Re-presencing the digital trace in networked learning design

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Abstract

Recent work in and on networked learning outlines the value in taking a relational view of complex assemblages of people and things such that, for example, non-human entities can be both/either learner and/or teacher. The sociomaterialist perspective brings questions of how power remains continuous yet transformed when the social reach of digital technology is accelerating towards a "tipping point" (Schwab & Malleret 2020). This paper will continue the Freirean work of e-quality set out by networked learning's founders through a transdisciplinary pattern-design learning approach capable of reflexively tracing macro-level technological, scientific, and social constructs and micro-level experience. This will be elaborated through phenomenological hermeneutic design imitative of how we generate or are traced and influenced by digital traces, seeking to 're-presence' (cf. van Loon in Johnson 2020) the digital trace as it plays out across extended systems while making care-ful use of the digital tool. Theory will draw on Ricoeur's work on the trace and Stiegler's concept of the recorded mark. Models of how to re-presence and leave further traces in technology enhanced networked learning design will draw on emergent co-creative knowledge networks also employing care-fully chosen digital tools, including Stiegler's hermeneutic web, community wikis, and digital gardens with the goal to augment that which is "valued in the rest of life" (Goodyear & Retalis 2010).

Keywords

Design thinking, epistemic fluency, systems theory, free software, digital gardening, permacomputing

Networked learning design for the technosocial "tipping point"

Technology-enhanced educational design is not new but it may feel new at a time the World Economic Forum (WEF) has dubbed a "tipping point" in its 2020 report (Schwab & Malleret 2020) which describes how the deterministic world is giving way to a highly interconnected "quantum world". This tipping point, characterized by the increased reach of digital technology (p. 11), is anticipated to accelerate "at alarming speed" (p.26). But despite growing awareness of the urgency of the technosocial problem, no one can agree what the domain of "science, technology and society" even means, if it exists at all, to paraphrase Bruno Latour (1987, p. 16). Work in networked learning that engages the artefacts of multiple knowledge domains (e.g. Marheineke 2016, Fawns 2019) suggests that the design of learning environments can afford to explore this problem while furnishing appropriate tools and artefacts without necessarily being "impossibly complex" (Goodyear, P., Carvalho, L., Dohn, N. 2016, p. 107). Building on that work, this paper will explore Freirean networked course design that is capable of taking a critical approach to the interrelation and management of digital tools, artefacts, and people (Koole and Gulson in Gourlay, L., Rodríguez-Illera, J.L. et al. 2021). This will be achieved through a design pattern learning approach which has a history of transdisciplinary applications (Alexander 1977, Gabriel 1996, Goodyear & Retalis 2010) and illuminates the epistemic potential of the network (Goodyear, Carvalho, Dohn 2016). This design approach can be re-presented in course sub-units to illustrate how tools, artefacts, and people 'play out' – both historically and in the digital knowledge system or cybernetic networks that we are born into today. The traces of networked knowledge systems that are externalized through the tool and the significance and heuristic value of the passage of our existence in our attempt to interpret these "traces" (Ricoeur 1988) are central to the design pattern learning approach presented here. Ricoeur's "trace" will be compared with Stiegler's (2018) concern with the traces of record-keeping mechanisms that are – historically – external to individuals (as exosomatic hypomnesic tertiary retention). The purpose of focusing on the trace is not only to reflect on "authorised" domain knowledge or to include "alien" perspectives from the past (Ricoeur 1988) in order to better understand the present. It is also to consider how to give students experience in re-presencing (van Loon in Johnson 2020) digital traces such that this includes critical analysis of (digital) knowledge tools while using them to manage and co-create sustainable knowledge systems. Such experience has the potential to

promote reflective, actionable decision-making and that which "is most deeply valued in the rest of life" (Goodyear & Retalis 2010, p. 19).

This paper is concerned with the recent attention given to the interrelationship of artefacts, people, tasks, activities, and outcomes, in which non-human agents are understood as learners or teachers with implications in sociocultural, political life (Koole in Gourlay, L., Rodríguez-Illera, J.L. et al. 2021; Goodyear, P., Carvalho, L., Dohn, N. 2016; Markauskaite & Goodyear 2017). Theoretical support for an interrelational approach includes sociomaterialist perspectives (cf. Goodyear, P., Carvalho, L., Dohn, N. 2016, p. 95) such as Actor Networked Theory (Latour 1987), which understands science to be produced through a network in which agents are not just people but also artefacts. Another example is Bernard Stiegler's organology (2018), which is a conjoined analysis of the history and future of physiological, social, and artificial organs. Stiegler's work on organology with Ars Industrialis identifies the trend in neoliberalism to replace social organizations and institutions with technological services which serve a completely speculative economy. Hyper-maladjustment results as the artificial organs constituting the technical system short-circuit psychosomatic and social organizations (Petit 2013). This will be unpacked below in the discussion of 24/7 capitalism though it already suggests the psychic and social significance of technological tools and suggests that careful consideration be made of the tools chosen in course design. Further, given the trend of technology companies to become involved in governance and educational policy networks, "power topologies" are also relevant topics in networked learning (Gulson in Gourlay, L., Rodríguez-Illera, J.L. et al. 2021, p. 340; cf. Fawns 2019, p. 137).

