SUPPORT DOCUMENT

NCVER

VET's response to Industry 4.0 and the digital economy: what works

Bridget Wibrow
Michelle Circelli
Patrick Korbel
NCVER

This document is a companion to two Good Practice Guides, *Incorporating digital skills into VET delivery* and *Teaching digital skills: implications for VET educators*, and is an added resource for further information. The Good Practice Guides are available on NCVER's Portal: <https://www.ncver.edu.au>.

Publisher's note

The views and opinions expressed in this document are those of NCVER and do not necessarily reflect the views of the Australian Government and state and territory governments. Any errors and omissions are the responsibility of the author(s).

This document should be attributed as Wibrow, B, Circelli, M & Korbel, P 2020, *VET's response to Industry 4.0 and the digital economy: what works,* NCVER, Adelaide.

This work has been produced by NCVER on behalf of the Australian Government and state and territory governments, with funding provided through the Australian Government Department of Education, Skills and Employment.

TD/TNC 140.03

Published by NCVER, ABN 87 007 967 311

Level 5, 60 Light Square, Adelaide, SA 5000
PO Box 8288 Station Arcade, Adelaide SA 5000, Australia

Phone +61 8 8230 8400 **Email** ncver@ncver.edu.au

Web <https://www.ncver.edu.au> <https://www.lsay.edu.au>

Follow us: <https://twitter.com/ncver> <https://www.linkedin.com/company/ncver>

Contents

Tables and figures 4
- Tables 4
- Figures 4

Context 5
- Purpose of the paper 5
- Guiding questions for discussion 5

VET's place in Industry 4.0: background 6
- Industry 4.0 and digital skills 6
- VET and digital skills 7

Incorporating digital skills into VET delivery 9
- International lessons 9
- Application to the Australian VET sector 11

Implications of Industry 4.0 and the digital economy for the VET educator workforce 14
- Digital competence of educators and educational institutions 16

References 19

Appendix A Exploration of enrolments in digital skills-related units of competencies 21
- Digital skills in training packages 21
- Enrolments in elective and core digital skills-related units of competency 22

Appendix B Digital Skills Framework 26

Appendix C European Framework for the Digital Competence of Educators (DigCompEdu): detail 28

Appendix D European Framework for Digitally Competent Educational Organisations (DigCompOrg): detail 32

Tables and figures

Tables

A1 Digital skills categorisation and search terms and sample content extraction results 22

A2 Number of units specified within qualifications as core, elective or both, by training package 23

A3 Number of times units are specified and used within qualifications as core or elective, by training package 24

A4 Top three digital skills-related units with the most enrolments as a core unit, 2018 24

A5 Top three digital skills-related units with the most enrolments as an elective unit, 2018 25

B1 Australian Workforce Digital Skills Framework 26

B2 Australian Workforce Digital Skills Framework: digital skills category dimensions 27

C1 Key areas of educator development and associated competencies in the European Framework for the Digital Competence of Educators (DigCompEdu) 28

C2 Levels of educator proficiency as prescribed in the DigCompEdu 31

D1 Elements, sub-elements and descriptors comprising the European Framework for Digitally Competent Educational Organisations (DigCompOrg) 32

Figures

1 European Framework for the Digital Competence of Educators (DigCompEdu): key areas of digital competence 17

2 European Framework for Digitally Competent Educational Organisations (DigCompOrg): key elements and sub-elements 18

Context

Purpose of the paper

This paper was used to guide discussions at the invitation-only forum, *VET's response to Industry 4.0 and the digital economy: what works*, hosted by the National Centre for Vocational Education Research (NCVER) in Melbourne on 20 November 2019. The focus of the forum was to develop practical strategies for the incorporation of digital skills into vocational education and training (VET) delivery and to determine how any implications for the VET educator workforce could be addressed. Information from the Australian and international literature on digital skills is presented throughout this paper, with questions underneath relevant content to guide discussion. The guiding questions for the discussions are also listed below.

Participants included representatives from skills service organisations; members of the Education Industry Reference Committee; industry, provider and practitioner-related bodies; policy-makers; and relevant researchers.

The key learnings from this forum can be found in two good practice guides published by NCVER:

- *Incorporating digital skills into VET delivery*
- *Teaching digital skills: implications for VET educators*

Guiding questions for discussion

Key theme	Question
VET delivery	Considering international lessons from digital skills delivery within TVET, what would be relevant for the Australian VET system? What would work or wouldn't work in the Australian context?
	Should more digital skills-related elective units become core units? What criteria should be used to determine whether a unit is core or elective?
	Is embedding digital skills into courses feasible and how would it work?
	What elements constitute good practice in developing specific digital skills-related qualifications?
	Could modular training or shorter digital skills-related courses work in the Australian VET system and are there any implications for quality?
	What are the implications for VET providers of a move to more digital forms of learning?
Workforce development for VET educators	What are providers currently doing to assist VET educators to build digital skills capability and what could they do more of to facilitate this?
	Do VET educators need additional training in digital skills, either general or industry-specific, apart from maintaining industry currency? Does the additional training need to be industry-specific, or is general training sufficient (for example, a new digital learning skill set, 'Digital training and assessment', as a companion to the Certificate IV in Training and Assessment)?
	What approaches can be applied to ensure the integrity of competency-based assessment using digital tools?
	How relevant are the competencies and proficiency levels described in the Digital Competence of Educators (DigCompEdu) framework for Australian VET educators? ▪ Could this framework complement other current teaching practice frameworks? In what way?
	Do the elements described in the European Framework for Digitally Competent Educational Organisations (DigCompOrg) have relevance to the Australian VET sector? If not, why? ▪ How can the constituent parts of the VET system support VET providers to deliver elements of the DigCompOrg framework (e.g. governments providing consistent funding to promote digital infrastructure development)?

VET's place in Industry 4.0 – background

- The term 'Industry 4.0' refers to the growing rate of advanced technologies in the workplace, such as automation, and the digital disruption occurring to the economy resulting from them.
- Digital skills refer not only to the more technical or expert skills such as those typically required for software development or complex coding, but also to those required to use digital technologies effectively to communicate and acquire information and operate within a digital work environment.
- Given its ties to industry, VET has an important role in ensuring the workforce is appropriately skilled to respond to Industry 4.0.

Industry 4.0 and digital skills

Interest in the use of new or advanced technologies in the workplace is growing. Examples of these technologies include artificial intelligence, automation, augmented and virtual reality, as well as 3D printing and cloud technology. Such technologies contribute to the digital disruption currently occurring to the economy, referred to as the Fourth Industrial Revolution, or Industry 4.0.

With advancing technologies, however, comes the need to ensure an appropriately skilled workforce. Consequently, the role of the VET sector in contributing to this skilled workforce is an important one.

Our interest here lies not in the new technologies per se but in the digital skills that will be required by the workforce to use them. It is important to note that, for our purposes, digital skills not only refer to the more technical or expert skills such as those typically required for software development or complex coding, but also those required to use digital technologies effectively to communicate and acquire information and operate within a digital work environment. Indeed, a report by the Productivity Commission (2016, p.82) states that 'all workers need the skills to interact with digital technology, whether it is maintaining records in caring professions, taking orders in retail, or operating equipment in the processing plant'.

Not every worker will require the same level of digital skills or expertise in the use of technologies, but most will need the skills to work with technology (Reeson et al. 2016). Based on this, Gekara et al. (2019a, p.12) detailed the four levels of workforce digital skills required:

- Level 1: having a basic understanding of digital devices and their operation, enabling data and information to be searched, captured, retrieved and transmitted
- Level 2: understanding and applying digital knowledge to the management and application of digital systems to process, analyse and manage data and information in order to facilitate efficient organisational operations
- Level 3: innovatively using digital technologies to create and enhance organisational systems and capabilities

- Level 4: having a broad and general digital culture and mindset to operate confidently, comfortably and safely within an entrenched digital environment.

