Postdigital Science and Education (2024) 6:194–210
https://doi.org/10.1007/s42438-023-00425-5

ORIGINAL ARTICLES

Co-design as a Networked Approach to Designing Educational Futures

Dewa Wardak[1] · **Stephanie Wilson**[1] · **Sandris Zeivots**[1]

Accepted: 4 September 2023 / Published online: 15 September 2023

Abstract

Design is a contested term, and this has implications for designing educational futures. Described through five senses to elucidate its complexity, design can be conceptualised as domain, as process, as plan, as the resulting product, and as the intentional creation of new possibilities. In this paper, we use the five design senses to illustrate how they could be useful for making sense of a large, complex, and multifaceted educational project. We define the design senses as a network of socio-material entanglements and illustrate how actor-network theory can be useful in unpacking this network. Taking a postdigital perspective, we illustrate that in designing for learning in higher education, the relationships between the five senses are fluid, constantly shifting, and emergent in a network of human and non-human actants. We argue that design research needs to move beyond cognitive approaches to the study of collaborative approaches that empower participants. In doing so, our study proposes a co-design approach to designing educational futures where multidisciplinary teams connect their knowledge, skills, and resources to carry out a design task. We present three mini-cases from our co-design project to illustrate how the five senses of design can be used to unpack and untangle the web of complex relationships in co-design. Furthermore, we reflect on the shifting role of educational developers as they lead and participate in co-design teams. We conclude by problematising educational design for designing educational futures in a postdigital world.

Keywords Co-design · Design senses · Postdigital design · Network · Educational design · Actor-network theory

✉ Dewa Wardak
dewa.wardak@sydney.edu.au

[1] Business Co-Design, The University of Sydney Business School, The University of Sydney, Sydney, Australia

Introduction

Abegglen et al. (2023) argue for a re-imagination of higher education where collaboration is added as a defining element and an important and measurable educational outcome. The authors argue that higher education is 'not autochthonous' but instead is designed and has 'been designed over time' (2023: 1). Design however is a contested term, and this has implications for the future of educational design (Macgilchrist et al. 2023). What do we mean by design? Who is a designer and what skills are needed to participate as a designer in designing the future of education?

When illustrating the multiple levels and complexities of design, Heskett presented what he called a 'seemingly nonsensical sentence: Design is to design a design to produce a design' (Heskett 2002: 5). However, every use of the word design in this sentence is grammatically correct. In addition, each use indicates a different sense of design. Dohn and Hansen (2018) use these different senses of design to articulate the complexities of design and to clarify the different conceptions of design within education. The authors developed Heskett's sentence further to describe the five senses of design 'as domain, as process, as plan, as product and as the creation of learning possibilities through the realisation of a conscious intention' (2018: 29). Taking a postdigital perspective, we illustrate that in designing for learning in higher education, the relationships between the five senses are fluid, constantly shifting, and emergent in a network of human and non-human actants. From this perspective, we do not take technology for granted (Matthews 2019). On the contrary, we are tracing its role through a network of relationships within a large educational strategic project at the University of Sydney Business School.

In this study, we use the five different design senses to illustrate how they can be useful for making sense of a large, complex, and multifaceted educational project. We define the design senses as a network of socio-material entanglements and illustrate how actor-network theory (ANT) can be useful in unpacking this network. Furthermore, we argue that design research needs to move beyond cognitive approaches where researchers study a designer's thought process (Lawson 2005), to the study of collaborative approaches that involve participants. In doing so, our study proposes a co-design approach to designing educational futures as 'a practice where people collaborate or connect their knowledge, skills and resources in order to carry out a design task' (Zamenopoulos and Alexiou 2018: 10). We provide a concrete educational design case analysing the socio-material entanglements in our co-design project. Through this process, we foreground the roles of the educational designer and how they play out in the co-design process.

In this paper, we elucidate the complexity of design to untangle its many senses in a network of relationships by exploring three co-design mini-cases. Our research question is, what is the role of co-design in a networked approach to designing educational futures?

Co-design in our context signifies a mindset as well as a methodology with distinct principles and practices (Manzini 2015). We adhere to the principles of active and collaborative participation of stakeholders, which aims to build

capacity and empower participants. We value the skills, knowledges, and lived experiences of stakeholders who may not necessarily be trained as designers (Steen et al. 2011). In our design work, relationship-building is prioritised, and as a result, decision-making is decentralised, which challenges power and hierarchy (Cantore 2018). In our experience, co-design promotes stakeholder buy-in and enhances the sustainability of educational outcomes (Zeivots et al. 2023).

Below, we first conceptualise design in a postdigital sense. We then explain how we utilise the five senses of design as an analytical framework to untangle the complex relationships in our chosen educational design context. We describe our process of active collaborative analysis of the networks and actions involved in our cases and propose ANT as a useful tool for untangling the human and non-human elements in the network of the five senses of design. Following this, we describe our context of co-design and the multidisciplinary team working on a large educational innovation project. We then present three mini-cases from our project to illustrate how the five senses of design can be used to unpack and untangle the web of complex relationships in co-design. We conclude by problematising educational design for designing educational futures in a postdigital world.

Design in a Postdigital Networked World

According to Latour (2008), design has been expanded to cities, landscapes, nations, bodies, and genes. Hence, the meaning of the word design has grown in two ways: comprehension and extension. As for comprehension, design encompasses more elements of what a thing is. To say that design has grown in extension means that design is applicable to large assemblages of production. In other words, there are a lot of things that can be designed, not just luxury products. This means we need to change the way we deal with objects and action (Latour 2008).

