

The Push-Pull of Digital Literacy

Jo Coldwell-Neilson

Deakin University, Australia, jo.coldwell@deakin.edu.au

Kat Cain

Deakin University, Australia, kat.cain@deakin.edu.au

Jo Coldwell-Neilson and Kat Cain, "The Push-Pull of Digital Literacy." *Proceedings of the IATUL Conferences*. Paper 2.
<https://docs.lib.purdue.edu/iatul/2019/bp/2>

This document has been made available through Purdue e-Pubs, a service of the Purdue University Libraries. Please contact epubs@purdue.edu for additional information.

THE PUSH-PULL OF DIGITAL LITERACY

Jo Coldwell-Neilson

Deakin University, Australia, jo.coldwell@deakin.edu.au

Kat Cain

Deakin University, Australia, kat.cain@deakin.edu.au

Abstract

Digital literacy within higher education was originally grounded in Gilster's (1997) definition that essentially framed it as information literacy using technologies. This has necessarily evolved over the past two decades in conjunction with rapid technological advances. Digital literacy concepts have attempted to match the changing landscape engendered by ubiquitous and ever more available technologies, where cybersecurity and accessibility, multimodal communication channels, and push-pull models of information delivery impact the way we learn, work and play. A dizzying plethora of digital literacy definitions has emerged, with no common understanding of what it means or what skills and capabilities it reflects. Concomitantly, there is no one digital literacy framework that is unilaterally accepted.

Recognising that digital literacy underpins teaching and research, regardless of discipline, Deakin University has positioned digital literacy as a core graduate learning outcome. A 2012 definition and a 2015 framework, developed collaboratively by the Library and Faculty over a three year period, currently guides Deakin's digital literacy teaching. However, awareness of the changing nature of digital literacy has prompted a reconsideration of definitions and frameworks. A cross-divisional team of librarians and academics have reviewed the framework and are in the process of extending it to capture the broader understanding of digital literacy, moving away from an information literacy focussed version. The ultimate goal of the project is to find good practice within the Deakin context for building digital literacy capabilities in students by creating nuanced and modifiable frameworks at AQF7-10 levels that can guide curriculum (re)development.

Keywords: digital literacy, framework, graduate outcomes, academic libraries, collaboration

Introduction and background

Digital literacy is now recognised as an essential skill for all, on a par with reading, writing and 'rithmetic, the 3Rs (Hajkowicz et al, 2016; Coldwell-Neilson, 2017). Technology is a transformative driver within our current age, with cultural, social, and economic success dependent on being responsive to the digital literacy skills required by this fourth industrial revolution (Schwab, 2016). Public and educational discourses, at both global and local levels, are consequently focused on definitional discussions, models and frameworks, along with the resultant strategies and approaches to building digital literacy capabilities within defined boundaries. This paper presents the rationale for an understanding of digital literacy, underpinned by a framework which will support curriculum redevelopment.

The United Nations positioned digital literacy as a key component within its 2030 Agenda for Sustainable Development and calls on countries to track minimum digital literacy skills proficiency within their populations (United Nations, 2015). Arising from consideration of this Agenda and its defined Sustainable Development Goals, the International Federation of Library Associations and Institutions (IFLA) published a statement that framed digital literacy as a driver of development and underpinned individual participation in a sustainable, flourishing society (IFLA, 2017). Within an Australian context, an increased focus on boosting digital literacy amongst citizens was stimulated by the Australian National Innovation and Science Agenda (Commonwealth of Australia, Department of the Prime Minister and Cabinet, 2015) and the associated funding to support "all Australians in digital literacy and STEM" (Australian Government, 2015). As reported by the Committee for Economic Development of Australia "[c]hanging demands from firms, consumers, students and communities means that apprenticeships, vocational qualifications and degrees need to deliver more general and also specific digital capabilities" (CEDA, 2015, p.163). Further, "technology-enabled HE [higher education] requires a mind-set change for which universities must focus more strongly on what their students want and what employers are looking for in graduates" (Gallagher and Garrett as cited in CEDA, 2015, p. 229).