Internationally, there have been similar approaches taken to defining digital skills requirements. One example is the UK Digital Skills Taskforce (cited in Miles Morgan Australia 2017, p.31), in which four types of occupations were defined, based on their requirements for digital skills. One of these categories identified occupations that required no digital skills. The remaining three categories were:

- Digital citizen: ability to use digital technology purposefully and confidently to communicate, find information and purchase goods/services
- Digital worker: ability to evaluate, configure/program, and use complex digital systems
- Digital maker: skills to actually build digital technology (typically software development but including creating complex Excel macros or 3D printing data files).

Examples of how digital skills are pervading Australian jobs include the use of GPS data for meter readers, telemetry in agricultural machinery, and remote diagnostics for heavy machinery (Misko & Wibrow 2020). With these skills becoming an everyday part of many jobs, there is growing demand that the VET sector ensures that workers possess these skills due to the strong relationship between VET and industry.

VET and digital skills

Previous research on VET and digital skills has highlighted the role VET can play in not only training new workers with the skills required for emerging technologies but also in upskilling the existing workforce. One suggestion is that VET should be working with firms to reskill or train their workers in the further skills and knowledge they require as a result of the disruptive technologies (Seet et al. 2018). VET can also help in the development of soft skills, such as creativity, teamwork and communication, these skills enabling workers to adapt to rapidly changing workplaces (Seet et al. 2018). The Prime Minister's Industry 4.0 Taskforce shares this view, noting that the 'Industry 4.0 workforce requires competency across digital, project coordination and soft skills' (Gallagher 2017, p.40). However, the current prescriptive nature of training packages is limiting the capability of training providers to adjust program offerings to meet future demand for digital skills and capabilities (Seet et al. 2018).

An analysis of training packages in two industry areas, transport and logistics, and public safety and correctional services, by Gekara et al. (2019b) revealed that, while each includes a significant amount of digital training, this training is mostly at low levels of basic digital literacy. Gekara et al. focused on these two industry areas for four main reasons: the growing need for digital skills in these industries and the threat to performance if the workforce is not adequately skilled; these industries hold great significance to the economy in terms of the scale of their national revenue and public service provision; these industries experience persistent skills and workforce challenges; and the diversity of the industries and their sub-sectors means the findings are more broadly applicable.

Gekara et al. (2019b) found that much of the digital training occurs in elective units rather than in core units, meaning that qualifications can be completed without any training in digital skills. In line with this, the 2018 Australian Industry and Skills Committee's Skills Forecasts rated skills relating to technology use and application as their third highest priority in the generic skill category (Australian

Industry and Skills Committee 2018), which has led to the establishment of the Digital Transformation Expert Panel.[1] The panel will provide advice on how Australia's VET system can effectively respond to the digital change occurring in industry, along with its impact on the workforce. Part of this work involves assessing the digital skills-related content in existing training package units, as well as looking at the future digital skills identified in industry skills forecasts of all the industry reference committees.

1 <https://www.australianindustrystandards.org.au/aisc-establishes-digital-transformation-irc/>.

Incorporating digital skills into VET delivery

Much research into the importance of digital skills and their development focuses on the schooling and university sectors and underestimates the role that VET can play.[2] However, because of their links with industry and their applied learning focus, VET providers are important in the development of digital skills (Gallagher 2019; TAFE Directors Australia 2019).

In this section we look at what is occurring internationally and how it can be applied to the Australian VET sector.

International lessons

- Speaking the same language
- Partnering with employers
- Regularly updating training content
- Covering digital skills at all levels
- Supporting lifelong learning
- Providing flexible training delivery
- Making digital skills a part of foundation skills
- Recognising digital skills in government policy
- Anticipating changing skill needs

Responding to the growing requirement for workers across the job spectrum to hold digital skills is a priority in many countries. The regions examined for this analysis include the United Kingdom, Germany and other European countries (as represented through the European Commission), Singapore, the United States and Canada. Here we identify the major themes extracted through this analysis rather than examine individual countries.

- *Speaking the same language*: currently a divide exists in the language employers use to describe skills and that used in qualifications and training. Having consistency in the language will help to ensure that employers and education providers have the same understanding of the skills (Digital Skills Qualifications Review Steering Group 2016). This issue was also raised by Gekara et al. (2017, p.8) in relation to the Australian system: they noted that employers failing to clearly articulate skill needs leads to a basic and open interpretation of technical content by training package developers.

2 See, for example, *Preparing for Australia's digital future: a strategic plan for information and communications science, engineering and technology* developed by the National Committee for Information and Communication Sciences, 2019.

- *Partnering with employers*: VET organisations and businesses should work together to improve cooperation in the process of building digital skills by ensuring that each has input into curriculum and VET delivery (Vroonhof et al. 2017). Strong partnerships also have the potential to improve the quality and attractiveness of VET (Vroonhof et al. 2017). This approach has been adopted with the UK strategy to introduce digital skills partnerships between government, industry and education providers, the aim being to improve both the coherence of digital skills provision and the training on offer (Innovation & Business Skills Australia [IBSA] 2017, Field & Langwell attachment).
- *Regularly updating training content*: a common theme presented in the literature is the need for digital skills training content to be adaptable and have the capacity to be updated quickly. The case studies presented in Orlik (2018) all advocated for the regular revision of curriculum to keep abreast of technological advances, with some programs undertaking this task twice per year. However, it is noted that 'the frequent revision of curricula is a challenge for traditional forms of accreditation' (Orlik 2018, p.28). In Singapore, more modularised training programs for digital skills are being supported (IBSA 2017, Field & Langwell attachment).
- *Covering digital skills at all levels*: the United Kingdom's Digital Skills Qualifications Review Steering Group (2016) pointed to the need to ensure support for the development of digital skills at all levels — basic, general/intermediate and advanced/specialist — as well as providing the capacity for progression to higher levels. In Canada, Huynh and Malli (2018) noted that there is currently a lack of intermediate-level courses, a situation that needs rectifying.
- *Supporting lifelong learning*: this issue is of growing importance, with the increasing need to upskill/reskill workers due to technological advances, and is particularly recognised in Germany, where a national strategy to guide lifelong learning is being considered (IBSA 2017, Field & Langwell attachment).
- *Providing flexible training delivery*: on a similar note, delivery of training must be flexible enough to be delivered as required and have the capacity to meet the needs of individuals as they transition through jobs (that is, just-in-time training and flexible delivery options) (Digital Skills Qualifications Review Steering Group 2016). The training will also need to be flexible enough to accommodate 'business as usual' (European Commission 2019). This issue has also been raised in the Australian context by Allen, Teodoro and Manley (2017, p.32) in the context of VET requiring more flexibility:

  > [there is] the growing expectation that training and education should adjust and cater to individual needs, at the right time, in the right way, and at the right price. To meet these demands a training system that does not delay or hinder continued learning and participation is needed.

  While recognising the need for flexibility to enable a rapid response to changes, Brolpito (2018) argues that VET needs to balance this with stability.
- *Making digital skills a part of foundation skills*: digital skills are increasingly seen as fundamental to a number of vocations outside the traditional digitally intense occupations (for example, ICT-related) and as such should be recognised as foundation skills (Markow, Hughes & Bundy 2018).
- *Recognising digital skills in government policy*: digital skills development is recognised as a priority in government policy, for example, in Singapore, the UK and Germany. In a working paper for UNESCO, Fau and Moreau (2018) argued that two types of public policy need to be considered in the development of digital skills: policies that create a supportive framework, such as

technological infrastructure, digitalisation of businesses and the development of online content; and sectoral policies for basic and further training, for instance, teaching more advanced technological skills at school, providing teacher training, monitoring digital skills, combating digital exclusion, and collaborating with government, educational institutions and businesses.

- *Anticipating changing skill needs*: as recognised by the Organisation for Economic Co-operation and Development (OECD), it is crucial for education and training systems to 'better assess and anticipate changing skill needs (including through the use of big data)' in order to meet the challenges raised by the Fourth Industrial Revolution (IBSA 2017, Field Langwell attachment, p.17). The European Commission (2017) suggests that this can be achieved by: making use of the EU skills panorama; using advanced web analytic tools; gathering evidence from different sectors on their digital skills needs; and accounting for geographic scope.

