Digital fluency – a dynamic capability continuum

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The impact of digital technologies on the ways people work, learn and live has been debated and researched for half a century. Digital literacy approaches have recurrently been the focus of educational and industry learning; however, current framings of digital literacy are not sufficient to support students' digital capability development, nor do static digital literacies reflect the dynamic and contextual nature of digital capabilities. A digital capability continuum that fluidly moves between digital foundation skills, digital literacies and digital fluency is a more robust model for education. By unpacking the digital capability continuum and responding to both learning and curriculum paradigms, this paper expands on an earlier framework (Coldwell-Neilson, 2020), the decoding digital literacy framework, as well as building on our research and academic experiences, to inform higher education. A key agenda is that the higher education sector frames digital fluency as a mindset and an attitude. The model and framework underscore that capabilities need to be flexible and transferable across technologies, disciplines and the world of work.

Implications for practice or policy:
- Curriculum development and learning support can be informed by the digital capability continuum model and framework.
- Institutional and educator expectations can be informed by understanding the dynamism of students' digital capabilities.
- Approaches to designing achievable learning outcomes can be informed by the digital capability continuum model and framework.

Keywords: digital capability, digital literacy, digital fluency, digital divide, digital poverty, digital learning, digital pedagogy

Introduction

Digital literacy, digital literacies and digital fluency are often used interchangeably. We argue for a non-adversarial distinction between the terms that reflects the relational connection between digital literacies and digital fluency and considers digital foundational skills and capabilities. Similarly to Dias-Trindade and Ferreira (2020), a digital capability continuum is positioned as including digital literacies and fluency as stages of evolving knowledge, with digital foundational skills as the grounding stage of this construct. This continuum is fluid, not static, reflecting how contextual elements can change where individuals are positioned at different times and circumstances. Digital fluency emerges from a complex blend of skills, attitudes underpinned by active engagement, and learner motivation (Akazaki et al., 2020; Ferrer et al., 2022). Moreover, digital fluency is transformative, emerging from motivation, choice, flexibility, agility and engagement. In considering people's interactions with and within digital environments, human behavioural and mindset aspects must be considered. As Athota (2021) has suggested, "A growth mindset is a necessary component in order to thrive in a digital work environment" (p. 1). Thus, growth mindsets necessarily underpin progression through a digital continuum, with practice, support and mentoring from others, experiencing meaningful curricula or teaching approaches, motivation and well-being all impacting success (Dweck, 2006).

By drawing on historical understandings of digital literacies and literature, we built on existing theories informed by our own research and academic experiences to develop a conceptual model and framework that broaden the scope of thinking in the digital capabilities space. The assimilation and combination of evidence from both previously developed concepts and through available data provide the conceptual framing of this research. Beginning with exploring the rich history of digital literacies, the paper provides a framing of digital capabilities within education and learning. We argue for a digital capability continuum

model and framework that addresses the needs and expectations required of current digitally enhanced learning in the context of higher education.

Historical perspectives

The concept of digital literacy was introduced as "the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers" (Gilster, 1997, p. 1). The digital landscape has transformed radically since that introduction, with even what people understand as a computer changing dramatically. The pace of change and its social implications has grown exponentially over the past 3 decades in line with increased computing functionality, the accessibility of digital tools and the reach of connectivity. Yet, most users are naïve to the full extent of the computational functionality and power of everyday devices (Coldwell-Neilson, 2020). Their engagement with digital worlds can be as deliberate as logging into online banking systems or as invisible as phone tracking their location and pushing café recommendations to them. Transformation is also embedded in all digital engagement, whether it is haptic feedback changing motor learnings, augmented reality technology redefining spatial experiences or shopping behaviours guided by push advertising. The acceleration, pervasiveness and ubiquity of digital technologies within every aspect of the sociocultural milieu, with continual new innovations "touch our lives in different and often profound ways" (Grand-Clement et al., 2017, p. 1). This is very apparent with the current generative artificial intelligence (AI) wave impacting the world, post the public release of ChatGPT (Lodge et al., 2023). The heady mix of technological advances and heightened engagement with digital environments radically impacts education, with the affordances of the digital world transforming teaching and learning in higher education institutes (Bashir et al., 2022). This paper argues both students and staff within higher education need support in developing digital foundational skills and literacies (and ultimately digital fluency) to thrive in academic, personal and work contexts. As part of that development, a clearer understanding of what a digital capability continuum means becomes imperative.

