

A DRAFT REPORT ON

A global framework of reference on digital literacy skills for indicator 4.4.2:

Percentage of youth/adults who have achieved at least a minimum
level of proficiency in digital literacy skills

Commissioned by

Global Alliance to Monitor Learning (GAML)

United Nations Educational, Scientific and Cultural Organization

UNESCO Institute for Statistics

March 2018

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Introduction

This draft report for the Digital Literacy Global Framework (DLGF for short) is submitted to UNESCO Institute for Statistics (UIS) by CITE for the purpose of seeking consultation feedback from experts.

The objective of the DLGF project is to develop a global framework that can serve as the foundation for thematic indicator 4.4.2. To achieve this objective, CITE will undertake a synthesis of existing regional, national and sub-national frameworks to identify skills and competencies 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 rich or poor and (ii) over time.

Background

Sustainable Development Goal target 4.4 aims to “substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.” Digital literacy encompasses some of these relevant skills, but the concept has not been under-developed for a global context, particularly for adult learners. As presently constituted, few countries have the information and communications technologies (ICTs) to develop curriculum for and to assess digital literacy, but all countries should be able to develop curriculum and to assess digital literacy within their means.

Objectives

This project aims to develop a framework of digital literacy skills and competencies that enables countries and United Nations (UN) entities to monitor and assess digital literacy in adult populations and to meet Sustainable Development Goal 4. Sustainable Development Goal target 4.4 aims to “substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.” Per thematic indicator 4.4.2, “Percentage of youth/adults who have achieved at least a minimum level of proficiency in digital literacy skills” digital literacy encompasses some of these relevant skills, but the concept has been under-developed for a global context, particularly for adult learners. This report proposes a framework of digital literacy skills and competences for the monitoring, assessment and further development of digital literacy that is sensitive to different developmental contexts.

Approach

We have taken as our starting point the European Commission’s Digital Competence Framework for Citizens (DigComp 2.1), as it has been developed on the basis of extensive research and consultation in the EU countries. The proposed framework is an extension of DigComp, underpinned by two sets of mapping to the DigComp 2.1 framework: (1) digital literacy curriculum and assessment frameworks at cross-national, national and sub-national levels, and (2) use examples of digital literacy in major sectors of social economic activities. The frameworks and use examples have been collected from countries in the following regions: Asia; Sub-Saharan Africa; Middle East and North Africa; European Union; High-income countries outside European Union; Latin America. This report starts with a definition for digital literacy adopted in this project, followed by a description of the methods and the findings from the mapping exercise. The proposed framework is then presented. This report concludes with the questions for consultation.

Definitions of Digital Literacy

The importance of digital literacy is evidenced by the many national and regional efforts to develop and implement DL frameworks and strategic plans to bolster citizens' digital literacy. However, the reasons for countries to adopt and develop frameworks vary. For example, Young (2016) stated that Korea had wanted to enhance public officials' digital literacy to increase the efficiency, transparency and delivery of services to citizens through public administration. Oman, on the other hand, had adopted the Microsoft Digital Literacy Curriculum to bridge the digital divide, to bolster its ICT industry and to build young citizens' employment capacity (Sultanate of Oman Information Technology Authority, 2008). Likewise, definitions for DL also differ. Some consider DL 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 (i.e. information and communications technology) 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.

UNESCO commissioned the present project to develop a DL framework in order to serve as the foundation for thematic indicator 4.4.2, to guide the further development of monitoring and assessment plans for digital literacy. Hence, the resulting framework need to be operationalizable to serve this purpose. In reviewing the DL related frameworks collected from government and non-government agencies, we find that DL related frameworks always include the specification of competence areas and tools. Further, within the competence areas dimension, "define", "access", "manage", "integrate", "communicate", "evaluate" and "create" were recurring consistently. Based on the purpose and our observations, we propose the following as the definition we use for 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.

Mapping of Digital Literacy Frameworks

As mentioned earlier, DigComp 2.1 is selected as the base framework for mapping the collected frameworks and digital literacy use examples in our research process. It has been synthesized from other, major digital literacy frameworks, and has undergone a long, consultation and development process. It presents a comprehensive view on digital literacy and competences from economically advanced countries. This framework has also been further deployed to guide curriculum and assessment development in education. The specific competence areas and competences included in DigComp 2.1 is presented in Table 1.

Table 1. DigComp 2.1 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 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

Digital Literacy Frameworks Included in the Analysis

We conducted systematic searches 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 the fact that our searchers are constrained to information available in the English language. Nonetheless, we were able to find information about specific digital literacy frameworks being adopted in 43 countries (Appendix 1). Table 2 shows the distribution of the 43 countries across geographical regions and income level of the country according to the World Bank rating. Figure 1 presents the geographic locations of the countries for which the frameworks have been collected.

Table 2. Distribution of the 43 countries across geographical regions and income levels.

Geographical region	Income level of country				Total
	High	Medium high	Medium low	Low	
1. East, South & Southeast Asia	1	2	4		7
2. Central & West Asia		1	4		5
3. Middle East	4	2	2		8
4. Africa		3	6	3	12
5. Caribbean & Pacific Islands	1	2			3
6. Central & South America	1	4			5
7. North America	1				1
8. Europe	1	1			2
Total	9	15	16	3	43

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



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 43 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, those developed at the national (including sub-national) level, and others that are adopting the training courses and assessment framework developed 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. Only 11 countries have developed their own national frameworks. Three of these countries have multiple national frameworks: Canada has 2, India has 2, and Kenya has 4.
5. Of the 11 countries that have developed their own national frameworks, 7 also has adopted enterprise frameworks. The 4 countries that we have not found information about their adoption of any enterprise frameworks are Hungary, India, Jordan, and Korea.
6. 32 out of the 43 countries do not have a national DL framework, and only enterprise frameworks are found to be in use in these countries. There are only three enterprise frameworks found to be in use in the 39 countries that have adopted them in our sample of countries. These three frameworks are from the following providers, in decreasing order of popularity:
 - International Computer Drivers Licence (ICDL)¹—adopted in 26 countries;
 - Certiport Internet and Computing Core Certification (IC³)²—adopted in 13 countries;
 - Microsoft Digital Literacy Standard Curriculum³—adopted in 11 countries.
7. Of the 39 countries that have adopted enterprise frameworks, eight have adopted two of the three frameworks (Colombia, Egypt, Indonesia, Oman, Qatar, Rwanda, Thailand, UAE), and two countries have adopted all three frameworks (Malaysia and Vietnam).

The above analysis of the distribution of the various types of frameworks found in the 43 countries included in our framework indicate that multinational commercial enterprises have a major role in influencing the digital literacy competences that are being taught and assessed in countries around the world, including both those that are economically developed and those that are under-developed. The enterprise courses and examinations are sometimes delivered by international organizations or businesses, and sometimes by national providers in collaboration with them.

Contents in the Digital Literacy Frameworks

The content coverage and specificity of the frameworks vary greatly. Many of the national frameworks contain rather general statements and the roles to be served by these frameworks are not always clear. There are generally five types of content found in the DL frameworks:

- Purpose of the framework—the DL context (such as for leisure, work, learning or consuming) and the population/age group targeted.
- Competence areas and competences—specific performance areas such as searching, developing digital content, protecting personal data and privacy.
- Learning domains—such as knowledge, skills, and attitudes.
- Modes—specification of how tasks should be performed, such as safely, responsibly, creatively, or effectively.
- Digital tools to be included

However, because of the lack of specificity in language use in many of the national frameworks collected, we are not always able to identify whether the frameworks have sufficiently clear descriptions on each of these five content areas for the reader. We have analysed six of the national frameworks that are more easily interpretable along the above five content areas, as well as the three enterprise frameworks. Table 3 is a summary of the contents found in the 9 frameworks analysed.

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>

Table 3. The content areas included in some digital literacy frameworks.