For Latour (2008), objects are akin to matters of fact, which are hegemonic claims that close down debates on alternatives. More broadly, claims to matters of fact are often done for political reasons, to resist enquiry, to deny the multiplicity of views, and to put forward one viable solution to a complex problem. Matters of concern on the other hand invite debate and discussion around uncertainties. No matter of fact is indisputable. This perspective helps us acknowledge and deal with complexity and entangled relationships. Matters of concern are no longer objects but gatherings and assemblages. According to Latour, '[t]he more objects are turned into things – that is, the more matters of facts are turned into matters of concern – the more they are rendered into objects of design' (2008: 2).

This brings us to how we conceptualise design in a postdigital sense. Drawing on Latour's (2008) five benefits of design, we agree that design never starts from scratch. There is no absolute beginning or starting point for design. When this is the case, design implies a kind of humility as it does not claim a breaking with the past, conquering, establishing, or colonising. Design is not about a radical change but a careful attention to details. In this process 'things are no longer "made" or "fabricated", but rather carefully "designed" [or] precautionarily designed' (Latour 2008: 4). The implication of this careful process is that the object of design is always open to interpretation as it

carries the meaning, symbolic or otherwise, that tells a story about the designer(s), the tools, skills, and intentions. When objects are designed, they are open to value judgements. In other words, designs can be good or bad, and as such, designed objects are no longer taken as matters of fact. In this sense, they are conceived as things rather than objects. All this lends itself to the conclusion that all designs have an ethical dimension (Latour 2008). Designers have a responsibility to the social and natural. Designers do not simply draw conclusions from matters of fact; their designs can make things better or worse. Within these conceptual boundaries, we utilise the five senses of design as an analytical framework to untangle the complex web of relationships in our educational design project.

Design as domain is the general concept of the field. We argue that, in education, *design should always be co-design*. This is because 'all designs are "collaborative" designs – even if in some cases the "collaborators" are not all visible, welcomed or willing' (Latour 2008: 6). Design as process is the act of giving form to something and design as plan is the form to be given (Dohn and Hansen 2018). The plan is often in the form of a drawing or a prototype. Design as the resulting product is the final realisation of design, which can have a material, conceptual, or abstract form (Heskett 2002). We contend that in educational design, the resulting product is never final. We acknowledge the role of the teacher as a knowledgeable actor (Goodyear and Dimitriadis 2013) and what students actually do and how they interpret the learning tasks may differ considerably from the initial design (Goodyear et al. 2021). In other words, '[g]ood design acknowledges the fact that redesign is the norm, not the exception' (Goodyear and Dimitriadis 2013: 11). Lastly, design as the intentional creation of new possibilities is the conscious realisation of certain aims. This fifth sense brings together the other senses as the '*intentional creation* of new possibilities takes place through a *process* articulating the conscious intention into a *plan* which is then realised in a *resulting product*' (Dohn and Hansen 2018: 27) (emphases in original).

In this paper, we illustrate that the relationship between the five design senses is not linear and involves back-and-forth movement from one sense to another. On this, we are in agreement with Dohn and Hansen (2018) who acknowledged that even after a blueprint plan has been produced, the process of negotiation with stakeholders can lead to further changes before a final realisation of design is initiated. Dohn and Hansen state that in practice, the senses are not easily separated. We agree and, in response, suggest that the five senses should be framed as a network, and the relationship amongst them analysed in terms of the entanglement of human and non-human actors impacting the realisation of educational designs. Conceptualising the five senses as a network is a methodological stance that allows us to illustrate the entanglement of tools, skills, roles, and relationships in our large educational co-design project.

Active Collaborative Analysis of the Network

Researchers of science and technology studies have written extensively on ANT. Initially developed by French sociologists Bruno Latour and Michel Callon in the 1980s (Callon and Latour 1981), ANT has since been applied in various fields including education (Fenwick and Edwards 2010). Storni et al. (2015) believe

that ANT can help us 'further "unpack" the co- in co-design' (2015: 149). The authors are critical of the role of designer as 'hero' and reject the designer and user dichotomy. They view 'ANT as a means of rethinking collaborative design practices towards a design democracy' (2015: 149).

Here, we discuss how ANT can be used to untangle the web of relations in a heterogeneous network comprised of human and non-human elements. It proved to be a helpful methodological tool that enabled us to explore what material practices were involved in the network of the five design senses in our co-design practice. In other words, we used ANT as a holistic approach to exploring the entangled relationships in how educational co-design happens. Our approach was inspired by Latour's (2007) conceptualisation that '[n]etwork is a concept, not a thing out there. It is a tool to help describe something, not what is being described' (2007: 131). When an entity is considered a network, we can trace all its attributes and its relationships, and thus, it becomes describable (Latour 2011). Following this approach allowed us to conceptualise the five senses of design as a network to analyse how action is distributed throughout the senses.

We began the analysis of each mini-case by mapping out all the design actions involved against the five senses of design on a Miro board. For analytical purposes, we identified an action that could be held as the starting point from where we traced further actions. This action was of consequence to the design, one that could be said to have initiated a process or one that changed the direction of design. Our discussion at this stage involved merely tracing the traceable actions across many project documents, including internal reports, plans, evaluation results, meeting notes, and team workshop artefacts. In the next stage, we identified the human and non-human elements involved in each action. This mapping of actions and actors facilitated the discernment of matters of concern. In other words, it was in the process of 'making things public' through the visualisation (Latour and Weibel 2005), that we noticed the matters of concern. Our active collaborative analysis of the co-design networks can be described as a form of 'actor-networking' (Storni 2015), through which we mapped the matters of concern in an open and visible approach. While the collaborative analysis process facilitated the generation of greater insights and helped reduced researcher bias, it also introduced some challenges such as negotiating shared understanding when coding the data and assigning actions to the five senses of design.