Q: Considering international lessons from digital skills delivery within TVET, what would be relevant for the Australian VET system? What would work or wouldn't work in the Australian context?

Application to the Australian VET sector

- Change digital skills-related units from elective to core skills.
- Embed digital skills into courses/incorporate into the Australian Core Skills Framework.
- Develop specific qualifications related to digital skills.
- Deliver more modular training or shorter courses.
- Overhaul approaches to training delivery.

The current structure of training packages and the length of time it takes for changes to be incorporated are currently barriers to the ability of the VET sector to deliver the digital skills the workforce requires (Reeson et al. 2016; TAFE Directors Australia 2019; Seet et al. 2017; Gekara et al. 2019b). One reason for this, as noted by Reeson et al. (2016), is that the technology used in the workplace can change even while the student is undertaking their training program. The need for more adaptability and flexibility in the delivery of VET training packages to ensure they are regularly updated with the most appropriate digital skills is recognised in the Australian literature.

Considerations for VET delivery

The literature suggested the following approaches to assist the Australian VET sector to more adequately deliver digital skills content:

- *Change digital skills-related units from elective to core skills*: although training packages already contain a considerable amount of digital skills content, most of it is offered via electives only, meaning a student can receive a qualification without completing these units of competency (Gekara et al. 2017). See appendix A for an overview of the Gekara et al. work and an exploration of enrolments in digital skills-related units of competencies.

Q: Should more digital skills-related elective units become core units? What criteria should be used to determine whether a unit is a core unit or an elective unit?

- *Embed digital skills into courses/incorporate into the Australian Core Skills Framework*: given the increasing importance placed on workers possessing digital skills, an approach could be adopted whereby these skills are embedded into existing courses, as has been done previously with literacy and numeracy skills and employability skills. This approach is supported by Gallagher (2019), who believes that digital, technological and functional skills aligned to the future of work must be embedded into existing courses. On a similar note, Gekara et al. (2019b, p.34) have developed an 'Australian Workforce Digital Skills Framework', which could be integrated into the Australian Core Skills Framework (see appendix B).

Q: Is embedding digital skills into courses feasible and how would it work?

- *Develop specific qualifications related to digital skills*: on the other hand, specific qualifications have already been developed to address some of the current gaps in digital skills training, such as in automation. Examples of these qualifications include:
  - Diploma of Applied Technologies (Swinburne University; Industry 4.0 higher apprenticeships)
  - Associate Degree of Applied Technologies (Swinburne University; Industry 4.0 higher apprenticeships)
  - Certificate II in Autonomous Workplace Operations (South Metro TAFE currently in pilot)
  - Certificate IV in Autonomous Control and Remote Operations (South Metro TAFE currently in pilot)
  - Micro-credential course, Working Effectively in an Automation Workplace (South Metro TAFE currently in pilot)

  Furthermore, the Australian Centre for Energy and Process Training (ACEPT) at South Metro TAFE[3] has partnered with oil and gas, processing and resources industries to provide students with training in a real-life setting.

Q: What elements constitute good practice in developing specific digital skills-related qualifications?

- *Deliver more modular training or shorter courses*: the push towards increasing lifelong learning to allow digital skills to be updated flexibly, and as needed through a person's working life, has prompted suggestions for more modular training or short courses (Reeson et al. 2016; PriceWaterhouseCoopers [PwC] Australia 2019). The flexibility of these shorter courses would allow them to be completed alongside work (Reeson et al. 2016), as well as enable their easy adaptation to current skill needs. Shorter courses are recognised by employers to be an asset due to these reasons (PriceWaterhouseCoopers Australia, Data and Analytics Services 2019). Seet et al.

3 <https://www.southmetrotafe.wa.edu.au/content/acept>.

(2018) also propose the use of accredited courses in digital skills in the short-term to accommodate the period in which changes are made to training packages; however, IBSA (2017) warns that too many accredited courses could lead to an inconsistent national approach to training.

Q: Could modular training or shorter digital skills-related courses work in the Australian VET system and are there any implications for quality?

- *Overhaul approaches to training delivery*: the literature on digital skills points to a shift from traditional forms of delivery, such as classroom-based, to more digital forms (Reeson et al. 2016). This change would help to provide the just-in-time and flexible training that enables individuals to complete training alongside their current work obligations.

Q: What are the implications for VET providers of a move to more digital forms of learning?

Implications of Industry 4.0 and the digital economy for the VET educator workforce

- Future students will expect more from teachers.
- Educators need to know how to use technology.
- Changes to pedagogy are required.

Tied to the increasing need for digital skills in the workplace is the need to consider the implications for the VET educator workforce itself: are VET educators sufficiently skilled to deliver the digital skills training requirements of learners? Furthermore, the introduction of new competencies related to digital skills into VET training package qualifications may have implications for the VET educator workforce. A situation such as this has arisen previously, when employability skills and language, literacy and numeracy skills were embedded into training packages. Following the introduction of employability skills into training packages, for example, many VET educators were unsure about how they should be taught and assessed, with suggestions that professional development programs were needed to help prepare them to teach these skills (Wibrow 2011).

A review of recent international and national literature highlights common issues for teachers and trainers across all educational settings with regard to their ability to identify and use digital skills and technologies and embed into their teaching and assessment practices. The issue of how digitally competent teachers and trainers should be professionally prepared has only recently come into focus both in Australia and internationally.

- *Future students will expect more from teachers*: as Reeson and colleagues (2016, p.34) noted:

  > Future VET students will not only have higher levels of digital literacy, they will also have higher expectations of educational providers, expecting them to use digital technology to provide the flexibility, convenience and more engaging learning experiences to which they have become accustomed. This, too, will increase the demands on educators.

  This almost role reversal of positions — who actually is the educator? — was also highlighted by Grand-Clement (2017). Through consultations with young people and senior representatives of academia, industry, government, volunteer and community organisations undertaken as part of a project examining how digital skills can assist in building a better connected society in the UK, three barriers to educators being able to keep up with changes in technology were identified:

  - systemic institutional barriers, which prevent or impede learning through digital technologies
  - lack of consultation between education technology developers and educators in relation to understanding the pedagogy behind the use of the technology
  - lack of skills development and the imperative to make digital technologies and skills development a greater focus of continuing professional development for educators (p.9).

- *Educators need to know how to use technology*: the rapid changes in technology, both in workplaces and everyday life, together with the ubiquity of digital devices and applications, necessitate teachers developing and keeping their own digital skills current. That said, not only do they need to be a competent user of technology, they must also be a competent teacher of that technology (Medlin 2016; Reeson et al. 2016).

  In a survey of the language, literacy and numeracy, and the education and training workforces undertaken for the 2014—15 National Foundation Skills Strategy Project, Circelli (2015) found that many respondents referred to the necessity to improve their own digital literacy skills and/or that of the learner. The areas of professional development need cited were: learning how to incorporate contemporary digital tools (such as iPads and mobile phones) into the teaching process; best practice in online delivery, including converting materials for engaging online delivery; and learning more about relevant online software and developing online learning tools. Reeson and colleagues (2016) also found that not all VET educators are 'comfortable with and proficient users of digital technology' and that 'time, investment and support will be required to build educators' capability to deliver VET in an increasingly digital learning and workplace environment' (p.5).

Q: What are providers currently doing to assist VET educators to build digital skills capability and what could they do more of to facilitate this?

- *Changes to pedagogy are required*: Reeson et al. (2016) noted that, given the increasing use of digital tools and mediums in education and training, 'educators will need different pedagogy and skill sets in order to use them effectively in their teaching'(p.34).

  In its 2019 Industry Skills Forecast for education, PwC's Skills for Australia also emphasised the imperative for VET educators to be not only 'digitally literate so that they can practically facilitate digital learning, but also that they understand e-learning pedagogy so as to appropriately employ digital learning strategies' (p.18). A similar point was made by Grand-Clement (2017): 'there remains a distinction between using technology for learning as opposed to teaching how to use technologies' (p.7).

