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Postdigital Teaching of Critical Thinking in Higher Education: Non-Instrumentalised Sociality and Interactivity

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Abstract

In the wake of the digital revolution, the digital teaching of critical thinking takes established forms in higher education. Its technologies are productively understood in postdigital terms as a diverse, inconsistent and cobbled-together collection of platforms and software. This paper considers the limits, problems and advantages of this messy and layered amalgam of technologies. Examining them shows that the benefits of digital critical thinking teaching are frequently bound up with digitisations' support of sociability and interactivity. This is counterbalanced by difficulties and limits encountered in digitised teaching of critical thinking, often framed as deficiencies in students, teachers, institutions or technologies. However, following Bernard Stiegler's work and postdigital scholarship, these distinctions can be countered to understand critical thinking technologies as performed within social, technical and psychic milieus processes. Stiegler's emphasis on temporality allows for a critical analysis of the constraints of digital forms of sociality and interactivity. His notion of *otium* suggests that techniques cultivating interruptions and layering in digital critical thinking technologies engage their negativity and enable temporal zones in which reflective thought can emerge.

Keywords Critical thinking · Critical pedagogy · Postdigital · Stiegler · Higher education

Introduction

In the wake of the digital revolution, the digital teaching of critical thinking takes established forms in higher education. Its technologies are productively understood in postdigital terms as a diverse, inconsistent and cobbled-together collection of platforms and software. This paper considers the limits, problems and advantages of this messy and layered amalgam of technologies employed in various dimensions of critical thinking. The examination of Learning Management Systems (LMS),

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social media and specifically targeted applications shows that the promises of digital critical thinking teaching centre on the technologies' support of the sociability and interactivity that facilitates collaboration, responsiveness and timeliness of guidance (for example, Saadé et al. 2012; Jahn and Kenner 2018; Green and Chewning 2020; Manca 2020; Radkowitsch et al. 2020; Rossi et al. 2021; Anwar and Muti'ah 2021; González-Cacho and Abbas 2022).

Counterbalancing these are difficulties and dissatisfactions with digitised critical thinking teaching, often framed as lacking or unsuitable qualities of students, teachers, institutes and technologies (for example, Arend 2009; Kirschner 2015; Jahn and Kenner 2018; Willems et al. 2018; Bhatt and MacKenzie 2019; Tathahira 2020; Swerzenski 2021; Belda-Medina 2022). On closer examination, however, the potentials and troubles of digital critical thinking pedagogies cannot be separated and distributed between humans, machines and institutions in such a straightforward fashion.

The work of philosopher of technics Stiegler (1998, 2014, 2015, 2016) suggests we need to situate this collection of technologies within the processes of broader cultural, technical and economic milieus from which they cannot be dissociated. Stiegler (2016: 11) sees technology as a *pharmakon* that may act as a poison or cure, as evident in the potentials and perils of digitised critical thinking. His account of the co-constitution of humans and technology enables the analysis of how digitisation changes sociability, interactivity and critical thinking, placing temporality at the centre of these processes. The notion of *otium*, or non-instrumental time not spent in attaining a specific goal, provides guidance on how digital technologies might evade the control of digital temporality (Stiegler 2015: 167–177; 2016: 68–85) and support the teaching of critical thinking.

This paper proposes that cultivating *otium* through interrupting and layering digital practices allows for the emergence of the negativity of digital teaching technologies, in a version of what Ford (2019) describes as 'a pedagogy of the not'. Techniques of *otium* can be cultivated in teaching critical thinking in the contemporary university, gaining from digital teaching technologies capacities while avoiding capture by digital time.

Critical Thinking in Postdigital Times

Critical thinking is a contested term with conflicting definitions (Mulnix 2012: 465–471). There are arguments against its existence as a general skill (McPeck 2016), and it has been identified as particularly problematic for students of non-European heritage (Song 2016; Liyanage et al. 2021). Despite these difficulties, critical thinking remains associated with higher education and embedded in national and international policies and university graduate attributes (Barnett 1997; Davies and Barnett 2015: 169; Bezanilla et al. 2019). Critical thinking is a term employed by teachers and students (Lloyd and Bahr 2010), and an array of teaching methodologies have arisen around it (Bezanilla et al. 2019). Rather than seeking to neaten its boundaries and practices, this discussion embraces the multiple expressions of digital critical thinking in higher education, following Davies and Barnett (2015) in including both analytic and critical pedagogical approaches.

In addition, this broad notion of critical thinking is assumed to be a prosthetic practice (Kerruish 2023) in alignment with Stiegler's (1998: 4–17) explanation of how intellectual practices are bound to technical systems and how humans and technology are co-constituted. Stiegler (1998: 136–138; 2015: 7, 75; 2016: 19–20) argues that mnemonic devices external to the human body, such as digital technologies, writing, cave drawings, audiovisual media or computational devices, enable culture and knowledge to pass on inter-generationally. His point is that external memory devices do not simply prompt or support what would otherwise be thought but form how and what we remember, understand, imagine and reason.

