NCVER

Skilling the Australian workforce for the digital economy

Support document 1: a review of digital skills frameworks literature

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Contents

Tables and figures

Tables

Introduction

This support document presents a review of digital skills frameworks with particular attention to how digital skills are conceptualised, identified, measured and evaluated.

Project background

The NCVER project this report supports explores current digital skills requirements of the general Australian workforce, the capacity of the Vocational Education and Training (VET) system to effectively meet the growing need for digital skills across the general workforce and employers' views, strategies and commitment on adopting digital technologies and meeting the accompanying digital skills needs of their general workforces.

Unlike other research which focuses on demand for skills in the Information and Communications Technology (ICT) sector, the primary focus of the project is on the digital skills of the general workforce that is not directly employed in specialised ICT roles, but which is increasingly expected to effectively use digital systems, technology and processes in the emerging highly digitalised systems of work. The ultimate goals of the project are to develop a better understanding of the specific ways in which new technologies are changing the nature of digital skills requirements in Australian industry and their supply, develop the first Digital Skills Framework suited to the Australian context, and inform sound policy and best practice in skills formation and workforce planning. In view of these objectives, this review of international frameworks analyses how digital skills are identified, measured and evaluated.

Aims of the review

The aims of the review are to:

- analyse challenges around framing digital skills in terms of terminology and scope and develop a better understanding of digital skills conception;

- evaluate different frameworks suggested for measuring and developing digital skills particularly the extent to which these frameworks focus on employee skills;

- develop better understanding of the scope of the extant frameworks, discuss what digital skills are commonly identified, how the content of digital skills frameworks evolved overtime, which skills have become more valued and draw out common themes:

- identify the building block and structure towards developing a digital skills framework in this NCVER project.

Method and procedures

Currently there is no universally accepted definition of 'digital skills' and different terms exist to describe skills related to the use of digital technology. The most often applied is digital literacy (Lankshear & Knobel, 2008). Other common terms include digital skills, digital competence, Information and Communication Technology (ICT) skills, information literacy and internet skills (Ilomäki et al. 2016; van Deursen & van Dijk, 2008; Zhong 2011).

As a result, we began the review by searching for frameworks related to 'digital skills', 'digital competence' and 'digital literacy'[1]. We limited our search to post-2010, however we included several frameworks from earlier years (i.e. 2004, 2006, 2007) where they were explicitly mentioned in the post-2010 frameworks. We screened the sources to ensure that authors had explicitly developed, refined or conceptualised a digital skills framework. Documents that only referred to digital skills frameworks in passing were excluded. Importantly, we excluded frameworks that focused specifically on Information Technology (IT) professionals—such as the Skills Framework for the Information Age (SFIA Foundation, 2011) and the ICT Workforce Skills Framework (Innovation & Business Skills Australia, 2015). This process resulted in 63 frameworks from academic, government and other inter/national institutional sources.

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[1] While the terms 'digital skills', 'digital competence' and 'digital literacy' are used interchangeably in the literature we continue to use the term digital skills.

A review of digital skills frameworks literature

Analysis of international digital skills frameworks

Overview

Our analysis was not intended to provide a detailed description of all existing types of digital skills but rather to understand the scope of the existing frameworks, discuss what digital skills are commonly identified and draw out common themes. We begin the review by describing the sample of frameworks in terms of focus, authorship and scope. We then examine more closely the concepts and skills they identify and the levels of proficiency related to the skills. We conclude by discussing the main themes arising from the review and implications for the development of future digital skills frameworks.

Sample of frameworks details

The 63 frameworks cover a wide cross-section in terms of countries, purposes, approaches and perspectives. These include frameworks that focused on workforce and citizens (e.g. Ferrari et al., 2012), country level digital skills (e.g. UNESCO, 2013) as well as specific aspects of digital skills related to the internet (e.g. Hargittai, 2007; Mohammadyari & Singh, 2015; van Deursen & van Dijk, 2010), specific populations such as students and digital natives (e.g. Jara et al., 2015; Ng, 2012) and cultural and societal aspects (e.g. Hatelvik et al., 2015). Most frameworks were based on a review and synthesis of existing works, industry consultation and case studies (e.g. Chinien & Boutin, 2011; ECORYS, 2016; Janssen et al., 2013). In addition, they were complimented by labour market surveys and skills surveys (e.g. Asliturk, Cameron & Faisal, 2016) and to a lesser extent analysis of training packages (e.g. Innovation & Business Skills Australia, 2010) and individual self-assessments of skills (e.g. Hargittai, 2007). This provided a broad understanding of the themes, skills and framing of digital skills investigated in the literature.