  PwC's Skills for Australia (2019) summarised the key skill needs required of VET educators for meeting and adapting to the increasing digital environment as being:

  - digital fluency and strategies for continuous learning to maintain digital currency
  - numeracy and computational skills of VET trainers and assessors, as these skills provide a foundation for the attainment of digital fluency and other STEM skills
  - the ability to deliver materials through e-learning and to assess online learning, including the ability to make resources and assessments available online, deliver training sessions online and facilitate a collaborative online learning environment
  - the ability to teach basic digital skills as a part of industry specific training (p.18).

  The increasing integration of digital technologies into VET learning and teaching practices also has implications for assessment, as noted in the key skills listed above, in that this approach can allow for more regular, and personalised, formative assessment opportunities through the use of tools such as e-portfolios, electronic textbooks and learning analytic tools (Brolpito 2018). But, as PwC's

> Skills for Australia warn, challenges related to competency-based assessments may arise in confirming the authenticity of the student's identity (is this their own work?) and the integrity of the evidence; that is, accounting for or limiting issues such as plagiarism and inappropriate collaboration (p.18).

Q: Do VET educators need additional training in digital skills, either general or industry-specific, apart from maintaining industry currency? Does the additional training need to be industry-specific, or is general training enough, for example, a new digital learning skill set in digital training and assessment as a companion to the Certificate IV in Training and Assessment?

Q: What approaches can be applied to ensure the integrity of competency-based assessment using digital tools?

Digital competence of educators and educational institutions

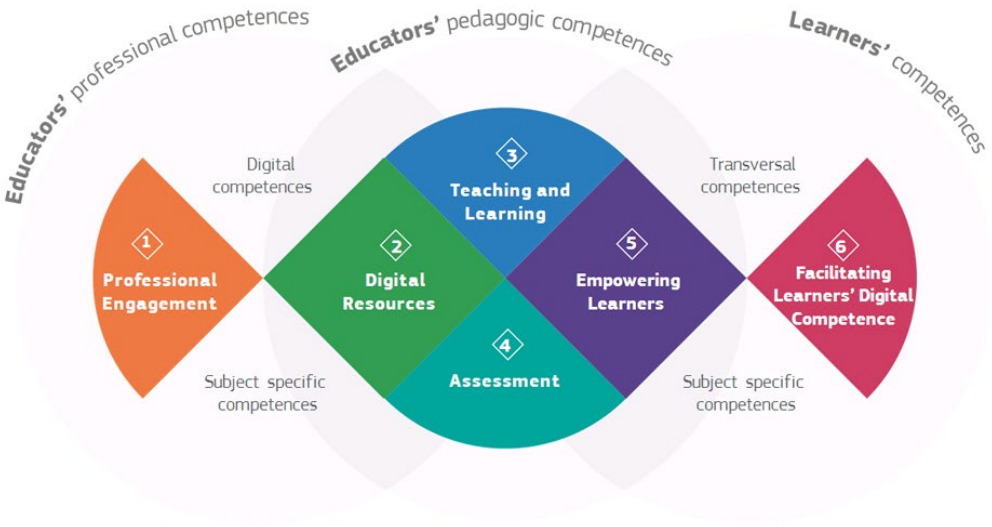
To help support a systematic approach to the continuing development of the digital capability of educators and training providers, there may be merit in considering the European Commission's recently developed European Framework for the Digital Competence of Educators (DigCompEdu) and European Framework for Digitally Competent Educational Organisations (DigCompOrg).

Both frameworks provide a common language and approach to determining the current digital competence of educators and educational institutions, including those in the VET space, and highlight the key aspects of focus as educators and providers deepen their engagement with digital learning and digital pedagogies (Kampylis, Punie & Devine 2015; Redecker 2017).

DigCompEdu

The framework for the Digital Competence of Educators outlines six key areas of digital competence, encompassing 22 competencies, and describes the progress of educator proficiency in each of these key areas, from the position of a 'newcomer' to 'pioneer' (Redecker 2017). The key areas are summarised in figure 1, with the 22 competencies and levels of proficiency detailed in appendix C.

Figure 1 European Framework for the Digital Competence of Educators (DigCompEdu): key areas of digital competence



Source: Redecker (2017).

Q: How relevant are the competencies and proficiency levels described in the Digital Competence of Educators (DigCompEdu) framework for Australian VET educators?

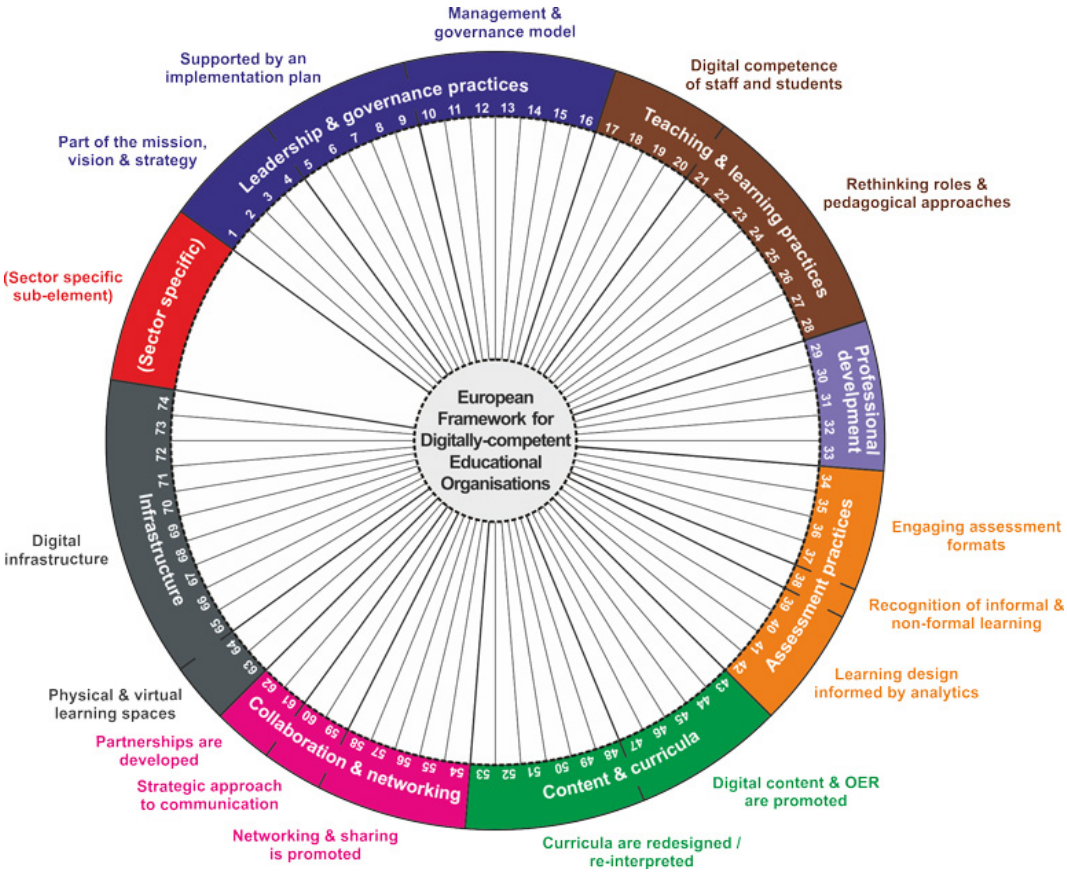
- **Could this framework complement other current teaching practice frameworks? In what way?**

DigCompOrg

The framework for Digitally Competent Educational Organisations (DigCompOrg) comprises seven interrelated key elements, with 15 sub-elements (see figure 2). Each of the sub-elements has several descriptors, with this detail provided in appendix D. The focus of DigCompOrg is primarily on teaching, learning, assessment and learning support activities, with the elements encompassing both organisational responsibilities (such as leadership and governance, and infrastructure) and individual responsibilities (such as teaching and learning practices). The framework was developed through a review of academic and grey literature, analyses of existing frameworks and self-assessment questionnaires relating to the integration of digital technologies in education and training across European countries, along with a series of consultations with key experts and stakeholders (Kampylis, Punie & Devine 2015).