Autonomy in thought is not opposed to automation but instead occurs as a 'technical heteronomy' (Stiegler 2016: 78). Thinking is subject to technological and social conditions, and conditional autonomy arises through self-reflective intellectual processes in which individuals consider and incorporate automated memories. Bringing Stiegler's ideas to bear on teaching critical thinking sees it as a contextual and technologically inflected practice that always involves some degree of automation, digital or otherwise. The heterogeneous digital technologies used in teaching critical thinking seek to cultivate an intellectual practice that is co-shaped by them. Stiegler's thought is here complemented and developed by recent research on education in postdigital studies (Ford 2019; Hodgson and McConnell 2019; Lazarus 2019; Wei and Peters 2019; Jandrić and Hayes 2020; Jandrić et al. 2023a). The diversity of digital teaching can be characterised as postdigitisation, a collection of digital practices that have modulated analytic techniques and critical pedagogy to comprise a new epistemic regime of educational bioinformational capitalism (Wei and Peters 2019). Postdigital scholars share Stiegler's view that the crucial questions about digitisation relate to its effects and possibilities rather than its value or rejection.

Stiegler's (1998: 286) account of human originary technicity is continuous with comments of postdigital thinkers such as Jandrić and Hayes (2020), who argue for the interrelation between thinking and reasoning and technological, as well as physical and political, change.[1] Postdigital studies recognise the entwining of humans, machines and software (Jandrić and Hayes 2020: 287), acknowledging that 'digital technology and media is [no longer] separate, virtual, "other" to a "natural" human and social life' (Jandrić et al. 2018: 893). Committed to investigating and exploring the consequences of digitisation, postdigital research advocates the need to engage digital technologies for non-instrumental purposes (Jandrić et al. 2023a, b).

With this in mind, this paper sees the digital teaching of critical thinking as a postdigital practice that is 'messy; unpredictable; digital and analog; technological and non-technological; biological and informational' (Jandrić et al. 2023a: 7). The following discussion examines the potentials, limitations and problems of an ad hoc, overlapping and layered collection of software and platforms as found in research on the use of these technologies in higher education. What are the

[1] In addition, it connects Stiegler's work to other education researchers concerned with relationship between technology, education and their economic and political framing, such as Jagodzinski (2015).

beneficial and adverse effects of the digital *pharmakon* for critical thinking teaching? The research examined below indicates that their potential is strongly tied to their support of sociality and interactivity. In turn, examining the problems and obstacles of using such technologies shows them to be often understood in terms of deficits and issues with students, teachers, institutions and technologies. To address the limits of maintaining these distinctions, it becomes apparent that understanding the ambivalence of digital technologies requires situating them in their broader social, technological and economic milieus, as Stiegler's work advises.

The Promise of Digital Critical Teaching

A broad, imbricated and disorderly range of digital technologies is used to teach critical thinking in higher education and critical pedagogy. Some learning technologies used to teach critical thinking are ubiquitous in online teaching. Learning Management Systems (LMSs) provide the core of online delivery in the developed world, whether for large-scale massive online open courses (MOOCs) or for smaller cohorts attending on-campus classes. They structure the online learning environment and contain an array of functions, like discussion boards, messaging, video conferencing and recording, file upload, quizzes, interactive learning modules, assessment submission and grading and student data collection. Other critical thinking teaching technologies, such as social media, digital games and augmented and virtual reality, are widely used in society. In addition, there are applications (computer-supported argumentation knowledge construction (AKC)) specifically designed to teach aspects of critical thinking, such as argument mapping applications. These technologies overlap (for example, LMS is the starting place for the digital delivery of most units) and interrupt each other (for example, an automated argument script might be used to change poor argumentative approaches arising in social media (Tsovaltzi et al. 2014)). The amalgamated and layered techniques do not form a consistent, sealed system suggesting they are able to harbour the uncertainty and disequilibrium that foster the neganthropic organisation of knowledge (Stiegler 2016: 12–15). There is scope for difference, complexity and engagement with external contexts, which are required to teach socially and culturally informed critical thinking (Davies and Barnett 2015: 153–168).

In general, online learning environments have a series of characteristics thought to assist the acquisition of critical thinking skills, such as their fostering of active and deep learning, support for interactivity and collaboration, freeing of students from class time constraints so they can reflect and facilitation of information processing, research, and analysis. Tathahira's (2020: 88) review of the literature on the online teaching of critical thinking (in its analytical sense) concludes that the online environment is 'an excellent support to promote students' critical thinking'. To achieve this, researchers note that educators need to create an interactive environment (Mandernach 2006; Saadé et al. 2012; Anwar and Muti'ah 2021) and promote active collaboration (Rossi et al. 2021; González-Cacho and Abbas 2022); for example, well-crafted discussion questions should be discussed

in forums like discussion boards or other mechanisms facilitating human and machine responses.

