital technologies 2.4 Collaborating through digital technologies 2.5 Netiquette 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 licenses 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 technologies 5.4 Identifying digital competence gaps
6. Career-related competences	6. Career-related competences refers to the knowledge and skills required to operate specialized hardware/software for a particular field, such as engineering design software and hardware tools, or the use of learning management systems to deliver fully online or blended courses.

Note: Underscored competence areas and competences are proposed additions to the existing DigComp 2.0 competence areas and competences.

Mapping Examples of Digital Literacy Use in Everyday Contexts

DigComp 2.1 includes use examples to provide vivid illustrations of the different levels of proficiency required to adequately address the DL competence needed under different authentic situations. The usefulness of these European examples motivated us to gather everyday digital literacy use examples under different cultural, economic and technological settings as an additional empirical input to our development of the DLGF. We have focused our search for use examples in low- and middle- income countries, and in major economic or employment areas: agriculture, energy, finance, and transportation. We used English-language searches in a snowball process on Google and YouTube to find news articles, videos, non-governmental organizational reports, software applications and company websites with rich information on everyday digital technology use in the four selected economic areas. Of the 42 initial use examples, we selected 17 highly detailed examples to map to DigComp 2.1. We identified 13 general functions of smartphone and basic mobile phone use grounded in these use examples, and mapped the DL competences required to operationalize these functions to the proposed framework presented in Table 1.

An important finding of the mapping exercise is that even though the 17 use examples covered all four economic sectors involving the use of both mobile and smart phones, the DL competences mapped covered only half (11) of the 22 competences in the framework. The absence of 11 of the competences in this mapping exercise suggests that they are not immediately necessary or useful to everyday operations in a wide range of developmental contexts. Basic technical and interactive competences seem more immediately necessary. Another important finding is that the competences associated with the examples of use are strongly differentiated based on the nature of the device used.

Pathways for Digital Literacy Development and Assessment

For the purpose of designing curricula and assessment, we recommend that DL frameworks should include descriptions of proficiency and examples of use. We further recommend that in determining the competences to emphasize and proficiency levels to target in a country's DL strategic development plan, a country should adopt a pathway mapping methodology as developed and included in this proposed DLGF. By connecting the DLGF with meaningful illustrative examples of use suited to the social, economic and cultural development needs of specific countries through the mapping methodology, stakeholders in different countries can have a systematic contextualized approach to identify appropriate DL development goals and strategies.

Based on examples of use that are meaningful for employment, decent jobs and entrepreneurship in specific sectors, and sensitive to the relevant ICT context, one can design meaningful pathways of digital literacy development. In other words, the developmental context determines the pathway to digital literacy and by comparing developmental contexts, a country can make decisions to change its context and to show progress on pathways to digital literacy. Each pathway comprises competences and task contexts grounded in examples of use. A pathway may involve more than one device type, and more than one sector, representing how in some developmental contexts, digital literacy competence for employment, decent jobs and entrepreneurship is closely linked with a set of interrelated sectors and technologies. A pathway can be further elaborated for different roles in an economic sector.

Next steps

This draft document is the first step in the process:

- It adds two new competences to the DigComp 2.0 framework that are likely to be relevant in low- and middle-income countries: basic operations of digital devices and career-related competences; and
- It proposes a methodology for further extending the breadth and depth of the framework in these two competences.

The second step is to consult in depth with a select and representative group of experts from different parts of the world with the objective to:

- validate the methodological approach for extending DigComp 2.0 from a high-income country-centric to a proposed global framework; and
- enrich the proposed global framework, especially with respect to more use examples

The third step is to then consult widely with a large number of experts from different countries to finalize the proposed framework. Following that, existing assessments will be mapped on to the framework and gaps will be identified in assessments that would need to be addressed in the next phase of the project.

Appendix 17. In-depth consultation interview

Thank you very much for agreeing to participate in this interview on the draft Digital Literacy Global Framework, which the UNESCO Institute of Statistics commissioned our team to develop.