Title of digital literacy framework	Purpose	Competency area	Learning domain	Modes	Tools
British Columbia Digital Literacy Framework		✓	✓	✓	✓
Costa Rica Student Performance Standards in Digital Technology-enhanced Learning		✓	✓	✓	✓
India's Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA)		✓			✓
Kenya Basic Education Curriculum Framework		✓	✓	✓	✓
Philippines K TO 12 Basic Education Curriculum (ALS-K to 12) Learning Strand 6: Digital Literacy		✓	✓	✓	✓
Korea Public Officials' ICT Competency Assessment Model	✓	✓	✓		✓
IC3 Digital Literacy Certification Global Standard 5	✓	✓	✓		✓
ICDL Competences	✓	✓			✓
Microsoft Digital Literacy Standard Curriculum 4		✓	✓		✓

The results of the analysis presented in Table 3 shows that even for the frameworks that are relatively specific in their contents, they do not provide a full coverage of descriptions on all five content areas. On the other hand, all of the 9 frameworks listed in Table 3 contain specifications of the competency areas and tools. The area that is least covered is the purpose of the framework.

Mapping of the Frameworks to DigComp 2.1—Methodology

We have selected six of the national frameworks that are most clearly written with regard to the competency areas as well as two of the most popular enterprise frameworks to map against the DigComp 2 framework. The salient features of these six frameworks are presented through fact sheets, which can be found in Appendix 2a to 2i.

In developing a coding scheme for mapping a competence in a DL framework to DigComp 2 competency areas and competences, we have adopted a low-inference approach to reduce the subjective judgement exercised by the researcher. Under this principle, when the source framework and DigComp 2 use the exact same word, with verbs such as browse, develop, organize, manage and create, the mapping can be done through direct 1:1 mapping. For competences in source frameworks that do not use words found in any DigComp competence, a codebook was developed to manage and organize synonymous words to code competences. In some cases, a competence in a source framework may be too general and vague in language so that it can be mapped to several DigComp 2 competences. Based on the low inference principle, this kind of source competences are not coded.

There are also cases of DL source frameworks containing competences that are qualitatively different from any competence defined in the DigComp 2 framework and warrants the creation of new competence area/competences. In particular, we have added two competence areas. The first relates to basic operations of the digital devices, such as turning on and off hardware,

understanding basic concepts of hardware and software, operations on a graphical user interface. We label this competence area as *Hardware and software operations*. Another competence area we found mentioned in a number of the frameworks relate to specific careers or career opportunities. Careers related competences are found in two of the three enterprise frameworks, the ICDL and the Microsoft Digital Literacy Standard Curriculum. Examples include: competence in using classroom technologies for teachers (in ICT in Education), using computer aided design (CAD) and computer aided manufacturing (CAM) applications for architects, engineers and construction workers, using a health information system for medical practitioners, and using social media for marketers (Digital Marketing). We label this competence area as *Career-related competences*. These new competences were then defined in the codebook and used in the mapping exercise. The codebook can be found in Appendix 3.

Findings from Mapping of the Frameworks

A total of 16 national frameworks have been collected from 11 countries. However, as mentioned earlier, not all of them contain sufficiently detailed and specific information about the targeted competence areas or competences for the mapping to be conducted under the low inference principle. We have selected six national frameworks from six countries for the mapping exercise: Costa Rica, India, Kenya, Philippines, Chile, and British Columbia (Canada). We have also conducted the mapping for the three enterprise frameworks collected. The results of the mapping is presented in Table 4.

Competences

The mapping results presented in Table 4 shows that only the British Columbia (Canada) framework has a full coverage of all the competences presented in DigComp 2.1. In addition, the British Columbia framework includes competences in the Hardware and software category, but no specific reference to the Career-related competences category. Reviewing the competences covered in the other five national frameworks, we cannot see any specific pattern of competence coverage related to the state of economic development of the countries. For example, Chile has a very narrow coverage of the competences even though it is the only high income country among these five countries.

These mapping results cannot be appropriately understood if we do not take into account the nature of these frameworks are very different. The national frameworks from Chile and India are used as guides for examinations on digital literacy. The Chilean framework prescribes the scope of a nation-wide examination for second-year high school students. It is reported that there are approximately 10,000 students from municipal, private/subsidized, and private/paid schools taking the examination every year. The results of the examination are publicly reported nationally, regionally, and by school administration type. The Indian framework prescribes the assessment to be taken by persons who have attended a nation-wide training program provided to one nominated digitally illiterate person, aged between 14 to 60, from every eligible rural household. The assessment is in the form of independent external evaluation conducted by a National level certifying agency.

The other four frameworks (those from British Columbia, Costa Rica, Philippines, and Kenya) are designed to be guides for K-12 curricula development. Hence these have more competences included. However, as there are many other contextual and culture factors influencing implementation of curriculum frameworks, it is not possible to conclude that these frameworks are comparable in terms of their execution or impact. 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 based on different states of economic development.

Table 4. Mapping of selected digital literacy frameworks onto the extended DigComp framework.

Digital literacy frameworks	<u>0</u>	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	<u>6</u>	Total
Kenya Basic Education Curriculum Framework.docx	5			2		4			3					5		2	3			2			2			2	2	6	38
Philippines ALS-K to 12 LS 6.docx	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).docx	1		4		2	1	1	1	1					1															12
Costa Rica Student Performance Standards in Digital Technology-enhanced Learning.docx	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.docx			2	2	2		1								3	1				1	1						1		14
British Columbia Digital Literacy Framework.docx	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.docx	16		16	1	14		5	3			2	1		14	2	1	1	1	5	4	3			1		1	3		94
ICDL Competences.docx	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.docx	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 2.1 competence areas and competences.

For the three enterprise frameworks, they serve relatively similar purposes in framing the courses and certification programs that they offer. It can be seen that their coverage are also similar, although ICDL has a slightly broader coverage, while the Microsoft Digital Literacy Standard Curriculum is the narrowest among the three.

If instead of comparing the mapping results across frameworks, we compare the intensity of coverage across competences, we can get some good idea about which are the most popularly valued competences: hardware and software operations, information and data literacy (competence area 1), interacting through digital technologies (competence 2.1, or C2.1 for short), developing digital content (C3.1), copyright and licences (C3.3), protecting personal data and privacy (C4.2) and identifying digital competence gaps (C5.4). Each of the above competences are included in eight of the nine frameworks mapped.

The numbers in each cell in Table 4 represents the number of discrete performance standards / objectives / learning outcomes / skills in the given framework coded to one of the specific competences. It should be noted that a discrete performance standard / objective / learning outcome / skill cannot be mapped to more than one DigComp competence because of its specificity. Comparing the numbers of discrete mappings for each of the competences in Table 4, it is clear 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 well specified compared to the basic technical skills.

As mentioned above, the national frameworks associated with assessment are mapped onto a narrower set of competences. The three enterprise frameworks, on the other hand, provide a relatively wider competence coverage even though these also prescribe assessment for certification. However, the assessments associated with the three enterprise frameworks and the frameworks of Chile and India are mostly conducted on standalone desktop computers. This assessment mode does not reflect the popular uses of digital technology by adults, particularly those in developing countries. Desktop computers are primarily used for productivity purposes, often by people in white collar jobs. The most popular devices that are used by the majority of adults are mobile devices, such as mobile or smart phones and tablets. Further, irrespective of the form factor of the devices used, non-networked devices have very limited uses for day to day purposes, except in schools or training institutions.