The social imbalance effected through technology has been observed by programmers themselves (e.g. Norvig 2021). Even the WEF 2020 report notes the risk of dystopia as any digital experience can be turned into a "product" designed to monitor and anticipate our behaviour (Schwab & Malleret 2020, p.127).

Inter- and transdisciplinary perspectives are needed at a time when large-scale technological development is to combine hardware, software, biology (cyber-physical systems), and machine-to-machine communication. That and the internet of things (IoT) are integrated not only to increase the automation begun in industrialization but to improve the self-automation of machines capable of diagnosing issues and "predict[ing] our cultural interests" (Schwab & Malleret 2020, pp. 68-9). This can take place through dark patterns that coerce, manipulate, and deceive (Zuboff 2019). These patterns have the potential to lead to social injustice (O'Neil 2016).

One cannot easily avoid being exposed to such influences due to what Cory Doctorow (2021) explains as network effects, switching costs, and interoperability: people remain on software applications (apps) because their friends or colleagues are there. Furthermore, these apps block communication with contacts in other walled gardens, which is to say with other software services that also function as closed ecosystems. Additionally, it can be difficult to download or control material once it has been uploaded to an app or Service as a Software Substitute (SaaSS). Personal computing can be at the mercy of the software providers or service operators, who are also likely to be spying on us (Stallman 2021). Stiegler (2018) posits that the 24/7 digital panopticon of capitalism impedes our ability to dream, want, reflect, and decide by automatically generating a neoliberal technological vision of the future that is ultimately a "*systemic impediment to thinking*" (p. 46). Stiegler (2014a) notes that we are consequently permitted only to consume pre-fabricated symbols, not to contribute to their production (p. 78).

If the above illustrations are already familiar, it is worth asking why, if we know all of this, we permit the use of spyware in the design of our learning environments. One example is the ubiquity of Zoom, which warranted the negative attention of cybersecurity expert Bruce Schneier (2020). Recognition of this problem illustrates the importance of an approach to learning design that improves "design performance while also educating the designer" (Goodyear & Retalis 2010, p. 4) through critical analysis of the digital tools being used. But even education designers who have taken the extra step to maintain full control of the data that they upload, such as by designing their own learning or content management systems (LMS, CMS), are not guaranteed to be free of these problems unless they are able to host the software they use themselves, which comes with a variety of security problems, such as bots designed to attack smaller servers. The alternative, to seek a professional web hosting service, is problematic because many such services also sell (or "share") user data. This is to say that knowledge of users is collected through spying and not made transparent to users. This can be understood as an imbalance.

Networked learning is positioned to address this imbalance due to its roots in Freirean pedagogy. In the update to the Networked Learning Manifesto (Beaty et al. 2002), the authors note the importance of engaging not just

with others but "one's position in the world". Networked learning takes a view that "demands both the nature of the knowledge being developed and identities constructed". It supports "e-quality of opportunity", which is to say the opportunity to co-create knowledge through participatory relational dialogue and critical reflexivity (Beaty et al. 2002). A problem today is that data is being mined from us 24/7 in order to be used to make decisions about us. We are not able to contribute to how it is interpreted nor are we consciously creating it.

Freire writes that every age produces new forms of concealment and bondage and that people will be carried along in the wake of change if they fail to critically perceive what is significant. This can happen if they are unable to use their capacity for reflection to provoke transformative action or self-actionability (cf. Freire 2005a, p.6). This can be illustrated by developing an example from above. Education designers may feel they have freedom of choice over the software they use, but this is illusory where the software is a pre-fabricated service that reduces control over personal computing while spying on users (Stallman 2021). Only free software guarantees user freedom to run, study, and change the software as well as redistribute copies with or without changes (Stallman 2002, p. 121). Freire's work on power and oppression remains relevant. Its place in networked learning demonstrates continuity in the experience that has accumulated in the field albeit through new iterations and formulations on the "surface of change" (cf. Goodyear & Retalis 2010, p. 1), such as any responses to the changing power topologies described above. In Freirean terms (2005b), we ask what types of mutism software services can produce and how, by contrast, to promote "generative themes" in the way students "think about and face the world" (p. 106).

Networked learning engages "heterogeneous digital tools and resources, used in ways that interweave with the other activities of life". These include the "'messy realities' (Selwyn 2010, p. 70) of technology-related practice" (Fawns 2019, p.138). As such, networked learning supports the iterative design of learning environments while furnishing critically-analysed tools and artefacts. A case in point central to this paper is how networked learning has adopted a pattern design approach introduced by architect and design theorist Christopher Alexander (1977) that is also popular among computer scientists (Lea 1994; Gabriel 1996).