To analyse socio-material entanglements, ANT was applied to three mini-cases within our broader project. While these cases are discussed separately below, they are themselves entangled. The first example examines the network around a multi-stakeholder workshop that is often conducted at the outset of large course development projects. The second explores the development of a Learning Management System (LMS) template to foster active learning, consistency in the student experience, and sustainability in large courses, and the third focuses on the development of educational design patterns to share and disseminate the work of the co-design project. These cases were chosen as they allow us to compare different facets of design across the project and because collectively, they involve the full range of stakeholders involved in the project. Each case has the potential to offer unique insights and perspectives on the interplay

of the five design senses and how they appear as a network of human and non-human actants.

Our Co-design Context

Co-design in education is 'a highly-facilitated, team-based process in which teachers, researchers, and developers work together in defined roles to design an educational innovation, realise the design in one or more prototypes, and evaluate each prototype's significance for addressing a concrete educational need' (Roschelle et al. 2006: 606). We, the authors, are educational developers working with the multidisciplinary Business Co-Design team on a strategic project called connected learning at scale (CLaS). In the CLaS project, the definition of co-design is extended to encompass a broader range of actors including students, alumni, industry, learning designers, media producers, and other professionals involved in supporting educational practice (Wilson et al. 2021).

In the CLaS project, co-design teams move through an iterative design cycle involving five phases: explore/ideate, plan/design, build/test, implement/observe, and reflect/evaluate. Development begins with a *Connect:In* workshop involving key stakeholders where possible. The collection of evaluation data is embedded throughout the course development process. This includes conducting surveys, interviews, and focus groups with key stakeholders.

The roles carried out by educational developers in the CLaS project mirror new and emerging roles identified in research on design practice more broadly. Designing with others and leading co-design teams have seen educational developers assuming new roles that require a unique set of skills. Educational developers working on the CLaS project for example have assumed roles such as mediator between stakeholders, visualiser of intangibles, navigator of complexity, negotiator of value, co-creator, capacity builder, and generator of new design knowledge (roles identified in Inns 2010; and Wilson and Zamberlan 2015). Our study further extends existing research through the identification of additional roles tied to the relational aspects of educational co-design such as relationship builder and custodian of collective ideas. Educational developers also need to be able to read and respond to the broader 'ecology' involved in the design process. That is, to be mindful of how designs evolve as they intersect with different mediums and people over time, and to respond appropriately as needed. Educational developers in each of these design roles pull different levers, which rely on building trust and clear communication of shared goals. We have discussed some of these aspects elsewhere (Zeivots et al. 2023). The analytical approach used in this study to examine the networks involved in aspects of our design work was effective in helping us 'tune in' to this ecology. Throughout this paper, such roles are highlighted and explained in our analysis.

Connect:In Workshops

The *Connect:In* workshop is an intentional and structured initiative that was developed to bring together diverse stakeholders as part of a course development process in the CLaS project (Zeivots et al. 2023). Workshop participants might

include teachers, students, alumni, industry representatives, learning designers, and educational developers (who also act as facilitators). Its primary purpose is to achieve an inclusive design through collaboration with these stakeholders who bring their own experiences, ideas, processes, and educational values. While the workshop is typically run at the beginning of the development project, it can also be run at the start of a new phase of the project. We view the *Connect:In* workshop as an anchor that generates conversations, ideas, and artefacts that are used to seed the future work of the project.

We as educational developers have facilitated *Connect:In* workshops in in-person, online, and hybrid modes and used a variety of visualising tools to capture the outputs as traces for future work. In the workshops, stakeholders have the opportunity to 'look back to look forward'. Looking back may include reflecting on past experiences or engaging with data, while looking forward may involve engaging in blue-sky thinking activities, considering strategies to address issues, and sketching potential design ideas (sense 2). When implemented effectively, these workshops can provide a solid foundation for the development of innovative, sustainable, and inclusive educational designs.

The analysis of the network involved in the *Connect:In* workshop across the five senses revealed a multilayered story. The workshops, which are integral to and framed by the broader collaborative development process can be viewed as being driven by the domain of co-design (sense 1). The workshops can also be described as both a process and a plan. That is, the workshops reflect a design process to generate design ideas amongst diverse stakeholders (sense 2). Through this process, the workshops produce design artefacts and outputs that then serve as plans (sense 3) for the broader, ongoing design and development process. The educational developers facilitating these workshops are responsible for carrying the ideas and plans generated in the workshop into the subsequent stages of the design process. In this way, they have a role as custodians of these collective ideas which form the foundations of what is valued by stakeholders. These ideas need to continue 'living' through the project in very real ways. Audio recordings of wrap-up discussion, visual artefacts, workshop evaluation data, and educational developers' reflections on the workshops all assist in carrying valuable input forward. After numerous workshops were run in different contexts as part of the CLaS project, the educational developers in the team developed a formal *Connect:In* design pattern. This pattern can be seen as a design product to be reused by others (sense 4). It is acknowledged that the design pattern 'product' has evolved over time to accommodate the needs of specific development projects and stakeholders, including incorporating more flexibility in terms of the timepoints at which the workshop is run during the development process.

