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Gently down the stream(ing): Can digital literacy help turn the tide on the climate crisis?

Peter Tiernan
Assistant Professor, School of STEM Education, Innovation & Global Studies, Dublin City University
peter.d.tiernan@dcu.ie

Abstract
The development of digital literacy and digital competencies are widely recognised as essential in an increasingly digitised world. However, as we begin to come to terms with the extent of the climate crisis facing the world, this paper asks the question: is it time for digital literacy to focus its attention on the impact digital activity has on the environment? This desk-based research piece begins by examining popular digital tools and services used for entertainment and work purposes, and highlights their environmental impact and potential mitigating factors. Following this, definitions of digital literacy are examined to reveal a complex set of competencies which, as yet do not engage with the environmental impact of activity. The paper then examines widely used digital literacy frameworks and exposes their relative lack of engagement with this area. Finally, the paper urges that we begin to discuss environmental impact as a component of digital literacy. It proposes ways to achieve this with students, using the language of existing digital literacy definitions. It also recommends the inclusion of environmental impact as a separate strand in digital literacy frameworks.

Keywords
Digital literacy, digital competencies, climate crisis, environmental impact

Introduction
The ubiquitous availability of digital content and relatively unfettered access to the internet and web services has transformed the way we live, work, and learn (List et al., 2020). Technology permeates every aspect of life, providing tools to manage and accomplish work, content to entertain through various platforms and services, and applications to document, store and share users' lives online. It is within this context that digital literacy features prominently in policy documentation and educational literature, all of which recognise it as an essential skill for 21st century living (Pérez-Escoda et al., 2019) and lifelong learning (Rohatgi et al., 2016), in an increasingly digitised world. However, as we stand on the precipice of climate disaster, is it time for digital literacy to focus its attention on the impact increasing digital activity has on the environment? To address this question, this paper begins by examining a range of popular platforms and services to discuss their impact. Following this, it engages with definitions of digital literacy, as well as key digital literacy frameworks, to understand the extent to which environmental impact is currently being discussed and addressed. Finally, potential ways to incorporate environmental impact as part of digital literacy discourse and delivery are discussed.

Environmental impact of users' digital lives

Conversations around the impact of educational technology (edtech) on the environment have begun in earnest, with authors such as Facer & Selwyn (2021) urging providers to consider their use of edtech. They propose a reorientation of users' practices to prioritise only essential use of technologies, and the employment of said technologies in a more sustainable manner. While edtech constitutes a significant portion of technology use, digital content distribution and online engagement are prevalent across many other aspects of life. This section is not an exhaustive technical examination, but rather a contextualisation of these activities and services for the reader, their impact on the environment, and certain mitigating factors that warrant consideration. The focus here is to raise awareness around this neglected aspect of digital literacy. It is hoped that, through dialogue and careful consideration of academics' role within this debate, academics and policy makers will encourage students to be more informed users of these services, so that a collective understanding of the impact of digital behaviour can emerge. I begin by examining popular entertainment services. The usage of video streaming services has soared in recent years, to the point where they now account for a large portion of day-to-day entertainment viewing. Netflix has almost 67 million European subscribers (Abbatescianni, 2021), Amazon Prime has 1.2 million, and is growing fast (Coppola, 2021). Users are spending, on average, approximately nine hours per week viewing content via streaming services, and while the providers have improved efficiencies in these services, their carbon footprint is still significant (Stephens et al., 2021). It is important to acknowledge the impact of the device used for viewing content. The vast majority of the emissions created from viewing streamed content are driven by the device the content is viewed on. For example, streaming content on a mobile phone reduces emissions by over 80% when compared with viewing on a 50-inch smart TV. With the advent of services such as Spotify, music consumption habits have shifted firmly away from physical media, with the exception of the re-emergence of the vinyl record as an iconic music format (Eleftheriadis & Alexiou, 2020). This shift has drastically reduced the amount of plastic being used in the music production and distribution process. However, similar to Selwyn's (2021) commentary on edtech, we must begin to challenge assumptions about the 'greening' impact of this technology, and acknowledge that the overall greenhouse gas emissions from storing and distributing music online have soared, doubling since 2000 (Brennan, 2019).

Social media activity continues to increase at a remarkable pace, and a significant carbon cost (Perrin, 2015). Not all social media applications are equal in this regard, however. Certain platforms, particularly TikTok and Reddit, have a disproportionately large carbon footprint. Regular checking of social media applications and scrolling of 'news feeds' contributes carbon emissions equivalent to a short light vehicle journey, per person, per day (Derudder, 2021). This online activity, coupled with the desire to store photos, videos and documents in the cloud, places huge strain on storage solutions and increases the footprint of data centres globally. Increasing political pressure on technology giants such as Google and Facebook has prompted the adoption of more renewable energy sources, improving the energy efficiency of these data centres. Yet, data centres still account for 1% of the global energy demand (Obringer et al., 2021), more than the energy consumption of many small nations. So, while it may seem far-fetched to say that every upload, post and comment contributes to environmental pollution, an insatiable appetite for 'connection' and storage is driving demand for cloud storage solutions. The continued desire for the latest phone is also costing more than the money in consumers' wallets. The environmental impact of the device lifecycle is well documented, from the exploitation of labour to mine materials and produce devices, to the digital rubbish left behind by their disposal (MacGilchrist et al., 2021).