The overlapping interest in pattern design thinking that is shared by computer science and networked learning is fruitful on multiple levels. First, it suggests the epistemic potential of networks as design patterns, a capacity that will be returned to in the section on the trace. Learning networks can be patterns because "coherence among the activities helps resolve the learning agenda of the network … As Jones (2004) has pointed out, calling something a network can be seen as bringing the network into being" (Goodyear, Carvalho, Dohn 2016: 93). The strength of the metaphor can be very powerful: "Seeing something as a network necessarily focuses on node-link structures, foregrounding connectivity and topology and backgrounding such things as spatial relations" (Goodyear, Carvalho, Dohn 2016, p. 94). The significance of the metaphor only increases if understood by way of the hermeneutic circle and comprehension of the mimetic disclosure of the world.

The network, as a created, emergent metaphor – or disclosure of the world, requires its 'readers' to actively construct the means by which to receive it (Ricoeur 1991a, pp. 311-12). The explanation and interpretation required in comprehension assist in the appropriation of any distant "alien" concepts (Ricoeur, 1991b, p. 60). The new perspective that emerges through this process gives a person a new capacity to know themselves (Ricoeur 1991a, p. 316). After all, that which is re-presented, through mimesis, is referential of a world that is already there. But mimesis is not just an expression of a world that is already there; it is also a fabrication, construction, creation – as are interpretations of traces when limited to a single moment and place in time. The appeal of Alexander's work is that it centres on patterns of disclosure to the world that are creations unto themselves (Gabriel 1996, p. 93), with an eye for pattern design solutions that are almost mystical in nature (Gabriel 1996).

According to Alexander (1977), pattern design solutions are understood on the micro- and macro-level. On the micro-level (e.g. building a house, or a porch) they involve a specific solution that blends artefact and method together (e.g. "Make small places at the edge of any common room … 6 feet wide and 3 to 6 feet deep" in Goodyear & Retalis 2010, p. 15). An illustration of the macro-level is to view all of the patterns together. For Peter Goodyear and Symeon Retalis (2010), this potentially confusing approach is nevertheless helpful by bringing indefinite extensibility to situations like "creating a new course, or moving a course from face-to-face to blended mode" (p. 17). Goodyear and Retalis consider the value of applying a patterns-based approach to education to lie in the possibility to reuse them in myriad contexts in myriad ways. They note that Alexander's pattern design thinking is explicitly critical of the outcomes of "mechanical" design that squashes and erodes those things that make us human and conclude that:

> *good* TEL [technology-enhanced learning] design is characterized by a commitment to helping people create circumstances in which learning can be experienced as coherent with what is most deeply valued in the rest of life, as a source of pleasure, growth and transformation. (Goodyear & Retalis 2010, p. 19).

This architecturally-inspired approach to TEL illustrates how epistemic constructs can be meaningfully coordinated across knowledge domains as examples of epistemic fluency (Markauskaite & Goodyear 2017, p. 604). This is also illustrated by Richard P. Gabriel's (1996) popularization of Alexander's approach among programmers in a book chapter that had begun as an article entitled "The Bead Game, Rugs, and Beauty". The work references Herman Hesse's novel exploring the pursuit of the synthesis of all knowledge domains. The focus of the article compares Alexander's (1993) work on Turkish carpets with object-oriented systems in programming. Gabriel (1996) writes that "The goal is to build a system which is necessarily made up of other systems" (pp. 94-5). Like in TEL, the advantage of a design pattern approach is the potential for customization and specialization while allowing for reuse. Gabriel describes this potential as a framework: "A *framework* is a system that can be customized, specialized, or extended to provide more specific, more appropriate, or slightly different capabilities" (p. 95).

The use of design patterns in both TEL and programming can itself be visualized as "node-link structures, foregrounding connectivity and topology and backgrounding such things as spatial relations" (Goodyear, Carvalho, Dohn 2016, p. 94). It also effectively uses Alexander's pattern-based approach as a boundary artefact, which, to draw on a work by Marc Marheineke (2016), brings "common ground" to the perspectives of various knowledge domains by crossing boundaries while conveying meaning (p. 82). Boundary artefacts are useful to "innovation communities" which are "characterized by different knowledge domains and special requirements for knowledge transformation" (p.110). Where "sense-making in innovation communities requires aligning mutual mental models and group cognition", innovation communities "must build upon a 'common ground' (Clark, 1996)". This is "established when actors use a joint language," and is "formed with boundary objects into a new, shared ground. … This means members of a community know (implicitly) that they agree upon a set of beliefs" (p. 111).

Common grounding has traces in earlier work in networked learning which mentions the importance of "generic competences", described as the skills employers increasingly seek from employees. These include "literacy, numeracy, communication, foreign language, leadership, teamworking and IT skills" – skills noted to be key to innovation (Goodyear 2001, p. 61). The WEF promotes similar "21st century skills" (Soffel 2016). These require literacy in multiple knowledge domains and can be described in terms of epistemic fluency, which involves "juxtaposing tools and practices and jointly inhabiting a material environment" (Goodwin 2005 cited in Markauskate and Goodyear 2017, p. 61) and "blending" different ways of knowing (Markauskaite and Goodyear 2017, pp. 306–7). Employers value innovation over specialized knowledge which can quickly become obsolete (Goodyear 2001, p. 61).