Communicating design ideas with diverse stakeholders during the workshops relied heavily on visualisation, or on 'making things public' (Latour and Weibel 2005). This approach supported us as facilitators of thinking to engage the different stakeholders in a collective process of building a common understanding (sense 1). As visualisers of intangibles by making things public in the *Connect:In* workshops, we were able to engage stakeholders in sustained participation (sense 2) while also facilitating and capturing emerging design ideas for future use (sense 3). During the workshops, the participants created a variety of

visualisations such as linked post-it notes, graphs, charts, and tables using paper and whiteboards, including digital whiteboards (senses 2 and 3). These visualisations helped make transparent the complex relationship between different elements including learning outcomes, assessments, and course content. In addition, they facilitated sense-making and reflection, which are necessary for moving from discussing matters of fact to matters of concern (Schoffelen et al. 2015). Making things public also necessitated the making of space where things were made public (Latour and Weibel 2005). *Connect:In* workshops were designed to be informal (sense 5). Coffee and light snacks were provided for the in-person participants to encourage interaction and the forming of personal connections.

While the primary purpose of the visualisations that were used in and emerged from the workshops was to support the design process (sense 2) and to capture ideas for the course design (sense 3), they also became the resulting product (sense 4) of the workshops. Some of the design ideas captured from the workshops were later used as part of collective resources (senses 4) that were shared with the broader team and used in the design of other courses. In a co-design team, the focus of design moves constantly and often becomes open-ended. From an analytical perspective, the visualisations had a dual purpose. On the one hand, making things public supported the design process (sense 2) during the workshops, and on the other hand, it revealed the complexity of design and the entanglement of human and non-human elements which are often taken for granted in educational design.

The *Connect:In* workshop processes (sense 2) prioritised shared experience (sense 5). The workshop was a relational point of connections that captured and consolidated shared experience, which both shaped and was shaped by co-design. Although co-design is a risky process involving people who have not worked together before, the *Connect:In* workshop provided a neutral and inclusive space for stakeholders, particularly students and academic staff, to contribute their experiences and express themselves. These types of interactions offered opportunities to capture less visible voices and perspectives, which is at the core of successful co-design (sense 1). In implementing the *Connect:In* workshops, specific attention was given to the creation of inclusive spaces tailored to the unique needs, stakeholders, and objectives of each workshop. Strategies included not only discussions about the role of co-design and its impact on bringing diverse stakeholder voices together, but also understanding the benefits to educational development from integrating these different perspectives. The workshops were structured yet maintained flexibility, allowing for adaptations that resonated with stakeholders' needs and curiosities. The facilitators frequently prioritised a responsive approach, demonstrating a willingness to follow the direction and needs expressed by stakeholders. The focus on inclusivity aligned with the workshops' underlying philosophy, which emphasised collaboration, voice equality, and a collective contribution to the design process.

In addition, the language and tone used in *Connect:In* workshops played a crucial role in shaping shared experience. For example, the language the facilitator employed to discuss the workshop plan (sense 3) and to invite participants to engage and produce artefacts shaped the nature of the activities and overall stakeholder experience, which impacted the workshop process (sense 2) and captured outputs (sense 4). These conversations were often foregrounded by open, inviting, and future-looking enquiries, which fostered a diversity of viewpoints and prioritised ideation. Although there was a tension

between blue sky thinking and structured activities, language and prompts used by facilitators established a creative space for sharing and collaboration. The facilitator's role was critical in considering ways of capturing the shared experience respectfully as data for subsequent course development.

Canvas Templates

Canvas is an LMS that is used in our university. We saw a massive adoption and more extensive use of the LMS in higher education during the pandemic when educators scrambled to pivot to online teaching. However, it seems that the use of the LMS in higher education is still growing, despite many universities around the world reverting to in-person teaching and learning. According to a report by future market insights released in May 2022, the global LMS market share is anticipated to reach US$98.5 billion in 2032, from US$18.8 billion in 2022. This staggering growth is attributed to several factors, including initiatives geared towards the continued digitalisation of education.

A Canvas template is a course shell that is often pre-formatted and pre-populated with structures that house modules, pages, and assignments. Educators can import a template into their Canvas courses and then add their own course content to those pre-built pages and modules. A template can be created by the LMS provider organisation, or it can be built in-house for specific purposes. For an educator, the template is often a final product of a design process, which they are not part of. It represents a black box that is often immutable. We are exploring the material aspects of co-designing the template, which include human labour, skills, roles, and responsibilities. This is often hidden when technology is taken for granted or when technology is 'viewed as something beneficially intangible, and able to bypass many of the limitations of physical, embodied reality' (Knox 2019: 365).

In 2019, our team decided to build a new Canvas template that was initially offered to the courses we were working with. Our analysis of how the template was designed using the five senses uncovered the dynamic backstories which formed an entanglement of people, artefacts, skills, and relationships. We begin the story with the intentional design decision that initiated the process. This is an analytical choice as we acknowledge that design never starts from scratch and so 'to design is always to *redesign*' (Latour 2008: 5). The decision was initiated by a discussion around the redundancy of some of the features in the old template (sense 5). The new template was planned to be rolled out to the entire faculty (sense 4). Digital learning designers, who are the members of the Business Co-Design team and mediators between stakeholders, began reviewing previous template designs to distil the core of functionalities that would be needed by the educators (sense 2). The design process at this stage was targeted at the educators and their needs (sense 5). The initial design plans included several mock-up versions (sense 3) created by the learning designers and sent to specific members of the team for feedback (sense 1).