The DigCompOrg framework can be used by educational institutions to examine those pedagogical, technological and/or organisational aspects that require development or enhancement in order to support a deeper engagement with, and application of, digital learning technologies in the delivery of courses (Kampylis, Punie & Devine 2015).

Figure 2 European Framework for Digitally Competent Educational Organisations (DigCompOrg): key elements and sub-elements



Source: <https://ec.europa.eu/jrc/en/digcomporg/framework>.

Q: Do the elements described in the Digitally Competent Educational Organisations (DigCompOrg) framework have relevance to the Australian VET sector? If not, why?

- **How can the constituent parts of the VET system support VET providers to deliver elements of the DigCompOrg framework (for example, governments providing consistent funding to promote digital infrastructure development)?**

References

Allen, R, Teodoro, N & Manley, C 2017, *Future skills and training: a practical resource to help identify future skills and training*, Australian Industry Skills Committee, viewed 1 October 2019, <https://www.aisc.net.au/sites/aisc/files/documents/Future%20Priority%20Skills%20Resource.pdf>.

Australian Industry and Skills Committee 2018, 'Digital skills', viewed August 2019, <https://nationalindustryinsights.aisc.net.au/national/digital-skills>.

Brolpito, A 2018, *Digital skills and competence, and digital and online learning*, European Training Foundation, Turin, viewed 2 October 2019, <https://www.etf.europa.eu/en/publications-and-resources/publications/digital-skills-and-competence-and-digital-and-online>.

Circelli, M 2015, *Who is delivering foundation skills?: a survey of the LLN and education and training workforces*, National Foundation Skills Strategy Project 2014—15, Department of State Development, Adelaide.

Digital Skills Qualifications Review Steering Group 2016, *Review of publicly funded digital skills qualifications*, Skills Funding Agency, Coventry, viewed 25 September 2019, <https://www.gov.uk/government/publications/review-of-publicly-funded-digital-skills-qualifications>.

European Commission 2017, *A common European response to shared goals: a concept for tackling the digital skills challenges in Europe*, European Commission, Luxembourg.

——2019, *Digital skills: new professions, new educational methods, new jobs*, Publications Office of the European Union, Luxembourg, viewed 1 April 2020, <https://ec.europa.eu/digital-single-market/en/news/digital-skills-training-blueprints-upskilling-sme-employees-and-unemployed-persons>.

Fau, S & Moreau, Y 2018, *Building tomorrow's digital skills: what conclusions can we draw from international comparative indicators?*, UNESCO working papers on education policy no. 06, UNESCO, Paris, viewed 2 October 2019, <http://www.unesco.org/ulis/cgi-bin/ulis.pl?catno=261853&set=005B76470C_2_256&gp=1&lin=1&ll=1>.

Gallagher, S 2017, *Industry 4.0 Testlabs in Australia: preparing for the future*, Prime Minister's Industry 4.0 Taskforce, Department of Industry, Innovation and Science and Swinburne University of Technology, Canberra, viewed 19 June 2019, <https://www.industry.gov.au/sites/g/files/net3906/f/July 2018/document/pdf/industry-4.0-testlabs-report.pdf>.

——2019, *Peak human potential: preparing Australia's workforce for the digital future*, Centre for the New Workforce, Swinburne University of Technology, Hawthorn, viewed 4 September 2019, <https://www.swinburne.edu.au/media/swinburneeduau/centre-for-the-new-workforce/cnew-national-survey-report.pdf>.

Gekara, V, Molla, A, Snell, D, Karanasios, S & Thomas, A 2017, *Developing appropriate workforce skills for Australia's emerging digital economy: working paper*, NCVER, Adelaide.

Gekara, V, Snell, D, Molla, A, Karanasios, S & Thomas, A 2019a, *Skilling the Australian workforce for the digital economy: Support document 2— case studies and survey findings*, NCVER, Adelaide.

——2019b, *Skilling the Australian workforce for the digital economy*, NCVER, Adelaide.

Grand-Clement, S 2017, *Digital learning: education and skills in the digital age*, RAND Corporation, viewed 2 October 2019, <https://www.rand.org/content/dam/rand/pubs/conf_proceedings/CF300/CF369/RAND_CF369.pdf>.

Huynh, A & Malli, N 2018, *Levelling up: the quest for digital literacy*, Brookfield Institute for Innovation + Entrepreneurship, Toronto, viewed 13 August 2019, <https://brookfieldinstitute.ca/report/levelling-up/>.

Innovation and Business Skills Australia (IBSA) 2017, *Digital Skills Cross Sector Project: case for change*, November 2017, IBSA, East Melbourne, viewed 10 September 2019, <https://www.ibsa.org.au/consultation-project/coding-skills-cross-sector-project/coding-skills-cross-sector-project-outcome/>.

Kampylis, P, Punie, Y & Devine, J 2015, *Promoting effective digital-age learning: a European Framework for Digitally-Competent Educational Organisations*, Publications Office of the European Union, Luxembourg.

Markow, W, Hughes, D & Bundy, A 2018, *The new foundational skills of the digital economy: developing the professionals of the future*, BHEF market intelligence highlights, Business-Higher Education Forum, Washington, viewed 30 September 2019, <http://www.bhef.com/publications/new-foundational-skills-digital-economy-developing-professionals-future>.

Medlin, J 2016, *The Australian literacy and numeracy workforce: a literature review*, NCVER, Adelaide.

Miles Morgan Australia 2017, *Future skills and training: a practical resource to help identify future skills and training*, Commonwealth of Australia.

Misko, J & Wibrow, B 2020, *Traditional apprenticeships: learnings from the field*, NCVER, Adelaide.

National Committee for Information and Communication Sciences 2019, *Preparing for Australia's digital future: a strategic plan for information and communications science, engineering and technology*, Australian Academy of Science & Australian Academy of Technology and Engineering, Canberra.

Orlik, J 2018, *Delivering digital skills: a guide to preparing the workforce for an inclusive digital economy*, Nesta, London, viewed 28 August 2019, <https://www.nesta.org.uk/report/delivering-digital-skills/>.

PricewaterhouseCoopers (PwC) Australia 2019, *Transforming Australian manufacturing: preparing businesses and workplaces for Industry 4.0*, PricewaterhouseCoopers Australia, Melbourne, viewed 25 September 2019, <https://www.pwc.com.au/education/industry-proposal-13may2019.pdf>.

PricewaterhouseCoopers Australia, Data and Analytics Services 2019, *Industry skills forecast and proposed schedule of work: education*, Skills for Australia, PricewaterhouseCoopers, Sydney, viewed 1 April 2020, <https://s3-ap-southeast-2.amazonaws.com/pwcau.prod.s4aprod.assets/wp-content/uploads/20190621114611/Education-2019-Industry-Skills-Forecast-Final-AISC-Submission-1.pdf>.

Productivity Commission 2016, *Digital Disruption: What do governments need to do?*, Commission Research Paper, Canberra.

Redecker, C 2017, *European Framework for the Digital Competence of Educators: DigCompEdu,* Publications Office of the European Union, Luxembourg.

Reeson, A, Mason, C, Sanderson, T, Bratanova, A & Hajkowicz, S 2016, *The VET era: equipping Australia's workforce for the future digital economy*, CSIRO, Clayton, Vic., viewed 21 August 2019, <https://web.archive.org/web/20180312142624/http://tafeqld.edu.au/resources/pdf/about-us/research-papers/vet-era.pdf>.

Seet, P-S, Jones, J, Spoehr, J & Hordacre, A-L 2018, *The Fourth Industrial Revolution: the implications of technological disruption for Australian VET*, NCVER, Adelaide, viewed 1 October 2019, <https://www.ncver.edu.au/research-and-statistics/publications/all-publications/the-fourth-industrial-revolution-the-implications-of-technological-disruption-for-australian-vet>.