The multitude of terms currently used to capture the notion of digital engagement includes digital competence, digital capability, digital dexterity, data literacy, AI literacy, information and communication technology (ICT) capability, ICT literacy, Web literacy, media literacy, digital literacy, digital literacies and digital fluency – all of which have resulted in a complicated and confusing area of research and practice (Coldwell-Neilson, 2020). Further, discussions of digital literacies recurrently fall back into an information literacy space (Coldwell-Neilson & Cain, 2019). By advocating for digital fluency as a core concept of digital engagement, we amalgamate related literacies under the umbrella of digital literacies. We argue that digital literacies encompass any literacy related to human and digital technology engagement, whether that engagement involves AI, data, media, information, communication or any other digital area. Digital fluency framing also allows the distinction to be made between skills that are adequate to survive in the digital age and those that are needed to flourish in a digital environment. We position digital fluency as fundamental to active, critical and reflexive engagement in society (Akazaki et al., 2020). This challenge to digital literacies assumptions enables a shift in thinking to a more contemporary approach to the skills and capabilities needed to safely negotiate modern digital environments and, in particular, higher education learning environments. Our goal is to overcome the confusion that Brown (2017) described as a "messy topography".

Unpacking the messy topography

Digital literacy has been identified as an essential skill together with reading, writing and arithmetic (Hajkowicz et al., 2016; Coldwell-Neilson, 2017a). In Australia, digital literacy is considered to underpin future growth and success, with recommendations that it is embedded at all education levels (Australian Curriculum Assessment and Reporting Authority, 2023; Foundation for Young Australians, 2015). Globally, the United Nations (n.d.) has positioned digital literacy as a key component in its 2030 Agenda for Sustainable Development. Digital literacy is an established part of national and international conversations, as evidenced by the growing body of scholarship and the proliferation of frameworks in the digital literacy space.

Similarly, myriad definitions of digital literacy have proliferated, with the added complication of overlapping understandings of computer and information literacy (Spante et al., 2018). Moreover, there have been strong arguments to move away from unitary digital literacy to a framing of digital literacies to reflect the diversity connected to this area (Lankshear & Knobel, 2015). The inextricable linkages of digital literacy with technology also entail evolution, with definitional usefulness undermined by approaches that prioritise technology. Coldwell-Neilson's (2017b, 2018, 2020) sustained research into digital literacy — informed by the work of JISC in the United Kingdom, All Aboard in Eire, and others — positioned digital literacy more expansively, framing it as 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. However, this definition does not capture the developmental nature of digital skills and capabilities through education, starting with pre-primary education all the way through to higher education and beyond. This umbrella approach also fails to unpack the details of what digital literacy entails, requiring an underlying framework, the decoding digital literacy framework, to articulate the breadth and depth of capabilities required (Coldwell-Neilson, 2020). Having a broad umbrella statement is useful to set context, while the framework elaborates on the context, but neither provide the rationale for the ongoing need for continuous development. The digital world is not a static environment, but an evolving world presenting new problems, challenges and dilemmas which need to be negotiated. This dynamic environment requires people to be more than just digitally literate but also have the confidence and capability to be digitally fluent, a moving feast requiring lifelong learning.

Malchenko et al.'s (2020) critical review of digital capability frameworks highlighted how existing frameworks vary from wide, generalised approaches to more targeted approaches designed for specific subgroups or that have an industry focus. Many European digital competencies programmes, initiatives and extended frameworks are based on the European Commission's DIGCOMP (Ferrari, 2013) model. This model includes the key capabilities associated with digital literacy, together with skills individuals need to achieve a certain level of competence. The DIGCOMP model focuses on technology and skills, using a two-dimensional approach that does not adequately consider affective nor socioeconomic factors. The initial DIGCOMP has been reconsidered, with DigComp 2.2 (Vuorikari et al., 2022) taking a more nuanced perspective to include attitudinal factors to support knowledge and skills. However, the pragmatic reality of any digital capabilities framework is the impact that the digital divide and digital poverty have on learning and skill building. DigComp 2.2 does not accommodate this reality, whereas the new framework this paper introduces does (see Figure 3). The digital capability continuum framework – a flipped pyramid approach (Coldwell-Neilson & Cain, 2023) – highlights the impact of the digital divide and digital poverty on the continuum of digital capabilities learning.

Beetham and Sharpe's work with JISC built on earlier learner literacies research, investigating institutional approaches to digital literacy development in higher education. This programme of work and the digital capability pyramid (Sharpe & Beetham, 2010) made a significant contribution to educators thinking on how students learn in a digital environment and how they can be encouraged to develop their skills and capabilities. This work has continued with JISC publishing a significant body of work focussed on digital capability and supporting technology-enhanced learning and teaching (https://www.jisc.ac.uk/). However, like DIGCOMP (Ferrari, 2013), the digital capability pyramid is unidirectional and focuses on technology and skill building without consideration of the fluidity of people's experience within digital environments. Returning to Malchenko et al.'s (2020) critical review, although this work was undertaken in the context of supporting business with a marketing focus, they highlighted the need to understand empowerment, how decision making can be supported, the impact of limited resources and the need to mitigate the impact of the digital divide, which is related not only to lack of access to technology, but aggravated by lack of knowledge and skills as well as opportunity. All these insights into digital behaviours provide touchpoints that can be used in educational programmes to develop digital capabilities.