Proficiency Levels and Assessment

DigComp 1.0 proposed three proficiency levels in its competence framework. This was later expanded into eight proficiency levels in DigComp 2.1, which are defined with systematicity and accompanied by exemplars. However, we have not encountered any DL framework that has provided such comprehensive descriptions of different proficiency levels. In fact, most of the national DL frameworks we collected do not include explicit specifications or descriptions of proficiency levels. Some of the frameworks that serve as the basis for K-12 curriculum

development use grade levels in formal schooling as proxies for defining proficiency levels. The Chilean SIMCE TIC framework specifies three proficiency levels: initial, intermediate, and advanced. For the enterprise frameworks, such as ICDL, there may be a categorization of their modules and assessments as at introductory, basic, intermediate or advanced levels, but there have been no published criteria for differentiating between the different levels of proficiency.

As described in the previous section, only some, but not all, of the national frameworks are connected directly to formal assessments by external agencies. It is noteworthy that the British Columbia Digital Literacy Framework includes guidelines for assessment, not in the form of formal, high stake computer-based digital literacy tests, but as school-based continuous assessment.

Collecting and Mapping Examples of Digital Literacy Use in Everyday Contexts

It is clear from the findings based on the mapping of DL frameworks to the DigComp 2.0 competences that such an exercise would not be able to serve the purpose of providing a robust, empirical basis for the establishment of a DL framework that can cater for a wide range of national developmental contexts and advances in technology adoption by the broad community. In particular, we note that UNESCO commissioned this DL framework to be developed so that it can provide meaningful guidelines to the provision of training, monitoring and assessment of DL associated with employment, decent jobs and entrepreneurship in disparate contextual settings. In looking for ways to address the objectives of the present project, we are inspired by the examples of use for employment and learning found in the DigComp 2.1 framework, which are grounded in specific contexts. The challenge in adopting the DigComp 2.1 directly is in the contextual setting of the examples of use included, which are confined to the European context, and may have limited utility for people located in different sociocultural, economic and technological settings. Thus, we have decided to gather an additional form of empirical input to inform the DL framework development: collecting examples of DL use in everyday contexts in a wide range of countries outside the European context, particularly those within the specified geographical regions.

Selection of Sectors for Collecting Examples of Use

Since the Sustainable Development Goal 4.4 aims to “substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship”, we have focused our selection of examples of use from major economic and/or employment sectors, with particular attention to select sectors that are important in low income countries. Based on this criterion, we have selected four sectors closely related to everyday life for our systematic search for examples of use. Below is a brief description of the nature of the basic digital technology use in these economic sectors:

1. Agriculture: People in this sector need to be able to know (1) where to look for information sources and communities relevant to agricultural workers; (2) how to access real-time information to make decisions that can maximize their agricultural profits and yields; and (3) how to interpret information to make appropriate decisions.
2. Energy: In developing countries, having continuous access to stable energy sources is non-trivial. People need to know how to access and maintain reliable and cost-effective energy sources for their businesses, and their digital devices.
3. Finance: People need secure and expedient methods to handle their everyday financial transaction needs: to deposit money, pay bills, transfer funds, send remittances, get loans

or access other financing sources. Further, not everyone who has such financial transaction needs may or may not have bank accounts, and hence there are also demands for digital financial transactions outside of the traditional banking system.

4. **Transportation:** There are high demands for efficient and convenient access to transport services and supporting information. This includes accessing geographic location information and payment for transport services.

Methodology for Searching and Selecting Examples of Use

We searched for examples of use primarily through search engines for news and media reports on uses of digital technology in these sectors in low and middle income countries. Two kinds of systematic searches were carried out:

- Google searches for mainstream media and government websites in English language text
- YouTube searches for videos in any language

Often, initial results are followed up 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 language about the case.

This initial round of search resulted in a total of 42 examples of use from countries outside Europe, covering all World Bank national income classifications (high; upper-middle; lower-middle; low), with priority given to examples of use from lower middle and low income countries. Appendix 4 shows the examples of use grouped by country and sector. From these examples we further selected a sample of 17 that have sufficiently detail information readily accessible for us to map the DL required for proficient functioning in these examples to the DigComp competences. These 17 examples (see Table 5) come from 12 countries in five regions (Latin America; Sub-Saharan Africa; Asia; and a high-income country outside the European Union). It should be noted that while we associate each case with a country based on the search term we used to identify them, it does not mean that these example applications are 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.

The examples of use, as opposed to entries in a DL framework, are enterprise digital solutions to authentic everyday situations. Some of these use examples belong to more than one sector. For example, both Grab Pay and Go-Jeck are all-in-one smartphone applications that integrate functions in the mobile finance and transportation sectors. We further find that the integration of services involving more than one sector is not exclusive to a specific type of ICT, but the ICT used (e.g. smart phone; mobile phone) does mediate how the sectors converge in a particular application. For example, in Kenya, mobile phones serve the integration of services across three sectors in its rural and remote areas: agriculture (M-Farm), energy (M-Kopa) and finance (M-Pesa). This integration makes strong sense from an ecological perspective: reliable energy is needed to avoid death through generator fumes and to charge mobile phones; mobile phones are necessary to conduct financial transactions to access reliable energy and agricultural information. Service providers for Kenyan agriculture, for Kenyan finance, and for Kenyan energy operate through mobile phones.

Table 5. List of the 17 use cases selected for mapping on to the DigComp competences.

Region	National income	Country	Example of Use	Sector
Sub-Saharan Africa	Low	Somalia	GoFundMe	Finance
	Low	Somalia	Whatsapp	Finance
	Middle low	Kenya	M-Farm	Agriculture
	Middle low	Kenya	M-Kopa	Energy
	Middle low	Kenya	M-Pesa	Finance
	Middle low	Nigeria	Arnergy	Energy
	Low	Rwanda	Tigo Cash	Finance
Asia	Middle low	India	IFFCO Kisan	Agriculture
	Middle low	India	RML Farmer	Agriculture
	Middle low	India	RML Trader	Agriculture
	Middle low	Indonesia	Go-Jeck	Finance; transport
	Middle low	Pakistan	Easypaisa	Finance
	Middle low	Philippines	FarmHelp	Agriculture
	Middle high	China	Alipay / Tenpay	Finance
	High	HKSAR, China	Android Pay / Apple Pay	Finance
Latin America	Low	Haiti	MonCash	Finance
High-income country outside European Union	High	Singapore	Grab / Grab Pay	Finance; transport

To more easily understand the convergence of geography and sectors, we graphically present the examples of use 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 DL use identified by sector and countries.

Mapping of Examples of Use to DigComp Competences

The mapping of examples of use to the DigComp competences is more complex compared to the mapping of the DL frameworks. The content to be mapped was largely mainstream media, which use imprecise language, and visual media, including screenshots and YouTube videos, which made the mapping process particularly challenging.

Another challenge in the mapping process is that the competences involved in the use examples have to be derived from an interpretation of the steps the user has to go through in completing the tasks needed to achieve the goal. For example, in using mobile phone or smart phones for agriculture-related tasks and operations, there are 10 types of functions that the user may need to engage in:

1. Turn on / off and charging the device
2. Sending and receiving text messages
3. Set or change App language
4. Sharing location data
5. Creating a public profile
6. Searching for, choosing, downloading and approving privacy policy of an application
7. Intra-app finance transactions
8. Searching for goods & services and comparing price information
9. Buyer and seller interaction
10. Topping up account through an agent

Likewise, we can identify 8, 10 and 11 functions respectively for use examples in the energy, finance and transportation sectors. A further inspection of these functions indicates that these fall into two categories: (1) generic functions such as turning on/off and charging the device,

sending and receiving text messages, searching for goods & services and comparing price information; and (2) Financial transactions such as topping up one's account through an agent. Another important observation is that the way a specific function can be accomplished and the DL competence required for the same function depends on the specific device used. First of all, all of the use examples can be completed using a phone and does not require a computer. Secondly, all of the use examples require a network-enabled device, which can be a mobile phone or a smartphone connected to the Internet. The sophistication and quality of the user experience for the same function such as to search for goods and services and to compare price information differ greatly depending on whether the device used is a mobile phone or a smartphone. In mapping the same function when conducted on these two types of devices, we find that the type of competence mapped is the same, but the understanding of the competence and proficiency level required can be much higher if it is conducted on an application designed for the smartphone. For example, to search for information using a mobile phone is tedious, but the skill involved is simple: you need to know the number to dial to get the right information. A person's performance in conducting a search on the Internet may be widely different depending on his/her knowledge and skills in information search, and one can define different levels of proficiency in information search and evaluation.