Course design which seeks to develop context-sensitive blending is also "good" design as it develops the types of skills that can be used to solve the complex sociocultural problems defined as wicked for being ill-defined and extremely tricky to design for (Rittel & Webber 1973). The WEF acknowledges such problems as central to the "great reset", which is "complex, adaptive, fast-paced, and ambiguous" and cannot be understood in linear terms (Schwab & Malleret 2020, p. 18). Course design which integrates blending is "good" because it can function to represent, through mimesis, networks of intersecting knowledge domains as a topic, framework, and experience of course design. This approach has the potential to intensify, magnify and transfigure the signification (Ricoeur 1991a, p. 140) of networks by encouraging participants to face them (cf. Freire 2005b, p. 106) as critics, explainers, interpreters, assemblers, editors, consci(enti)ous tool-users, and creators.

Re-presencing traces

Ricoeur (1988) is interested in the causal relations involved in the series of operations that comprise the passing by of people while they are alive and their particular passing that results in a particular material mark (p. 120).

To follow a trace is to be concerned with its datability while also retracing its trajectory in space over a lapse of successive time (despite whether the trajectory was that linear); to reason by means of causality about the chain of operations constitutive of the action of passing by (p. 120). It is also to be concerned with its public time,

apparent to everyone (p.124). To move from the mark (or artefact) to the thing that made it is to isolate the significance of the causal relation of vestige to passage (p.128). Following a trace means effacing the self before the trace – even though such absorption does not exhaust the relations of successive time between the trace, what it left behind, and the mark in the "here and now" (p. 124). Therefore, to re-presence a trace in the always ongoing present is to allow for new connections, new readings, and new interpretations to be made about the significance of "passing by". This "endless work of distancing and renewing our historical substance" is never finished but must be carried on "with patience" (Ricoeur 1991b, p. 269).

The term re-presence is based on Joost van Loon's (2007) exploration of the problem of representation in ethnography. He asks whether the ethnographer can ever accurately represent their subjects in writing and whether writing can ever adequately represent what is happening (p. 280). Representation is defined as a social and symbolic relationship which "speaks for" – and is "associated with 'speaking for', as in political representation" where a delegate takes the place of a larger collective, "returning [it] to presence" (p. 279). In this respect, it correlates with the problem of power topologies and big data mentioned earlier. Mike Johnson's (2020) consideration of Van Loon's "re-presencing" questions the possibility of garnering more "direct [ethnographic] accounts" through digital technology, specifically mobilage, but also meditates upon the problem of the potential lack of analysis in raw information.

Similarly, Ricoeur (1988) considers the problem of how a trace such as a document needs to be "authorised" by an institution such as the archive, which is where a document is deposited (p. 117) and which ultimately produces, gathers, and conserves the trace. While the ideology of the archive is not above criticism, the "authorisation" that it represents is significant. What we think of as being "authorised" domain knowledge is important to consider when we are dealing with digital traces and networks – which include raw information.

Ricoeur identifies the problem of the work of data banks, computers and information theory where their data is no longer accountable to the dead or "to people of flesh and blood to whom something really happened in the past" (p. 118). Cut off from the significance of the document's function as a trace left by the past, "the datum becomes truly insignificant" (p. 118). While the scientific use of computer data leads to a new kind of research, "this activity constitutes only a long methodological detour destined to lead to an enlargement of our collective memory in its encounter with the monopoly exercised over speech by the powerful and the clerisy" (pp. 118-9). For history, Ricoeur observes, has always been a critique of social narratives and, as such, serves as "a rectification of common memory" (p. 119). Therefore, from a Freirean pedagogical perspective, the pursuit of the trace is of social significance.

The importance of understanding the "mark" of the trace as the sign of a "human activity" is illustrated by the digital knowledge domain (cf. Naur 1992), where one of the problems of legacy software lies in the tacit knowledge possessed by individual or groups of programmers. This means that the concepts that shaped the trace may no longer be available or comprehensible when the people who created it are no more (e.g. Naur 1985). For this reason, Alistair Cockburn (2002) recommends that systems designers use good, or even multiple, metaphors in the documentation in order to "help the next programmer build an adequate theory of the program". The easier it is for a design team to guess about the structure of the software based on the metaphor(s), "the greater the resulting consistency in the final system design" (pp. 239-40).

This is a good description of Ricoeur's (1988) "double allegiance of the trace" (p.120). On the one hand, it involves the empirical, causal "chain of operations constitutive of action of passing by". This takes place in ordinary, universal time. On the other hand, "to return from the mark to the thing that made it", which is to say from the software system design to the existential mental model that created it, "is to isolate, among all the possible causal chains, the ones that also carry the significance belonging to the relationship of the vestige to the passage" (pp. 120-125). This takes place in phenomenological time.