The Foundation for Young Australians (FYA) are amongst many articulating that "by 2030, automation, globalisation and flexibility will change what we do in every job" (FYA, 2017, p.3). FYA suggest that the skills required to be employable include self-directed learning, critical thinking and problem-solving using science, mathematics and technology skills, as well as creativity, problem solving and having an entrepreneurial mindset. Further, they indicate that employees will be spending less time on administrative tasks and more time being digitally engaged. Essentially, FYA emphasise smart learning, smart thinking, and smart doing as essential skills of the future that are all underpinned by advanced digital literacy skills. The significance to humanities of digital literacy skills that involve creativity and problem solving is also flagged within FYA's The New Basics report (FYA, 2016). In a similar vein, a recent industry study provided insight into the pitfalls and potential for young working professionals navigating this intersection between technology, work and education (Infosys, 2016). A clear narrative emerged from this report, where the confidence with which young people rate their technological skills underpins their level of optimism about their own future career aspirations (Infosys, 2016 p. 3) and that they consider education as failing to prepare them for working life (Infosys, 2016, p. 4). Notably, half of Australian young people believe their academic experiences did not prepare them for the skillsets required in the workplace.

All indications are that regardless of career aspirations, developing advanced digital literacy capabilities are an essential component of secondary and tertiary education. Moreover, critical aspects of digital literacy capacity building need to be responsive to future workplace demands and have to address learners as active knowledge creators. It is beholden on universities to incorporate digital literacy capacity building into the system, embedding it across the curricula rather than in singular engagement points. In view of that, Deakin University has recognised digital literacy as a graduate learning outcome (GLO), core to the knowledge and capabilities that Deakin students acquire and demonstrate at the completion of their course. However, digital literacy capabilities extend beyond graduate attributes and are also understood by Deakin as necessary for inclusion within our increasingly digital existence and is therefore of vital importance for both students and staff.

Digital literacy and higher education

Digital literacy within higher education was originally grounded in Gilster's (1997) definition that essentially framed it as information literacy using technologies. As digital technologies started infiltrating their way into every aspect of our lives it became apparent that managing information would be a key skill for all. However, this has necessarily evolved over the past two decades in conjunction with the rapid march of technological advances. The push-pull relationship between humans and technologies has become ever more complex in a multimodal, faceted digital landscape where tools direct the user (for example artificial intelligence guiding access and engagement, and filter bubbles that structure our discovery experiences) but humans design and build these tools (Van den Ende & Dolfsma, 2005). Information literacy is still a key skill—particularly in this age of decontextualized surfeit of information dogged by fake news and manipulated post-truths—but it is no longer the single focus. Moreover, research over the past two decades has attested that skills required for resource navigation and sense-making within a multimodal and layered digital environment significantly differ from traditional literacy skills (Combes, 2016).

Digital literacy concepts have therefore emerged that attempt to match the changing landscape engendered by ubiquitous and ever more available technologies, where cybersecurity and accessibility, multimodal communication channels, and push-pull models of information delivery impact the way we learn, work, and play. Not surprisingly, a dizzying plethora of digital literacy definitions have arisen, with no common understanding of what it means or what skills and capabilities it reflects. As Brown (2017) bemoaned, "The truth is that digital literacy is a messy topography". Recent research underlined the muddied water of digital literacies within the Australian tertiary sector, along with the inability to consider it as a singular construct, noting how digital literacy becomes particularly "'messy' in terms of who owns it, drives it and promotes it" (Huber & Shalavin, 2018). While Spante et al (2018) undertook a systematic review of the literature related to digital literacy and digital competence in the context of higher education, in an attempt to establish an understanding of how and where these terms have developed over time and in what context. Through an analysis of 107 relevant publications dating from 1997, they demonstrated that digital literacy has a history of use starting with Gilster's definition, whereas digital competence only started to appear from 2010. Interestingly, they also identified regional differences with studies conducted in the UK or US more likely to use the term digital literacy and studies in Europe more likely to use the term digital competence. They also identified a relationship between the use of digital competence with reference to policy documents.