TAFE Directors Australia 2019, *Capitalising on the 'Blue Tech' opportunity: the vital role TAFE plays in equipping the Australian workforce for a digitised world*, TDA, Canberra, viewed 1 April 2020, <https://www.tda.edu.au/study-tours/study-tour-2019/>.

Vroonhof, P, Durazzi, N et al. 2017, *Business cooperating with vocational education and training providers for quality skills and attractive futures*, Publications Office of the European Union, Luxembourg, viewed 13 August 2019, <http://ec.europa.eu/social/main.jsp?catId=738&langId=en&pubId=8053&furtherPubs=yes>.

Wibrow, B 2011, *Employability skills: at a glance*, NCVER, Adelaide.

Appendix A Exploration of enrolments in digital skills-related units of competencies

Digital skills in training packages

Work by Gekara et al. conducted in 2017 showed that digital skills-related units of competency do appear in training packages, but that they are often specified as elective units. In practice, this means that qualifications can be completed without them and learners may not develop these important skills.

In this section we will expand upon the work of Gekara et al. — where they identified the digital skills content of 11 training packages in the transport and logistics, and public safety and correctional services sectors — by investigating the enrolment activity in these digital skills-related units of competency. The aim is to compare elective units of competency with core units and to gain an insight into how they are used in training packages.

We analyse the same training packages included in their investigation:

- Aviation (AVI)
- Correctional Services (CSC)
- Local Government (LGA)
- Maritime (MAR)
- Aeroskills (MEA)
- Police (POL)
- Public Sector (PSP)
- Public Safety (PUA)
- Training and Education (TAE)
- Transport and Logistics (TLI)
- Electrotechnology (UEE).

For the purposes of their study, Gekara et al. (2017) defined digital skills as encompassing the following elements: a digital mindset (hardware, software, information, systems, security and innovation); knowledge (theoretical comprehension and understanding); competence (cognitive and practical knowhow); and attitude (value and beliefs).

Based on this definition, they developed 44 search terms, grouped into five categories, to be applied across the 11 training packages (table A1). Using those search terms and looking at the unit content, Gekara et al. identified 68 units of competency specified within these 11 training packages that were considered to be digital skills-related units, based on their working definition of digital skills.

Table A1 Digital skills categorisation and search terms and sample content extraction results

Search term category	Search terms	Examples of digital skills text string extracted from units of competency
Digital device	Computer, hardware, information technology, information technologies, infotechnology, mobile, communication technology, keyboard, digital device, digital tools, touchpad, tablet, 3-D printing, GPS	*Operating infotechnology devices used within the workplace in accordance with operational requirements* *Selecting and using relevant computer, communications and office equipment*
Data and information processing	Software, internet, data, database, web, social media, social network, wiki, information processing, data entry, data retrieval, big data, online, text messaging, online collaboration, analytics	*Use management information system to collect, store and retrieve data to support the preparation of business plans and/or budgets* *Using information technology for data analysis, recording and reporting*
Enterprise information systems and analytics	Information system, information systems, enterprise systems, analytics, big data analytics	*Selecting and appropriately applying technology, information systems and procedures to complete workplace tasks.* *using offender information system and files*
Security and privacy	Information security, information privacy, online security, virus, data breach, copyright, digital risk, online safety	*Handling and storing information securely and safely* *Identify relevant copyright, moral rights and intellectual property issues and legislation relevant to the use of information from databases.*
Digital innovation	Process innovation, system/process analysis, system/process design, system/process development, system/process improvement system/process innovation, digital marketing, app development, system evaluation, digital assessment, digital service, process improvement.	*Identifying potential areas for inspection process improvement as a quality system activity* *Analysing requirements for improved computer applications, evaluating relevant software, investigating appropriate hardware enhancements, implementing system improvements and measuring systemic improvement.*

Source: Gekara et al. (2017, p.17).

Enrolments in elective and core digital skills-related units of competency

An examination of the digital skills content of 11 training packages in the transport and logistics, and public safety and correctional services sectors found that:

- Most digital skills-related units were used as electives only (44 out of 68 units).
- These units were used as electives 80% of the time (321 out of 399 uses).
- Of the 28 540 enrolments in these units in 2018, 74% were as an elective unit.

Based on the 68 units identified by Gekara et al., we now do some further analyses of how these units are being utilised. Of these 68 units, only 8 were specified in the training packages as core units, 16 were specified as being both a core and an elective unit, and 44 were specified in the training packages as elective units only (table A2).

Table A2 Number of units specified within qualifications as core, elective or both, by training package

Training package	Number of units		
	Core unit	Core and elective unit	Elective unit
Aviation (AVI)	2	3	8
Correctional Services (CSC)	1	0	3
Maritime (MAR)	3	0	0
Aeroskills (MEA)	1	4	1
Police (POL)	1	0	0
Public Sector (PSP)	0	1	5
Public Safety (PUA12)	0	0	8
Training and Education (TAE)	0	0	3
Transport and Logistics (TLI)	0	6	11
Electrotechnology (UEE11)	0	2	5
Total	**8**	**16**	**44**

Note: The Local Government Training Package (LGA04) is not listed because, while it did have units containing digital skills search terms, they were not digital skills-related units (e.g. 'LGACOM503B Prepare a budget'); see Gekara et al (2017, p.45).

Counting each time a unit is specified within a distinct qualification also indicates a trend towards using these units as electives. Of the 399 times these units were specified in a qualification, they were specified as an elective 321 times (80%) and as a core unit 78 times (20%) (table A3).

Despite being specified in a qualification 399 times, on only 204 occasions were these units actually used in the selected qualifications between 2015 and 2018 (that is, with at least one enrolment). The core units were used in 72% of the qualifications in which they were specified (56 times of 78) and the elective units were used in 46% of the qualifications in which they were specified (148 times of 321) (table A3). Even when elective units are offered as part of the qualification, they are not necessarily available at each provider or chosen by the learners.

The currency of the units may also be another reason for a lack of enrolments. As part of the Digital Skills Cross Sector Project, Innovation & Business Skills Australia (2017) conducted an analysis of training packages similar to that of Gekara et al. (2017) but with a focus on manufacturing. They identified 211 units as containing digital skills but noted that:

> 35 have not been updated since they were first introduced in 2005, an additional 24 have not been updated since 2011 and 60 have not been updated since 2012. In addition, some of the updates to units with more recent release dates have involved changes to update the unit content to meet nationally agreed standards, rather than to make substantive changes to the content of the units (p.10).

This means that, even though there may be digital skills-related units of competencies on offer in training packages, they are not necessarily keeping up to date with technological change.

Table A3 Number of times units are specified and used within qualifications as core or elective, by training package

Training package	Core unit		Elective unit	
	Specified	Used (2015–18)	Specified	Used (2015–18)
Aviation (AVI)	13	9	18	9
Correctional Services (CSC)	1	1	4	2
Maritime (MAR)	4	4	0	0
Aeroskills (MEA)	14	11	14	7
Police (POL)	1	1	0	0
Public Sector (PSP)	3	3	17	11
Public Safety (PUA12)	0	0	10	7
Training and Education (TAE)	0	0	5	5
Transport and Logistics (TLI)	27	18	104	39
Electrotechnology (UEE11)	15	9	149	68
Total	**78**	**56**	**321**	**148**

Note: The Local Government Training Package (LGA04) is not listed because, while it did have units containing digital skills search terms, they were not digital skills-related units (e.g. 'LGACOM503B Prepare a budget'); see Gekara et al. (2017, p.45).

Just looking at enrolments in 2018, the trend towards including these units as electives is also reflected in the enrolments in these units (as part of an in-scope qualification). In 2018, there were 7 344 enrolments in these units as part of a qualification where the unit was a core unit and 21 196 enrolments in these units as part of a qualification where the unit was an elective unit. Tables A4 and A5 show the digital skills-related units with the most enrolments in 2018 as an illustrative example.