Tables 1 and 2 provide a breakdown of the authorship of the frameworks and their focus. It shows that the frameworks reviewed were largely based on academic research published as reports or academic papers. The second most common type of source was reports produced by institutional and government agencies (e.g. UNESCO; Human Resources and Skills Development, Canada) and independent reports by organisations and research institutes (e.g. The Aspen Institute Communications and Society Program). The largest focus was on general digital skills for citizen participation in the information society (e.g. Carretero et al., 2017; ECORYS, 2016). There was also a focus on both citizens and the general workforce and specific work settings such as carers, librarians and military personal (e.g. Khan & Bhatti, 2017; Mobley, 2011). Unsurprisingly, there was a strong focus on the education sector, both students and teachers and educators (e.g. Siddiq et al., 2016). However, even within these groupings there were also sub-distinctions. For instance, Chetty and colleagues (2017) focus on bridging the digital divide in developing markets. In addition, while most frameworks focused on digital skills broadly, there was often a difference in the scope of technology. For instance, Mohammadyari and Singh (2015) focus on e-learning and van Deursen and colleagues (2016) and van Deursen and van Dijk (2010) focus specifically on skills related to the internet while neglecting other aspects of digital skills.

Table 1   Type of literature

Type of report	Number
Academic	40
Institutional report	23
Total	**63**

Table 2   Digital skills focus

Context	Number
Citizen and societal level	22
Citizens and workforce	12
Students (up to higher education)	9
Workforce (teachers)	7
Workforce (specific)	5
Workforce (general)	5
Students (higher education)	2
Other	1
Total	63

As per other recent reviews of digital skill frameworks (van Laar et al., 2017), we note a lack of frameworks focusing on employee skills. Rather, much of the focus is on the education sector—both primary and secondary.[2] This suggests, that despite recognition of a digital skills gap, most of the focus has been on improving skills at the primary-secondary education level and sidelined the needs of the current workforce. While frameworks focused on students and the workplace may emphasize different areas, they are largely consistent in terms of recommending the need to adapt the curriculum to better prepare students for the workplace (Hinrichsen & Coombs, 2013; Mohammadyari & Singh, 2015).

Several of the workplace focused digital skills frameworks[3] have been designed for adoption by policy makers and industry—predominately those developed by institutions such as the Joint Research Centre of the European Commission (e.g. DigComp), the UK government (e.g. ECORYS) and international bodies such as UNESCO. The DigComp framework developed by Carretero and colleagues (2017), Ferrari (2012) and others is based on a programme of research on Learning and Skills for the Digital Era, which started in 2005 and is perhaps the most sophisticated. It has been used for multiple purposes, particularly in the context of employment, education and training, and lifelong learning and there is evidence of its application in: (i) policy formulation and support (including at the EU level); (ii) informing education, training and employment; and, (iii) assessment and certification (see Vuorikari et al., 2016). Despite this, some suggest its level of sophistication and underlining complexity make it a challenge for organisations to adopt and apply (Iordache et al., 2017). The Digital Skills for the UK Economy Framework (ECORYS, 2016) is used to provide policy recommendations around addressing skills gap and education and training and deliver further government initiatives. The Canadian Digital Skills Framework has been validated by industry stakeholders who believe that it can be useful for practitioners (Chinien & Boutin, 2011); likewise, the Canadian Information and Communication Technology Council (ICTC) framework provides recommendations on investment and training. It also underlines the need for conducting further digital skills gap analysis (Asliturk et al., 2016). UNESCO's (2013) media and literacy framework aims to "provide evidence based information for the planning and development of national policies, strategies and competencies on MIL [Media and Information Literacy] and the implementation of concrete activities aimed at building knowledge societies" (p.46). In particular, it aims to contribute

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[2] In our review we privilege frameworks that focus on the workplace.
[3] It merits mentioning that roughly half of the workplace digital skills frameworks are generalizable to society (e.g. using digital technologies for everyday activity).

to the Post-2015 Development Agenda, Education for All. In Australia, the Identifying Digital Literacy Skills study (Innovation & Business Skills Australia, 2010) focuses on the general workforce, but lags behind in terms of development and application compared to the recent EU, UK and Canadian frameworks.[4]

Digital skills - debates and definitions

Australia needs to urgently develop a pool of digitally skilled workers across all sectors in order to realize the opportunities associated with new technologies. In order to succeed in this effort, however, we must develop a clear understanding of what digital skills are and devise effective approaches to developing them.

Of the identified 63 frameworks, 26 offer definitions for the key concepts that form the focus of their framework. As noted in Table 3, the three most common concepts used are (i) competence; (ii) literacy; and, (iii) skills, as well as combinations of the three. To a lesser extent, concepts such as 'capabilities' and 'use' are used.

Table 3   Key concepts

Context	Number
Competence	24
Literacy	18
Skills	16
Skills, competence, literacy	2
Capabilities	1
Literacy and competence	1
Use	1
Total	**63**

Digital competency typically focuses on technical skills, such as how to retrieve information and computer mediated tasks (e.g. online communication) in a range of settings (e.g. work, socialising). It also refers to knowledge, attitude and motivation to engage the digital society. For instance, Ilomäki and colleagues (2011, p.8) define it as "digital competence consists of technical skills to use digital technologies, abilities to use digital technologies in a meaningful way for working, studying and for everyday life in general in various activities, and abilities to critically evaluate the digital technologies, and motivation to participate in the digital culture".

Digital literacy typically focuses on the knowledge required to use technology in a meaningful way for work and social activity and includes operational, cognitive, cultural and critical dimensions of literacy. For instance, Eshet-Alkalai (2004, p.93) defines "digital literacy [as involving] more than the mere ability to use software or operate a digital device; it includes a large variety of complex cognitive, motor, sociological, and emotional skills, which users need in order to function effectively in digital environments".