A recent Deloitte study found that up to 83% of emissions associated with smartphones come from their manufacturing and distribution (Lee et al., 2021). Emejulu & McGregor (2019) have argued that as society becomes more informed about the environmental impact of technology, technology may move from a thing of prestige to something that symbolises exploitation. However, current figures suggest this sentiment is slow to take hold, with over half of consumers in many EU countries renewing their devices every 18 – 24 months.

In the work environment, too, the digital impact must be acknowledged. It is known that online meetings and conferences have had a positive environmental impact, with the potential to reduce the carbon footprint and energy use by 94% and 90% respectively when compared with face-to-face meetings and conferences (Tao et al., 2021). With that said, video conferencing platforms such as Zoom still require significant technological infrastructure, which has its own energy demands and implications. Simple steps can be taken to reduce these demands. For example, turning one's camera off when it is not required can reduce the carbon footprint of Zoom meetings by a further 96% (Obringer et al., 2021). While this may fly in the face of 'camera on' policies (Castelli & Sarvary, 2020) adopted by many universities for lectures, we must consider whether this is a sacrifice worth making for the sake of the environment. Similarly, while sending emails may seem fairly innocuous, their impact may be greater than expected. Simply sending 65 text emails can cost as much carbon as a short car journey, and when factors such as attachments are considered, the cost is even higher (Duncan, 2022). This is brought into sharp focus when we consider that a global concerted effort to reduce 'thank you' emails could significantly reduce carbon emissions. A recent study by OVO energy (OVO, 2019) suggested that if every adult in the UK stopped sending 'thank you' replies and forwarding on funny emails, enough carbon would be saved equivalent to taking over 3,000 diesel cars off the road.

The above snapshot of technology use and environmental impact begins to reveal an alternative narrative to the greening potential of technology. This sentiment is echoed by authors such as Maxwell and Miller (2020), who contend that consumer electronics and digital technologies are made in ways that cause some of the worst environmental impacts of our time.

Current focus of digital literacy and digital literacy frameworks

An acknowledgement of the need to develop students' digital literacy has existed since Gilster (1997) first coined the term and defined it as "the ability to understand and use information in multiple formats from a wide range of [digital] sources". In the decades that followed, academics and policy makers have devoted much time and energy to (re)conceptualising digital literacy as it relates to an increasingly digitised world. Scholarly definitions of digital literacy have remained remarkably consistent around the ability to source, evaluate and use digital information. However, in more recent years, there has been an increasing emphasis on communication and content creation. For example: Martin (2005) spoke of digital literacy in terms of using digital tools to identify, evaluate, analyse, and synthesise digital resources; Ng (2012a) suggested it is the ability to search for, evaluate, understand, and integrate information found online; Kim (2019) defined it as the ability to use digital technologies to collect, analyse and evaluate information, as well as construct new information and communicate with others during the process; and Churchill (2020) asserts it is the ability to search for and evaluate information using digital tools, then use this information to address an authentic problem. It must be noted here that none of these definitions addresses the need to understand the environmental cost or impact of digital activity. In fact, while this piece does not claim to be a complete review of the literature, a system-

atised (Grant & Booth, 2009) search[1] of a range of academic databases[2] returned no results discussing this as an element of digital literacy. This is not to say that academics have shied away from the broad, nuanced nature of digital literacy. The range of digital competencies associated with being digitally literate has prompted authors such as Phillips and Manderino (2015) and Goodfellow (2011) to propose a number of 'literacies of the digital', including ICT literacy – basic computer skills; Media literacy – interpreting media practices; Information literacy – locating, evaluating and using information; New literacies – understanding information presented on social media sites and mobile devices; and Critical literacy – evaluating the purpose and motivations of media productions. Similarly, Kurtz and Peled (2016) have proposed seven domains of digital literacy: Information collection – gathering and locating information effectively and efficiently in an electronic context; Information evaluation – evaluating the quality, relevance, and usefulness of digital resources; Information management – the ability to organise, store, and retrieve data; Information processing – the ability to design or create new knowledge from information already acquired; Teamwork – sharing information, collaborating and communicating with others; Integrity awareness – ethical use of information gathered; and Social responsibility – understanding how to behave in digital contexts. Elsewhere, Ng's (2012b) digital literacy framework drew together three intersecting dimensions: Technical – the operational ICT skills to use technology for learning; Cognitive – the ability to locate, evaluate, and create information using digital tools; and Social-emotional – using digital tools to communicate and socialise. While these contributions must be acknowledged and commended for the enormous contribution they make to the digital literacy debate, there is, again, a noted lack of focus on the impact digital activities have on the environment.