Table A4 Top three digital skills-related units with the most enrolments as a core unit, 2018

Training package	Subject	Enrolments as a core unit	Enrolments as an elective unit
TLI	TLIH2001 Interpret road maps and navigate pre-determined routes	2 316	7
TLI	TLIE2007 Use communications systems	1 832	1 809
AVI	AVIF0004 Implement aviation risk management processes	983	31

Table A5 Top three digital skills-related units with the most enrolments as an elective unit, 2018

Training package	Subject	Enrolments as a core unit	Enrolments as an elective unit
UEE	UEENEED101A Use computer applications relevant to a workplace	12	9 360
TLI	TLIA3016 Use inventory systems to organise stock control	0	2 264
TLI	TLIE2007 Use communications systems	1 832	1 809

Overall, the data show us that there are more digital skills-related elective units of competencies than core; however, they are used in less than 50% of the qualifications in which they are specified. Those elective units with the most enrolments appear to have broader applicability to many industries.

Appendix B Digital Skills Framework

Table B1 Australian Workforce Digital Skills Framework

Digital skill content	Level of need/ performance				
	Literacy (1)	Competency (2)	Proficiency (3)	Fluency (4)	Savvy (5)
Digital tools for working	Understand various digital tools	Basic use of various digital tools	Application of advanced digital tools confidently and efficiently	Evaluate and select appropriate digital tools for working	Suggest solutions to solve problems in the use of digital tools
Digital ways of working	Recognise various digital ways of working	Basic ability to work digitally such as find, retrieve and communicate information from a variety of information systems in a variety of formats	Apply advanced features to work digitally such as to search, find, retrieve, process and communicate information from advanced systems	Manage (analyse, compare, evaluate) the usefulness, relevancy, credibility, and reliability of digital ways of working	Identify and articulate digital ways of working issues; propose alternatives and participate in the implementation of new ways of working
Digital ways of thinking	Awareness of how to seek support and assistance when facing digital problems	Ability to communicate problems related to digital processes, routines and products	Investigates digital business processes, routines and products through an analytical and systematic approach to problem-solving	Analyse and evaluate the strengths and weaknesses of alternative digital solutions, conclusions or approaches to problems	Absorbs complex work problems and demonstrates a broad and deep ability to create innovative workplace digital work processes, routines and products
Living in the digital age	Awareness of digital threats and the social and environmental implications of digital technologies as well as basic privacy and copyright provisions.	Follow/comply with basic organisational rules and policies to protect hardware, software, information and systems (for example, using anti-viruses and passwords).	Apply advanced tools, techniques and configurations to protect hardware, software, information and systems.	Analyse digital risks and compliance to copyright and privacy to identify security threats and vulnerabilities.	Create policies and guidelines to improve digital security and protect copyright and privacy and keep up to date with latest security, privacy and copyright developments.

Source: Gekara et al. (2019b, p.34).

Table B2 Australian Workforce Digital Skills Framework: digital skills category dimensions

Category	Subcategory	Indicator
Digital tools for working	Digital device	Keyboard skills (keyboard dexterity)
		Operate industry (job) specific digital technologies
		Learn and adapt quickly to nascent and emerging technologies (such as social, mobile, internet of things, apps, robotics, artificial intelligence etc.)
	System competency	Use different enterprise information systems to complete complex transactions
		Ability to extract insight from data analytics systems, engines and dashboards
Digital ways of working	Data analytics	Ability to gather and analyse big data
	Digital communication and collaboration	Use advanced features of digital technologies with confidence for communication, cooperation and collaboration
		Effectively search, find, retrieve, process and communicate information from a variety of digital sources and in a variety of formats
Digital ways of thinking	Digital creativity and innovation	A mindset to function with an increasingly digitised workplace
		Entrepreneurial and commercialisation mindset in the digital workplace environment
		Creativity and experimental mindset in the digital workplace environment
	Digital problem-solving	Troubleshoot/solve problems that arise when using digital technologies
		Recognise workplace problems and needs in the digital environment and propose innovative solutions
Living in the digital age	Digital safety and security	Comply with organisational policies to protect hardware, software, information and systems
		Analyse digital risks to identify cyber security threats and vulnerabilities
	Social and ethical responsibility	Understand the importance of privacy in handling data and information
		Understand the positive and negative environmental impacts of digital technologies.

Source: Gekara et al. (2019b, p.32).

Appendix C European Framework for the Digital Competence of Educators (DigCompEdu): detail

Table C1 Key areas of educator development and associated competencies in the European Framework for the Digital Competence of Educators (DigCompEdu)

Key area	Competency	
Professional engagement	Organisational communication	To use digital technologies to enhance organisational communication with learners, parents and third parties To contribute to collaboratively developing and improving organisational communication strategies
	Professional collaboration	To use digital technologies to engage in collaboration with other educators, sharing and exchanging knowledge and experiences and collaboratively innovating pedagogic practices
	Reflective practice	To individually and collectively reflect on, critically assess and actively develop one's own digital pedagogical practice and that of one's educational community
	Digital continuous professional development	To use digital sources and resources for continuous professional development
Digital resources	Selecting	To identify, assess and select digital resources for teaching and learning To consider the specific learning objective, context, pedagogical approach, and learner group, when selecting digital resources and planning their use
	Creating & modifying	To modify and build on existing openly licensed resources and other resources where this is permitted To create or co-create new digital educational resources To consider the specific learning objective, context, pedagogical approach, and learner group, when designing digital resources and planning their use

Table C1 cont.

Key area	Competency	
Digital resources cont.	Managing, protecting, sharing	To organise digital content and make it available to learners, parents and other educators To effectively protect sensitive digital content To respect and correctly apply privacy and copyright rules To understand the use and creation of open licences and open educational resources, including their proper attribution
Teaching and learning	Teaching	To plan for and implement digital devices and resources in the teaching process, so as to enhance the effectiveness of teaching interventions To appropriately manage and orchestrate digital teaching interventions To experiment with and develop new formats and pedagogical methods for instruction
	Guidance	To use digital technologies and services to enhance the interaction with learners, individually and collectively, within and outside the learning session To use digital technologies to offer timely and targeted guidance and assistance To experiment with and develop new forms and formats for offering guidance and support
	Collaborative learning	To use digital technologies to foster and enhance learner collaboration To enable learners to use digital technologies as part of collaborative assignments, as a means of enhancing communication, collaboration and collaborative knowledge creation
	Self-regulated learning	To use digital technologies to support self-regulated learning processes i.e. to enable learners to plan, monitor and reflect on their own learning, provide evidence of progress, share insights and come up with creative solutions.
Assessment	Assessment strategies	To use digital technologies for formative and summative assessment To enhance the diversity and suitability of assessment formats and approaches
	Analysing evidence	To generate, select, critically analyse and interpret digital evidence on learner activity, performance and progress, in order to inform teaching and learning
	Feedback and planning	To use digital technologies to provide targeted and timely feedback to learners To adapt teaching strategies and to provide targeted support, based on the evidence generated by the digital technologies used To enable learners and parents to understand the evidence provided by digital technologies and use it for decision-making

Table C1 cont.

Key area	Competency	
Empowering learners	Accessibility & inclusion	To ensure accessibility to learning resources and activities, for all learners, including those with special needs. To consider and respond to learners' (digital) expectations, abilities, uses and misconceptions, as well as contextual, physical or cognitive constraints to their use of digital technologies
	Differentiation & personalisation	To use digital technologies to address learners' diverse learning needs, by allowing learners to advance at different levels and speeds, and to follow individual learning pathways and objectives
	Actively engaging learners	To use digital technologies to foster learners' active and creative engagement with a subject matter To use digital technologies within pedagogic strategies that foster learners' transversal skills, deep thinking and creative expression To open up learning to new, real-world contexts, which involve learners themselves in hands-on activities, scientific investigation or complex problem-solving, or in other ways increase learners' active involvement in complex subject matters
Facilitating learners' digital competence	Information & media literacy	To incorporate learning activities, assignments and assessments which require learners to articulate information needs; to find information and resources in digital environments; to organise, process, analyse and interpret information; and to compare and critically evaluate the credibility and reliability of information and its sources
	Communication & collaboration	To incorporate learning activities, assignments and assessments which require learners to effectively and responsibly use digital technologies for communication, collaboration and civic participation
	Content creation	To incorporate learning activities, assignments and assessments which require learners to express themselves through digital means, and to modify and create digital content in different formats To teach learners how copyright and licences apply to digital content, how to reference sources and attribute licences
	Responsible use	To take measures to ensure learners' physical, psychological and social wellbeing while using digital technologies To empower learners to manage risks and use digital technologies safely and responsibly
	Problem-solving	To incorporate learning activities, assignments and assessments which require learners to identify and solve technical problems, or to transfer technological knowledge creatively to new situations.