One of the challenges faced by many co-design initiatives is communicating within a multidisciplinary team. Galle (2002) acknowledges that multidisciplinary design teams often do not have a shared language, and instead, they use a limited

language of negotiation using sketches, bar charts, mock-ups, and acronyms. We argue that visualising ideas is a powerful means of communicating design ideas. Our template mock-ups moved fluently and frequently between the design senses from a design plan (sense 3) that resulted from an intentional design decision (sense 5), to facilitating the design process (sense 2) in a co-design team (sense 1).

Many of the mock-ups (sense 3) were used during all-team workshops (sense 2) where decisions were made about the main elements and about the visual features of the template. Surprisingly, it was not difficult to come to a consensus about the main elements of the template in terms of what features it should include. The discussion about what the template would look like however was a contentious one (senses 2 and 4). The template would represent the team and eventually the faculty (sense 5). We wanted students to differentiate between the courses designed by us and those designed by other faculties and schools (sense 4). In other words, the template would become our identity, and the role of the designers as the negotiator of values was vital in guiding this process (senses 1 and 2). Our design decisions however had to comply with the university's visual identity guidelines, which are in place to ensure consistency and cohesiveness of communication with diverse audiences (sense 5). Although this was a restriction on our design choices, it provided some structure when working with diverse stakeholders in a co-design team (sense 1).

As drivers and translators of innovation working with limiting technologies, our design strategy is focused on enhancing learning and teaching at scale (sense 5), which impacts our design decisions (sense 2). Canvas allows us to provide a consistent experience to a large number of students in terms of content and assessment (sense 4). However, as is the case with most legacy systems, current LMSs have limitations because they are fundamentally built on a linear system of content organisation. Modules are sequentially organised, and pages follow other pages. Platforms such as Canvas are built by big tech companies, and their use and customisation are shaped by entangled socio-technical practices local to educational contexts (Knox 2019). For example, one member of the team initiated the design of a non-linear navigation system (sense 4). Each online module in the course contained between five and seven content pages that could be accessed in any order. The navigation was colour-coded and used textual signposting to show how the topics were related to each other. The main purpose of the navigation was to give students agency in how they engaged with their learning material (sense 5). This navigation system was initially embedded in a large undergraduate core course with over 1000 students (sense 4). As navigators of complexity working with the course coordinators and students (sense 1), the educational developers identified several issues, which invited a redesign of the template (sense 2). Most students were not moving through the content in a non-linear way. The main reason for this was students' navigation habits. They were used to approaching their learning content in a linear way because all their other courses presented the content this way and students expected the content to build on each other. Another reason was related to the flow of content. It was easier to monitor progress when starting from the first page and finishing with the last, to avoid missing any parts.

To challenge these structures, we need to break the normative habits students have developed through engaging with restrictive tools and technologies. The material

boundaries of these tools dictate how they are used from books (both paper and digital) to legacy systems dependent on limiting software and hardware specifications. The assumptions that come with these habits influence student agency and how they approach learning, remaining consumers of knowledge rather than contributors.

The final design of the template emerged from the distributed co-design activities entangled with socio-material practices, shaped by technology limitations, guided by organisational policies, and embedded within local individual and team practices.

Design Patterns

Educational design patterns are intended to capture and share solutions to educational problems based on common challenges. Design patterns originated in the field of architecture and have since been developed and applied in a range of disciplines including software engineering, information systems, and education. In architecture, an example of a design pattern is the 'Entrance Transition' pattern, which emphasises the importance of creating a gradual and welcoming transition from a public to a private realm, for example from the street to inside a house (Alexander et al. 1977). An example of an educational design pattern from the CLaS project is 'Wayfinding', which emphasises the importance of helping students find their way around online content in large courses.

In the CLaS project, design patterns were considered an appropriate way of sharing solutions to common problems of scale in learning and teaching, and their development became a sub-project led by a group of educational developers (sense 5). A core goal of the CLaS project is to share outcomes across the University, and more broadly with the educational sector. As the purpose of creating design patterns is to provide 'the teacher-designer with a comprehensive set of design ideas' and provide them 'in a structured way' (Goodyear 2004: 341), they were considered an appropriate way to disseminate our learning from the project (sense 4) and invite the broader community to both engage with and contribute to the shaping of the patterns over time (sense 2): https://clasdesignpatterns.com.

An analysis of the network involved in the development of the CLaS design patterns revealed the entanglement of and movement through the design senses in a number of ways. The particular context in which the patterns were developed can be seen as influencing the shape and shaping of the design patterns across the senses. For example, the co-designed patterns were bound by the two key project parameters: connection and scale, as well as by a vision statement produced by the educational developers to help frame and focus the pattern development process and designs (sense 5). The co-design process underpinning the CLaS project had a significant bearing on the design of patterns: how they were conceptualised, the way they were developed (sense 2), and the way patterns were presented and shared (sense 4). As educational developers, we recognised that our entry into educational design patterns was influenced by our local domain, that is, our awareness of another educational pattern project at the university (Goodyear 2005) (sense 1).