Through the trace, then, historical narrative can "refigure" time: signifying something without making it appear, forming the intersection that results from the overlap of the existential and empirical (p. 125). The challenge is the phenomenological difficulty of reckoning with time through computations inscribed in ordinary time while following the trajectory of the "sought-for object" that left a trace in geometrical space. The significance of the trace consists in the reference "that requires the quasi-instantaneous synthesis of the print left here and now, and the event that occurred" (p.124).

Naur's (1985) illustration of the need for shared mental models – or shared passages – reveals that Ricoeur's (1988) concern for "the problem of what the trace as such signifies" is not just the work of the sociologist (p.

117) or even of the historian who seeks to understand the marks that are "left behind" (p. 119). It is ultimately the work of the philosopher, able to distinguish signs from traces (p. 126) – which is what big data can be said to be confusing. Ricoeur, as seen above, considers big data to cut off the significance of the trace by rejecting its accountability "to people of flesh and blood" (p. 118). Stiegler (2018) takes this critique further by pointing to the problem of how big data, through algorithmic governmentality, outstrips and overtakes the subjective role in producing traces by continuously inciting protentions (or anticipations) (p. 46). Further, the "automated production and exploitation of traces, dispossesses us of the possibility of interpreting our retentions and protentions – both psychic and collective." (p. 47). As will be seen, Stiegler argues for the cultivation and practice of a hermeneutic web which opens up multiple traces of passages and possibility. These can be understood in Ricoeur's (1988) terms to phenomenologically trace passages "from the mark to the thing that made it" (p. 128), revealing the complexity of reconstituting "human activities" (Naur 1992). Networked learning through its engagement of the technology actively leaving traces today is positioned to explicitly address these traces and the tools that inscribe them, which are already always a tacit component of teaching.

What is at issue here is the Freirean problem of power, which Ricoeur (1988) portrays as the "monument in the document" and the "scientific use of big data" dissected from the past (p. 118). Who gets to decide the relation between the fabric of everyday life and its re-presencing?

Stiegler's concern over the trace identifies the problem of technology as a substitute for or supplement to human memory (cf. Plato 1925, p. 275), particularly where memory becomes transgenerational through memory-keeping (hypomnesic) tools or apparatuses that are exterior to ourselves (exosomatic). These exteriorize, conserve, express, or transmit memory – and could be said to operate in Ricoeur's "public time". The scope of these technological apparatuses are bigger than ever before due to the global, networked (reticular), and interactive traceability of 24/7 capitalism (Stiegler 2018, p. 47).

How did we get here? Looking at the bigger picture can induce Freirean mutism imposed by the sheer scale of the systems that now increasingly influence and shape our lives. But like in the tale of Hansel and Gretel, filling pockets with traces can lead to treasure. In the post-knowledge age, we cannot afford to not be meta and bring "the network into being" (Jones in Goodyear, Carvalho, Dohn 2016, p. 93). To do so is to continue the work of 'e-quality' in networked learning (Beaty et al. 2002) and to seek to critically analyse design pattern solutions for the meaningful use and management of technological trends and tools. It is also to acknowledge the need for the ongoing critique of social narratives and the rectification of common memory (Ricoeur 1988, p. 119) by encouraging individual fluency with large-scale networks. One way to do this is to not limit imaginative interactivity and engage the "temple" of "authorized" documents as well as the "forum" where explanation and interpretation is exchanged (Caillet 2008, p. 152).

Re-presencing traces in networked learning design

A pedagogy of traces would involve the explicit re-presencing of the contemporary digital marks and vestiges that threaten the Freirean generational capacity. It would also involve the attempted phenomenological (ongoing re-)tracing of their passages and generation of new marks and vestiges. A pedagogy of traces would, theoretically, allow for simultaneous different levels of learning and interpretations.

To trace the problem of digital memory that is external to ourselves (exosomatic digital tertiary retention), "as we are now being traced when we enter terms in a search engine or send messages" (Stiegler in Goetz 2021), networks can be re-presenced in syllabi that at once trace digital traces while creating an environment for the co-creation of new traces through care-fully chosen digital tools. Networked learning design can position itself to imitate and leverage the structure – or pattern-design – of systems to give experience in producing more of what we want and less of that which is undesirable (Meadows 2008, Goodyear & Retalis 2010, p. 19).