In examining the functions a user may need to manipulate in these 17 use examples, we find that there are three situations in terms of device dependence:

- (1) There is no substantive difference between these two types of devices for the function—there are two functions that fall into this category: turning on/off and charging the device (G1), 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 has 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.

The functionalities available for mobile phone and smartphone applications in the four selected sectors are summarized in Table 6.

Table 6. A 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

While the functions identified in the use examples are general functions, there are differences in the specific functions that are found to be operating in the four sectors. Table 7 presents the functions found to be operating in the use examples collected. It has to be pointed out that it is often the case that in the agriculture, energy and transport sectors, there will be applications that are connected to financial transactions, for example in buying or selling in agriculture and energy, and in payment for transportation services.

In terms of the financial transactions, two types of applications may be used. Intra-app transactions (T4S) are services only available to clients of the same financial institutions, such as GoJek in Indonesia. Inter-app transactions (T5S), such as ApplePay and Alipay, provide transaction services to clients of different banks or financial institutions. Whether intra- or inter- app transactions are used generally do not depend on the user as an individual, but on the technological infrastructure and regulatory frameworks operating in a country.

The analysis results in Table 7 shows that T4S (intra-app financial transactions) is found in all four sectors. This is simply an indication that transactions in agriculture, energy and transport generally involve financial transactions across different parties in buyer-seller or service provide-client relationships. On the other hand, T3S (evaluating price information, costs, service provider profiles, rate service provider) is only reported for the transport sector and T5S (inter-app finance transactions) is only reported for the finance and transport sectors. Such differences do not reflect an intrinsic difference between transport and the other three sectors. Instead, it reflects the higher levels of technology infrastructure (and income level) of the countries that have developed digital transport payment services among the target countries we have conducted our searches. It is possible that given a higher number of use examples or the inclusion of more economic sectors for this study, we could find new functions beyond the current list.

Table 7. The functions found to be operating in the use examples collected in each of the four economic sectors.

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

N.B. Green colour represents functions available on mobile phones and orange colour indicates that the function is only available on smartphones.

Since the DL competence required in the use examples in the four selected sectors relate only to the functions which 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, 1.1, 1.2 and 1.3
- 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.

Table 8 summarizes the mapping of the 15 types of functions listed in Table 7 to 22 competences (0, hardware and software operations and 21 from the DigComp framework). The results of this mapping clearly shows that there is a big difference in the scope of opportunities to exercise DL in everyday transactions in any of the four sectors if a person is only doing digital transactions using a mobile phone, which as no Internet connectivity. The only competences they will be able to exercise are hardware and software operations (0), rudimentary operations in searching for information (part of 1.1), very basic evaluation of data in textual format (1.2), managing digital text data received from the mobile phone using other devices or non-digital formats (1.3), rudimentary ways of digital interactions and sharing of information using text messages with specific recipients (2.1, 2.2), addressing personal financial transaction needs through text messaging (5.2). For functions related to financial transactions (which can take place in any of the four sectors we investigated), users will have to be able to protect their own devices (4.1) through locking devices, user account, login and password management. For those using smartphones, there can be more sophisticated methods of device protection through other means such as finger print or face recognition if that is available through their service provider.

Salient differences exist between mobile phones and smart phones that have implications for digital literacies. Smart phones provide access to many applications, which enables competition between similar applications, integration of many apps (WePay or Android Pay), and end-to-end or all-in-one apps (e.g. Go-Jek; M-farm), as well as more features in an app. Mobile phones generally provide one graphical user interface per application. In addition, smart phones are more able to facilitate one to many interactions through an individual application (e.g. GoFundMe; Whatsapp) or several applications simultaneously, than a mobile phone, which is primarily designed for one to one interactions. Hence, for people whose access to digital devices is limited to mobile phones, their DL competence will be extremely limited to rudimentary levels of operation in 7 out of the 22 competences mapped. For those performing the same set of functions on a smartphone, they would be able to perform at the full range of proficiency levels in the DigComp competences covered by mobile phones: 1.1, 1.2, 1.3, 2.1, 2.2, 4.1 and 5.2.

The results presented in Table 8 show that there are four competences smartphone users will have the opportunity to exercise in digital operations, but not available to mobile phone users, in the four sectors we investigated. These include managing one's digital identity online (2.6), developing digital content (3.1) in relation to oneself or the goods and services one may wish to sell, protecting one's personal data and privacy online (4.2) and identifying one's needs and technological responses (5.2) in choosing specific goods and services.

Another important finding revealed in Table 8 is that irrespective of the nature of the devices used, the functions required of users in the use examples we collected only covered half (11) of the 22 competences listed. A majority of the more sophisticated DL competences in communication and collaboration (2.3 Engaging in citizenship through digital technologies, 2.4 Collaborating through digital technologies, and 2.5 Netiquette), all of the digital content creation competences except for content creation in simple marketing websites for goods and

services or one's personal profile, half of the safety related competences (4.3 Protecting health and well-being, 4.4 Protecting the environment), as well as most of the competences in digital problem solving (5.1 solving technical problems, 5.3 Creatively using digital technologies, 5.4 Identifying digital competence gaps) are not needed for the day-to-day operations in these four sectors. These 11 "missing" DigComp competences are important competences that are given serious attention to not only in DigComp, but also in some of the DL frameworks we mapped (see Table 4), as well as in the US National Educational Technology Standard (ISTE, 2016), which is another influential DL framework.

The absence of these 11 competences in this mapping exercise suggests that they are not immediately necessary or useful to everyday operations in a wide range of economic and developmental contexts. Basic technical and interactive competences seem more immediately necessary. Besides, the constructs in some competences such as copyright and licenses may not be relevant or readily understood in a largely agricultural economy. Safety concerns such as physical well-being and psychological well-being (4.3) would only become apparent when a large sector of the population is exposed to screen time for many facets of their personal, social and work life. The competence to creatively use digital technologies (5.3) for problem solving becomes a major concern when a country has reached Knowledge Creation as its dominant mode of economic development or at least at the stage of transitioning from the Knowledge Deepening according to the UNESCO (2012) knowledge ladder framework. The need for us to add an additional competence area on hardware and software operations knowledge and skills also indicates that the competence that is taken for granted in developed countries is not trivial in other developmental contexts.

Table 8. Mapping of the functions involved in the use 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	✓	✓	✓	✓	✓										✓	✓					✓		

N.B. Green colour represents functions available on mobile phones and orange colour indicates that the function is only available on smartphones.

ICT Access, Infrastructure Availability and Digital Literacy Development

ICT access at an individual level and ICT infrastructure availability such as costs of Internet access and bandwidth are prerequisites to the development of digital literacy competences. Official digital literacy frameworks are created within specific developmental contexts. For example, the examples of use mentioned in DigComp 2.1 include MOOCs, Twitter, YouTube, Instagram, Facebook, and social bookmarking websites and assume the availability of Internet-connected computers, be they smartphones, tablets, laptops or desktops. However, national DL frameworks may not necessarily reflect a country's developmental status as these frameworks often serve different purposes as revealed in the earlier sections in this report. When the frameworks serve as guidelines for curriculum development (as opposed to high stake examinations), they may reflect the aspirations for national economic development rather than the actual situation.