Coldwell-Neilson has developed a definition of digital literacy that draws on the work of JISC in the UK, All Aboard in Eire, UNESCO and others. The definition, or understanding, is intended as a guiding statement to understand the breadth and ubiquity of the requirement of digital skills, competence and dexterity. Specifically, digital literacy is the ability to identify and use technology confidently, creatively and critically to effectively meet the demands and challenges of living, learning and working in a digital society (Coldwell-Neilson, 2018). Underpinning this understanding is a model, which captures the ever-growing range of skills that are required for individuals to be digitally literate digital citizens. The model includes:

- ICT proficiency
- Information and media literacy
- Creation and innovation
- Communication, collaboration and participation
- Information and data management
- Security and privacy
- Digital identity and wellbeing

Governments and education departments, amongst many others, talk about the importance of developing digital literacy skills to meet the requirements and expectations of the fourth industrial revolution. The aim of Coldwell-Neilson's definition, together with the underlying model, was to resolve the variety of terminology currently being used in the digital literacy space into a single understanding that captures the depth and breadth of skills required to be effective and efficient in a digitally enhanced and disrupted environment.

Regardless of how digital literacy is understood, students entering higher education bring a range of skills and competencies to their studies, skills they have developed not only through their prior studies and work experience, but also through their extensive use of smart phones and other digital devices. As a result, there is an expectation by higher education providers that students are able to navigate the range of learning technologies that are becoming normalised within our institutions. However, Ng (2012) has highlighted the fact that young people of today (often referred to as digital natives) are not necessarily digitally literate. Further, Coldwell-Neilson (2018) found that there was a disparity between the expectations by academic staff of the skill set of their students, and their observations of student capabilities. Just as the digital native archetype has been debunked (White & Le Cornu, 2017), the term that we use to describe a particular generation is also redundant in this context, as the goal is to prepare our students to be productive digitally fluent graduates who can participate in a digital world with ease. In essence, digitally literate digital citizens.

Digital literacy frameworks and contextualised understanding

Just as definitions of digital literacy and variants such as digital dexterity or digital fluency have abounded, so too have frameworks and models (Brown, 2017). There is no one digital literacy framework designed to foster digital literacy capabilities. Within the Australian tertiary sector this has resulted in a profusion of digital literacy models and approaches being used, ranging from transposal of external frameworks through to individually contextualised structures (Huber & Shalavin, 2018). Notably, Huber and Shalavin's research also flagged that responsibility for digital literacy commonly falls onto the institution's library or central learning and teaching unit, surmising this reflects libraries historic remit in delivering informational literacies is being

reharnessed into driving digital literacy teaching. Adding to the complexity within the Australian context, the Council of Australian University Librarians (CAUL) have published a position statement on digital dexterity, being the “cognitive ability and social practice needed to leverage and employ various types of media, information and technology for advantage in unique and highly innovative ways that optimise personal and business value”, and have formulated a digital dexterity framework (CAUL, 2019).

Recognising that digital literacy underpins teaching and research, regardless of discipline, Deakin University has positioned digital literacy as a core graduate learning outcome (GLO). Currently guiding Deakin’s digital literacy teaching practices are a 2012 digital literacy definition (Deakin, 2012) and a 2015 Library-Faculty collaboratively developed framework (Deakin, 2015), both grounded in a comprehensive body of research. Underpinning this Deakin approach was the core defining concept of digital literacy as “using technologies to find, use and disseminate information” (Deakin University, 2012). This understanding of digital literacy emerged from a two-stage review that focused on conceptualising and defining digital literacy in the context of Australian higher education and in identifying good practice in the development, assessment and evaluation of digital literacy for graduate employability (Hagel, 2015). Significantly, this 2012 Deakin definition of digital literacy and the 2015 framework approach to practice, specifically intended to reflect “knowledge creation and the expectation that students will develop higher order cognitive skills such as those of synthesis, critical thinking and analysis” (Hagel, 2015, p. 7), diverged from more foundational aspects of literacy and digital competence. The approach explicitly noted that “while digital literacy may be understood and defined differently within disciplines, the concept is primarily about literacies rather than digital technologies or digital competence (Owens, Hagel, Lingham, & Tyson, 2016). Additionally, this framework was focused on both aligning to Australian AQF 7 (Bachelor program) standards and to identified Deakin strategic objectives for cloud (off-campus or distance education) and located (campus-based) learning.