Digital skills typically focus on the practical and measurable application of digital technologies and the ethical and responsible use of technology. For instance, Iordache and colleagues (2017, p.47) define such skills as "the more practical and measurable application of certain knowledge and aptitudes in digital usage".

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[4] The ICT Workforce Skills Framework (IBSA, 2015) was not reviewed because it focused specifically on the ICT workforce.

It is unequivocal that there is overlap between these concepts. The blurred boundary between the concepts is recognised in the literature (e.g. JISC, 2017) and some argue that their interchangeable use has led to conceptual confusion (Iordache et al., 2017; Lloyd, 2010; Martin and Grudziecki, 2006). Furthermore, some frameworks reflect the multiple and socio-cultural aspects of these concepts. Because of this, debates around establishing the boundaries of digital skills in the literature have also grown (Janssen et al., 2013). Iordache and colleagues (2017) suggest that this confusion is due to the convergence between media literacy, digital literacy and the notion of "transliteracy," defined as a movement across technology, media and contexts (Sukovic, 2016).

Interestingly, definitions of digital skills have not evolved significantly from early attempts (for early definitions, see Knobel & Lankshear, 2006; Martin, 2005). Where definitional change has occurred, it is in the broadening of digital skills to include multiple types of skill-sets such as basic, operational, cognitive, social and attitudinal.

ECORYS (2016) argue that a further challenge is that there is no clear distinction between different user groups, with work and social activity often blended together. On the other hand, some frameworks specifically focus on occupations and contexts such as the military (Mobley, 2011), roles such as educators (Hall et al., 2014) and students (Hatlevik & Christophersen, 2013) and elements such as "digital wellbeing skill" (Gui et al., 2017). ECORYS (2016) attempts to overcome this challenge by defining skills at a meta-level based on skills for (i) basic literacy for individuals; (ii) for the general workforce; and, (iii) for ICT professionals.

Scope and content of digital skills frameworks

While the 63 frameworks covered a large number of digital skills and it is beyond the scope of this review to cover them all, there are several interpretations that stand out. The frameworks consider up to three levels of skills, which we refer to as first level, second level and third level. The first level skills focus on broad areas such as 'problem solving' and 'information'; 54 of the frameworks identify first level skills. The second level skills focus on specific elements within the first level. For instance, 'information' may include 'browse/search/locate' and 'assess/validate information/media'; 19 frameworks identify this level of detail. The third level skills go one step further and offer another level of granularity. For example, within 'browse/search/locate' it includes 'accessing and searching for online information' and 'selecting resources effectively'.

In this section, we discuss the first level skills.[5] As illustrated in Table 4, the most frequent first level concepts that form the focus of the frameworks are around five key areas: (i) informational; (ii) communication; (iii) digital and technical; (iv) safety; (v) media; and, (vi) problem solving.

Table 3   First level digital skills

1st level skill	No. of frameworks
Informational	43
Communication	39
Digital and technical	38
Safety	25
Media	24
Problem solving	17

[5] See Appendix 1 for a breakdown of all levels.

Knowledge creation	8
Societal	5
Create/innovate	5
Foundational	4
Business and interpersonal	4
Critical	4
Attitude	3
Entrepreneurial	2
Cognitive	2
Other	4

One of the most interesting aspects of this part of our review was that the frameworks almost exclusively privileged conceptual and non-task specific aspects. For instance, skills are articulated as "accessing and searching for online information". Furthermore, other than few references to tools, such as social media, cloud, mobile and analytics and Internet of Things (e.g. Asliturk et al., 2016), there are few technology specific skills mentioned.

Skills around information and communication were expected to be included in digital skills frameworks. However, the other areas are quite varied. For instance, several frameworks consider personal, interpersonal and foundation/core skills and elaborate these in the digital domain (e.g. Asliturk, Cameron & Faisal, 2016; Iordache et al., 2017; Valenta, 2015). Two examples include: (i) business interpersonal skills, which consider aspects related to communication, social skills as well as marketing skills (including understanding how to use social media), management and continuous learning skills; and, (ii) entrepreneurship, which focused on digital elements around social, mobile, cloud and analytics but also business aspects such as identifying trends and business development (Asliturk, Cameron & Faisal, 2016). The focus on problem solving by a large number of frameworks (e.g. Hadziristic, 2017; Siddiq et al., 2016a) is consistent with other (non-digital) skill frameworks (e.g. OECD, 2014). As noted by others (Iordache et al., 2017) strategic and analytical skills are largely neglected.

A notable distinction between the earlier and more recent frameworks is that safety has increasingly developed a level of priority and become more valued (Cantú-Ballesteros et al., 2017; Carretero, Vuorikari & Punie, 2017; Gui, Fasoli & Carradore, 2017). This is almost exclusively framed as cybersecurity, such as "to protect digital devices and contents, and to understand risks and threats in digital environments. To know about safety and security measures, protect personal data and privacy, avoid health risk and aware of the impact of digital devices on the environment" (Carretero, Vuorikari & Punie 2017, p.36-39) and around specific actions such as "password protection and understanding cloud security" (Asliturk, Cameron & Faisal 2016). Beyond security aspects, few frameworks consider social aspects related to information and identity; for instance, van Deursen and colleague's (2014, p.13) framework is one of few to consider what information should and shouldn't be shared online and to emphasise care in making "comments and behaviours appropriate to the situation [one finds oneself] in online". This is surprising given that many frameworks focus on young persons.