Promoting social processes rather than individualised ones through online collaborative exercises and assignments, such as peer discussion and assessment, enhances the acquisition of analytic critical thinking skills (Ekahitanond 2013; Tathahira 2020; Fang et al. 2021). Technology-enhanced peer, teacher and self-feedback positively affect student learning in several dimensions, including students' critical thinking (Zou et al. 2023). Employing a broad notion of critical thinking, Jahn and Kenner (2018: 95) note the importance of creating a 'rich and open' digital environment that harbours interaction and dialogue.

The digital environments' capacity to support collaboration is also emphasised in the teaching of critical pedagogy. Within the postdigital framework, Hodgson and McDonnell (2019) explore how employing networked learning technologies according to a set of guiding principles can foster the teaching of critical pedagogy, forging connections between learners and teachers. Green and Chewning (2020: 423) write that, through teacher reflection and iteration, LMSs can and should 'be leveraged as a vehicle for critical pedagogy and praxis through technology', noting that features like live chat and discussion forums offer student-focused teaching potential. Rodriguez (2017) provides an example of how using digital devices in the classroom develops critical digital humanities skills, allowing for 'guerilla praxis' in which students use technologies in socially engaged, critically minded and transformative ways.

Well-designed cMOOCScultivating student collaboration, community and play can maximise the teaching of critical pedagogy online, demonstrating 'critical hope' in digital pedagogies (Lazarus 2019). O'Halloran (2020) shows how digital text analysis can create a new vantage point for students, facilitating critical literacy. Gallagher et al. (2021: 427-428) point out the opportunity for teachers to incorporate critical praxis if teachers and students are given choices in how to engage, noting that digital techniques can challenge 'social and spatial binaries' unpinning the classroom.

Social media are part of everyday social life for most students and are widely used in higher education. Puhl and colleagues (2015: 114) point out that a social media environment is conducive to learning skills in argument, allowing groups to develop shared argumentative practices over time. In addition to cultivating digital literacy, social media's encouragement of participation, collaboration and generation of content gives it the potential to support student cooperation and provoke active learning and high-order thinking (Menzies et al. 2017; Manca 2020: 78). We-Chat has been found to facilitate higher-order skills in the flipped classroom (Liu and Zhang 2022); Facebook has been effectively used for cultivating critical thinking through peer tutoring (Zulkifli et al. 2020); and Twitter has supported collaborative aspects of the teaching–learning process (Abella-García et al. 2019). Continuing an emphasis on how connectedness promotes critical thinking skills, Willems et al. (2018: 41) observe an alignment between social constructivist pedagogies and social media that facilitates critical awareness, writing it has the potential to meet 'students where they are at, and thereby establishing learning communities in which the co-construction of knowledge can easily be facilitated'. In addition to facilitating

collaboration, social media can also provide rich material about which to think critically (Wells 2018).

Delivering learning digitally enables multimedia practices that enhance the teaching of critical thinking (Jahn and Kenner 2018), for example, digital storytelling (Ryan and Aasetre 2021; Belda-Medina 2022), multimedia case studies (Heiney et al. 2019) or using memes to teach logical fallacies (Ugalingan et al. 2022). Engaging students through multimedia is most intense in digital game-based learning (DGBL) and augmented and virtual reality (AR and VR). Digital games designed for entertainment or specific educational games can be incorporated into the digital teaching environment (Sourmelis et al. 2017). Teachers may ask students to create games or incorporate aspects of games into the learning process (gamification) (Aguielara and de Roock 2022). A review of research on using games to teach critical thinking concludes they positively affected critical thinking skills (Mao et al. 2022), and a survey employing a typology of DGBL determined that role-playing games, in particular, support critical thinking (Sourmelis et al. 2017). AR's ability to juxtapose objects on the world in multimodal stimulations facilitates teaching critical thinking (Poce et al. 2019), enhancing the peer assessment and interaction that enables critical thinking skills (Ştefan and Moldoveanu 2013).

Two forms of computer applications designed to specifically teach critical thinking target argumentation: digital argument diagramming and AKC (digital dialogue games and scripting), which can be used separately or together.[2] Argument diagramming visually maps the structure of arguments, which software applications can do today. Concept maps are closely related to argument diagrams and have been shown to develop skills in this regard (Alt and Naamati-Schneider 2022). AKC systems are tools for the collaborative development of arguments and argumentation schemas. They may call upon the technologies discussed earlier in this paper, for example, using features of LMSs such as discussion boards or social media but in carefully scripted ways. They support learning about argumentation in a disciplinary area or as a generalisable skill by allowing arguers to check form and semantics and providing scaffolding for collaborative problem-solving (Tsovaltzi et al. 2014; Cáceres et al. 2018).

