CYBERNETIC TRANSDISCIPLINARITY AS PEDAGOGY

Ben Sweeting, Sally Sutherland
School of Architecture, Technology and Engineering, University of Brighton

---

Abstract
Cybernetics is often abstract in character, seeking to understand principles that apply in many situations. This abstraction affords cybernetics its extraordinarily broad scope, explanatory power, and transgressive quality, with ideas able to move between contexts. However, this abstraction also brings limitations, focusing attention on explaining general principles at the expense of the specifics of a situation and creating a distanced relation to practice. In this paper, we present a way in which cybernetic analogies may be deployed in a manner which is enacted (rather than abstract) and methodological (rather than explanatory). The example we take is from our own teaching practices, focusing on a curriculum developed in the context of supporting postgraduate architecture and design students in understanding research. This is an area in which cybernetics has theory to offer, notably Ranulph Glanville's argument that research (including scientific research) is designed. By outlining the approach to teaching and learning developed in this curriculum, we describe how Glanville's theoretical stance may be reformulated as a pedagogic process, where students reposition their growing expertise in design as expertise in (designing) research. We discuss the advantages of this in the context of education for design research, such as avoiding research being seen as external to design and the opening of research to the sorts of critique that one may apply to other design outcomes. We conclude by speculating on the extent to which the pedagogic approach presented here may be taken up in other practical situations.

Keywords
Cybernetics, Transdisciplinarity, Design, Pedagogy.

Introduction
A core characteristic of cybernetics is the construction of transdisciplinary theory through the creation of analogies between different situations. What distinguishes cybernetics from other forms of transdisciplinarity is that these analogies are constructed in terms of feedback processes. Feedback, which can be understood as those circular causal processes where the observed outcomes of action are taken as input for new action, is widespread across social, ecological, biological, and technological contexts, giving cybernetics its broad scope and transdisciplinary character. The making of analogies between these contexts is at the heart of what has always been distinctive about cybernetics, with ideas able to move between radically different domains. For instance, Norbert Wiener (1948/1961) characterized cybernetics as applying across "the animal and the machine", Ross Ashby (1956/1964) saw it as concerned with "all possible machines" (p. 2), and Margaret Mead (1968) understood it as form of language "sufficiently abstract to make it possible to cross disciplinary boundaries" (p. 2).

The abstraction Mead refers to brings limitations as well as connections, however. First, cybernetics has tended to focus on general principles at the expense of material embodiment and the specifics of a situation. For Ashby (1956/1964), cybernetics is focused on what things do, not what they consist of, leading to the view that "materiality is irrelevant" (p. 1) to cybernetics. Yet, there are many situations that involve feedback processes where embodiment is an important consideration, such as in some of our own interests in bodies and places (Sutherland, 2019; Sweeting, 2020). Second, focusing on general principles positions cybernetics primarily in the mode of explanatory theory, which in turn implies a relation to practice that is both distant and linear (this is the case whether one characterizes such explanations as

scientific or philosophical). While cybernetics has much explanatory potential, to see it primarily as a body of theory seeking application elsewhere is inevitably limiting towards its own practical and methodological development. Moreover, linear relationships between theory and practice are in tension with understanding practice in terms of cybernetic circularity (e.g. Glanville, 2014; Sweeting, 2015) and with the reflexive, performative, and situated practices with which cybernetics is associated in domains such as action research, the creative arts, design, education, and family therapy. Third, the ease with which cybernetics moves ideas between contexts risks uncritical deployments of its analogies as if they represent equivalencies between these domains. For instance, while cybernetics' analogies between biology and technology (Wiener's animals and machines) bring new insights and connections, eroding the contextual differences between these domains may have undesirable social consequences, such as where treating automated algorithms as if they are intelligent diminishes human agency (Krippendorff, 2021).

In this paper, we present a practical example in which cybernetic analogies are deployed in a manner which is enacted (rather than abstract) and methodological (not just explanatory). The example is situated in the context of our own teaching practices, focusing on a curriculum that has been developed to support taught postgraduate students in architecture and design disciplines as they become active in research. This is an area in which cybernetics has significant explanatory theory to offer, notably Ranulph Glanville's (1999, 1981/2014) argument that research (including scientific research) can be understood as a specific form of design activity. We describe how Glanville's theoretical stance may be reformulated as a pedagogic and methodological process, through which students reposition their growing expertise in design as expertise in (designing) research. Whereas cybernetics is conventionally utilized as a body of theoretical support for explaining transdisciplinary content, in this curriculum we position cybernetic transdisciplinarity as a mode of engagement within students' own learning where an unfamiliar topic (research) is approached through analogy to a familiar one (design). We begin by contextualizing the curriculum, introducing the rationale for this approach in the context of design research. We then outline the structure of the curriculum, the approach to teaching and learning that supports this, and our observations of its impact in students' subsequent project work. We conclude by speculating on the extent to which enacted analogies such as the example presented here may be taken up in other practical situations, and the potential value of doing so.