Proficiency and levels of maturity in digital skills frameworks

In addition to identifying digital skills, 13 frameworks specified concepts to help evaluate the proficiency and levels of maturity of those digital skills. The relative low number of frameworks that identify levels of proficiency is indicative of the challenge of aligning skills with maturity levels. As a

consequence, many of the frameworks lack clarity in terms of the types of skills they define because they do not distinguish a spectrum of skills (e.g. high-low) and detail around the types of digital skills needed for certain tasks to be performed is omitted. As van Deursen and van Dijk (2010) note, it is important to separate skills from measurement of use.

Of the 13 frameworks that did provide some type of measure of maturity, they typically focused on a scale starting with foundational/absence and progressed to specialised/advanced skills. They also accommodated different levels of certification. These are presented in Table 5, which shows that they were either evaluated on a scale of three or four levels of maturity.

Table 4   Levels of maturity

Level	Examples of maturity levels	Reference
Three levels	Literate, fluent, master	(Chetty et al., 2017)
	Basic digital skills (high school graduates), workforce digital skills (post-secondary school graduates), professional digital skills (ICT-sector specific)	(Hadziristic, 2017)
	Basic, intermediate, advanced	(UNESCO, 2013)
	Basic, extended, special (lower to higher order thinking skills)	(Micheuz ,2011)
	General, enabling, care-specific	(Valenta,2015)
	Certificate I-Introductory, Certificate II-Business Transaction, Certificate III-Interaction and innovation	(Smith & Anderson, 2010)
	Basic digital literacy, intermediate digital literacy, advance digital literacy	(Mnet, 2010)
	Level I-Digital competence, Level II-digital usage, Level III-digital transformation	(Martin & Grudziecki, 2006)
Four levels	Foundation, intermediate, advanced, highly specialised	(Carretero et al., 2017)
	No, low, basic, and above basic digital skills	(Cernison & Ostling, 2017)
	Basic, general and advance and specialist	(UK Digital Task Force, 2016)
	Entry, core, developer, pioneer	(Hall, Atkins & Fraser, 2014)
	Baseline, functional, advance, expert	(Mobley, 2011)

Of the 13 frameworks that specified a level a maturity, 10 specified a further layer of maturity, which described the level of use or related to a type of task. These varied from general, such as "being able to use the internet" in all areas of maturity (i.e. no, low, basic, and above basic) (Cernison & Ostling, 2017), and general statements such as "relevant proficiency levels and useful technologies" (Hadziristic, 2017). They also included levels that matured alongside the specificity of the work and type of task such as "general use, context of work, and specific providing services" (Valenta, 2015). Only the DigComp framework specified further levels of maturity (Carretero et al., 2017). It did so by looking at the level of skills and then examining the complexity of the task, how the individual is able to work autonomously and the cognitive domain where the individual can make sense of, and reflect on, their digital skills.

Key lessons and themes

This document has provided a review of international digital skill frameworks. It was undertaken to understand how these frameworks define digital skills, the skills they identify and how they are evaluated. Our review of 63 frameworks included a broad frame of reference and unequivocally highlights the complexity of defining, identifying and evaluating digital skills. At the same time, our findings align with recent investigations on identifying digital skills. We identify several lessons and themes for future frameworks:

- There is a lack of frameworks focusing on employee skills. This suggests, that despite recognition of a digital skills gap, most of the focus has been at improving skills at the primary-secondary education or societal level rather than within the current workforce.

- The frameworks almost exclusively favoured conceptual and non-task specific aspects. In addition, while some frameworks were mono technology focused and others made some reference to specific tools, such as social media, cloud, mobile and analytics, overall there were few technology specific skills identified. This is contrary to our analysis of job advertisements, where we found employers framed jobs in terms of specific tasks and technologies (see Gekara et al., 2017). Therefore, a possible mismatch exists between how employers and existing frameworks articulate digital skills. This is suggestive of employers' need to ground digital skill frameworks within task specific contexts. It is also suggestive of the need for a digital skills framework that can be applied by employers—e.g. by mapping tool specific tasks onto the framework—as well by trainers and individuals to assess needs and requirements.

- While early frameworks considered adoption and foundation skills, in recent years there is awareness that the efficient and effective use of digital technology is governed by the deployment of complex cognitive skills.

- Few frameworks considered interpersonal, entrepreneurial and innovation dimensions of digital skills. The strategic and analytical skills are also largely neglected. This may be due to the frameworks being preoccupied with specific technology use rather than its broader application. There were some exceptions, such as Iordache et al. (2017) and Valenta (2015), who linked social media skills to communicative aspects of work and understanding of new technology to being able to understanding business development.

- Safety—framed around cyber security, privacy and protection of personal data—has become more present and more valued in recent discussions on digital skills. However, few frameworks considered social aspects related to information and identity, such as what constitutes inappropriate comments online.