Within Deakin, graduate learning outcomes are operationalized within course design through course learning outcomes (CLOs) and through unit design by articulating unit learning outcomes (ULOs). The 2015 digital literacy framework was specifically designed to support Unit Chairs in applying and exploring the elements of Digital Literacy within the context of their disciplines and professional practice. Both the 2012 Deakin definition of digital literacy and the 2015 framework have functioned as an indispensable lens into digital literacy-focused course and unit design. Perhaps the best exemplar of the serviceability of the definition and framework to Deakin outcomes is a Professional Literacy Suite that embedded digital literacy across the curricula within a Deakin Business course. Focused on preparing business students with digital skills to “help them navigate through the multiple demands of living, learning and working in a digital 21st century society”, the course-wide engagement has enhanced graduate employability and careers by contextualizing digital literacy to the relevant discipline and industry expectations (Ngo, Tyrell, Volkov, & Bridson, 2018). Emerging from a Deakin Library-Business Faculty collaboration over 2014-2018, the impact of this work was recognized with a 2018 ASCILITE Innovation Award for exemplary and research informed use of technologies for teaching and learning in tertiary education.

An analogous drive to enhance digital literacy graduate capabilities was the stimulus for a 2017-2018 project to better understand the representation of digital literacy throughout the Deakin Bachelor of Vision Science/Master of Optometry (Coldwell-Neilson, Armitage, Wood-Bradley,

Kelly, & Gentle, 2019). The Optometry digital literacy project began by using a reverse-design curriculum mapping process of unit learning outcomes to identify where and how digital literacy was assessed over the span of the course. As a corollary to the mapping, the project explored the match between Deakin's defined digital literacy and the requirements of digital literacy as embedded in the Optometry course. This exploration flagged that the existing Deakin digital literacy approach was not quite fit-for-purpose in this project. This gave rise to a methodology that supported an updated digital literacy understanding that is embedded in curricula and is based on the creation of a digitally literate optometry graduate framework that adapted Sharpe and Beetham's (2010) development model.

Essentially, the Optometry project made evident that the 2012 digital literacy definition and 2015 framework did not connect to the graduate skillset range that this combination AQF7/AQF9 cohort of digital literate optometry students would require. Moreover, what the Optometry project encapsulated is that Deakin had identified digital literacy as a wicked problem at many levels within the university. The fluid nature of digital literacy, in addition to a growing understanding of the diverse digital literacy skills required across discipline areas, meant that different teams (including the Deputy Vice Chancellor Education, Deakin Learning Futures, Faculties, Library, Student Support) were nibbling at this wicked problem either implicitly or explicitly, with a resultant lacuna of agreed understanding emerging from the absence of a holistic view.

Deakin reconsiderations of digital literacy

At the intersection of these considerations of digital literacy was a growing understanding that the 2012 definition and 2015 framework at Deakin had some areas of limitation:

1. The definition and the associated framework were shaped by understandings of digital literacy pre-2012
2. The definition clearly positions itself within the Gilster information literacy space
3. The definition and framework are shaped to a linear conception of digital literacy (find, use, disseminate)
4. The framework only considers undergraduate outcomes – thereby neglecting students within other degree structures

Awareness of the changing nature of digital literacy, the lack of a holistic view within Deakin, and the understanding that digital literacy does not maintain itself was the basis of both Coldwell-Neilson's digital literacy Learning and Teaching Fellowship (ALTF, 2016) and a Library led project to reconsider digital literacy definitions and frameworks. Of particular focus in this reconsideration was the drive for an inclusive cross-institutional understanding of digital literacy. As Huber and Shalavin's (2018) analysis made clear, collaboration is key to developing a common and therefore serviceable institutional definition and approach to digital literacy, as it "is only through collaboration that institutions can stop working in silos on this 'wicked problem'" (p. 156). Moreover, as earlier digital literacy exploration at Deakin had detailed, "There are various stakeholders within Deakin whose perspectives about digital literacy are relevant including the University Executive, Faculties and their disciplines, academics/teachers, students, the Library, IT services and academic skills units" (Hagel, 2015). Consequently, the Library began their reconsideration of digital literacy as all good projects should begin – in having conversations.