One way to introduce the concept of the trace would be to explore its history in a course sub-unit. It could be pointed out that the pursuit to assemble, organize, relate, and possess learning from different domains is not new. Examples range from Aristotelian classification, to *scala praedicamentalis* (3 CE), to Francis Bacon's *arbor scientiae* (1901 [1605]), to the interest Thomas Jefferson took in them. Jefferson sought to apply this classification of knowledge to a college course of study "to effect the greatest possible good" (1854), further raising the question of which sciences may have become "nugatory", or, of little consequence. It was in that same century that what had until then been viewed as a single tree of knowledge became broken up, branch by branch, with no "common problems" (Latour 1987, p. 17); the tools and practices of knowledge domains united

no longer (e.g. Snow 1959). The 20th-century attempt to establish communication across disciplines, the Macy Conferences, established cybernetics as a discipline, though practitioners disagreed over its implementation. Kurt Lewin (1948, p. 213) and Norbert Wiener (1948, p. 25) argued that the most intractable problems are social ones, which need to be dealt with on their own terms. Nevertheless, cybernetics has origins in bioinformation and includes the scientific study of communication and regulation in biological and social systems (Wiener 1948, 1954; Pias 2003 in Umpleby 2017, p. 6). While Wiener did see automatization as a human aid, this was to augment human capacities (1954; also cf. Engelbart 1962). Similarly, while design theorists like Horst Rittel and Christopher Alexander were influenced by cybernetics (Rith & Dubberly 2007, p. 72; Alexander 1964), their approach was decidedly human-centered. Today, the algorithms used to predict, decide on, and project the outcomes of human problems receive much criticism (e.g O'Neil 2016; Pasquale 2016).

If humans are now being traced by digital tools, networked learning sub-units can also trace knowledge tracing and further give experience in leaving knowledge traces, digital or otherwise. How we organize knowledge, both collectively and in our personal knowledge systems, and through which tools, is significant and applicable as explicit subject matter in a variety of knowledge domains.

Experience in tracing knowledge can be achieved by including at least a few sub-units that relate a subject matter to its history and the history of knowledge and tools used to create or store this knowledge, as suggested in the *arbor scientiae* paragraph above. It can also be achieved by trying to appropriate an "alien" historical perspective and re-presence the ephemeral nature of the trace, such as in Naur's (1985) problem. Consideration of the trace can remind us of our temporal passing (as *memento mori*), as it does in Ricoeur (1988, p. 123). This transient perspective makes it easier to include a prompt inquiring into student values and how they envision the values and heuristics required to leave a meaningful trace in the future. Models of exercises in heuristics can be found in Howard Gardner's Good Project (n.d.) but have also been shown to improve student performance (Kross & Guo 2018, p. 6). Of central importance to this paper is how this meta- and macro-knowledge, or inter- and intra-domain knowledge, is used in pedagogical design that seeks to generate "good" configurations among humans (who are symbol and sign-making and reading organisms), technological tools, and activities.

Third-order cybernetics can help clarify the significance of making macro-level pattern design explicit in learning design. Vladimir Lepskiy (2018) defines third-order cybernetics as a transdisciplinary, post-non-classical cybernetics of self-developing, reflexive-active environments, involving subject-meta-subject relations and the humanistic interpretation of philosophical constructivism (p. 33). Tatjana Medvedeva's work shows how this approach can be extended through multidisciplinary relations and systems theory to think through problems like labour relations. Her "extended systems approach" assumes actors are both members and observers of the labour process, so are not just participants adjusting to changes in the environment but are able to re-conceptualize it (2018a). Such an interrelational model of labour relations "depends on employees"' ability to take advantage of new organizational forms – the networked enterprise and culture and their ability to engage in social learning and self-organization (Medvedeva 2018b, p. 280). This requires that workers be "more aware of the whole process in which they are involved", continually modifying or redesigning the process (Medvedeva 2014). Similarly, students can become more aware of the epistemic processes in which they are involved and from which to gain practice in co-producing signification shared through co-individuation (Stiegler 2018, p. 46).

A different systems view that could be used in networked learning as a point of departure for understanding macro- and meta-design is Castellani's seminal complexity map, which explicitly claims it is not complete and invites interaction and improvement (Castellani & Gerrits 2021). Castellani's map is based on Fritjof Capra's *The web of life: A new synthesis of mind and matter* (1996) – a work which has also found applications in third-order cybernetics (Medvedeva 2018a).

The design principle here explicitly invokes macro- and meta-level awareness to encourage synchronous diversity of content and possible paths of interactivity while honouring "authorised" guiding documentation (c.f. Ricoeur 1988, Caillet in Andler & Guerry 2007). It attempts to give students a birds'-eye view of their place in the world, reminding them of the relational skills and tools they need for the collective production of their own traces. The moment students understand that they are navigating their own lives, knowledge becomes dis-automatized (cf. Stiegler 2018) as they are heuristically applying it to their specific case.

The question is whether a course can give experience in the (dialogic) forum and the ("authorised") temple (c.f. Caillet 2008), encouraging students to take responsibility for following their own traces while interconnecting them through common ground and some understanding of meta, macro, and micro level design.

Models re-presencing digital traces in learning design

Networked learning design for the "wicked problems" (Rittel & Webber 1973) of the highly interconnected "quantum world" requires more than charting out the history of the interrelation of knowledge domains especially given the "accelerated" change of the increasingly digital world (Schwab & Malleret 2020, pp. 11, 26). It requires experience not only in the interpretation, annotation, assembly, categorization, sharing, editing, and reconfiguration of those traces but also in leaving new traces. The latter affords experience in establishing common ground, hybrid thinking, and the potential for different interpretations of the same model. This section will consider models that can be implemented in networked learning design that would encourage such an experience of digital traces. These models are: Stiegler's hermeneutic web, digital gardens, and Rekka Bellum and Devine Lu Linvega's permacomputing knowledge building community. They re-presence the digital trace such that it makes co-creative use of the digital tool while critiquing it.