- Developing a framework to capture the broad area of digital skills is a challenge. As noted, the current frameworks can be critiqued for being too specific (e.g. a particular type of worker) or for being too broad, which is important because not all workers, citizens or learners will be interested in developing the competences described in some of these frameworks (ECORYS, 2016).

- Digital skills frameworks refer to individual attributes and proficiencies, without taking into account the social context. This is a limitation for their adoption by organisations and institutions and restricts their use as a sense-making tool for individuals. This also suggests that frameworks need to consider the notion of "transliteracy"—that is, that digital skills frameworks need to account for technical (e.g. how to use technology), cognitive aspects (e.g. knowing how to use information), while being sensitive to context (e.g. job role, workplace).

In the next section we discuss the implications of this review for developing an Australian Workforce Digital Skills Framework.

Towards an Australian Workforce Digital Skills Framework

Overview

A premise of this study and review of frameworks is that to meet the demands of the Australian workforce, it is necessary to propose an expanded conceptual framework that includes digital skills. As noted in the discussion points above, we have highlighted several key themes and challenges for developing a digital skills framework. This has implications for the development of a framework that meets workforce needs in the Australian context.

A working definition of digital skills

Our review has established that there is no standardised definition of digital skills. Instead, three concepts are widely used in both academic and non-academic literature in this area: "digital skills", "digital competence" and "digital literacy" (Eshet-Alkalai 2004; Ilomäki et al., 2016; Iordache et al., 2017). While some researchers differentiate between the concepts of digital literacy, skills, and competences, others use them interchangeably (Iordache et al., 2017; Janssen et al., 2013). For example, digital literacy is mainly used to describe basic awareness, knowledge, and attitude towards information and communications technology use in locating, organizing, evaluating and creating information (Eshet-Alkalai, 2004). Digital competence is used to refer to how people apply specific technology skills for work and life situation. On the other hand, digital skills are broader and encompass both digital literacy and competence in a dynamic digital society and economy, which may involve developing and nurturing technical collaboration and creativity attributes.

Challenges remain around framing digital skills in terms of terminology and scope. Van Laar and colleagues (2017, p.584) argue that defining digital skills as "precisely as possible is an essential first step to identify, and possibly quantify, current and expected needs". As a result, and as a first step towards developing a workplace digital skills framework, we have revised our initial conception (Gekara et al., 2017) and define digital skills as follows:

> *Digital skills refer to a combination of digital knowledge (theoretical comprehension and understanding), cognitive knowhow (involving the use of logical, intuitive, innovative and creative thinking in the digital space), practical knowhow (including the use of digital tools such as hardware, software, information and security systems), competence (ability to learn, adapt and apply digital knowledge in a new setting) and attitude (value and beliefs) that workers need to master and demonstrate in the digital age.*

We test the extent to which Australian employers recognise and adopt such a definition of digital skills in their workforce development through a mixed-method field study, findings from which are reported in Support Document 2.

Building blocks for an Australian Workforce Digital Skills Framework

Nearly all digital skill frameworks indicate a common structure of 1-3 levels of various skills description and content and up to four extents of proficiency and maturity. In terms of content, while our review of digital skills frameworks is broader than studies which typically have focused solely on

reviewing the academic literature on digital skills, our findings align with studies that show that the broad areas of digital skills—information, technical, communication and problem solving—have been identified as the most studied (Iordache et al., 2017; van Laar et al., 2017). The overarching message from the analysis of various frameworks is that a digital skills framework needs to consider not just the technical hard skills associated with operating digital technologies but also the more generic and 'soft' interpersonal, entrepreneurial and innovation skills that are increasingly required to work effectively, safely and ethically in the digital workplace.

In terms of levels of maturity, frameworks need to consider the notion of "transliteracy"—that is, accounting for technical (e.g. how to use technology) and cognitive aspects (e.g. knowing how to use information), while also considering the context (e.g. job role, workplace). It may also be necessary to maintain flexibility because of the nature of the rapid change in digital technologies and associated skills demands.

These building blocks for an Australian Workforce Digital Skills Framework will be enhanced further by a mixed-method field study combining qualitative interviews with key stakeholders and a quantitative survey of Human Resources, Skills and Training (HRST) decision makers (see Support Document 2) to ensure that it fits the Australian workplace context. First, an analysis of interview data collected from representatives of different organisations in the Transport, Postal and Warehousing and Public Administration and Safety industries will provide content to develop a framework that supports identification of digital skills across industries. Second, an analysis of a quantitative survey of HRST decision makers, with specific attention to the skills impact of digital disruption, requirements for digitally skilled workforce and management attitudes and practices in relation to digital skills, will help identify the skills needed to populate our framework. Combined, these analyses will provide a first step towards an Australian Workforce Digital Skills Framework.