The aim of this interview is to seek your expert views on the requirements on digital literacy competence for youths (ages 15-24) and adults in countries and regions where you are professionally active, whether there are existing digital literacy frameworks in use in these places, and your views on the draft Digital Literacy Global Framework that we have developed. Your input will help the research team to validate and refine the draft framework, and to find out if the pathway mapping methodology would be an easy and feasible way for use by people in different contexts to guide their digital literacy development plans. For more information, please read the draft executive summary, the digital literacy use exemplars and the pathway mapping methodology on the project website.

Digital Literacy in the local context and Local Framework Questions

1. With reference to youths (15-24 age range) and adults in the context of the regions that you are professionally active in, is digital literacy important for them in their everyday life, including employment?
    a. If yes,
        i. Can you please comment on which DL competences are required?
        ii. What specific ICTs are required?
        iii. In which economic areas?
        iv. Are you speaking urban areas or rural areas?
        v. Do you have a particular demographic group in mind (e.g youths; productive age; near-retirement age; retirees)?
    b. If no,
        i. What are the most important economic areas and employment roles for the local population?
        ii. What ICTs do people generally use for their everyday lives, inside and outside of work?
        iii. Is your local population generally urban or rural?

2. Looking ahead to the next 3 to 5 years, do you think there will be increased demands on the DL competences of youths and adults in your country because of advances in technology, economic development, or workplace and social changes?
    a. If yes,
        i. What do you foresee the advances in your country to be?
        ii. Can you please elaborate on what these digital competence demands will be?

3. DL frameworks can be used for different purposes, such as to guide training provisions, and staff selection in employment situations, or to engage in entrepreneurial innovations. Are you aware of any digital literacy frameworks used in the regions that you are professionally active in or familiar with?

a. If yes, how many frameworks are operating in the region that you are most familiar with? Are any of these open for access? If available, could you please provide the links to the source(s)?
    i. What are the sources of these frameworks? Do you know how these were developed?
    ii. Which demographic group and economic area(s) do(es) the framework(s) target and for what purposes?
    iii. How is/are these frameworks being used in everyday practices?
    iv. Do you think that the DL competences of the majority of the youth and adult populations are adequate with reference to those in regions that you are familiar with?
    v. Do you think the DL frameworks you identified are adequate in guiding DL developments in the regions they serve?
b. If no, do you see any specific need for a framework to guide digital literacy developments in your country, for government and different sectors of economy and individuals for employment, economic and social well-being?
    i. If yes, can you comment on which demographic groups and economic areas in your country are most in need of a digital literacy framework, and what kind of need should the framework serve?
    ii. If no, why not? Is it because the digital literacy competence of the people in your country is already adequate, or because you feel that a digital literacy framework would not affect digital literacy development in the society at large? Please elaborate.

Global Framework Questions

In the executive summary, please review Table 1: The proposed digital literacy competence areas and competences. You may also consult the DigComp 2.1 document, which is available at https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/DigComp-21-digital-competence-framework-citizens-eight-proficiency-levels-and-examples-use

1. From an employer perspective, we would like you to go through the competences in Table 1 and for you to rate each competence for its importance for future development in your country and sector contexts that you are knowledgeable about. 0 indicates not relevant; 1 low relevance; 2 relevant and most people have attained this competence; 3 relevant and most people have not attained this competence. – to 3 – relevant, but most people do not have this competence.

2. Are there any missing DL competences that you think should be included in the framework?

3. Do you think a digital literacy global framework such as the draft that we have proposed should be promoted to support DL developments in the countries/sectors that you are familiar with?
    c. If yes,
        i. Which are the key sectors/stakeholders that would be the key beneficiaries from having such a framework, and what strategies should be used to promote it?

Table 17.6. Proposed digital literacy competence areas and competences

Competence area	Competences
0. Fundamentals of hardware and software	0.1 Basic knowledge of hardware such as turning on/off and charging, locking devices 0.2 Basic knowledge of software such as user account and password management, login, and how to do privacy settings, etc.
1. nformation 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 in citizenship through digital technologies 2.4 Collaborating through digital technologies 2.5 Netiquette 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 licenses 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 technologies 5.4 Identifying digital competence gaps
6. Career-related competences	6. Career-related competences refers to the knowledge and skills required to operate specialized hardware/software for a particular field, such as engineering design software and hardware tools, or the use of learning management systems to deliver fully online or blended courses.