What further complicates digital literacy definitions is that there is never a singular literacy with which people engage in a multiplicity of ways in digital worlds and that equates to digital literacies plural (Lankshear & Knobel, 2015). As Street (1996, as cited in Littlejohn et al., 2012, p. 549) outlined, literacies are recurrently framed as knowledge practices, "social practices of using code making and exchanging

meanings. The connection between being literate and being situated in specific social and cultural contexts is undeniable (Martínez-Bravo et al, 2022; Street, 2003).

Digital capability continuum: stepped development from foundation to fluency

Literacies alone are no longer sufficient to support thriving engagement in the modern digital world (Crockett et al., 2011). Fluency emerges from literacy (Lalonde, 2019). Although digital fluency has recently been positioned as "the need for an ever-present readiness to identify, adopt and use new technologies" (Fleming et al., 2021, p. 42), we argue this lens is overly tied to tools and digital artefacts in its conception and negates the importance of digital cultures, behaviours and identities in achieving fluency. Just as reading fluency is more than knowing words and understanding sentence construction (or just as reading fluency is more than simply decoding text – accuracy, rate, prosody), digital fluency is more than having digital tools and some proficiency in using them. Thriving in digital worlds involves moving through stages or steps, from a foundational base to digital literacy and onto digital fluency. The likelihood of moving up and down those steps at different points of life correlates with encountering new digital elements or regularity of interaction with known elements. As Biggs and Makice (2011) have argued, just as one speaks of fluency in a given language or in the playing of a musical instrument, digital fluency requires effective practice, "because first-hand experience is so critical to learning, the process to become fluent demands an investment of time and patience, with ourselves and with those around us" (p. 61). Digital fluency therefore incorporates functional digital skills, behavioural underpinnings and identity formation. Further, research into digital poverty and digital divide has also highlighted that digital fluency understandings must accommodate socio-economic impacts on the digital environment (Russo, 2019; Russo et al., 2018).

We contend that digital fluency emerges from an empowered agency to leverage appropriate digital tools and strategies as part of problem-solving and generating new knowledge in response to need. By framing digital fluency as an embodied identity and as behavioural actions – which enable adaptive and free-flowing inquiry, communication or creation using digital technologies – digital fluency development can be better supported. In other words, it is not all about learning how to use Microsoft Teams but looking across the levels of foundation or technical skills, digital behaviours and motivational drivers to determine whether using Microsoft Teams would be a suitable approach to supporting project team collaboration and communication for example. Wang, Myers, and Sundaram (2013) proposed that digital fluency is "the ability to reformulate knowledge and produce information to express oneself creatively and appropriately in a digital environment" (p. 409). They further suggested that digital fluency is one way of conceptualising the difference between digital natives and digital immigrants where digital literacy is "teaching learners to make syntactically correct expressions" (p. 410) whereas digital fluency implies "not only … knowing how to engage with technology, but also [being] able to produce things of significance with technology" (p. 410). This distinction provides the basis for the argument that digital fluency moves beyond digital skills into a fluid engagement with the digital world. In many ways, digital fluency concepts need to step beyond tools to instead focus on embodied context and identities, which aligns with Beetham and Sharpe's digital literacy development framework pyramid model (introduced in Sharpe & Beetham, 2010). By drawing heavily on Krathwohl's (2002) revised Bloom's taxonomy with its continuum of skills and abilities, the Beetham and Sharpe pyramid model fosters the identification of learning objectives and scaffolding of digital literacies development. While Sparrow (2018) conceives digital fluency as ability based, requiring critical thinking, complex problem-solving and social intelligence to solve problems, as well as leveraging technology to create new knowledge, new challenges and new problems, this frames digital fluency within a technology or tools context. An important aspect of digital fluency is confidence, which impacts on behaviours and, in turn, shapes digital experience. Hence, digital fluency is the ability to leverage technology to create new knowledge, new challenges and new problems and to complement these with critical thinking, complex problem- solving and social intelligence to solve the new challenges.

Digital capability continuum model

Resulting from this grounded understanding of the nuanced, complex and contextual nature of human engagement in digital environments, we proposed a digital capability continuum model to frame and approach this area (Coldwell-Neilson & Cain, 2023). The impact of digital literacies and digital fluency was explored in the context of digital equity and inclusion as well as the impact that lack of digital capability has on the digital divide and digital poverty. The digital capability continuum model resulting from this exploration is explained here. The digital capability model (shown in Figure 1) includes a foundation stage with digital literacies and fluency as stages of evolving knowledge, a moving journey that shifts along the continuum as digital needs and experience dictate. Digital experiences exist as a continuum in a changeable context. Rather than a stepped development process, always beginning at the foundation level, digital capabilities are impacted by individual circumstances and changing context, including time factors. The arrowed circular path of the model signifies how people can find themselves at different points of the continuum, fluidly moving along it as a consequence of both individual circumstances and the dynamic evolving nature of the digital world.