Scripts and dialogues offer the opportunity to digitally enhance group work and collaboration to support the acquisition of analytical skills (Ibrahim and Harun 2015; Schwarz 2018; Radkowitsch et al. 2020). Such online scripts can be used to develop arguments to be used in written assignments (Latifi and Noroozi 2021). Research on the collaborative mapping tool AGORA-net shows that in doing so, practices of philosophical reflection, collaboration and communication change (Hoffman 2018). Artificial Intelligence further automates these technologies; for example, data mining on argumentation can extract and analyse arguments from a body of texts based on a defined argumentation structure (Wambsganss et al. 2020). Automated feedback supported by social nudging skills (for example, 'you have

[2] See Schwarz (2018) for an overview of different models and approaches in computer supported argumentation for learning.

used more arguments than other students completing this task') improves the acquisition of argumentation skills (Wambsganss et al. 2022).

The discussion of research across various critical thinking teaching technologies shows how their potential is strongly associated with their facilitation of sociability (collaboration and peer assessment) and interactivity (feedback and guidance) (for example, Saadé et al. 2012; Green and Chewning 2020; Manca 2020; Radkowitsch et al. 2020; Rossi et al. 2021; Anwar and Muti'ah 2021; González-Cacho and Abbas 2022). The support of digital technologies for students' social relationships with each other and teachers is a significant factor influencing whether they enhance the teaching of critical thinking. Also crucial is the degree to which these technologies engender student responsiveness to learning materials and teacher and technological responsiveness towards students.

Hazards in Digitised Critical Thinking Teaching

Despite the promise of digital techniques in teaching critical thinking, research identifies a series of impediments to its efficacy, such as the limited skill levels of teachers and students, institutional resources and the structures of technologies themselves. Teaching critical thinking digitally depends on the circumstances and skills of students and teachers, who must be adequately prepared (Belda-Medina 2022). It calls upon pre-existing developmental levels of students, familiarity with technology, and their degree of engagement (Arend 2009), none of which can be assumed. So-called 'digital natives' may not be digitally literate (Phippen et al. 2021), and this classification has been problematised as essentialist and adversely mapping onto categories of teachers, students and Indigeneity (Bayne 2020). This lack of literacy extends beyond simply being able to use digital tools to a critical awareness of the risks and potentials of online spaces (Bhatt and MacKenzie 2019; Phippen et al. 2021). For example, researchers have noted that students need to employ critical thinking when using AR to assess information provided by juxtaposing virtual objects with the physical world (Ariso 2017). Critical digital literacy is a skill that students are assumed to have before they engage with digital learning (Reyna et al. 2018).

Often, teachers and institutions lack the expertise and resources to support digital teaching. With the rapid expansion of online learning, limited resources may be available to higher educators, leaving them unfamiliar with effective online learning methods designed for critical thinking (Liesa-Orus et al. 2020; Tathahira 2020). Higher education institutions can lack the readiness to adopt technologies such as social media and games, both in terms of staff resourcing and developing relevant policies (Willems et al. 2018). Guidelines for online teaching, assessment and quality learning design in critical thinking may not be established and circulated (Jahn and Kenner 2018). An absence of supporting institutional frameworks extends to using MMORPGs (Sourmelis et al. 2017) and other DGBLs (Aguilera and de Roock 2022: 13–14).

The structure and characteristics of technologies have also been identified as obstacles to teaching critical thinking. Omitting students' physical presence can

elide the backgrounds of students engaging in a learning space, removing social and cultural context to the detriment of teaching critical thinking (Tathahira 2020). Removing embodied encounters can limit the ability to think critically about social differences (Smith and Jeffery 2013). Although thought to enhance student learning, using multimodal essays rather than written ones leads to a decrease in students engaging with counterarguments (Smith et al. 2016).

There are a series of concerns surrounding teaching via social media, including its vulnerability to trends, the inaccessibility of its pages and its addictive nature (Rowell 2019). Its argumentative style has been assessed as negatively affecting learning (Asterhan and Hever 2015). Kirschner (2015: 622) argues that social media is an unsuitable technology when teaching argumentation because it supports narcissistic tendencies with many posts 'simply about "me, me, me"'. With their basis in networks of like-minded friends, social media may not foster diverse opinions in groups, narrowing the variety of information a person receives rather than broadening it (Kirschner 2015: 623), an effect accentuated by filter bubbles. Sites like Facebook employ 'threads in a flat-structured discussion board or conversation' rather than the nested, hierarchical discussion characterising human cognition (Kirschner 2015: 622). While this structure can be addressed by adding in AKC (Tsovaltzi et al. 2014), this solution raises the question of what social media contributes to the learning process if the absence of a script means that the use of social media adds nothing to learning argumentation (Weinberger et al. 2010).