Note: Underscored competence areas and competences are proposed additions to the existing DigComp 2.1 competences.

Pathway Mapping Methodology Questions

In order that the DLGF can be a useful resource to guide digital literacy development and assessment for diverse country and sector developmental contexts, the project team has developed a pathway mapping methodology to guide countries, sectors, groups and individuals to develop strategies and plans for advancing their own digital literacy development goals and pathways. A pathway for digital literacy development can be developed through comparing use case exemplars for specific targeted contexts to identify the difference in digital literacy competence required for adequate performance between the popular current use exemplar and the use exemplar to aspire to.

In the project website, we have illustrated the methodology through showing how three use scenarios of DL, each involving a farmer at different levels of DL use sophistication, can be mapped to the competences in the DLGF. The difference in DL between the existing popular use and the targeted, more advanced use scenario would be the priority focus for DL development for the specific context.

Referring to the use case exemplars and the pathway mapping methodology page on the website, we would like to get your feedback on the following:

1. Do you have any questions about the pathway mapping methodology or the use case exemplars?
2. Do you think that this mapping methodology can in fact help stakeholders in different country and sector contexts identify their pathway for DL development most suited to their specific needs? How would this mapping methodology help the countries/sectors that you are familiar with?
3. Are there specific economic areas and/or demographic groups in your country/sector context that would likely benefit from adopting such a pathway to plan their strategic digital literacy development?
4. What difficulties do you foresee in popularizing/implementing a pathway mapping methodology? Do you have suggestions on how the mapping methodology can be effectively disseminated?
5. "Do you have one current digital literacy use case example /sector contexts and one future use case example from an important sector in your country that we could map and include as a pathway in the DLGF?"
    d. If yes, would you mind sharing the URL or relevant resource with us? Thank you!

Appendix 18. List of in-depth consultation interviewees

We gratefully acknowledge all the experts who have contributed to the in-depth consultation.

Title	Name (Surname, first name)	Region	Country	Organization
Dr.	Barbosa, Alexandre	Latin America	Brazil	CETIC- Brazil
Dr.	Bender, Penelope	Sub-Saharan Africa	West and Central Africa	Burda Education
Mr.	Cagasan Jr., Louie	Asia	Philippines	HKU CITE
Dr.	Černochová, Miroslava	EU	Czechia	Faculty of Education, Charles University
Dr.	Chehidi, Tarek	Middle East and North Africa	Tunisia	Global E-schools and Communities Initiative
Ms.	DeWaard, Helen	High-income countries outside EU	Canada	Media Smarts
Mr.	El Hajir, Aziz	Middle East and North Africa	Morocco	Islamic Educational, Scientific and Cultural Organization
Ms.	Farias Herrera, Liliana	Latin America	Mexico	HKU CITE
Dr.	Fraillon, Julian	High-income countries outside EU	Australia	Australian Council for Educational Research
Mr.	Liang, Leming	Asia	China	HKU CITE
Mr.	Maudarbocus, Iqbal	Sub-Saharan Africa	Mauritius	National Computer Board Management Team
Dr.	Punie, Yves	EU	Spain	European Commission Joint Research Centre
Mr.	Raja Toolseeya, Ashwin	Sub-Saharan Africa	Mauritius	National Computer Board Management Team
Dr.	Schulz, Wolfram	High-income countries outside EU	Australia	Australian Council for Educational Research
Dr.	Vuorikari, Riina	EU	Spain	Information Society Unit of the European Commission's in-house science service JRC-IPTS

Appendix 19. Online consultation survey

About the Digital Literacy Competences in the Proposed Global Framework

Indicate your agreement with the following statements.