Alongside the plethora of definitions and categorisations of digital literacy, numerous frameworks have been developed which help academics and other users understand digital literacy and its component competencies. For the purposes of this piece, the author conducted a detailed examination of five of the most commonly used and cited digital literacy frameworks: the European Union's DigiComp framework (Vuorikari et al., 2016), UNESCO's digital literacy competence framework (2018), British Columbia's (BC) digital literacy framework (2013), the JISC digital capability framework (2015), and the Open University's digital and information literacy framework (2020). This examination reveals 8 themes, represented across the frameworks to varying degrees. 1) Information, media, and digital literacy; 2) communication, collaboration and participation in digital society; 3) digital content creation and copyright; 4) digital safety; 5) problem solving; 6) operating devices and software; 7) wellbeing and the wellbeing of others; and 8) digital learning and development. Across all of the frameworks, the only reference to the environmental impact of technologies and their use is nestled under 'digital safety' in the UNESCO and DigiComp frameworks, where users are encouraged to move from foundational proficiency (recognising simple environmental impacts of digital technologies and their use), through to advanced proficiency (show different ways to protect the environment from the impact of digital technologies and their use).

1. Digital literacy AND climate in title OR abstract; Digital literacy AND carbon footprint in title OR abstract; Digital literacy AND global warming in title OR abstract; Digital literacy AND environmental impact in title OR abstract.
2. Academic Search Complete; AccessScience; Applied Social Sciences Index and Abstracts(ASSIA); British Education Index.

It is clear that academics and policy makers are committed to the development of digital literacy, and much work has been done to progress the field over the past number of decades. However, it appears that the impact of users' digital lives on the environment has been largely left out of the debate and area of focus.

Discussion

At the time of writing, calls for action to avert a climate catastrophe have become more strident. The time for talking is over, and there is an urgent need to shift mindsets and re-evaluate people's relationship with the planet. According to the United Nations (2022), humanity is "on a pathway to global warming of more than double the 1.5 degrees Celsius that was agreed in Paris in 2015". They warned, "This is not fiction or exaggeration. It is what science tells us will result from our current energy policies." These statements come following the launch of Intergovernmental Panel on Climate Change (IPCC) report (2022), which paints a very troubling picture. Their report states that the impact of climate change is already more widespread and severe than expected. On the current trajectory, major impacts will become apparent in the near-term and may escalate quickly as temperatures continue to rise. Their message is simple and sombre. We must act now, adapt our practices, and become more sustainable in everything we do.

At the outset, I stated that policy documentation and educational literature recognise digital literacy as essential in being able to participate in a digital world. I have been involved in digital liteacy research for many years (e.g., Tiernan & Farren, 2017; Tiernan, 2021) and I believe there is potential to refocus attention and use familiar language and strategies to guide students to being more critical users of technology and in understanding its impact on the world. The requisite competencies are already framed in existing conceptualisations of digital literacy. Repurposing Gilster's (1997) original definition, we might say it is "the ability to locate and understand information regarding the impact of digital tools and use this information to make decisions which are cognisant of the natural environment". We can draw on many other aspects of current digital literacy definitions to facilitate critical thinking in this regard. Using Martin's (2005) definition as inspiration, we might encourage students to identify their current digital activities and analyse their carbon footprint, before evaluating areas where improvements can be made. Further still, we can draw inspiration from Kim (2019) and encourage students to construct new meaning from their investigations, by building a picture of trends associated with work, study and social practices, and communicating these findings with a wider audience. These kinds of actions, this shift in focus, is essentially a repurposing of what we already ask students to do with regard to digital content, but targeted at addressing the authentic and urgent issue of climate change (Churchill, 2020).

Turning attention to the existing digital literacy and digital competence frameworks. First, the DigiComp and UNESCO frameworks must be commended for including the environmental impact of users' digital lives. However, further development of this area in these frameworks should be encouraged. Perhaps, rather than focusing on a single line of proficiency, a separate competence area for environmental impact should be created. This might provide a detailed scaffold which encourages a multidimensional understanding of digital tools, their impact on the environment, and consideration of actions that can be taken to affect change. Similarly, other framework developers (JISC, BC, Open University, etc.) should begin to articulate the importance of this area, and include environmental impact as a key component of understanding and addressing digital activities.

The benefit of including environmental impact as a digital competence is twofold. First, it would increase understanding of the 'cost' of technology, and promote a more critical use of these tools and services in day-to-day life. This would encourage students to be more cognisant of why they are using technology, the ways they are using it, and strategies for reducing their impact. Second, it may contribute to an increased criticality in terms of the 'cost' of student actions more broadly. For example, if a student becomes more cautious of how often they replace their smartphone, might they become more conscious of how and when they replace their car, their laptop, or their clothes?

Conclusion

The coming years present major challenges for society at large to get to grips with the climate emergency. It is crucial that society shifts its mindset, in all of its activities, begins to understand the impact people's actions have on the environment, and that it makes the necessary changes to recalibrate and rebalance its relationship with nature. Changes are required in all aspects of life, from energy and waste, to the provision and rewilding of natural spaces. While a refocussing of digital literacy and digital competencies in this way is not the panacea for the situation, it can act as a move in the right direction, one more component of life where people begin to understand and address the impact on the environment.

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