The effects of AKC scaffolding on the teaching of argumentation are diverse across discipline-specific and general contexts (Haro et al. 2019: 339). Often used in the sciences, AKC systems may not always teach students how to employ argument outside narrow domain knowledge, inconsistently developing general skills in critical thinking (Noroozi et al. 2018). Students taught argumentation simply by doing it in a scripted, interactive online environment, without any theoretical underpinning, may learn in a way that is 'more mechanical, concrete and practical' (Wambsganss et al. 2020). Over-scripting can disrupt collaboration (Radkowitsch et al. 2020) and provides little space for exploring, reflecting and interacting without negative consequences, activities required for learning critical thinking (Jahn and Kenner 2018). In general, spaces for unaccountable play are hard to find in the recorded and datafied environment of digital teaching (Gallagher et al. 2021).

Swerzenski (2021) comments on the tendency of software to support a transmission model of learning, concluding that LMSs's datafication and affordances overly direct students and naturalise the transmission model of learning. A transmission — or banking–learning model (Freire 1973) curtails the role of reflective practice, discouraging students from fulfilling their critical potential (Swerzenski 2021). Bogost's (2015) widely circulated criticism of gamification sees it as marginalising critical reflection through control and discipline, reward and punishment, with its use in digital education adopting a positivist approach grounded in behaviourism. DGBL's use of such training practices conflicts with thinking through ideas for oneself and critically evaluating the processes and conditions of one's thinking.

The problems and constraints encountered in employing assorted and layered digital critical thinking teaching technologies are often thought to result from the people using the technologies (students, teachers and institutions) (for example, Arend

2009; Bhatt and MacKenzie 2019; Phippen et al. 2021; Belda-Medina 2022) or the qualities and structures of the technologies themselves (for example, Smith and Jeffery 2013; Asterhan and Hever 2015; Kirschner 2015; Tathahira 2020; Swerenski 2021; Wambsganss et al. 2020). Problems relating to people are presented as potentially addressed by better training, support and resourcing, and technology-related issues are to be addressed by supplementary or alternative practices. This division is unsurprising given that, as Jandrić and Hayes (2020: 287) point out, 'educational policy has persistently separated the performance of humans from machines'. In contrast, Stiegler (1998, 2015, 2016) and postdigital scholars (Jandrić et al. 2018; Jandrić and Hayes 2020) suggest that the co-constitution of people and technology means such a separation cannot be made. To support digital sociality and interactivity and address digital hindrances, critical thinking teaching needs to be understood as enmeshed in broader environments of which people and technology are a part. Educational practices are set in interrelated technological, social and psychic milieus that are more or less conducive to critical thinking.

Digital Critical Thinking Teaching Techniques and their Milieus

Digital technologies in higher education are inextricable from broader systems, as evident in non-pedagogical forces' role in motivating online teaching implementation, such as governance, institutional circumstances and the circumstances of academic and administration staff (Tomte et al. 2019). Social, technical and economic values and ideas are entwined with higher education, its participants and digital technologies and can counter the teaching of critical thinking. Of importance here, as Jandrić and Hayes (2020: 287) state, is that 'education, within institutionalised capitalism, [is] portrayed in policy as a means to an end, where the flexible skills of individuals are developed to meet the needs of the economy'. Applying this narrow understanding to higher education sees it as fixing societal and economic issues and conceptualises learning as 'an individualistic and economically driven endeavour' (Jandrić and Hayes 2020: 288). Digital technology is regarded as just another tool to enhance economic and social goals (Jandrić and Hayes 2020).

According to Knox (2016), such an instrumental approach to digital teaching is epitomised in LMSs in MOOCs that promote an uncritical attitude towards learning as part of marketplace practice of higher education tied to a late capitalist intensification of labour. The force of beliefs has also been examined in critical approaches to DGBL that examine the role of power, agency and ideology in educational uses (Aguilera and de Roock 2022). Some of the criticisms made of DGBL apply to video games generally, an example of the intertwining between digital learning technologies and the society and culture in which they are embedded. It includes a spectrum of concerns about commercialism, representation, accessibility, equity, antisocial behaviours, misogyny, addiction and the promotion of violence (Gray and Leonard 2018). DGBL has been criticised for employing gamification beyond gaming and exploiting participants' labour, behaviour and psychological responses (Bogost 2015). In Stiegler's terms, it is an example of how the sensory-motor loop broken

by *noesis* is reinstated when digital technology cuts out time for human reflection (2014: 64–66, 2016: 114–117).