1. I am clear about the competence areas and competences in the proposed framework.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

    Please provide comments, if any, on the clarity of the information in the proposed Digital Literacy Competence Global Framework (DLGF), and /suggestions on its improvement. (100 character maximum textbox provided)

2. Competence area 0 (Hardware and software operations) and its 2 competences should be included in the DLGF and specified separately as in the proposed framework.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

    Please write any additional comments or suggestions, if any, on competences related to hardware and software operations. (100 character maximum textbox provided)

3. It is important for the DLGF to include Competence area 1 (Information and data literacy) and its 3 competences.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

    Please write any additional comments or suggestions, if any, on competences related to Information and data literacy. (100 character maximum textbox provided)

4. It is important for the DLGF to include Competence area 2 (Communication and collaboration) and its 6 competences.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

    Please write any additional comments or suggestions, if any, on competences related to ccommunication and collaboration. (100 character maximum textbox provided)

5. It is important for the DLGF to include Competence area 3 (Digital content creation) and its 4 competences.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

    Please write any additional comments or suggestions, if any, on competences related to digital content creation. (100 character maximum textbox provided)

6. It is important for the DLGF to include Competence area 4 (Safety) and its 4 competences.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

    Please write any additional comments or suggestions, if any, on competences related to safety. (100 character maximum textbox provided)

7. It is important for the DLGF to include Competence area 5 (Problem solving) and its 5 competences.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

    Please write any additional comments or suggestions, if any, on competences related to problem solving. (100 character maximum textbox provided)

8. It is important for the DLGF to include computational thinking as a competence.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

    Please write any additional comments or suggestions, if any, on computational thinking. (100 character maximum textbox provided)

9. It is important for the DLGF to include Competence area 6 (Career-related competences) and its 2 competences.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

    Please write any additional comments or suggestions, if any, on career-related competences. (100 character maximum textbox provided)

10. A competence should include knowledge, skills and attitudes rather than knowledge and skills.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

    Please write below any additional comments or suggestions, if any, on the inclusion of dispositions (attitudes and values) in the definition of what constitutes a competence. (100 character maximum textbox provided)

11. Is there any digital literacy competence that is missing from the above DLGF? Please use the textbox below to enter any missing digital literacy competence that should be included in the global framework, and any other suggestions that you may have.

About the Pathway Mapping Methodology and Use Case Scenarios

Indicate your agreement with the following statements.

12. The pathway mapping methodology provides a useful method to make use of the DLGF in a local/national context.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

13. I find it easy to select the appropriate use case scenarios for digital literacy for constructing the digital literacy development pathway for my own organization.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

14. The steps described in the pathway mapping methodology are easy to follow.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

    Please write below any additional comments or suggestions on the pathway mapping methodology. (100 characters max textbox provided)

15. Is/are there any specific use case scenario(s) that you would be interested in using for mapping a pathway that is relevant to you? If so, please provide us with the relevant URLs or descriptions in the text box below.

About You and Your Organization

16. What is the nature of the organization do you belong to? (Check all that applies)
    a. National Body
    b. International agency
    c. Non-Government Organization
    d. Private firm
    e. Other _____

17. What is/are the business nature of your organization? (Check all that applies)
    a. Education/training
    b. Assessment
    c. Technology
    d. Research
    e. Policy development/implementation
    f. Other _____

18. What is your role in the organization? _____

19. My organization is interested in making use of the digital literacy global framework (DLGF), if available.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree

    Please provide a brief description for the likely uses for the DLGF. (100 characters max textbox provided.)

Appendix 20. List of acknowledged online consultation respondents

We gratefully acknowledge all the experts who have contributed to the online consultation. Below are the individuals who have given us permission to acknowledge them in this report.

In alphabetical order, SURNAME given name, organization (if applicable)

AINLEY John
BEECKMANS Ivan, NIST International School
BOCCONI Stefania, National Research Council of Italy, Institute for Educational Technology (CNR-ITD)
BOULANGER Victor
CERNOCHOVA Miroslava
CHEW Han Ei, PhD, RySense Ltd Singapore
CHIOCCARIELLO Augusto, National Research Council, Institute for Educational Technology (CNR-ITD)
COBO Cristóbal, PhD
DENG Xiaoyin, UNESCO
FARIAS Liliana
HARRIS Matt, Ed.D.
HASTEDT Dirk
ISAACS Shafika, Independent Consultant, South Africa
JACK Meshingo
MARSCHALL Carla
MCCARTHY Andrew
MCHUGH Sean
MOGOS Ariam, UNICEF
PETIT Thomas
QUAICOE James Sunney
SINYOLO Dennis, Education International
SMITH Alexander, GSMA
SOMAROO Ritesh
VALENZUELA GONZALEZ Susana
ZUNIGA CESPEDES Magaly