Appendix 1: Identified digital skills, 1st level, 2nd level, 3rd level

1st level	No.	2nd level	No.	3rd level	No.
Informational	42	Articulate/define	4	Understanding when information is needed and what type of information will fill a knowledge gap	1
				Articulating information needs in efficient way	1
		Browse /search/locate	13	Accessing and searching for online information	1
				Finding relevant information	1
				Selecting resources effectively	1
				Creating personal information strategies	1
		Identify/select	1	Blank	
		Access data/information/digital content	6	Blank	
		Retrieve, Store data/information/digital content	12	Manipulating and storing information and content for easier retrieval	1
				Organising information and data	1
		Understand data/information/media	12	Blank	
		Assess/Validate information/media	2	Blank	
		Evaluate data/information/digital content	7	Making sure that the information fulfils the needs	1
				gathering, processing, understanding and critically evaluating information	1
		Organise data/information/digital content	10	Blank	
		Digital information processing skills	6	Digital literacy and information processing skills	1
				Define information needs, accessing, assessing, organizing, integrating, applying, creating and communication information	1
				Using search and research tools	1
		Data literacy and intermediate data analytics	6	Understanding structure of data and data presentation	1
				Transforming data and preparing for analysis	1
				Conduct basic data analysis	1
		Information security and privacy (cybersecurity)	2	Ensuring cybersecurity	1
				Password protect and understand cloud security	1
		Communicate information	4	Blank	
		Create/modify information	3	Blank	
		Input information	2	Blank	
		Use information in different format/Devices	1	Blank	
		Disseminate/share	4	Blank	
		Distributed Cognition	1	Blank	
		Multitasking	1	Blank	
		Digital problem-solving skills	1	Blank	
		Support others in developing digital competence	1	Blank	
		Transmedia navigation	1	Blank	
		Attention management	1	Manage information from multiple devices	2

1st level	No.	2nd level	No.	3rd level	No.
				Identify priority	1
				Information processing time management	1
		Reference information source	1	Blank	
Communication	38	Interact through digital technology	10	Asynchronous Communication	1
				Synchronous Communication	1
				Understanding how digital communication is distributed, displayed and managed	1
				Understanding appropriate ways of communicating through digital means; referring to different communication formats	1
				Adapting communication modes and strategies to specific audiences	1
		Share through digital technology	10	Communicating with others the location and content of information found	1
				Sharing knowledge, content and resources	1
				Acting as an intermediary	1
				Spreading news, content and resources	1
				Applying citation practices and integrating new information into existing bodies of knowledge	1
		Display information for specific audience and purpose	2	Blank	
		Engage in citizenship through digital technology	5	Participating in society through online engagement	1
				Seeking opportunities for self-development and empowerment in using technologies and digital environments	1
				Being aware of the potential of technologies for citizen participation	1
		Participate in online communities	1	Blank	
		Efficiency of Communication	1	blank	
		Collaborate through digital technology	9	Asynchronous Collaboration	1
				Synchronous Collaboration	1
				Using technologies and media for team work, collaborative processes and co-construction of digital content and resources	1
		Provide digital feedback	1	Blank	
		Netiquette	8	Knowing behavioural norms in online/virtual interactions	1
				Understanding cultural diversity aspects	1
				Protecting self and others from possible online dangers	1
				Developing active strategies to identify bad behaviour	1
		Manage digital identity	5	Creating, adapting and managing one or multiple digital identities	1
				Protecting one's online reputation	1
				Dealing with the data that one produces through several accounts and applications	1
Digital and Technical	38	Computer/ICT literacy/new developments	8	Computer and technical skills including basic interaction with computer	1
				Configuring computer and software options	1
				Troubleshooting and problem-solving	1
				Network related skills, file sharing, printing and other traditional skills	1
		ICT Features/Functions	8	Blank	
		Using software	5	Interaction using key office programs	1
				Using features of key software interface	1

1st level	No.	2nd level	No.	3rd level	No.
				Configure software options	1
				Productivity skills (e.g. basic photo and video editing)	1
		Knowledge and use of internet	5	Blank	
		Technological content knowledge	1	Blank	
		Using SMAAC technology	4	Understanding Social media, Mobile technology, Apps, Analytics or Cloud technology	1
				Use social media for outreach	1
				Use mobile devices, apps and cloud technology for productivity	1
		Maintain digital device/application and content	1	Blank	
		Knowledge/Using sector or enterprise-specific programs	3	Using sector or enterprise-specific programs	1
				Using specific programs across different platforms	1
		Knowledge/use of sector related content	1	Blank	
		Digital communication and collaboration	5	Working remotely with multiple team members	1
				Manage projects online	1
				Exercise traditional business competencies using digital tools	1
		Working with IIOT technology (e.g. Industry internet of things)	4	Working with automated manufacturing technologies	1
				Work with smart sensors, remote monitoring systems and digital interfaces	1
		Digital skills for changing workplace	1	Blank	
		Adapt to New digital technology	1	Blank	
		Use digital systems and tools	4	Blank	
		Design New digital systems and tools	3	Blank	
		Apply security measure in digital environment	2	Blank	
		Device safety	1	blank	
		Knowledge of where to seek assistance	1	blank	
		Cross-platform navigation	1	Blank	
		Handle digital structure	1	Blank	
		Sector digital strategy	2	Blank	
		Solve technical problems	2	Blank	
		Guardians and monitoring	1	Blank	
Safety	24	Protect device	5	Protecting own devices and understanding related risks and threats	1
				Applying safety and security measures	1
		Protective software	3	Blank	
		Protect personal data, information and privacy	8	Actively protecting own data	1
				Actively protecting own data	1
				Respecting other people's privacy	1
				Protecting self from online fraud, threats and cyber bullying	1
		Protect health and well-being	5	Avoiding health-risks related with the use of technology in terms of threats to physical and psychological well-being	1
		Secure all operations	1	Blank	1
		Protect the environment	5	Being aware of the impact of ICT on the environment	1
				Observing principles of efficiency and effectiveness	1