Beliefs about how technology should relate to education may project and engender a particular figure of the student, excluding others from the practice of critical thinking. The interaction between education and technology is often pervaded with unquestioned Silicon Valley values that preserve 'and privilege of a particular kind of human subject' (Knox 2016: 306). Conceptualising higher education students as consumerist individuals collecting knowledge in a transactive process ignores the variety of student lives and what this diversity brings to learning (Jandrić and Hayes 2020: 289).

The privileging of one understanding of the subject embedded in a humanist understanding of the collective occurs to the detriment of other subjectivities, such as transnational, postcolonial and queer identities (Atay 2021), in addition to the differently abled, socio-economically disadvantaged and those seeking education for non-instrumental purposes. Digitalisation brings a new hidden curriculum (Gallagher et al. 2021), a term Giroux (1994) uses to refer to the implicit values, norms and politics embedded in formal instruction and educational experiences. It includes norms of class, gender, race and sexuality, among other things, that shape and limit the terms of students' participation and collaboration, allowing some people to engage, succeed and feel included in higher education more readily.

This discussion shows how digital critical thinking teaching is embedded in broader technological, economic and social milieus that place conditions on students' sociality and interactivity. Values, ideas and subjectivities are circulating within these milieus that constrain the ability of platforms and software to support critical thinking. Stiegler's work (1998, 2015, 2016) allows us to analyse how contemporary digital environments reshape sociability and interactivity in ways that undermine critical thought. This, in turn, suggests how technologies can be used to examine conditions of sociality and interactivity in an open-ended and reflective practice involving students and teachers questioning and making meaning together. The urgency and difficulty of accomplishing this are even greater if one considers Stiegler's account of digitisation technology's capacity to disrupt noetic practices (2014: 64–66, 2016: 114–117).

Suspending Digital Time in Digital Teaching

Critical thinking modulates with a diverse, overlapping and sometimes conflicting collection of digital technologies embedded in political, technical and economic milieus that can impede students' access, reflection and learning. Addressing these obstacles needs to occur from within digital practices that favour unquestioned knowledge transmission, instrumentalism, economic rationalism and reductive subjectivities. In *State of Shock*, Stiegler (2015) discusses how combatting a digital hypercapitalist, instrumental higher education requires a renewal of disciplinary frameworks, textual and archival practices and pedagogical spaces. New ways of externalising and transmitting culture could be created in 'universities of the future' able to intergenerationally communicate standards of knowledge and critically

evaluate the digital conditions of knowledge production, resisting automated industrial education (Stiegler 2015: 160–171).

There is now a considerable body of work examining the relevance of Stiegler's thought to educational philosophy (Bradley and Kennedy 2021; Bradley 2022), with specific attention paid to (post)digital education (Kouppanou 2015; Bojesen 2016; Lewin 2016; Vlieghe 2018; Lindberg 2021; Goetz 2023). Stiegler (2015: 159–164) understands that learning is a mode of becoming of individuals and collectives — processes of individuation and transindividuation — requiring individual learners and groups to make meaning for themselves. Stiegler's (2014, 2015, 2016) view that people and technology are co-constituted with its account of how intellectual processes are shaped by digitisation enables the examination of this circumstance. What can critical thinking teachers contribute to this project working from within the contemporary university? Stiegler's work informs a response to this question through its account of how sociality and interactivity are transformed by digital teaching, offering insight into how local pockets of resistance can be generated.

According to Stiegler (1998: 136–138, 2015: 7, 75, 2016: 19–20), cultural and political modulations occur when our primary external memory techniques change from the written word to computational devices. Earlier technologies of the written word do not simply remain alongside digitisation but are transformed and threatened by it in a comprehensive shift of social and symbolic milieus that transforms our relation to earlier technologies. The pace of digitally automated technologies allows them to outstrip our retention and reflection processes unless their use is devised with care for non-instrumental purposes. Memories produced and preserved by algorithmic and datafied operations overwhelm individuals, disrupting the human processes of reflection, evaluation and memory by removing the temporal space for self-reflective intellectual processes or *noesis* (Stiegler 2016: 114–117).

Established institutions, discourses and processes securing truth and knowledge for collectives are destabilised. Instead of returning through other members of a collective in a process of differentiation and recognition that is individual becoming, mass digital communication becomes highly mimetic and reflexive (Stiegler 2016: 36). Individuals' symbolic meaning-making and reflective processes are disrupted, and they cease to make meaning for themselves and fall into symbolic misery (Stiegler 2014: 1–13). Stiegler (2016: 37–8) refers to social media as exemplary of this disruption of transindividuation by digital tertiary retentions. The digital technical milieu transforms the symbolic milieu so that non-digital pedagogical practices do not simply remain within digital hypercapitalism but are also transformed by it. The problem with the 'program industries' is not capitalism or biopower as such but their disruption of individual and collective capacity to interiorise and desire.