This infinite cycle of learning and experience in the digital context steps through three elements:

- digital foundations – access to digital tools or technologies and some technical proficiency
- digital literacies – consciously and competently apply digital skills and behaviours
- digital fluency – the knowledges, skills, attributes and identity formation that enable adaptive inquiry, communication, problem-solving and creation in digital worlds.
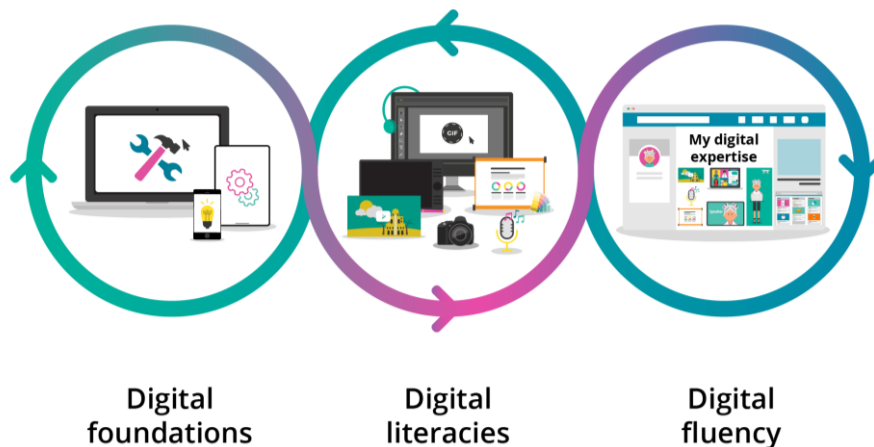

| Digital foundations | Digital literacies | Digital fluency |

Figure 1. Digital capability continuum model

We define digital fluency as contextualised, knowledge-based behaviours that enable adaptive and successful engagement in dynamic digital worlds. Digital fluency relies on continual active engagement with digital cultures and spaces. It is possible to become more literate by lurking, but fluency requires active involvement with creation and flexible application. For example, consumption and passive engagement with reading a recipe or watching a cooking show can improve understanding of food preparation but applying and adapting that knowledge in the kitchen provide the opportunity to build cooking confidence and expertise. What this also reveals is that digital fluency requires a need driver whether it is an innate desire for mastery to professional demands, to connect with others successfully or a need to engage with digital citizen systems. Essentially, digital capabilities are not tied to specific jobs or study areas but rather are essential capabilities for thriving in the 21st century.

Digital fluency – impact and importance in higher education

Technology's role as a transformative societal driver necessarily impacts higher education in an ongoing capacity. Responsive digital skills are key enablers in the business of living, learning and working (Sicilia et

al., 2018). The pandemic and recent generative AI impacts have brought to the fore the need for digital fluency in work, life and study; the need to continually pivot, switch, work around or innovate as traditional ways of being became unsupportable. Sicilia et al. noted that industry needs for digital skills training has resulted in digital competencies-focused frameworks and approaches at different educational levels. The criticality of innovative and digitally fluent graduates was a finding echoed in research by Bashir et al. (2022). Higher education has a responsibility to ensure graduates have the skills industry is seeking, not just discipline-specific but professional, transferrable skills including digital competencies. More than this, higher education must redefine curricula to integrate digital capability development in the context of the discipline.

In the higher education context, students are perceived as being digitally savvy as they are constantly connected to the digital world through their continuous use of mobile devices. As Coldwell-Neilson (2018) reported, "students … are assumed to be sufficiently savvy to improve their skills … with little or no intervention through the curriculum" (p. 103). Savin-Baden (2015) referred to this constant connection as digital tethering, "the constant interaction and engagement with digital technology; the sense of always being on, always engaged" (p. 11). Further, digital tethering does not necessarily equate to skills and knowledge. Digitally fluent graduates need to have built flexible technical skills, to be able to think through designing digital solutions and to frame themselves as digital citizens with all that entails (Bashir et al., 2022). This reinforces the need for digital capability development to be explicitly integrated into student learning and contextualised within their programme of study.