It is important to note that in nearly all of the DL frameworks mapped, there is no specific mention of devices or infrastructure, which would be reasonable if ready access to the Internet and devices can be assumed for almost everyone in the country, such as is the case in Europe or many other high-income countries. An exception is the frameworks from Kenya, in which the tools dimension focused on network-enabled devices including mobile phones, smart phones, tablets, laptops, and desktops. This probably reflects the fact that in some countries, access to networked devices and the Internet can still be a challenge. In fact, in some areas, one cannot even assume a reliable electricity supply. This is one of the reasons why mobile devices such as phones are the most popular devices used for digital transactions in low and middle-income countries, rather than desktop computers.

While the descriptions of the competences in DL frameworks do not make reference to specific ICT requirements, the competences associated with the examples of use are strongly differentiated based on the nature of the devices used, as discussed in the previous section. Another ICT related observation is that the DL assessments associated with the analysed frameworks were all performed on desktop computers, which generally do not need to be Internet connected, whereas the use examples we collected for everyday digital transactions were carried out on networked mobile devices, primarily mobile phones or smartphones. There are fine distinctions in the proficiency level required for optimal performance for the same competence whether the operations are carried out on a phone or a computer. Computers are still the primary productivity tool in the workplace, and some higher-level proficiency in digital content creation and problem solving would not be easily achieved if such tasks are done on phones and tablets only.

A Proposed Digital Literacy Framework to Cater for Different Developmental Contexts

Based on the mapping exercise, this section proposes the adjustments and extensions to the DigComp framework that can be adapted to serve strategic planning for human resource development in digital literacy, monitoring and assessment of progress in DL performance in different social sectors to cater for the sustainable development needs in a wide range of social,

economic and cultural contexts. This proposal comprises five sections: definition, competences, examples of use, proficiency levels, pathways for DL development and assessment.

Definition of Digital Literacy

Based on the findings from our two mapping exercises, we find the definition of digital literacy that we used when we embarked on our study to be broadly appropriate. However, in view of the important impact that access to digital devices and network connectivity have on digital literacy competence development, we propose a slight change in the definition to highlight this concern in formulating DL frameworks.

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.

Competences

DigComp provides a comprehensive set of 21 competences categorized under five competence areas, which formed the basis for the two mapping exercises conducted in this study. In the mapping of both the DL frameworks and the use examples, we found that hardware and software operations is an important, basic competence area that needs to be made explicit in a DL framework. In the mapping of frameworks, we also find that some frameworks targeting adults would include career specific competences such as use of digital technology in computer-aided design and in education. As the focus of this framework has to be relevant for employment, we consider career specific competences as a necessary addition to be included. Obviously, which career specific competence should be included is dependent upon the specific socioeconomic context and changes over time. One advantage of the openness and flexibility for this dimension is that countries and economies can leverage this competence area strategically to facilitate economic growth and development in targeted fields.

This study also reveals that many of the DigComp competences are not found in a large proportion of the DL frameworks mapped, and 11 of the 21 competences listed in the DigComp framework are not mapped to any of the use cases identified in the four economic areas studied (agriculture, energy, finance and transport). This shows that some of the DigComp competences such as those in the information and data literacy area, and a few of the competences in communication and collaboration and digital safety areas are more immediately relevant to a wide range of developmental contexts. We recommend that the more immediately accessible competences such as the ones mapped to the use examples (0, 1.1, 1.2, 1.3, 2.1, 2.2, 2.6, 3.1, 4.1, 4.2, 5.2) be given priority in strategic development plans for training, monitoring and assessment. The other “missing” competences can be gradually moved into strategic developmental focus as the country’s economy and infrastructure advances. We further recommend that the trajectory for extending the competences included in a country’s DL development framework should follow the expansion in DL use examples in that country. In other words, we recommend that the mapping methodology developed and used in this study can be used by countries in identifying the competences as priorities for their DL strategic development.

To summarize, we propose the following competence areas and competences for the purpose of further consultation through the UNESCO network.

Table 9. The recommended digital literacy competence areas and competences for further consultation.

Competence area	Competences
0. Hardware and software operations**	0.1 Physical operations of digital technologies** 0.2 Identifying data, information and digital content 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 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 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**

Note. Except for those indicated by **, the competence areas and competences in this table are identical to those in the DigComp 2.1 framework.

Examples of use and proficiency levels

The thematic indicator 4.4.2 focuses on a minimum level of proficiency in digital literacy skills. Most DL frameworks reviewed in this report do not specify proficiency levels for competences and therefore do not provide a view on minimum levels. Another view on a minimum level of proficiency is that not all competences may be necessary and be given equal priority in developing proficiency level specifications. Findings from the present study show that some competences are more immediate relevant to a broader range of developmental contexts, and that the minimum proficiency level required can be considered as a construct to be empirically determined.

DigComp 1.0 differentiates four levels of proficiency: foundation, intermediate, advanced and highly specialized. The 8 levels of proficiency in DigComp 2.1 is derived from further refining the performance proficiency at each DigComp 2.0 level into two, and specifying three aspects in the progression from foundation to highly specialized. The three aspects are complexity of tasks, autonomy (from needing guidance to contributing new ideas and processes), and the cognitive domain of performance required (which can be broadly mapped onto the Bloom's taxonomy from remembering to understanding, applying, evaluating and creating).

DigComp 2.1 provides an example of use for each competence, and describes the proficiency level demonstrated in the example. Hence, for each of the 21 competences in the DigComp 2.1 framework, there are no examples of use for illustration purpose for seven of the proficiency levels that are theoretically described. Examples of use, if well selected, can be used to illustrate for easy comprehension the nature of specific competences through authentic case scenarios. However, since these are authentic, real life contexts, the proficiency level required for adequate performance would be determined by the nature of the task and hence would only be used to illustrate performance at a specific proficiency.

In mapping of the DL use examples to DigComp competences in the present study, we have found that the proficiency level required for adequate performance is constrained not only by the use example, but also the nature of the device used (hence the network infrastructure, as well as the modes and complexity of the data and processes the device can access). For example, searching information using a mobile phone for agricultural contexts requires a much lower level of proficiency than searching information related to transport on a smartphone.

We recommend that DL frameworks should include descriptions of proficiency and examples of use. The former gives clear guidelines about the hierarchy of performance that exist, which would be useful for the development of training programs, monitoring and assessment in DL. The specification of the three aspects in conceptualizing the differences across proficiency levels are useful in providing clear descriptors for the levels, even though the levels in the three aspects are clearly related. However, the proficiency level specifications are only meaningful when these can be clearly understood by the targeted public. Given that the proficiency level accessible to users are dependent on the state of development in a country, we further recommend that in determining the levels of proficiency that should be emphasized, a country should also adopt a use example mapping methodology to identify the required levels of proficiency for adequate performance in the selected use examples important for the targeted population. The findings from the mapping can then guide the proficiency levels that are emphasized in a country's DL framework. The focal proficiency levels included in a DL framework should thus be extended and further elaborated as the country advances in its socioeconomic development.

Pathways for Digital Literacy Development and Assessment

The prevalent assessment mode for digital literacy is often in the form of high-stakes performance tasks carried out on stand-alone computers without any need for collaboration. Such assessment has the advantage of being easier to scale in diverse developmental contexts, and providing some useful information about a person's technical skills in the use of productivity software, confined

to the lower levels of performance—remembering, understanding, and applying—according to the Bloom’s Taxonomy.

We propose here that designing curricula and assessment around examples of use may be a more meaningful approach that can also be sensitive to the development context of the systems involved. A prevalent example of use in a developmental context is the minimum proficiency level for its competences. Digital literacy frameworks provide systematic descriptions of competences and proficiency levels, which are useful as a conceptual map for considering strategic development and for monitoring progress at a high level of abstraction. However, a framework per se is inadequate to guide policy implementation or program development. Assessment designed around authentic example of use can be used to assess performance at appropriate levels of proficiency and be meaningful for the assessee and the users of the assessment outcomes. Ultimately, grounding digital literacy levels and assessments at the practical level in examples of use, and not at the conceptual level in frameworks, can show a non-linear and contextualized approach to digital literacy competence achievement.