Sociability and interactivity can be reframed through Stiegler's account of how digital techniques can work against intellectual activity. The distinct temporality of digital systems gives them the capacity to outstrip and defy the pace of human attention, reflection and decision, undermining the time of human attention (Stiegler 2014: 64–66, 2016: 114–117). Shutting down noetic practice means that students are prevented from critically reflecting on the material presented to them, rendering them unable to decide what it means to them as individuals, constraining the individuating process. However, individuation is only one side of a twofold process

that includes transindividuation, the becoming of collectives within which individuals individuate (Stiegler 2015: 162–163, 2016: 186–193). In digital disruption of the individual's noetic processes, the formation of collectives, including specific learning groups that harbour student diversity, is also hampered. The subjective and intersubjective conditions of sociality — or other-directedness — are undermined because the processes through which a student becomes a self within a group of others fail to occur.

Similarly, Stiegler's thought can contribute to understanding the interactivity potentially beneficial to critical thinking teaching yet also a mechanical and prejudicial training device. Interactivity is a complex term, but if, in a general sense, it refers to mutual communication between two or more agents (human or machine) mediated by technology, we see that the automation and speed of interactivity in digital systems can eliminate the temporal space for reflection. Mechanical responsiveness is faster than human processes of comprehension and reflection and simply following it does not entail learning. In seeking the benefits of automated guidance and feedback, the *noesis* central to critical thought must be carefully protected and cultivated. Otherwise, interactivity functions as training that transmits information without psychic processes of reflection and incorporation.

For interactivity to support acquiring critical thinking skills that a student can use in other circumstances, including ones of their choice, a temporal space is required so that students can reflect, question and potentially think otherwise. Automatic nudging, suggestion and correction need to be transduced into non-digitally paced temporal space, whether it involves digitisation or otherwise, in which learners reflect on automated processes and make their own meaning of them. This includes subjecting the interactive process itself to critical analysis.

Stiegler's analysis of the digital threat to *noesis* suggests how the teaching of critical thinking can flourish from within proliferating and sometimes encompassing, layered and sometimes conflicting, industrialised digital education techniques. His notion of *otium* can be understood via the French labour practice of intermittence, a time for cultivating skills not for a goal or direct financial gain but for non-financial wealth (Stiegler 2015:167–177, 2016: 68–85). As opposed to *negotium*, purposeful time used for labour and instrumental purposes, *otium* is a non-instrumental temporality. Activities performed intermittently cannot be evaluated by calculation, for example, the immeasurable thinking, dreaming, play and self-reflection that occurs sporadically within an overall length of time when a student deeply reflects on new knowledge. This time allows learners and teachers to consider information at the pace of their own attention, incorporating it into their processes of individuation in addition to the transindividuation of learning groups.

Such a space would, for example, enable a student to incorporate an argument structure learned through AKC so it can be translated to a new situation or to identify and challenge the hidden curriculum present in their digital environment. Structures and framing of digital learning able to support such temporality are discussed in Gallagher and colleagues' (2021) examination of automation and the teacher function, which stresses the importance of transparency (making apparent the different roles of humans, algorithms and code) and pedagogically engaging with questions of visibility and invisibility (datafication and surveillance).

A crucial role for non-instrumental temporality is also identified in Ford's postdigital scholarship in the 'pedagogy of "the not,"' which resists the demand of capitalist, postdigital time (Ford 2019: 105). This suspension of negation — a double negation or negativity — refuses oppositions and 'exposes us to a radical indeterminacy and potentiality that is always untimely' (Ford 2019: 106). Under these circumstances, attention can be given to what could be otherwise in the learning setting, that which is not present (Ford 2019: 111), allowing drives to be attached to objects different from those offered to the student.

Ford formulates the problem of humans' entrapment in the present as an ongoing, constant demand to learn new technologies (2019: 105), while Stiegler emphasises how digital technology's threat to noesis lies in the temporality of their operations (Stiegler 2014: 64–66, 2016: 114–117). This is why the digital milieu is not only a technical milieu but also a symbolic one, differing from the technique of the written word in how it connects beings over distances and transforms processes of receiving and returning speech and writing. Stiegler articulates the danger of an industrial mnemotechnical system displacing the human reflection that allows alternative pathways to be decided on (2014: 1–13, 2015: 167, 204). Noetic reflection requires protection from hypercapitalist digitisation so that meaning can be made, and individuation and alternative collectives might arise. Thus, Stiegler's notion of temporal suspension is slightly different from Ford's, with Stiegler's account of digital technology's temporality emphasising not that students' drives are attached to the wrong object but that they lose the very ability to attach drives to objects.