This involved the Library seeking out researchers actively conducting investigations in this area, looking for innovators who were already embedding expanded digital literacy aspects into units and courses, and forging connections with colleagues who were open to collaborating on development of digital literacy resources. Not surprisingly for an academic library, the reconsideration of a digital literacy framework was also informed heavily by benchmarking and reference to organisations identified in an environmental scan.

The Journey to Redevelopment and Beyond

All of this combined to spearhead an initial redeveloped framework in 2017 by the Library Learning & Teaching team, with input from Research Librarians on higher degree digital literacy capability requirements. It should be noted that this initial redevelopment shaped its approach around Coldwell-Neilson's definition of digital literacy, "the ability to identify and use technology confidently, creatively and critically to effectively meet the demands and challenges of living, learning and working in a digital society" (Coldwell-Neilson, 2018).

This 2017 redeveloped framework was tested within a curriculum mapping project, in partnership with academics from the Faculty of Science, Engineering and Built Environment. The Library utilised the proposed new draft framework, matching it against the current course learning outcomes and minimum standards across the Faculty course offerings. The redeveloped framework was used as a lens to understand where digital literacy was explicitly included in the curriculum, to identify where the gaps were, and where digital literacy expectations were implicitly included. Notably, this 2017 version buttressed a number of limitations identified in the 2015 framework and had serviceably worked as a digital literacy mapping tool. In particular, the redeveloped framework had positioned digital literacy within a continuum of learning, rather than a linear progression of find, use, disseminate.

A stronger focus within the framework on capabilities in creation and communication had also ensured a more rounded digital literacy consideration through which to approach course review. By moving from a linear to a matrixed approach in visualising digital literacy capabilities, this redeveloped framework also enabled a more accurate mapping of what digital literacy aspects were explicitly or implicitly included within the targeted course. The 2017 redevelopment had also ensured that digital literacy capabilities were scaffolded over the breadth of a student journey (AQF7-10), aligning with standards in many ways.

To further draw out the requirements and to ensure a further development of a digital literacy approach with whole-of-Deakin relevancy, a series of workshops were organised with cross-divisional representation (Faculty, Librarians, Academic and Peer Support, Students, Learning Futures), with individuals ranging from teaching academics to learning designers, course enhancement academics to research librarians. At each workshop a redeveloped Framework was presented (responsively changing in light of previous feedback) and the group invited to examine, debate and collaboratively continue the redraft process; thus utilising a cross-divisional team (brains-trust) to review the framework.

The ultimate goal of the project is to find good practice within the Deakin context for building digital literacy capabilities in students by creating nuanced and modifiable frameworks at AQF7-10 levels that can guide curriculum (re)development. Our vision is that both Deakin educators

and students understand that digital literacy is a mindset and an attitude; with the framework underlining that digital literacy capabilities need to be flexible and transferable across technologies, disciplines and the world of work. In line with this is the next piece of work, which will focus on a resource kit that unpacks the framework with rationale, exemplars, case studies and other supporting documentation.

Conclusion

The term digital literacy has been around for over 20 years, since Gilster coined the term in 1997, and yet it is not very well understood. As the ubiquity of technology expanded, terms such as ICT literacy, media literacy and others entered the vocabulary with the intention of capturing the expansion of skills required. Rather than clarifying the situation, the outcome was to create confusion. Digital literacy skills have become so important that the confusion needs to be eradicated and the language simplified. This need for a common understanding becomes particularly critical within higher education which is tasked with preparing students to develop the necessary skills to thrive within a digitally complex and disrupted world.

In preparing our students for their future in a digitally disrupted world, we need to prepare them to be digitally fluent, to enable them to have the competence and confidence to use almost any technology, to understand that digital skills learned in one environment are transferrable to other environments, and to be creators in the digital space, not just consumers. An analogy is driving a car. A competent driver does not think about the process of driving, nor does getting behind the wheel of a different car cause problems. There may be a moment of reorientation locating indicator and wiper controls, or reverse gear, but the set of driving skills are automatically transferred from one situation to the next. Similarly, language literacy provides the means to use the language; language fluency provides the means to be creators in the language. Building digital fluency requires a strong foundation of digital literacy skills combined with learning that is embedded and contextualised within discipline learning, alongside other enterprise skills that will allow students to thrive in the future.