Based on examples of use in specific sectors, one can also design meaningful pathways of digital literacy development. Four example pathways are provided in Appendix 5 based on the examples of use in four sectors reported in this study: agriculture, energy, finance and transportation. Each pathway comprises competences and task contexts grounded in examples of use in given developmental contexts. These examples of use are meaningful for employment, decent jobs and entrepreneurship, and sensitive to the relevant ICT context. A pathway may involve more than one technology 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. The developmental context determines the pathway to digital literacy and by comparing developmental contexts, countries can make decisions to change them and to show progress on pathways to digital literacy.

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 digital literacy development with local/national developmental state and priorities would be immediately meaningful and motivating for those involved, and bring tangible benefits.

In-depth Consultation

We have conducted in-depth consultation with at least two experts from two countries from six regions of the world: Asia; Sub-Saharan Africa; Middle East and North Africa; Latin America; European Union; and high-income countries outside European Union. The objective of the in-depth consultation was, first, to validate the proposed extension to DigComp 2.1 in its ability to serve not only high-income country contexts but as a global framework; and second, to enrich the proposed global framework with more use examples. The following two sections present findings related to the proposed competence areas and competences, and to the pathway mapping methodology.

Responses to the Proposed Competence Areas and Competences

The addition of competence area 0, Hardware and software operations, elicited useful 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.*, an expert recommended making the language of the proposed competence area and competences more consistent with the language of the existing competence areas and competences by removing possible reference to proficiency levels and specific digital technologies. In addition, some experts consider these two competences to be unimportant to their contexts' future development, while some find these competences to be logically better subsumed under competences within the existing DigComp framework. However, there are also others who recognize the importance of these competences for some developmental contexts and thus, the opportunity to make these competences explicit will help to make these more visible. The addition of competence area 6, Career-related competences, did not draw as much expert support as competence area 0, not least because some experts viewed the competence area as highly specialized, and out of place amongst more everyday competences.

The addition of competence 5.5, computational thinking, to the framework has been controversial. Several experts named computational thinking as a missing competence that should be included in the framework. However, one expert thought computational thinking should not be visible as it could be subsumed under competence 3.4 programming. Another expert thought computational thinking could be a highly specialized competence and may not fall within everyday competences. An expert thought that computational thinking could be a fad, and recommended computational thinking with algorithmic thinking as an everyday competence for competence area 0.

The inclusion of attitudes and values as dimensions of competence proved controversial amongst experts. On the one hand, when asked to name any missing digital literacy competences that should be included in the framework, several experts named competences that prescribe specific attitudes and values within the competence areas of safety, digital content creation, and communication and collaboration. On the other hand, several other experts, particularly assessment professionals, said while attitudes are important and should be a part of digital competence assessment, what constitutes an attitude can be confusing and attitude should not be included in a description of competence alongside knowledge and skills

Responses to the Pathway Mapping Methodology

Experts thought that the mapping methodology could help their countries and sectors to identify pathways for digital literacy development most suited to their specific needs. One expert said this is in part because the global framework is internationally credible and contemporary. Other experts said the methodology could facilitate international and inter-sector comparison and benchmarking. Besides, some experts said the use case examples for the mapping methodology support contextualization through the use of video and stories.

Experts foresaw difficulties in popularizing/implementing the pathway mapping methodology. Some cited the relevance and credibility of the use case examples, which on the consultation website are illustrative as a proof of concept, and helps to illustrate the usefulness and promote the adoption likelihood of the methodology. (One expert could not personally identify with any of the use case examples; another from a small state asked if all the use case examples came from large states.) A recommendation to address this concern is to have organizational structures that are clearly responsible for digital literacy or advancing digital technology use in specific contexts/sectors to do the case selection. Some experts also foresaw the difficulty of comparability and assessment at a global level, not least because of a wide range of ICT infrastructure contexts, and the generic language of competences. At the same time, experts recommended collaboration to address this difficulty. Collaboration could take the form of regional/international collaboration pertaining to specific sectors, possibly involving technology developers/vendors to provide specifications/standards descriptions for digital literacy competence, and training opportunities to potential users of the technology applications. It could also take the form of national or international collaboration with informal communities/NGOs to promote digital literacy for development and well-being.

Online consultation

The research team is grateful to all the experts who have contributed ideas and critiques during the in-depth consultation stage. This document is a draft report on the Digital Literacy Global Framework that the team releases in conjunction with the online consultation stage of the project, which runs from March 7 to April 5.

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Appendix 1. Information about digital literacy frameworks collected

#	Country	Region	Econ level	Fwk type	Framework provider	Framework
1	Algeria	4. Africa	2. Middle high	2	Enterprise	ICDL
2	Bermuda	5. Caribbean & Pacific Islands	1. High	2	Enterprise	ICDL
3	Canada	7. N America	1. High	1	National	British Columbia's Digital Literacy Framework
3	Canada	7. N America	1. High	1	National	USE, UNDERSTAND & CREATE: A Digital Literacy Framework for Canadian Schools
4	Chile	6. Central & S America	1. High	1	National	ICT SIMCE competences
4	Chile	6. Central & S America	1. High	2	Enterprise	ICDL
5	Colombia	6. Central & S America	2. Middle high	2	Enterprise	ICDL
5	Colombia	6. Central & S America	2. Middle high	2	Enterprise	ICDL-ECDL e-citizen programme
6	Costa Rica	6. Central & S America	2. Middle high	1	National	Student performance standards in learning with digital technologies
6	Costa Rica	6. Central & S America	2. Middle high	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2007
7	Egypt	4. Africa	3. Middle low	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2007
7	Egypt	4. Africa	3. Middle low	2	Enterprise	ICDL
8	Fiji	5. Caribbean & Pacific Islands	2. Middle high	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 4
9	Georgia	2. Central & W Asia	3. Middle low	2	Enterprise	ICDL
10	Hungary	8. Europe	1. High	1	National	Digital Education Strategy
11	India	1. E, S & SE Asia	3. Middle low	1	National	National Digital Literacy Mission
11	India	1. E, S & SE Asia	3. Middle low	1	National	The Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA)
12	Indonesia	1. E, S & SE Asia	3. Middle low	1	National	SiBerkreasi
12	Indonesia	1. E, S & SE Asia	3. Middle low	2	Enterprise	ICDL
13	Indonesia	1. E, S & SE Asia	3. Middle low	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 5
14	Iran	3. Middle East	2. Middle high	2	Enterprise	ICDL courses
15	Iraq	3. Middle East	2. Middle high	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2008
16	Jordan	3. Middle East	3. Middle low	1	National	Queen Rania Foundation for Education and Development (QRF) (Formerly Jordan Education Initiative)
17	Kazakhstan	2. Central & W Asia	2. Middle high	2	Enterprise	ICDL
18	Kenya	4. Africa	3. Middle low	1	National	Digischool: the Digital Literacy Programme
18	Kenya	4. Africa	3. Middle low	1	National	ICT Authority Strategic Plan 2013-2018
18	Kenya	4. Africa	3. Middle low	1	National	Presidential Digitalent Programme Curriculum
18	Kenya	4. Africa	3. Middle low	1	National	The Kenya National ICT Masterplan
18	Kenya	4. Africa	3. Middle low	2	Enterprise	ICDL
19	Korea	1. E, S & SE Asia	1. High	1	National	Baeumnara