The notion of 'transference' of various kinds can be seen throughout the design pattern network and in the relationships between the human and non-human actors

involved. The character and structure of the CLaS design patterns were informed by patterns in other disciplines and required transference into the educational domain through co-design (sense 1). Overall, the process used to develop the patterns was flexible and adaptive, unfolding as we progressed, based on our own observations, feedback from those engaging with the process, and our exposure to other design pattern processes reported in the literature (sense 2). These frequent inputs triggered the adoption of new processes and tools as needed and continually tested our assumptions about both the nature of design patterns in general and problems and solutions related to learning and teaching at scale. The pattern template used to generate the patterns (sense 3) evolved over time based on ongoing engagement with the design patterns literature and feedback from those working with the template (sense 2). It moved through different iterations and mediums, including several Word document versions, printed copies for use in workshops with stakeholders (sense 3), a variation suitable for sharing via an educational blog site, and a template to guide the presentation of the patterns as 'product' (sense 4) on a dedicated CLaS design patterns website. These mediums dictate the degree of multimodality in the presentation of the pattern, and transference and movement from one to the other can be seen to involve processes of entextualisation such as framing, selecting, summarising, resemiotising, and positioning (Jones 2022). As educational developers, we need to be aware of the broader design ecology and how designs change as they move through different hands and media over time.

Early in the project, a 'pattern storming' exercise was run to identify pattern candidates emerging from the CLaS work (sense 2). The list of candidates, used as a design plan (sense 3), is continually reviewed and updated over time based on new developments in the CLaS project and the ongoing evaluation of course developments. The platform used to house and present the plan influences the way team members engage with the patterns. For example, a project management tool, which was used to capture pattern candidates (Monday.com), allowed team members to nominate themselves as writers or peer reviewers of a pattern, leave comments specific to a pattern, revise the timeframe for development, and update the pattern status. Similarly, the affordances of the platform housing the design pattern template impacted the way peer reviewers engaged with the pattern (for example, it was more difficult to provide annotated feedback on a pattern when the template was built into a blog platform).

As more patterns were developed over time, it was possible to see potential relationships between them. Early in the project, a Miro board (sense 3) was used to create a preliminary map of these connections and consider how best to present and share the patterns as a collection. The CLaS design patterns template requires the pattern author to indicate how the pattern relates to other CLaS design patterns. As the network of patterns grows, these connections need to be updated and added to (sense 2). Further connections may become apparent as educators engage with the patterns (sense 4) and combine them in different and unexpected ways to address the challenges associated with connected learning at scale. This demonstrates that the process involved in the development of the CLaS design patterns is iterative and moves in two directions. That is, it involves both a bottom-up process of sketching individual design patterns from our collective experience and interpreting them through research-based evidence and theory, and a top-down process of attempting to 'structure the problem space of design, scoping

out the largest and smallest patterns, and sketching relationships' between existing and potential patterns (Goodyear 2005: 96). Over time, the stories of 'patterns in use' gathered through various feedback channels will be used to refine the patterns, making them dynamic in nature. Both the individual patterns and the collection of patterns as a whole can be viewed as 'products' of the design process (sense 4). Educational developers are required to navigate a degree of complexity in managing the relationships between a growing number of existing and potential patterns and curating patterns which are live and ever-changing products in conversation with their creators and users.

The design patterns initiative, as an 'arm' of the broader project, emerged through the shared interest and energy of a core group who were previously aware of educational design patterns, curious about their potential, and had willingness to become skilled at developing patterns. In examining the network of activities and actors involved in the generation of the patterns, the importance of shared values in shaping the design process, plan, and product was revealed. As co-design was already seen as a valuable design process, the core group recognised the value of including a broad range of 'actants' in the process of pattern development and its potential to support the democratisation of knowledge. This broader engagement (through workshops and other means) revealed new categories of challenges associated with connected learning at scale, unearthed new pattern candidates, and provided feedback on the usefulness of the patterns.

Co-design for Educational Futures

To design the future of education, we need to engage with matters of concern that invite debate and discussion around the uncertainties inherent in educational design. We encourage a multiplicity of views and a more democratic approach to design that requires breaking down hierarchies and decentralising decision-making. A postdigital design for learning needs new approaches where 'collaboration is vital to bringing together specialist skillsets to create new learning and teaching environments' (Matthews 2019: 416). This can be achieved through co-design, which brings together different perspectives and expertise to address increasingly challenging educational scenarios. To unpack the complexity of relationships and actions in co-design, we need a holistic approach, one that acknowledges the role of human and non-human actants.

To untangle the complex and multidimensional relationships between the different actants, educational design needs to be explored through the five design senses. In our study, this exploration uncovered how the design senses are linked in a network of assemblages where a design action has no clear start or end point. For example, our analysis of design networks demonstrated that 'design does not stop at the moment the artefact is produced, but that the con-figuration of these artefacts continues across the sites of their use' (Macgilchrist et al 2023: 4). Design plans generated in *Connect:In* workshops are carried forward into later phases of design and used by academics and students who further shape those designs. Canvas templates are designed and handed over to educators who extend the designs across multiple sites of use. Design patterns capture designs that emerge from co-design processes

and are themselves co-designed. Those who use them reconfigure the generic patterns to meet their needs. As suggested by Macgilchrist et al., this ongoing configuration 'challenges whose knowledge and expertise are valued and decentres the position of a "professional" designer to those affected by designs' (2023: 4).

Through our analysis, we identified 'turning points' in the design trajectory that impacted the course of action. This allowed us to reflect on the human and non-human actors playing into these evolutions and changes in direction. Shining a spotlight on these junctions is important when trying to address questions such as '[w]hose designs are we talking about?' and 'whose futures are at stake?' In examining the networks involved in our mini-cases, we became more aware of how design is 'entangled with epistemological and ontological groundings, with political and affective relations, with historical legacies of exclusion and oppression, and with socio-material and planetary impact' (Macgilchrist et al. 2023: 2). The analytical process allowed us to reflect on the 'path dependencies' and power relations between different actors in the co-design process.