Digital capability continuum framework

Similarly to Coldwell-Neilson's (2020) earlier digital literacy work, with an umbrella definition and underlying framework, the digital capability model required underlying frameworks to unpack the complexities and details of digital capability development. There are a myriad of learning models, frameworks and paradigms which have been developed to support different aspects of learner development and curriculum design. Here, we briefly explore the three models that contributed to the development and understanding of the digital capability continuum framework, which include our earlier digital capability continuum model (Figure 1), Beetham and Sharpe's pyramid model of digital literacy development (Sharpe & Beetham, 2010) and Barnett and Coate's (2005) knowing-acting-being paradigm. The relationship of these three models with the digital capability continuum model provides a basis for the digital capability continuum framework, shown in Figure 2.
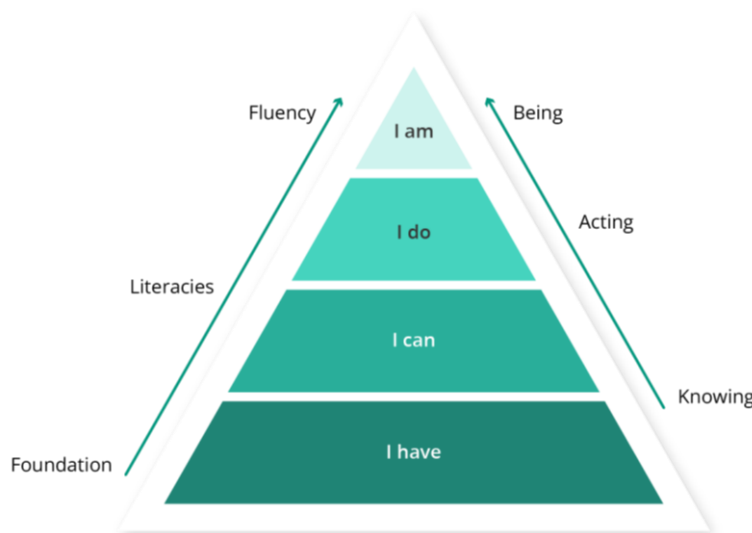

Figure 2. The relationship between the digital capability continuum model, the digital literacy pyramid model (Sharpe & Beetham, 2010) and the knowing-acting-being curriculum paradigm (Barnett & Coate, 2005)

Beetham and Sharpe's pyramid model of digital literacy development (Sharpe & Beetham, 2010) presents a way of understanding learner development in online environments. The model represents the shift from the functional access stage (I have access to technologies, resources and services), through skills (I can use the technologies, resources and services) and practices (I do make choices as to how to use the technologies, resources and services) stages, to the peak of creative appropriation (I am able to manage the technological environment to suit my purposes). This model, informed by Bloom's taxonomy, with its clear cognitive development and practical implementation for teaching, aligns with the digital capability continuum model's conception of foundational-literacies-fluency. The digital capability continuum model's movement between foundational (I have and I can) to literacies (I can and I do) to fluency (I am) is indebted to Beetham and Sharpe's pyramid model (Sharpe & Beetham, 2010). The key difference is that Beetham and Sharpe's unidirectional approach positions digital literacy skills as increasing in proficiency and fluency (with support and practice) over time, whereas the digital capability continuum model recognises the infinitely cyclic nature of digital capabilities development.

Barnett and Coate's (2005) knowing-acting-being paradigm is a "framework for understanding the main components of curricula" (p. 79). The three elements are interconnected and are enacted in different ways in different disciplines. Barnett and Coate have positioned curriculum as the enabling vehicle for learner development and eventual graduate identity. This is supportive of digital capability development opportunities being integrated into discipline curriculum and learning activities. The curriculum and pedagogical strengths of this paradigm support the digital capability continuum model and framework, providing a robust rationale and base for developing a digital capabilities curriculum.

Toffler (1971) argued that to meet the disruptive impacts of technology on work, ways of learning must be adaptive and flexible, a learn-unlearn-relearn cycle. A linear approach to learning and skills would be insufficient to meet the demands of the 21st century and it requires metacognitive awareness (Biggs & Moore, 1993) and higher order learning abilities in the individual to be supported. Although Toffler's work occurred over 50 years ago, it supports the digital capability continuum concept by focusing on ways of doing and the cyclic nature of digital capability development. The digital capability continuum framework captures notions of how students learn, how the curriculum should support that learning, with the digital capability continuum framework reflecting Toffler's cycle as an encompassing engagement which is enacted by students and staff.

Aligned to the notion that technology use does not guarantee that students have the necessary skills and knowledge to support their digital learning, we use a flipped variant of Beetham and Sharpe's pyramid model (Sharpe & Beetham, 2010) to explore the impact of not only the digital divide (in the broader sense of Lenhart and Horrigan's 2003 continuum) but also digital poverty on the lack of digital literacy and higher order digital fluency on students' preparedness to learn in digitally enhanced environments, shown in Figure 3. The impact of the flipped model is explored below.
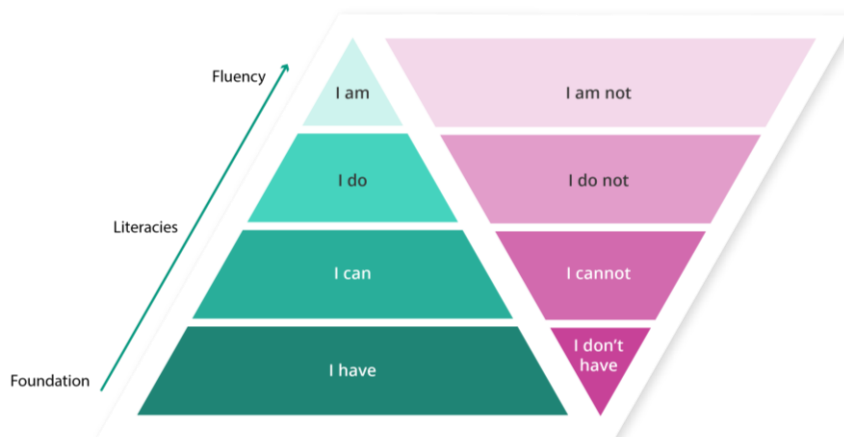