Source: Redecker 2017, p.24-25

Table C2 Levels of educator proficiency as prescribed in the DigCompEdu

Newcomer (A1):	**Explorer (A2):**
Newcomers are aware of the potential of digital technologies for enhancing pedagogical and professional practice. However, they have had very little contact with digital technologies and use them mainly for lesson preparation, administration or organisational communication. Newcomers need guidance and encouragement to expand their repertoire and to apply their existing digital competence in the pedagogical realm.	Explorers are aware of the potential of digital technologies and are interested in exploring them to enhance pedagogical and professional practice. They have started using digital technologies in some areas of digital competence, without, however, following a comprehensive or consistent approach. Explorers need encouragement, insight and inspiration e.g. through the example and guidance of colleagues, embedded in a collaborative exchange of practices.
Integrator (B1):	**Expert (B2):**
Integrators experiment with digital technologies in a variety of contexts and for a range of purposes, integrating them into many of their practices. They creatively use them to enhance diverse aspects of their professional engagement. They are eager to expand their repertoire of practices. They are, however, still working on understanding which tools work best in which situations and on fitting digital technologies to pedagogic strategies and methods. Integrators just need some more time for experimentation and reflection, complemented by collaborative encouragement and knowledge exchange to become Experts.	Experts use a range of digital technologies confidently, creatively and critically to enhance their professional activities. They purposefully select digital technologies for particular situations, and try to understand the benefits and drawbacks of different digital strategies. They are curious and open to new ideas, knowing that there are many things they have not tried out yet. They use experimentation as a means of expanding, structuring and consolidating their repertoire of strategies. Experts are the backbone of any educational organisation when it comes to innovating practice.
Leader (C1):	**Pioneer (C2):**
Leaders have a consistent and comprehensive approach to using digital technologies to enhance pedagogic and professional practices. They rely on a broad repertoire of digital strategies, from which they know how to choose the most appropriate for any given situation. They continuously reflect on and further develop their practices. Exchanging with peers, they keep updated on new developments and ideas. They are a source of inspiration for others, to whom they pass on their expertise.	Pioneers question the adequacy of contemporary digital and pedagogical practices, of which they themselves are Leaders. They are concerned about the constraints or drawbacks of these practices and driven by the impulse to innovate education even further. Pioneers experiment with highly innovative and complex digital technologies and/or develop novel pedagogical approaches. Pioneers are a unique and rare species. They lead innovation and are a role model for younger teachers.

Source: Redecker (2017, p.30).

Appendix D European Framework for Digitally Competent Educational Organisations (DigCompOrg): detail

Table D1 Elements, sub-elements and descriptors comprising the European Framework for Digitally Competent Educational Organisations (DigCompOrg)

Thematic elements	Sub-elements	Descriptors
Leadership & governance practices	Integration of digital-age learning is part of the overall mission, vision and strategy.	1. The potential of digital learning technologies is clearly flagged.
		2. The benefits of digital learning technologies are communicated.
		3. The strategic plan encompasses digital-age learning.
		4. Open education is an aspect of public engagement.
	Strategy for digital-age learning is supported by an implementation plan.	5. Planning builds on enablers while addressing barriers.
		6. Internal stakeholders have a degree of autonomy.
		7. Opportunities, incentives and rewards for staff are identified.
		8. Digital-age learning is aligned with broader priorities.
		9. There are twin goals of modernising existing educational provision and offering new opportunities.
	A management and governance model is in place.	10. There is a shared understanding of and commitment to the implementation plan.
		11. Management responsibility is clearly assigned.
		12. Resources are aligned with budgets and staffing.
		13. The outcomes, quality and impact of the implementation plan are reviewed.
		14. Specific initiatives or pilots are evaluated.
		15. Implementation status is benchmarked.
		16. Oversight of policy and direction is evident.

Teaching and learning practices	Digital competence is promoted, benchmarked and assessed.	17. Staff and students are digitally competent.
		18. Safety, risks and responsible behaviour in online environments are foregrounded.
		19. The digital competence (DC) of staff and students is benchmarked.
		20. DC is included in staff appraisal.
	A rethinking of roles and pedagogical approaches takes place.	21. Staff are partners in change.
		22. New roles are envisaged for staff.
		23. New roles are envisaged for students.
		24. Pedagogical approaches are expanded.
		25. Personalised learning is developed.
		26. Creativity is promoted.
		27. Collaboration and group work is expected.
		28. Social and emotional skills are developed.
Professional development	—	29. A commitment to continuous professional development (CPD) is evident.
		30. CPD is provided for staff at all levels.
		31. CPD is aligned with individual and organisational needs.
		32. A wide range of CPD approaches is evident.
		33. Accredited/certified CPD opportunities are promoted.
Assessment practices	Assessment formats are engaging and motivating.	34. The scope of formative assessment is extended.
		35. Summative assessment is diversified.
		36. Self- and peer-assessment are promoted.
		37. Rich, personalised and meaningful feedback is encouraged and expected.
	Informal and non-formal learning are recognised.	38. Prior, experiential and open learning are recognised and accredited.
	Learning design is informed by analytics.	39. Learning analytics is given strategic consideration.
		40. A code of practice for learning analytics is in place.
		41. Learning is supported through learning analytics.
		42. Quality management and curriculum/program design are supported through learning analytics.

Content and curricula	Digital content and open educational resources are widely promoted and used.	43. Staff and students are the creators of contents.
		44. Content repositories are widely and effectively used.
		45. Intellectual property and copyright are respected.
		46. Digital tools and contents are licensed as required.
		47. Open educational resources are promoted and used.
	Curricula are redesigned or reinterpreted to reflect the pedagogical possibilities afforded by digital technologies.	48. Subject-based learning is reimagined to create more integrated approaches.
		49. The time and place of learning is rescheduled.
		50. Online provision is a reality.
		51. Learning in authentic contexts is promoted.
		52. Digital learning provision is evident across curriculum areas.
		53. Students' digital competence is developed across the curriculum.
Collaboration and networking	Networking, sharing & collaboration is promoted.	54. Networked collaboration for staff to pool expertise and share contents is the norm.
		55. Knowledge exchange efforts are recognised.
		56. Students engage in effective networking..
		57. Participation in knowledge-exchange activities and events is promoted.
		58. Internal collaboration and knowledge exchange are expected.
	A strategic approach is taken to communication.	59. An explicit communication strategy is in place.
		60. A dynamic online presence is evident.
	Partnerships are developed.	61. A commitment to knowledge exchange through partnerships is evident.
		62. Staff and students are incentivised to be actively involved in partnerships.
Infrastructure	Physical and virtual learning spaces are designed for digital-age learning.	63. Physical learning spaces optimise the affordances of digital-age learning.
		64. Virtual learning spaces are optimised.
		65. An acceptable usage policy is in place.
	The digital infrastructure is planned and managed.	66. Pedagogical and technical expertise direct investments in digital technologies.

		67. A range of digital learning technologies supports anytime/anyplace learning.
		68. Bring your own device (BYOD) approaches are supported.
		69. Risks relating to inequality and digital inclusion are addressed.
		70. Technical and user support is evident.
		71. Assistive technologies address special needs.
		72. Measures to protect privacy, confidentiality and safety are well established.
		73. Effective procurement planning is evident.
		74. An operational plan for core ICT backbone and services is in place.
Sector-specific element(s)	Sector-specific sub-element(s)	Sector-specific descriptor(s)

Source: Kampylis, Punie & Devine (2015, pp.18–20).