To prevent the handing over of design decisions that impact educational futures to 'dominant actors' (Macgilchrist et al. 2023), we need to find ways of sharing and replicating valued approaches to co-design. As highlighted by Wilson et al. (2021), there is a scarcity of practical guidance for educators embarking on co-design processes in education. Extending the purpose and scope of design patterns addressed in this paper, how might we create design patterns for co-design that assist those in education to design futures that matter to them? To what extent are co-design processes replicable and shareable given that they are emergent by nature and deal with the not-yet-known? Macgilchrist et al. question where responsibility lies when there are so many different actors involved over time in different parts of the process. Examining the networks involved in our designs helped us to recognise the responsibilities of those leading and facilitating co-design processes. How might design patterns for co-design also provide guidance to those leading co-design processes?

In this study, we highlighted a number of roles adopted by educational developers and learning designers leading co-design processes in our project. According to Latour, 'the notion of network is of use whenever action is to be redistributed' (2011: 797). When we follow design actions, the role of a designer could be attributed to an actant based on its attributes. In other words, a designer as an actant could be defined based on what tools and materials support their design actions. To enact a role, people are dependent on material objects: a surgeon cannot be a surgeon without surgical equipment, a pilot without a plane, and an educational developer practising co-design without visualisation and communication tools. To define an actor, we have to explore the network of relationships that makes that actor, or as Latour explains 'an actor is nothing but a network, except that a network is nothing but actors' (2011: 800). Many of the roles we identified in this study for designers were connected to guiding and nurturing the collaborative process in an inclusive way and required a sensitivity to the broader design ecology. These roles included relationship-builder, mediator between stakeholders, visualiser of intangibles, negotiator of value, navigator of complexity, and custodian of collective ideas. As the educational developers were both leading

and participating in co-design teams, roles also included co-creator in the design process and generator of new design knowledge.

Studies considering the transformative role of educational designers have described their potential as agents of social change at the personal, relational, and institutional level, recognising their 'personal capacity and efficacy for operating in ambiguous, collaborative, and transdisciplinary contexts' (Bisset 2019: 15). Campbell et al. (2009) describe the role as a moral practice involving dialogue with others 'about how to create a social world of access, equity, inclusion, personal agency and critical action', and suggest that a focus on 'agency' provides a language for discussing the roles played by designers 'in the larger context of education and society' (2009: 661). This suggests that while an understanding of new and emerging roles is important as we increasingly embrace co-design in education, research might further consider identifying the skills and dispositions required of those leading co-design processes in education (particularly in relation to the notion of agency) to support effective and 'care-ful' design (Macgilchrist et al. 2023).

Acknowledgements This research was conducted as part of the Connected Learning at Scale (CLaS) project at the University of Sydney Business School. The authors would like to acknowledge the CLaS lead, unit coordinators, tutors, students, educational developers, learning designers, media producers and project officers involved in the project.

Author Contribution Not applicable.

Funding Open Access funding enabled and organized by CAUL and its Member Institutions.

Availability of Data and Material Not applicable.

Code Availability Not applicable.

Declarations

Ethics Approval Ethics approval was granted by the University of Sydney's Research Integrity and Ethics Administration—Project number: 2019/892).

Consent to Participate Not applicable.

Consent for Publication Not applicable.

Conflict of Interest The authors declare no conflict of interests.

References

Abegglen, S., Burns, T., Heller, R., & Sinfield, S. (2023). Designing Educational Futures: Imagine a Collaborative Bloom. *Postdigital Science and Education.* https://doi.org/10.1007/s42438-023-00393-w.

Alexander, C., Ishikawa, S., Silverstein, M., Jacobson, M., Fiksdahl-King, I., & Angel, S. (1977). *A Pattern Language: Towns, Buildings, Construction*. New York: Oxford University Press.

Bisset, D. (2019). Role of Educational Designers in Higher Education Institutions. In C. Bossu & N. Brown (Eds.), *Professional and Support Staff in Higher Education* (pp. 1-19). Singapore: Springer. https://doi.org/10.1007/978-981-10-1607-3_14-1.

Callon, M., & Latour, B. (1981). Unscrewing the Big Leviathan: How Actors Macro-Structure Reality and How Sociologists Help Them to Do So. In K. Knorr-Cetina & A. V. Cicourel (Eds.), *Advances in Social Theory and Methodology: Toward an Integration of Micro- and Macro-Sociologies* (pp. 277–303). Boston, MA & London, UK: Routledge & Kegan Paul.

Campbell, K., Schwier, R. A., & Kenny, R. F. (2009). The Critical, Relational Practice of Instructional Design in Higher Education: An Emerging Model of Change Agency. *Educational Technology Research and Development, 57,* 645-663. https://doi.org/10.1007/s11423-007-9061-6.

Cantore, S. (2018). *Co-Design, Volume III: Practical Ideas for Developing Across Complex Systems*. New York: Business Expert Press.

Dohn, N. B., & Hansen, J. J. (2018). Design in Educational Research–Clarifying Conceptions and Presuppositions. In N. B. Dohn (Ed.), *Designing for Learning in a Networked World* (pp. 25-47). London: Routledge.

Fenwick, T., & Edwards, R. (2010). *Actor-Network Theory in Education*. New York: Routledge.

Galle, P. (2002). Philosophy of Design: An Editorial Introduction. *Design Studies, 23*(3), 211-218. https://doi.org/10.1016/S0142-694X(01)00034-5.