Figure 3. Digital capability continuum framework – a flipped pyramid approach

I don't have … functional access (digital foundation)

Many students come to higher education having used a computer at home, school or work. Although many students have access to their own digital technologies, these are often in the form of a smartphone or a tablet. If they have a laptop, there is no guarantee that it will be appropriate to support their learning, and there is an expectation that they will have access to computers via university-provided laboratories. Unfortunately, the digital technology and associated skills that students are expected to have when they arrive on Day 1 is not well articulated by universities, as Coldwell-Neilson (2017a) discovered. Even when minimum expectations are articulated, they are outdated and, in some cases, inappropriate. For example, one Australian university indicates that students need to have access to, and be able to use, Internet-connected devices. This is further qualified to indicate that a desktop or laptop computer is appropriate but then goes on to state that mobile devices such as tablets and smartphones may also be acceptable. Further statements about accessing university computers are included. But as many students discovered in 2020, during the pandemic when they did not have access to university laboratories, a smartphone is not a suitable device to be able to complete sophisticated learning activities online, nor is a shared computer in a share house, particularly when it came to completing online exams. Even when students have access to campus-based infrastructure, there are usually insufficient computers to meet demand.

I can't use … through lack of skills or access (digital literacies)

There is an expectation that students bring sufficient digital skills to support their learning, skills they have learned through prior education experiences, from their workplaces or from their everyday digital use to support personal activities. Australian higher education institutions have a demonstrably diverse cohort including school leavers, mature-age students, domestic and international students, those who are first in family or come from a low socioeconomic environment. As part of this, there is wide-ranging diversity in the level of digital access or capacities that equate to significant numbers of students who cannot meet staff expectations of their digital capability (Coldwell-Neilson, 2018). Students may have limited digital experience, either limited by device (only using an iPad) or by application (only using Messenger to communicate) for example. Russo's (2019) understanding of the emerging digital divide supports Coldwell-Neilson's (2018) findings that many students are transitioning to higher education without the digital skills expected to support their learning. Russo has suggested that a link exists between digital fluency, socioeconomic status, sociocultural capital, digital identity and student self-reported preparedness and digital skills.

I don't use … through lack of knowledge and skills (digital literacies)

Aligned with the limitations of skills is the lack of knowledge to understand or the ability to transfer skills from one device type to another or one application to another. As Savin-Baden (2015) highlighted, although students seem to be able to use their smartphones extensively and use social media to stay connected, this does not necessarily translate to an ability to communicate in a learning management system or use a computer. "Engaging with digital media and slipping through digital spaces with ease are things that many people appear to do well, although the benefits of such proficiency are unclear" (Savin-Baden, 2015, p. 7). This suggests that a lack of digital skills is aligned to a lack of good digital practices and knowledge. There appears to be a lack of basic understanding of how digital technologies work, and skills are aligned to specific technologies rather than being recognised as transferable skills. This is being addressed in the Australian schooling system through the recently implemented Digital Literacy Capability, which replaces the Information and Communication Technology (ICT) Capability (Australian Curriculum Assessment and Reporting Authority, 2023). It will take several years for this to impact the capabilities of school leavers and will have no impact on current higher education students.

I am not … lack of confidence (digitally fluent)

Building confidence in one's own digital skills and capabilities is paramount to moving beyond the I have, I can and I do elements of Beetham and Sharpe's pyramid model (Sharpe & Beetham, 2010). However, confidence is not the only required characteristic at this level. Confidence can be misplaced if knowledge

is lacking, for example, and these gaps are not recognised. Digital fluency implies not only access, ability to use and intention to use but it also requires creativity and knowledge to seamlessly move between digital environments and virtual and real worlds as well as skills and technologies. Importantly, it is the ability to recognise gaps in knowledge and to easily address or overcome them. Often overlooked is the ability to recognise when a digital solution is not necessarily the best solution. Building resilience and a digital identity are significant achievements here.

Relationship with the digital divide and digital poverty

Despite students' use of technology, there appears to be a disconnect between using and understanding. The term *digital divide* was first coined in 1995 as a metaphor to represent "a division between people who have access to and use of digital media and those who do not" (van Dijk, 2020, p. 10). This concept has persisted despite the increased access to digital technologies in recent times. However, understanding what the digital divide represents is changing. As van Dijk has pointed out, the discourse has moved from access to skills and usage, and the technology has changed from computers and dial-up to smart, mobile devices. van Dijk went on to argue that the digital divide is more complex than the metaphor suggests, and that digital inequality is not just a technical issue but is a social problem linked to social, economic and cultural divisions, which suggests that such inequalities have a greater impact on digital fluency than digital literacy.