20	Kyrgyz Republic	2. Central & W Asia	3. Middle low	2	Enterprise	ICDL
21	Libya	4. Africa	2. Middle high	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2007
22	Malaysia	1. E, S & SE Asia	2. Middle high	1	National	MANAGEMENT, TECHNICAL AND IT skills programs
22	Malaysia	1. E, S & SE Asia	2. Middle high	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2007
22	Malaysia	1. E, S & SE Asia	2. Middle high	2	Enterprise	ICDL-Malaysia's National Competency Standard (NCS) for ICT User (ICDL courses)
22	Malaysia	1. E, S & SE Asia	2. Middle high	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 6
23	Mauritius	5. Caribbean & Pacific Islands	2. Middle high	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2007
24	Mexico	6. Central & S America	2. Middle high	2	Enterprise	ICDL
25	Mongolia	2. Central & W Asia	3. Middle low	2	Enterprise	ICDL
26	Morocco	4. Africa	3. Middle low	2	Enterprise	Microsoft
27	Nigeria	4. Africa	3. Middle low	2	Enterprise	ICDL
28	Oman	3. Middle East	1. High	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2009
28	Oman	3. Middle East	1. High	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 4
29	Panama	6. Central & S America	2. Middle high	2	Enterprise	ICDL
30	Philippines	1. E, S & SE Asia	3. Middle low	1	National	National ICT Competency Standards (NICS) of the Philippines
30	Philippines	1. E, S & SE Asia	3. Middle low	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 7
31	Qatar	3. Middle East	1. High	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2010
31	Qatar	3. Middle East	1. High	2	Enterprise	ICDL
32	Romania	8. Europe	2. Middle high	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2007
33	Rwanda	4. Africa	4. Low	2	Enterprise	ICDL
33	Rwanda	4. Africa	4. Low	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 4
34	Saudi Arabia	3. Middle East	1. High	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2011
34	South Africa	4. Africa	2. Middle high	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 4
35	Sudan	4. Africa	3. Middle low	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2012
36	Syria	3. Middle East	3. Middle low	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2013
37	Tajikistan	2. Central & W Asia	3. Middle low	2	Enterprise	ICDL
38	Tanzania	4. Africa	4. Low	2	Enterprise	ICDL
39	Thailand	1. E, S & SE Asia	2. Middle high	2	Enterprise	ICDL-Thai national qualification framework for Digital Literacy Standards (mapped to ICDL modules)
39	Thailand	1. E, S & SE Asia	2. Middle high	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 8
40	UAE	3. Middle East	1. High	2	Enterprise	ICDL
40	UAE	3. Middle East	1. High	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 5
41	Vietnam	1. E, S & SE Asia	3. Middle low	2	Enterprise	Certiport Internet and Computing Core Certification (IC ³) 2007

41	Vietnam	1. E, S & SE Asia	3. Middle low	2	Enterprise	ICDL
41	Vietnam	1. E, S & SE Asia	3. Middle low	2	Enterprise	Microsoft Digital Literacy Standard Curriculum Version 9
42	Zambia	4. Africa	3. Middle low	2	Enterprise	ICDL
43	Zimbabwe	4. Africa	4. Low	2	Enterprise	ICDL

Note. Each number in the # column refers to a unique 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 level; e.g. compulsory school, primary/secondary, etc.)	Secondary level

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 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 31st 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)	<p>Learning Outcomes / Competency Standards:</p> <p>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;</p>
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 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 competencies). 5. Digital Devices: Make use of mobile devices as tools to access information and communicate with others (7 learning competencies). 6. Digital Ethics: Demonstrate ethical practices and values in using technology in the 21st century (6 learning competencies).
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-Matrix 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)	Microsoft digital literacy curriculum website with online and downloadable materials; national institution websites

disseminating/explaining the framework/initiative)	
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	<p>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.</p> <p>Productivity programs seem related to C1 and C3.</p>
2	3.3 Copyright and licences	<p>Copyright and licences: To understand how copyright and licences apply to data, information and digital content.</p> <p>Related words are legal, ethics, violation and intellectual property. Rules. Regulations</p>
3	3.1 Developing digital content	<p>Developing digital content: To create and edit digital content in different formats, to express oneself through digital means.</p> <p>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.</p>
4	3.2 Integrating and re-elaborating digital content	<p>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.</p> <p>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</p>
5	3.4 Programming	<p>Programming: To plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.</p> <p>Functions and formulas in spreadsheets go here. Steps. Instructions. Logic. Order. Computational thinking.</p>
6	1. Information and Data Literacy	<p>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.</p> <p>Productivity programs seem related to C1 and C3.</p>
7	1.2 Evaluating data, information and digital content	<p>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.</p> <p>Key word is reliability; equally trustworthy; rating; information sources; triangulation; synthesize sources; compare; contrast; validity</p>
8	1.1 Browsing, searching and filtering data, information and digital content	<p>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.</p>

		<p>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.</p> <p>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.</p>
9	1.3 Managing data, information and digital content	<p>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.</p> <p>Key words are organize and manage. Save. Structure. Classify. Genres. Schemes. Categorize. Backup. Restore. Filter. Sort. Install</p>
10	5. Problem Solving	<p>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.</p> <p>Developing solutions is a related phrase. Significant questions or investigation.</p>
11	5.4 Identifying digital competence gaps	<p>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.</p>
12	5.1 Solving technical problems	<p>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).</p> <p>Related words are using internal guidance. Troubleshoot. Help menus</p>
13	5.3 Creatively using digital technologies	<p>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.</p> <p>Related terms are crowdsourcing, collective intelligence and wikis. Create. Complex models. Simulations. Forecasting possibilities. Cloud computing utilization</p>
14	5.2 Identifying needs and technological responses	<p>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).</p> <p>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.</p> <p>Informed decision-making is problem solving. Apply.</p> <p>But are application, formatting and editing in office applications but developing content and not identifying needs?</p>

		<p>Competence seems cross-referenced with developing content.</p> <p>Help menus as a means to improve efficiency and productivity. Settings. Configurations. Cloud computing web apps. Interests. Important.</p>
15	2. Communication and Collaboration	<p>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.</p> <p>Keyword is community. Participate.</p>
16	2.1 Interacting through digital technologies	<p>Interacting through digital technologies: To interact through a variety of digital technologies and to understand appropriate digital communication means for a given context.</p> <p>This means references to synchronous and asynchronous ICTs like instant messaging and video chats.</p>
17	2.6 Managing digital identity	<p>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.</p> <p>Keyword is promote. Multiple audiences. Developing relationships and risking with people. Synonymous with digital footprint or trails.</p>
18	2.3 Engaging in citizenship through digital technologies	<p>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.</p> <p>Digcomp examples of use are at neighborhood and city level. Real life people.</p> <p>Strong digital citizenship. Public domain. Government.</p>
19	2.5 Netiquette	<p>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.</p> <p>Different pressures teens face; uncomfortable</p> <p>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.</p>
20	2.2 Sharing through digital technologies	<p>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.</p> <p>Synonymous words include referencing, and citing, and bibliography. Attachments. Authors.</p>
21	2.4 Collaborating through digital technologies	<p>Collaborating through digital technologies: To use digital tools and technologies for collaborative processes, and for co-construction and co-creation of resources and knowledge.</p>

		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 wordslike 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 opportunities	Contains the phrase career opportunities in descriptor or header. Or sets of competences for specific careers.

28	0. Fundamentals	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.
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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. Examples of use grouped by country and sector

Country	National income	Agriculture	Finance	Energy	Transportation	Total
Bangladesh	Middle low	1	1	0	0	2
Brazil	Middle high	0	0	0	1	1
China	Middle high	0	1	0	3	4
Ghana	Middle low	2	1	1	0	4
HKSAR, China	High	0	1	0	0	1
India	Middle low	4	1	0	1	6
Indonesia	Middle low	0	2	0	1	3
Japan	High	0	0	0	0	0
Kenya	Middle low	2	3	1	0	6
Nigeria	Middle low	1	0	2	0	3
Pakistan	Middle low	0	1	0	0	1
Philippines	Middle low	1	0	0	0	1
Rwanda	Low	0	1	0	0	1
Senegal	Low	1	0	0	0	1
Singapore	High	0	1	0	3	4
Somalia	Low	0	1	0	0	1
South Africa	Middle high	0	0	0	0	0
Sudan	Middle low	1	0	0	0	1
Uganda	Low	1	0	0	0	1
United Arab Emirates	High	0	0	0	1	1
Total		14	14	4	10	42

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. Examples of pathways of digital literacy development in four economic sectors.