1st level	No.	2nd level	No.	3rd level	No.
		Identify, evaluate and procure relevant ICTs(e.g. for disabilities)	2	Blank	
		Workplace legal, contractual and ethical related conditions	4	Blank	
Media	23	Develop digital content	10	Knowledge of digitisation	1
				Select and use of digital device for quality content creation	
				Knowledge and use on digital content creation software	1
				Apply the use of content development and recognition software	2
				Assigning metadata to digital content	1
				knowledge and use of different file format	2
				Knowledge and use of digital storage devices and applications	1
				Knowledge on backing-up digital content	1
		Manage digital content	1	Ability to manage digital content infrastructure	1
				Define policies and appropriate standards for digitisation	1
				Planning cost and generating funds	1
				Managing staff and copyright issues	1
				Training of staff and users	1
				Use of storage devices/applications to preserve digital material	1
				Ability to manage inappropriate issues	1
				Knowledge to conduct an evaluate of digital content	1
		Integrate and re-elaborate digital content	7	Modifying, refining, and combining existing resources to create new, original and relevant content and knowledge	1
		Produce creative expression	2	Improving and innovating with ICT	1
				Actively participating in collaborative digital and multimedia production	1
				Expressing self creatively through digital media and technologies	1
				Creating knowledge with the support of technologies	1
		Communicate information/media	5	Blank	
		Participate	4	Blank	
		Monitor influence of information/digital content	2	Blank	
		Protect digital content	1	Creating knowledge with the support of technologies	1
				Knowledge to apply filtering router (encryption and decryption measures on data)	1
				Knowledge of data security by assigning security measures on data	1
				Knowledge to protect access to digital contents by creating user names and passwords	1
				Knowledge to design administrative back-end control system for digital content	1
		Copyright and licences	8	Understanding how copyright and licenses apply to information and content	1
		Programming	4	Programming applications, software, devices; understanding the principles of programming	1
				Understanding what is behind programmes	1
	16	Solve technical problems	3	Blank	

1st level	No.	2nd level	No.	3rd level	No.
Problem solving		Interrogate to obtain or perceive possibilities and opportunities	1	Blank	
		Identify needs and technical responses	3	Blank	
		Creatively use digital technology/other resource	4	Blank	
		Obtain insightful details	1	Blank	
		Make judgement call	1	Blank	
		Identify digital competence gap	3	Blank	
		Collaborative problem solving	1	blank	
Knowledge Creation	8	Learning together	1	Strengthening the social bond between care worker and care recipient through the process of discovering digital technology together	1
				Balancing the role of guide with that of peer learner	1
				Identifying areas of common interest	1
				Promoting reciprocity, openness and cooperation	1
				Preserving mutual trust	1
		Evaluation of progress	1	Setting learning targets	1
				observing own and care recipients' advancements in digital competence	1
				verifying acquisition of specific knowledge and skills	1
				mapping the progress on competence frameworks and individual plans	1
		Feedback and modification	1	Reflecting with care recipients regularly the advantages and challenges brought in their lives by digital technology	1
				addressing obstacles	1
				Giving constructive and sensitive feedback	1
				Acknowledging achievements	1
				Modifying care recipients' digital user strategies and learning plans where appropriate	1
Societal	5	Blank		Blank	
Create/ innovate	5	Identification of digital needs	1	Identifying own as well as care recipients' needs that can be addressed by digital technology	1
				Inspecting own as well as care recipients' daily practices, routines, interests and wishes	1
				Determining where digital technology can provide more effectiveness, efficiency and comfort	1
		Identification of digital responses to needs	1	Identifying, based on own and care recipients' needs, appropriate digital solutions, strategies and activities	1
				Matching areas of need with available solutions	1
				Evaluating solutions and selecting ones best fitting particular situation's/person's context	1
		Tolerance and patience	1	Communicating digital technology to care recipients in appropriate manner	1
				Adjusting the pace of learning to individual capacities and objective setbacks	1
				Dealing with failure and finding alternative solutions	1
				Promoting cooperative optimism	1
				Maintaining realism in expectations	1
		Variability, creativity and resourcefulness	1	Supporting variability in digital technologies used and activities carried out	1
				Helping care recipients discover the creativity and multi-dimensionality of digital environments	1
1st level	No.	2nd level	No.	Preventing stereotypisation and boredom	1