For example, in a recent study focusing on students with special educational needs, Lebeničnik and Istenič Starčič (2020) investigated the factors that impact students' access to online learning resources. Their results suggest that the "digital divide is more related to cognitive and motivational aspects than to the lack of access to ICT and accessible online content" (p. 2435), not just for students with special educational needs but for all students. This further supports Savin-Baden's (2015) suggestion that digital tethering (the state of being permanently digitally connected) does not necessarily equate to skills and knowledge. The impact of perceived and developed self-efficacy on digital literacies and fluency has also been highlighted in the systematic review of digital literacy in the university setting conducted by Gutiérrez-Ángel et al. (2021).

In this context, it is useful to distinguish between the digital divide, being lack of access to digital technologies, and digital poverty, which the Digital Poverty Alliance (2022) defines as "the inability to interact with the online world fully, when where and how an individual needs to". Another helpful framing for digital poverty, one that makes its connections to the digital capability continuum clearer, is the "inability to access, understand, use and innovate with technology in a meaningful and productive way due to financial, social or personal barriers" (The Father Bob Maguire Foundation, 2019).

Individuals have a position on a digital spectrum, a continuum from low levels of skills and knowledge towards fluency. This position is informed not only by access to digital technologies but also by personal or economic circumstances as well as personal choice and need (Lenhart & Horrigan, 2003; Martínez-Bravo et al., 2022). It is also impacted by digital circumstances, for example, being faced with different digital infrastructure or having to use an unfamiliar piece of software. Higher levels of digital fluency would minimise any negative impact of such new encounters. As Barrantes (2007) made clear, digital poverty can occur in any population grouping, whether or not economically poor.

Digital divide and digital poverty are not independent of each other, particularly at the lower levels of the digital capability continuum, in the I have/I can space in the Beetham and Sharpe pyramid model (Sharpe & Beetham, 2010) (see Figure 4). However, the current generation students are not so much impacted by the digital divide but rather suffer through digital poverty, as demonstrated in the scenarios described above.
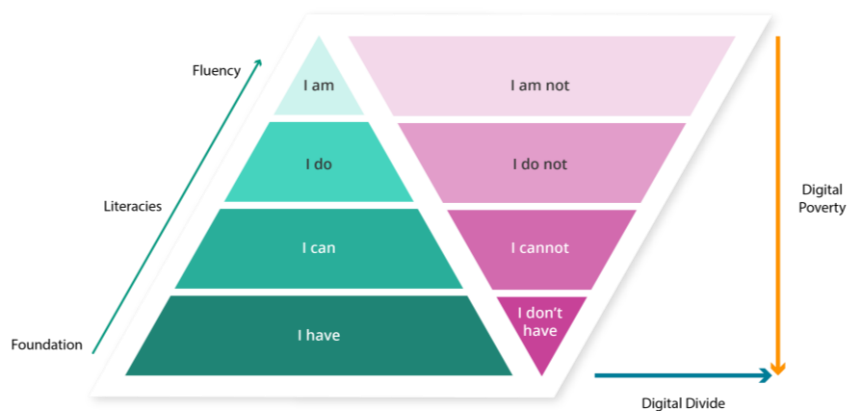
Figure 4. Digital divide and digital poverty in relation to the digital capability continuum framework

What becomes evident through this approach is that the I am not and fluency elements are as significant to thriving in the 21st century as the I do not and I cannot elements are, as well as the associated aspects of foundational skills, literacies, knowing and acting. Changes in the digital environment can be a major setback to confidence for those who are not digitally fluent. Strongly aligned to Dweck's (2006) growth mindset framework, the ability to negotiate digital technologies relies on strong foundations that have been built through the lower levels of the Beetham and Sharpe pyramid (Sharpe & Beetham, 2010) resulting in a broad comfort zone, extending the learning zone through practice to enable new skills acquisition and an ability to deal with challenges and problems before entering the panic zone. This further reinforces that, like literacies, movement across and through the digital divide and digital poverty is not static.

Educational approaches to improving students' digital capabilities

Broadly speaking, digital fluency in education is the ability to strategically integrate technology into teaching and learning, improving learning outcomes and enriching the classroom environment (Spencer, 2020). Good learning design includes strategies to develop foundational knowledges that scaffolds to higher levels of understanding within a context, such as discipline knowledge. Improving digital literacy requires similar attention; it needs to be scaffolded and built within the context of discipline curriculum, not bolted on as separate activities. Technologies and learning environments radically alter the where, when and how of student learning and educator teaching (Kluge & Stacy, 2008). Blended, hybrid or multimodal teaching is now embedded language in education dialogues at all levels. Educational technologies and the increasing centrality of digital learning environments are transforming how higher education curricula are conceptualised and embodied, with recent societal and cultural impacts from the pandemic and generative AI only heightening the rate of change (Crawford et al. 2020; Kreinsen & Schulz, 2023).