Goodyear, P. (2004). Patterns, Pattern Languages and Educational Design. In R. Atkinson, C. McBeath, D. Jonas-Dwyer, & R. Phillips (Eds), *Beyond the Comfort Zone: Proceedings of the 21st ASCILITE Conference* (pp. 339–347). ASCILITE.

Goodyear, P. (2005). Educational Design and Networked Learning: Patterns, Pattern Languages and Design Practice. *Australian Journal of Educational Technology*, *21*(1), 82–100. https://doi.org/10.14742/ajet.1344.

Goodyear, P., Carvalho, L., & Yeoman, P. (2021). Activity-Centred Analysis and Design (ACAD): Core Purposes, Distinctive Qualities and Current Developments. *Educational Technology Research and Development*, *69*, 445-464. https://doi.org/10.1007/s11423-020-09926-7.

Goodyear, P., & Dimitriadis, Y. (2013). In Medias Res: Reframing Design for Learning. *Research in Learning Technology*, *21*. https://doi.org/10.3402/rlt.v21i0.19909.

Heskett, J. (2002). *Toothpicks and Logos: Design in Everyday Life*. New York: Oxford University Press.

Inns, T. (2010). Introduction. In T. Inns (Ed.), *Designing for the 21st Century. Interdisciplinary Methods and Findings* (pp. 11–23). London: Routledge.

Jones, R. H. (2022). Data Collection and Transcription in Discourse Analysis: A Technological History. In K. Hyland, B. Paltridge, & L. L. C. Wong (Eds.), *The Bloomsbury Handbook of Discourse Analysis* (pp. 9–20). London: Bloomsbury Academic. https://doi.org/10.5040/9781350156111.ch-001.

Knox, J. (2019). What Does the 'Postdigital' Mean for Education? Three Critical Perspectives on the Digital, With Implications for Educational Research and Practice. *Postdigital Science and Education, 1*(2), 357-370. https://doi.org/10.1007/s42438-019-00045-y.

Latour, B. (2007). *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press.

Latour, B. (2008). *A cautious Prometheus? A Few Steps Toward a Philosophy of Design (With Special Attention to Peter Sloterdijk).* Keynote Lecture for the Networks of Design Meeting of the Design History Society.

Latour, B. (2011). Networks, Societies, Spheres: Reflections of an Actor-network Theorist. *International Journal of Communication, 5*, 796–810.

Latour, B., & Weibel, P. (2005). *Making Things Public: Atmospheres of Democracy*. Cambridge, MA: MIT Press.

Lawson, B. (2005). *How Designers Think: The Design Process Demystified*. Oxford: Oxford Architectural Press.

Macgilchrist, F., Allert, H., Pargman, T. C., & Jarke, J. (2023). Designing Postdigital Futures. Which Designs? Whose Futures? *Postdigital Science and Education.* https://doi.org/10.1007/s42438-022-00389-y.

Manzini, E. (2015). *Design, When Everybody Designs: An Introduction to Design for Social Innovation*. Cambridge, MA: MIT Press.

Matthews, A. (2019). Design as a Discipline for Postdigital Learning and Teaching: Bricolage and Actor-Network Theory. *Postdigital Science and Education, 1*(2), 413-426. https://doi.org/10.1007/s42438-019-00036-z.

Roschelle, J., Penuel, W. R., & Shechtman, N. (2006). Co-design of Innovations with Teachers: Definition and Dynamics. In *Proceedings of the 7th International Conference on Learning Sciences* (pp. 606–612). International Society of the Learning Sciences.

Schoffelen, J., Claes, S., Huybrechts, L., Martens, S., Chua, A., & Moere, A. V. (2015). Visualising Things. Perspectives on How to Make Things Public Through Visualisation. *CoDesign, 11*(3–4), 179–192. https://doi.org/10.1080/15710882.2015.1081240.

Steen, M., Manschot, M., & De Koning, N. (2011). Benefits of Co-design in Service Design Projects. *International Journal of Design, 5*(2), 53-60.

Storni, C. (2015). Notes on ANT for Designers: Ontological, Methodological and Epistemological Turn in Collaborative Design. *CoDesign*, *11*(3-4), 166-178. https://doi.org/10.1080/15710882.2015.1081242.

Storni, C., Binder, T., Linde, P., & Stuedahl, D. (2015). Designing Things Together: Intersections of Co-design and Actor–Network Theory. *CoDesign, 11*(3-4), 149-151. https://doi.org/10.1080/15710882.2015.1081442.

Wilson, S., Huber, E., & Bryant, P. (2021). Using Co-design Processes to Support Strategic Pedagogical Change in Business Education. In T. U. Thomsen, A. Lindgreen, A. Kjaergaard, E. Rosier, & A. Tuncdogan (Eds.), *Handbook of Teaching and Learning at Business Schools: A Practice-Based Approach*, (pp. 20-35). Cheltenham: Edward Elgar Publishing.

Wilson, S., & Zamberlan, L. (2015). Design for an Unknown Future: Amplified Roles for Collaboration, New Design Knowledge, and Creativity. *Design Issues, 31*(2), 3-15. https://doi.org/10.1162/DESI_a_00318.

Zamenopoulos, T., & Alexiou, K. (2018). *Co-Design as Collaborative Research*. Bristol: Bristol University/AHRC Connected Communities Programme.

Zeivots, S., Cram, A., & Wardak, D. (2023). Developing Project Management Principles by Examining Codesign Practices in Innovative Contexts. *Project Management Journal.* https://doi.org/10.1177/87569728231176924.