5.1 Agriculture pathways

- a. Mobile phone
 - i. Competence areas 0, 1 and 6 with a minimum level of proficiency comprising competences 0, 1.1, 1.2, 1.3 and 6
 - ii. Example of use: M-Farm
 - iii. Competence area 0: Turning on and off the phone. Understanding the phone requires energy in a battery, reading energy levels in a phone, physically connecting the phone to an energy source and ensuring the phone is charging.
 - iv. Competence area 1:
 1. 1.1: Finding interface to send SMS; finding numbers to retrieve information on market prices; group selling; and group buying
 2. 1.2: Comparing information on market prices over time; comparing prices through group resource buying tool
 3. 1.3: Organize and delete SMS messages with information
 - v. Competence area 6: a set of competences for farmers
- b. Smart phone
 - i. Summary of competences: Competence area and competences 0, 1, 2, 3, 4 and 6 with a minimum level of proficiency comprising competence 0, 1.1, 1.2, 1.3, 2.1, 3.1, 4.2 and 6. Beyond minimum level with competences 2.2 and 2.6
 - ii. Summary of example of use: Farm Help; RML products; IFFCO Kisan
 - iii. Competence area 0: Turning on and off the smartphone. Understanding the phone requires energy in a battery, reading energy levels in a phone, physically connecting the phone to an energy source and ensuring the phone is charging.
 - iv. Competence area 1:
 1. 1.1: Finding an app store, finding the appropriate agriculture sector app, and downloading an app
 2. 1.2: Evaluating farmers' public profiles on RML Trader; evaluating market evaluation reports, on demand prices, news, advisories and weather on RML Farmer
 3. 1.3: Organizing end-to-end expense log to track profit-loss on RML Farmer
 - v. Competence area 2:
 1. 2.1: Contacting a buyer or a seller on IFFCO Kisan buyer and seller meeting platform; soliciting for ad hoc expertise on IFFCO Kisan and FarmHelp
 - vi. Competence area 3: 3.1: Creating a public profile on IFFCO Kisan and RML Farmer
 - vii. Competence area 4: 4.2: Creating a public profile; allowing automatic geo-tagging for infrastructure repair on FarmHelp
 - viii. Competence area 6: a set of competences for farmers; a set of competences for traders

5.2 Energy pathways

- a. Mobile phone
 - i. Competence areas 0, 1, 2 and 4 with a minimum level of proficiency comprising competences 0, 1.1, 2.1 and 4.1.
 - ii. Example of use: M-Kopa
 1. Competence area 0: Turning on and off the smartphone and solar energy device. Understanding the phone requires energy in a battery, reading energy levels in a phone, physically connecting the phone to an energy source and ensuring the phone is charging. Understanding the solar energy device contains energy, and reading energy levels in the device.
 2. Competence area 2: 2.1: Contacting M-Kopa by their phone number; receiving a call from an M-Kopa sales agent.
 3. Competence area 4: 4.1: Inserting a SIM card from the kit into the mobile phone; make mobile payment using M-Pesa PIN
- b. Smart phone
 - i. Competence areas 0, 1, 2 and 4 with a minimum level of proficiency comprising competences 0, 1.1, 2.1 and 4.1
 - ii. Example of use: Arnergy
 1. Competence area 0: Turning on and off the smartphone and solar energy device. Understanding the phone requires energy in a battery, reading energy levels in a phone,

physically connecting the phone to an energy source and ensuring the phone is charging. Understanding the solar energy device contains energy, and reading energy levels in the device.

2. Competence area 1: 1.1: Finding an app store, finding the ArnergyRana app for vendors, and downloading the app
3. Competence area 2: 2.1: Selling energy tokens to customers via app; contacting Arnergy by email or through website form.
4. Competence area 4: 4.1: Inputting an agent code; and using a login ID and password in the app

5.3 Finance pathways

a. Mobile phone

- i. Competence areas 0, 1, and 4 with a minimum level of proficiency comprising competences 0, 1.1, 1.3 and 4.1. Beyond minimum level with competence 5.1
- ii. Example of use: M-Pesa; MonCash; TigoCash
- iii. Competence area 0:

Turning on and off the phone. Understanding the phone requires energy in a battery, reading energy levels in a phone, physically connecting the phone to an energy source and ensuring the phone is charging (C0).

iv. Competence area 1:

1. 1.1: Scanning transaction information in an SMS; searching for PIN number, phone numbers and codes for sending money
2. 1.3: Organizing and deleting made and receive payments by SMS
- v. Competence area 4: 4.1: Using four-digit PIN number within three tries to access MonCash account on phone

b. Smart phone

- i. Competence areas 0, 1, 2 and 4 with a minimum level of proficiency comprising competences 0, 1.1, 1.3, 2.1, 4.1, and 4.2. Beyond minimum level with competences 1.2, 2.2, 2.3, 2.6, and 5.1
- ii. Example of use: GoFundMe; Whatsapp; EasyPaiza; Android Pay / Apple Pay; AliPay / TenPay; Grab / Grab Pay; Go-Jeck
- iii. Competence area 0: Turning on and off the phone. Understanding the phone requires energy in a battery, reading energy levels in a phone, physically connecting the phone to an energy source and ensuring the phone is charging.
- iv. Competence area 1:
 1. 1.1: Scanning sections for a public fundraising campaign on GoFundMe page; searching for currencies for spot exchange for AliPay and TenPay; searching for a contactless symbol and brand symbols to signify acceptance of NFC such as Android Pay and Apple Pay
 2. 1.3: Store and organize credit cards in Android Pay and Apple Pay; organizing transaction history in Android Pay
- v. Competence area 2: 2.1: Pooling resources and finances through Whatsapp group; transferring funds to anyone not within the EasyPaiza app
- vi. Competence area 4:
 1. 4.1: Using virtual account numbers, and Android device manager to lock Android Pay from anywhere
 2. 4.2: Using QR codes, passwords, fingerprint recognition, and facial recognition for peer-to-peer, mobile, online and in-store payments for AliPay and TenPay

5.4 Transportation and finance pathway

a. Smart phone

- i. Competence areas 0, 1, 2, 4, 5 and 6 with a minimum level of proficiency comprising competences 0, 1.1, 1.3, 2.1, 4.1, 4.2, 5.1 and 6. Beyond minimum level with competences 2.3 and 2.6
- ii. Example of use: Grab / Grab-Pay and Go-Jeck
- iii. Competence area 0: Turning on and off the phone. Understanding the phone requires energy in a battery, reading energy levels in a phone, physically connecting the phone to an energy source and ensuring the phone is charging.
- iv. Competence area 1:

1. 1.1: Search for different sub-apps to hail a taxi, motorbike, or private vehicle on Grab or Go-Jeck; select a specific driver and vehicle; search through other services on Go-Jeck; searching for promotions to use in Go-Jeck services
2. 1.3: Organize transaction history and favorites on Grab or Go-Jeck; organizing time for booking a massage, and ordering transportation and food or other services through Go-Jeck; organizing credit card information and other payment systems (e.g. AliPay / WePay) in Grab
- v. Competence area 2: 2.1: Topping up mobile payment through agents or Go-Jeck drivers; rating drivers on Grab
- vi. Competence area 4:
 1. 4.1: Choosing a more secure payment system than another to pay for rides and services on Grab; using two-factor authentication for Grab; using a QR code to scan for services on Go-Jeck
 2. 4.2: Approving of privacy policies when downloading an app or several apps
- vii. Competence area 5: 5.1: Posing questions to Go-Jeck via Twitter
- viii. Competence area 6: a set of competences for drivers