Stiegler's (2018) MOOC, described in part in "The writing screen" (pp. 172-9), was designed to give students experience in co-creating a "hermeneutic web". Students could submit, create, edit commentary on, and engage with the 'gloss' involved in interpretation in hermeneutic work through employing care-fully designed digital tools (p. 173). The goal of this experience was to uphold the good life (pp. 174-5), which aligns with Goodyear and Retalis' (2010) goals for "good" learning design. Stiegler (2018) notes that the digital screen, as a hypomnesic support or tool for tertiary retention – like the cave wall – can reveal as much as it conceals. Nonetheless, it has the potential to make us dream (p. 175). He created social networks that students could use to develop and exchange interpretations, invented a standardized annotation language, and assembled a hermeneutic community comprising members from different knowledge domains (p. 179). Steigler (2014b) elaborates on how students would annotate their course notes by using the graphic language he invented and then transfer them to a digital platform, "enabling the creation of a common space of interpretation and engagement with works, leading to processes of transindividuation" (p. 10).

In the design of Stiegler's hermeneutic web (2014b), an algorithm was used to analyse convergences and divergences as well as similarities and differences to identify discussion points. Social networking software was designed to allow groups to form and debate and consolidate similarities and differences, etc., into collective memory (secondary retentions). Processes of contributory categorization ensued, focusing on the annotated materials. Pre-categorization was hermeneutically related to how the "life of understanding" allows one to understand and be understood as well as reformulate that which is understood in a different analytical form. The algorithm (otherwise described as automatized thinking) was used to serve the social circuit of (exosomatic) knowledge exteriorized in the MOOC. The circuit was contributory by design – designed, above all, to promote a search for meaning that would lead to transindividuation: individuating all the psychic individuals involved (Stiegler 2018, p. 175). "Good" TEL course design brings experience in the significance of individual traces.

Course design seeking to promote such experience can alternatively draw on the practice of digital gardening. This emerged in the 1990s (Caulfield 2015) but is seeing a resurgence as people try to make meaningful connections online and take ownership of their work and tools by sharing and crafting them on their own terms.

Digital gardening is an example of how the web can be experienced as a (garden) topology. This approach encourages visualization of how we – and others – leave traces across the network of the web, such as when we enter search terms or send a message (Stiegler 2018, p. 176). We map out and navigate the externalization of thought in web searches: "things in the Garden don't collapse to a single set of relations or canonical sequence … Every walk through the garden creates new paths, new meanings" (Caulfield 2015). This can be contrasted with Ted Nelson's (1974) Xanadu Project, in which works cannot be quoted without maintaining a connection to the original. Both the project and garden demonstrate a Ricoeurean interest in the trajectories of traces.

Mike Caulfield (2015) writes that approaching digital networks as if they were part of a digital garden allows one to build out "a network of often conflicting information into a web that can generate insights, iterating it, allowing that to grow into something bigger than a single event, a single narrative, or single meaning". The verbs "link, annotate, change, summarize, copy, and share" are very important to the garden, Caulfield writes. Mark Bernstein in his 1998 essay "Hypertext Gardens" further asks: "How can the craft of hypertext invite readers to stay, to explore, and to reflect?" Digital gardening, or the cultivation of personal knowledge systems, can be understood as fertile ground to promote the interpretative and creative skills associated with the trace. Vannever Bush (1945) describes recording (hypomnesic) traces through the use of a machine he invented called the Memex. He describes tying texts together, "building a trail of many items", inserting comments, branching

off, and longhand analysis culminating in “a trail of his interest through the maze of materials available to him”. This can be compared to the design of an annotated participatory hermeneutic web

In digital gardening, the web is a tool for thought (Matuschak & Nielsen 2019) and a tool to think with (Caulfield 2015). The history of this approach can be found in the work of Douglas Engelbart (1962), who saw computing as a way to augment intelligence. An understanding of augmentation can be deepened through a sociomaterialist approach. For example, organological analysis – involving tools and social organization – can be related to the organizational forms of third-order cybernetics described earlier. This would bring awareness of ongoing processes and make potential redesign by participants at once more comprehensible and complex.

“Good” networked learning design can bring experience in using digital tools while reflecting on or critiquing their use. This can be achieved through students creating, interlinking, and commenting on their own critically-assessed digital gardens which in turn link to, annotate, change, etc. “authorised” course material, such as on a wiki-inspired free-software CMS (Goetz 2021). However, a more elaborate wiki model – similarly interlinking a wiki with the forum of a knowledge-building community explicitly using critically-assessed software, but also including so much more, can be found in Bellum and Linvega’s (2006-) “digital playground and personal logging system”. Their wiki, XXIIVV, branches into community dialogue through links to its forum-like Mastadon channel, Merveilles: a “community project aimed at the establishment of new ways of speaking, seeing and organizing information”, but also its webring and associated search engine, Lieu.