The current exploration of digital literacy and the reconsideration of definitions and frameworks within Deakin University reflects the criticality of a common understanding of digital literacy for higher education institutions. At the same time, the current body of work at Deakin, focused on digital literacy definitions and frameworks, has emphasised that there can be no single source of truth. Essentially, digital literacy must be viewed contextually and can only be experienced through nuanced and layered conversation; where the push-pull of debate and discussion give rise to an institutionally agreed understanding. It is hoped that by taking the long path through collaboration and multiple iterations, that this project has given form to a framework that captures the broader twenty-first century understanding of digital literacy, that has moved away from an information literacy biased version, and that has institutional relevance and serviceability.

Acknowledgement

The Australian Government Department of Education and Training (Fellowship FS16-026) has provided support for this study. The views in this study do not necessarily reflect the views of the Australian Government Department of Education and Training.

References

- ALTF. (2016). *Unlocking the code to digital literacy*. Australian Learning and Teaching Fellowship Network. Retrieved from <https://altf.org/fellowships/unlocking-the-code-to-digital-literacy/>
- Australian Government. (2015). *National innovation and science agenda report*. Retrieved from <https://www.industry.gov.au/data-and-publications/national-innovation-and-science-agenda-report>
- Brown, M. (2017). *The challenge of digital literacy: Beyond narrow skills to critical mindsets*. Retrieved from: <https://www.linkedin.com/pulse/challenge-digital-literacy-beyond-narrow-skills-critical-mark-brown/>
- CEDA. (2015). *Australia's future workforce?* The Committee for Economic Development of Australia. Retrieved from <http://www.ceda.com.au/research-and-policy/policy-priorities/workforce>.
- CAUL. (2019). *Council of Australian University Librarians Digital Dexterity Framework*. Retrieved from: <https://www.caul.edu.au/sites/default/files/documents/digital-dexterity/digdex2019framework.pdf>
- Coldwell-Neilson, J. (2017). Assumed digital literacy knowledge by Australian universities: Are students informed? *Proceedings of the 19th Australasian Computing Education Conference, ACE 2017* (pp. 75-80). Association for Computing Machinery: New York, NY, USA. <https://doi.org/10.1145/3013499.3013505>
- Coldwell-Neilson, J. (2018). Digital Literacy expectations in Higher Education. *Proceedings of the Australasian Society for Computers in Learning in Tertiary Education, ASCILITE '18 25-28 November* (pp. 103-112). In M. Campbell, J. Willems, C. Adachi, D. Blake, I. Doherty, S. Krishnan, S. Macfarlane, L. Ngo, M. O'Donnell, S. Palmer, L. Riddell, I. Story, H. Suri & J. Tai (eds), Geelong, Australia. Retrieved from <http://2018conference.ascilite.org/wp-content/uploads/2018/12/ASCILITE-2018-Proceedings-Final.pdf>
- Coldwell-Neilson, J., Armitage, J. A., Wood-Bradley, R. J., Kelly, B., & Gentle, A. (2019). Implications of updating digital literacy – A case study in an optometric curriculum. *Issues in Informing Science and Information Technology*, 16, 33-49. <https://doi.org/10.28945/4285>
- Combes, B. (2016). Digital literacy: A new flavour of literacy or something different. *Synergy*, 14, 7.