A review of digital skills frameworks literature

1st level	No.	2nd level	No.	3rd level	No.
				Providing orientation and guidance	1
				Helping with systematisation	1
Foundational	4	Basic Literacy	4	Basic literacy (reading and writing)	1
		Basic Numeracy	3	Basic numeracy	1
		Writing	2	Document use	1
		Communication skills	3	Blank	
		Understanding of basic laws and ethics	1	Blank	
		Document use	1	Blank	
		Expressing	1	Blank	
Business and Interpersonal	4	Communication skills	2	Active listening	1
				Effective	1
				Mediate in a verity means of communication	1
				Build and maintain social relations through digital technologies	1
				Support in active participation in online social networks	1
				Online communication safety	1
		Interpersonal/social skills	2	Relationship	1
				Mitigating	1
				Inspiring	1
				Engaging in staff peer communities	1
		Creativity/innovation skills	1	Identify problems and potential solution	1
				Open to new perspectives	1
				Brainstorming and develop original ideas	1
				Experimental ideas, assess and take risks, tolerating ambiguity and keep focus on goals	1
		Sales/marketing skills	1	Customer service	1
				Knowledge of market	1
				Effective listening and writing	1
				Understanding digital marketing	1
				Understand business analytics and customer segmentation reports	1
		Business perspective	1	Understanding business goals and strategies	1
				Integrate business goals in daily activities	1
		Management skills	2	Inspire and motivate	1
				Professional integrity and honesty	1
				Analysing problems and solving issues	1
				Plan, monitor and Report activities	1
				Motivating the team for results	1
				Communicating, collaborating and promoting teamwork	1
				Display technical and professional expertise	1
				Identify staff areas of interest	1
				Pursue improvements	1
				Working towards specialisation and acquisition of expert knowledge and skills	1
				Understanding certification purpose and validating outcomes	1
				Using care organisations' systems for managing staff	1
				Coordinate and monitor work	1

1st level	No.	2nd level	No.	3rd level	No.
				Supervise and lead using digital means	1
		Continuous learning	2	Gathering information and identifying one's learning needs	1
				Continually acquiring knowledge	1
				Assessment of results	1
				Strategically planning and undertaking new content	1
				Mediating digital learning opportunities	1
		Use towards personal and professional goals	2	Helping care recipients understand, install and use digital technologies at their homes	1
				Selecting, combining and adjusting digital technologies, devices and software solutions to specific contexts and individual needs	1
		Identify Competency Gaps	1	Missing	
		Monitor and Assist	1	Supporting care recipients' independent living through the application of digital technologies used in the absence of care workers, or used by care workers for remote supervision	1
				Enabling remote consultation and off-site assistance to care recipients	1
				Providing care recipients with the means to monitor, record and report health- and care-related issues	1
				Ensuring care recipients' safety and well-being from distance	1
		Counselling	1	Being able to function as a first point of inquiry	1
				Providing orientation and advice	1
				Earning trust as a competent user as well as a guide through digital technologies	1
				Promoting different user strategies with a special focus on work-related digital solutions	1
				mediating professional/technical assistance where necessary	1
Critical	4	Blank		Blank	
Attitude	3	Role of digital competence in care work	1	Understanding the role of digital competence in care work	1
				Understanding how different kinds of digital technology can support care workers in their profession as well as care recipients in their daily lives	1
				Understanding how different kinds of digital technology can support care workers in their profession as well as care recipients in their daily lives	1
		Inception and promotion	1	Bringing digital competence and technology into own work practices	1
				clarifying the advantages of digital technology to care recipients	1
				introducing various types and possibilities of digital activity to care recipients; inspiring interest in ICT	1
		Encouragement and confidence building	1	Overcoming psychological obstacles to the implementation of digital technology in care work such as the fear and mistrust of technology	1
				Low self-esteem and lack of interest	1
				Encouraging care recipients to gradually discover ICT-based activities	1
				building confidence	1
		Sustainability	1	Ensuring user-friendliness and adequacy of digital technology used by the care recipient	1
				Avoiding over-complexity	1
				Observing sustainable user development; preventing discouragement and loss of interest	1

1st level	No.	2nd level	No.	3rd level	No.
Entrepreneurial	2	Digital entrepreneurship	2	Business knowledge of SMAAC technologies	1
				Ability to quickly spot new trends	1
				Investment skills	1
				Sales, marketing and business development	1
				Bring new products and services to market	1
				Networking and finding the right talent	1
				Leadership and ability to manage multidisciplinary teams	1
Cognitive	2	Blank		Blank	
Core	1	Technical	1	ICT Knowledge	1
				ICT Usage	1
				Online Navigation	1
		Information Management	1	Define Search	1
				Access Information	1
				Evaluate	1
				Manage	1
		Communication	1	Transmitting Information	1
		Collaboration	1	Interactive Communication	1
				Participation of Discussion	1
		Creativity	1	Content Creation	1
		Critical Thinking	1	Classify Solutions and Problems	1
				Assess solution suitability	1
				Justify solution	1
				Justify solution	1
				Novelty of ideas and notions	1
		Problem Solving	1	Knowledge acquisition	1
				Knowledge application	1
Contextual	1	Ethical Awareness	1	ICT responsible use	1
				ICT social impact	1
		Cultural Awareness	1	Cross-cultural communication	1
		Flexibility	1	Cross-cultural communication	1
		Self-direction	1	Goal setting	1
				Control	1
				Initiative	1
				Monitor progress	1
		Lifelong Learning	1	Knowledge creation efficacy	1
Persona	1	Identity Building	1	Blank	
		Managing Reputation	1	Blank	
		Participating	1	Blank	
Transversal	1	Thinking	1	Blank	
		Problem solving	1	Blank	
		Learning	1	Blank	
		Team work	1	Blank	

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