Within the constraints of the contemporary neoliberal university, *techniques of otium* can inhibit industrialised digital time and allow individuals and groups to create and order meaning.[3] For example, complex and layered digital environments can structure opportunities for shared, ungraded human–human, human–machine interaction that are fundamentally not about acquiring information or skills but supporting curiosity, communication and exploration in learning groups undergoing individuation and transindividuation. Advantage can be taken of the messy collection of digital teaching technologies, so different technologies and their techniques interrupt and overlap each other, checking the automation of digital interactivity by knocking them out of alignment and into an intermittent temporality. The uneven layering and inconsistency of digital technologies can be displayed (teachers and students might observe that it tends to show anyway), so their edges and margins require interrogation and comment aside from their purposeful intent in instances of 'hybrid, local experiments in the transformation of knowledge' (Bradley 2022: 461).

Examples of how digital technologies can cultivate noetic, explorative individual and group practice through layering and interruption in an automated environment are found

[3] The approach adopted here has resonances with Anna Kouppanou's (2015: 1120–1121) point resolving the tension between Stiegler's dual claims that our formation as subjects depends technological conditions and that comprises a framework sustaining an alternative perspective across generation. In the context of schooling, she points out that this tension is addressed at 'a more "regional" level, for example, the educational or digital level … the absence of differance can be challenged through the consideration of other forces (social organization, childhood, care, discreteness) that maintain possibilities for difference'.

in Bayne's research on using a teacherbot in a MOOC, showing that 'teacher automation does not have to be about rationalism and instrumentalism' (2015: 465). Set up in a Twitter feed, the teacherbot sent out reading extracts and study advice, and it was made clear to students that they were engaging with a bot. The bot's availability meant that students could play and interact with it in unstructured times, which functioned as a 'kind of experimental boundary work', engaging with its awkward or marginally useful responses and challenging any straightforward account of its automaticity.

Students tested and experimented with the teacherbot, subsequently writing about their experiences using another digital teaching technique, an online blog. They tweeted questions relating to the social and economic conditions of the teacherbot and figured their way into a social relationship of which the bot was a part. Students discussed terms of participation from both broader social and digital perspectives, with consideration given to what was excluded or marginalised in the learning space. The conditions of the sociality of the interaction became more transparent, and ongoing interaction was interrupted so that its conditions were reflected on and reworked. The exchanges were unscripted and spontaneous, led by the timing and reflection of the students in not directly productive, unscheduled temporal spaces. Students, teachers and machines negotiated and created meaning for themselves as individuals and as a collective co-constituted by the chatbot technology.

Writing of this project and the 2019–2020 'Expanding the Teacher Function' project designed by staff and students to examine the potential of automation in higher education, Gallagher and colleagues describe this kind of learning design as the use of 'provotypes' (provocative prototypes) to provide

> space to create meaning in an emergent context and then to connect meaning to cultural values (River and Mactavish 2017) around teaching. These provotypes begin to capture how technologies 'open up social spaces' (Gromme 2016: 1008) by making available space to respond with alternatives. (2021: 429)

Such an approach fosters the non-instrumental sociality and interactivity required for digital teaching to support critical thinking learning. It emphasises that, in addition to skills and dispositions of analysis, critical pedagogy is crucial to sustaining critical thinking in a digital milieu as 'a critical consciousness of the impact of design and code on enforcing the existing order' (Gallagher et al. 2021: 437).

Conclusion

The promises of digitised teaching critical thinking lie in its potential for sociability (collaboration) and interactivity (collaboration, responsiveness and timelessness of guidance and feedback). Taking advantage of these characteristics requires us to understand the obstacles that digital technologies can present to critical thinking, which asks us to examine these technologies as part of a broader technical, social and psychic milieu from which they cannot be disassociated. Thus understood, we can interrogate the particular forms that sociality and

interactivity take in digital higher education, enabling a response to digital hindrances to critical thinking and specifying techniques to counter them.

Stiegler's account of how digital mnemonic techniques can disrupt noetic processes involved in critical thinking and collective sense-making places temporality at the centre of any such techniques (2014: 64–66, 2016: 114–117), as does Ford's postdigital research (2019). Engaging Stiegler's idea of *otium* (Stiegler 2015:167–177, 2016: 68–85) as a guide for suspending hypercapitalist digital time suggests that layering, interruption and non-instrumental zones can support the non-instrumental reflection required to practice critical thinking. Allowing students to step out of industrial digital time and its constraints on subjectivity and learning, such techniques enable students to deliberate on what ideas and practices mean to them in an individuating process of incorporation and analysis that also comprises the transindividuation of learning groups in a version of a 'postdigital we' — as proposed by Jandrić and Hayes (2020). In this way, digital critical thinking learning overruns the classroom, moving beyond instrumental teaching goals to create and negotiate sociality and interactivity.

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