Commonwealth of Australia, Department of the Prime Minister and Cabinet. (2015). *National Innovation and Science Agenda*. Retrieved from <https://www.industry.gov.au/national-innovation-and-science-agenda-report>

Deakin University. (2012). *Graduate learning outcomes*. Deakin Learning Futures. Retrieved from <http://www.deakin.edu.au/learning/designing-assessing-and-evaluating-learning/deakin-graduatelearning-outcomes>

Deakin University. (2015). *Digital literacy framework*. Retrieved from https://www.deakin.edu.au/_data/assets/pdf_file/0008/268748/DL_framework_2014-CC_rev-2015.pdf

FYA. (2016). *The new basics: Big data reveals the skills young people need for the New Work Order*. FYA's New Work Order report series. Retrieved from <https://www.fya.org.au/report/the-new-basics/>

FYA. (2017). *The new work smarts: Thriving in the new work order*. Retrieved from <https://www.fya.org.au/report/the-new-work-smarts/>

Gilster, P. (1997). *Digital Literacy*. New York: John Wiley.

Hagel, P. (2015). Towards an understanding of 'Digital Literacy(ies)'. *Discourse: Deakin University Library research & practice*, 1. Retrieved from <http://dro.deakin.edu.au/view/DU:30073198>

Hajkowicz, S., Reeson, A., Rudd, L., Alexandra Bratanova, A., Hodggers, L., Mason, C., & Boughen, N. (2016). Tomorrow's digitally enabled workforce: megatrends and scenarios for jobs and employment in Australia over the coming twenty years. Australian Policy Online. Brisbane: Commonwealth Scientific and Industrial Research Organization (CSIRO). Retrieved from https://www.acs.org.au/content/dam/acs/acs-documents/16-0026_DATA61_REPORT_TomorrowsDigitallyEnabledWorkforce_WEB_160128.pdf

Huber, E. & Shalavin, C. (2018). 'Surveying the digital literacy landscape for academic and professional staff in higher education', in M. Campbell, J. Willems, C. Adachi, D. Blake, I. Doherty, S. Krishnan, S. Macfarlane, L. Ngo, M. O'Donnell, S. Palmer, L. Riddell, I. Story, H. Suri & J. Tai (eds), *Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education: ASCILITE 2018: Conference Proceedings*, ASCILITE, Australia, 151-158.

Infosys. (2016). *Amplifying human potential: education and skills for the fourth industrial revolution*. Retrieved from <http://www.experienceinfosys.com/humanpotential>

IFLA. (2017). *International Federation of Library Associations and Institutions Statement on Digital Literacy*. Retrieved from

https://www.ifla.org/files/assets/faife/statements/ifla_digital_literacy_statement.pdf

Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education*, 59(3), 1065–1078. Retrieved from <https://doi.org/10.1016/j.compedu.2012.04.016>

Ngo, L., Tyrell, S. Volkov, M., & Bridson, K. (2018). Embedding digital literacy: Towards transforming business education. *Proceedings of the Australasian Society for Computers in Learning in Tertiary Education, ASCILITE '18, 25-28 November*. Geelong, Australia, 103-112. Retrieved from <http://2018conference.ascilite.org/wp-content/uploads/2018/12/ASCILITE-2018-Proceedings-Final.pdf>

Owens, S., Hagel, P., Lingham, B & Tyson, D. (2016). Digital literacy, *discourse: Deakin University research and practice*, no. 3, Geelong, Deakin University Library. Retrieved from <http://dro.deakin.edu.au/eserv/DU:30082926/owen-digitalliteracy-2016.pdf>

Schwab, Klaus. (2016). *The Fourth Industrial Revolution*. New York: Crown Publishing.

Sharpe, R. & Beetham, H. (2010). Understanding students' uses of technology for learning: towards creative appropriation. In *Rethinking learning for a digital age: how learners shape their experiences*, Routledge, Editors: Rhona Sharpe, Helen Beetham, Sara de Freitas, 85-99.

Spante, M., Hashemi, S. S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent Education*, 5(1). doi:10.1080/2331186X.2018.1519143

United Nations. (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development*. Retrieved from <https://sustainabledevelopment.un.org/post2015/transformingourworld/publication>

Van den Ende, J., & Dolfsma, W. (2005). Technology-push, demand-pull and the shaping of technological paradigms-Patterns in the development of computing technology. *Journal of Evolutionary Economics*, 15(1), 83-99.

White, D. S., & Le Cornu, A. (2017). Using “visitors and residents” to visualize digital practices. *First Monday*, 22(8). Retrieved from <https://doi.org/10.5210/fm.v22i8.7802>