Consequently, emergent technologies and digital learning environments are a digital disruption that higher education teaching staff are currently grappling with (Elliot & Taylor, 2019). New ways of teaching and learning brought about by digital evolution is pushing educators to build their own digital competencies to align with educational outcomes (Dias-Trindade & Ferreira, 2020). However, the understanding and ability to create effective, implementable digital learning experiences are a new and frightening territory for many educators to come to grips with. Moreover, as Elliot and Taylor underlined, responding effectively to the digital disruption of emergent technologies, learning environments and overall learning experiences is complicated by an educator's own learning experiences that may have been within a traditional teacher-centric and face-to-face model. Digital pedagogies that match to this new landscape are therefore critical in this new reality of higher education but implementing those pedagogies requires educators to possess digital skills and digital knowledge. Or as Fulgence (2019) framed it, delivering effective curriculum in both face-to-face and digital learning environments requires both digital pedagogical understanding and digital fluency as key staff competencies. Therefore, building

digital fluency in teaching staff is a core step in exploring technology-enhanced learning (Wang, Wiesemes, & Gibbons, 2013). It is also a requisite investment for higher education to "facilitate learning environments that promote digital fluency and prepare students for a 21st century workforce" (Russo, 2019, p. 151). This is reinforced by Fleming et al.'s (2021) assertion that meeting the challenges of current and future digital education needs requires digital fluency, or other variant frameworks, providing a roadmap to foster agility in developing capabilities.

The Global Digital Citizen Foundation (Churches, 2008) has developed a digital taxonomy based on Bloom's work. The infographic features the span of the digital taxonomy beginning with lower order thinking skills aligned with remembering and understanding, through applying and analysing, to higher order thinking skills including evaluating and creating. This aligns well with Beetham and Sharpe's pyramid (Sharpe & Beetham, 2010) and provides a useful tool to facilitate learning. But most importantly is providing students with opportunities to build confidence in their own skills and to recognise the need to grow them in the context of their learning, working and social lives. Such opportunities need to be built into the curriculum, supporting Barnett and Coate's (2005) framing of knowing-acting-being. In other words, supporting digital capability development, as with any learner development programme, requires well-designed, integrated curriculum and pedagogy.

Conclusion

If digital fluency is framed as a continuum where knowledges, competencies and behaviours combine for fluid engagement in digital worlds, how can a digitally fluent graduate be defined? We contend that digitally fluent graduates can learn to explore, connect, create, critically evaluate and manage digital technologies and information. In building these digital literacies, students develop technical skill sets and a disposition to innovatively engage with technologies. A digitally fluent graduate is able to engage with the digital world critically and ethically and creatively use problem-solving, communication and collaboration skills to develop solutions to problems using appropriate tools, including digital tools. They can safely function within digital contexts while maintaining privacy, security and well-being.

We view digital fluency as a combination of (a) digital, technical and proficiency knowledges – one's understanding to select and use technologies and technological systems; (b) digital literacies (cognitive and/or intellectual competencies) – ability to read, create, evaluate and make judgements and apply technical skills in using technologies and the related systems; and (c) social competence and/or dispositional knowledge – one's ability to relate to others and communicate with them effectively in the digital environment. By educators framing their teaching in alignment with the digital continuum model and framework, a more people-focused and less technology- or jobs-focused approach to building digital fluency is enabled. The model also allows the education sector to partially address the wicked problem of creating digitally fluent graduates by scaffolding foundational skills and more complex literacies through curricula.

The take-home message for practitioners is that digital skills and literacies must be integrated within discipline learning to provide the context and opportunity for students to grow along the digital continuum to fluency. The responsibility is placed on the educator to do that work but for many this would require significant institutional support. As Russo's (2019) thesis concluded, unless effective support structures and curriculum design that build digital fluency are embedded in education, inequality will continue to grow. Higher education institutions must value, fund, provide capability building and evaluate effective digital technology infrastructure and services. Further investment is also required to build educators' digital skills to facilitate learning environments that promote digital fluency and prepare students for the 21st century workforce. If education is to be transformative, it should be supportive and accessible for all. A blue-sky goal for the sector is that educators and students understand that digital fluency is a mindset and an attitude; with the model and framework underlining that capabilities need to be flexible and transferable across technologies, discipline, and the world of work. Further work is required to explore how the continuum model and enacting framework can inform curriculum and

pedagogy in practice. In this context, it is important to also explore and address educator needs for their own digital development to support this enactment.

Author contributions

We both contributed fully to all aspects of the research, analysis and writing of this work.

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