The wiki, which is regularly updated and edited, is additionally available as a download. This was formerly hosted on GitHub, which controversially allowed the artificial intelligence tool Copilot to be trained on the code it stored and tracked changes on. The sourcecode was moved to SourceHut. XXIIVV assembles topics and pages as diverse as the End Of Work, Language, Ethics, and Nomadism, questions the need for full colour palettes on web pages given the ubiquity of bloat, and supports going slow and fixing things. The latter can be contrasted with the “velocity”, “alarming speed” “on steroids” anticipated by the WEF (Schwab & Malleret 2020, pp. 3-22). The Solarpunk page considers “sustainability, longevity, and balance with an emphasis on renewable energy” as well as deep ecology, regenerative stability, and permacomputing, drawing on work by Heikkilä (2020) that has been featured on Hacker News and lobste.rs, two popular social news websites on computer science. The Permacomputing page acknowledges the “abundance of digital storage and processing power has caused an explosion in wastefulness, which shows in things like ridiculous hardware requirements for computing even the most trivial tasks”. It asks how to “give computers a meaningful and sustainable place in a human civilization that has a meaningful and sustainable place in the planetary biosphere” – a question relevant to networked learning course designers. Their work demonstrates an awareness of consequences that can affect decision-making, which Stiegler (2018, p. 46) claims to be impeded at present.

Networked learning has never been a proponent of passive learning but the question addressed in this paper is how its design can engage with the dark patterns of contemporary digital design such that students can gain experience in re-presencing digital traces in a “good” way and understand common ground, hybrid thinking, and multiple interpretations and reconfigurations of the transdisciplinary digital trace. This would help in the development of individual and shared skills that could be used to solve the wicked problems (Rittel & Webber 1973) that are characteristic of the sociotechnological “tipping point” (Schwab & Malleret 2020, p. 11).

Conclusion

Large-scale technological development and the accompanying power topologies of technosocial networks threaten to make mute the ongoing work of the critique of social narrative and the rectification of common, now also digital, memory (Schwab & Malleret 2020, Gourlay, L., Rodríguez-Illera, J.L. et al. 2021, Freire 2005b, Ricoeur 1988). But networked learning has experience in the interrelation and management of digital tools, artefacts, people and other activities of life (Fawns 2019) as well as in cultivating the Freirean concern for reflective, participatory e-quality (Beaty et al. 2010). The significance of this pedagogical foundation can be seen in its overlap with socio-technological-scientific approaches involving artificial, physiological, and social organization (Stiegler 2018, Latour 1987), which are capable of addressing the transdiciplinary reach of technological networks and suggestive of further iterations of networked learning design. The networked learning design explored in this paper drew on Christopher Alexander’s (1977) pattern design solutions, which itself has transdisciplinary applications in architecture, software design (Lea 1994; Gabriel 1996), and pedagogy (Goodyear & Retalis 2010). The appeal of pattern design thinking is its applicability and extensibility on both the macro and micro levels. This paper suggests a pattern design approach that re-presences “traces” of the exteriorized record (Stiegler 2018) of digital information systems like those children are born into today. A

focus on traces affords the critique of "authorised" domain knowledge and demonstrates the difficulties involved in reconstituting (Ricoeur 1988, Naur 1985) and re-presencing (van Loon in Johnson 2020) digital traces. By re-presencing is meant returning them to presence in such a way that does not exercise a monopoly over what they mean. This may be contrasted with the trend to use digital technology as a powerful record-keeping tool used to influence behaviour (Zuboff 2019), not accountable to "people of the flesh" (Ricoeur 1988). A macro and meta view of tools that reveals their outcomes, or more experienced heuristics in selecting digital tools for use, can bring new perspectives. The potential for design thinking to generate constructive change was illustrated through third-order cybernetics (Medvedeva 2018), which discourages the vantage point of the passive observer adjusting to change and encourages the vantage point of participants able to progressively re-conceptualize a milieu (Stiegler 2018). Networked learning design can establish common ground (Marheineke 2016), hybrid thinking, and the potential for different interpretations of the digital trace by "blending" different ways of knowing (Markauskaite & Goodyear 2017). This can promote the type of innovation sought in the workplace (Goodyear 2001). Innovative learning design models that conscientiously re-presence digital traces and the tools used to generate them were illustrated through Stiegler's hermeneutic web (2018), digital gardens (Caulfield 2015), and Linvega and Bellum's (2006-) permacomputing, lifestyle, and knowledge-building wiki and community. Such complex assemblages of people, tools, activities, and outcomes model how to think through the "wicked problems" (Rittel & Webber 1973) characteristic of the highly interconnected digital world. They also teach how to safeguard the individuation of all involved and to value that which is valued in the rest of life (Stiegler 2018, Goodyear & Retalis 2010).

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Acknowledgement:
With thanks for Mike Johnson's digital input and support, which left a trace in this paper.