Designing research

One way to begin thinking about the relation between research and design is through comparison with academic disciplines such as anthropology, chemistry, or history. To learn how to be a chemist, anthropologist, or historian is to learn how to conduct research in these domains. In design, by contrast, the core of the discipline is the collection of practices that are typically learnt within design studio, while research has tended to make use of methods imported from other disciplines. For instance, design may be the object of study for research, such as where the outcomes and processes of designing are studied in the humanities and social sciences. Design studio practices may also make use of knowledge produced by research in other disciplines, such as market research, material science, reference to historical precedents, and the use of social science methods to inform design decisions. Within undergraduate design education, these modes of research are usually associated with distinct parts of the overall curriculum, both of which implicitly introduce the idea of their separation from design. More academic modules introduce a wider context of historical and theoretical enquiry, with students typically producing written essays and dissertations that are usually independent of studio work. Within studio modules, research is often associated with initial information gathering and concept development in the early stages of projects, which is then drawn on to support design work as it progresses.

Seeing design and research as separate activities is a viable way to understand their relationship, and much of the design research community continues to frame its approach along these lines. For instance, in the context of "practice-based" research, practice and research are framed by Candy et al. (2021) as independent and complementary processes. However, this way of relating design and research is far from

the only one. An example of an alternative framing is from Sadokierski (2020), who acknowledges that designers almost always, if not always, conduct research as a part of their practice. Sadokierski recognizes a distinction between research activities having a design agenda, or a research agenda. Nevertheless, research activities are happening in both instances, including through design. While thinking of design and research separately can make sense in some contexts, it can also have undesirable consequences. Other disciplines have much to offer design, but to characterize research as primarily outside of design is to hollow out design as a discipline by making it dependent on other fields. This can be distorting, as was the case with the design methods movement during the 1960s, a failed attempt to reformulate design on the basis of (how designers understood) the scientific method. Characterizing design and research as separate is also challenging for students in learning what research is, as it presents research as something other to design and so other to students' existing experience and understanding. To expect design students to adopt the methods and language of other disciplines is challenging and can be alienating, as students do not have the background in these disciplines to build on. It also risks design researchers becoming uncritical end users of other disciplines' research outcomes and methods without the deeper knowledge and context of the underlying principles and assumptions. The need to understand the principles underlying methods is especially important given that designers often operate in situations that are "ill-defined" and "essentially unique" (Rittel & Webber, 1973, p. 164). Whereas most academic subjects have established sets of methods that relate to relatively predictable situations, designers continually redesign their methodological repertoire in response to specific circumstances. The position we take is that, if they are to be rigorous, design researchers need to engage with research at a deeper level than that of adopting other disciplines' methods, understanding and challenging the reasoning behind different ways of working.

By the 1970s and 1980s, the exhaustion of attempts to base design on the scientific method led to efforts to develop design's independent foundations as a discipline. This work focused on understanding design's own methods and practices, leading to an appreciation of design activity as creating knowledge though its various tacit and reflective modes of enquiry. One major contributor to this work was Bruce Archer (1979), who positioned design as a third disciplinary pole of general education, complementing the "two cultures" (Snow, 1959) of the sciences and humanities that design has often found itself split between. While the work of Archer and others was mostly concerned with educational and professional settings, it has also prompted a still expanding discourse on the roles that designerly modes of knowledge production may play in research practice and vice versa.

Archer's framework gives design its own place alongside, and independent from, the sciences and humanities. Understanding design in its own terms is important in countering the tendency for design to become distorted by importing theory and methods from elsewhere. Yet, as Glanville (1981/2014) responded, placing design in its own domain risks isolating it from other disciplines, obscuring commonalities and shared concerns. While Glanville's point is usually taken in the broad sense of the relations between disciplines, the isolation of design research can also be encountered in practice. For instance, tacit and reflective design practices do not usually lend themselves to producing shareable and repeatable knowledge that is relevant beyond the specific context of a project. Design can even become isolated within transdisciplinary projects, where designers can find themselves limited to roles of communicating or applying research outcomes rather than contributing to the creation of these outcomes.

Glanville (1999, 1981/2014) suggests an alternative conceptualization, turning the conventional relationship between design and research around. Rather than asking how design activity can be a form of research, Glanville points to how all research activity (including science) is designed. That is, research isn't something that just happens but is a result of deliberate, purposeful action that (seen cybernetically) takes the same form as design activity. Experiments are designed in order to test some factors rather than others, using equipment and methods that are designed for these purposes. One can also think of the whole process of research as one of producing (designing) artefacts of various kinds, most obviously in

cases like biotechnology but also in the production and testing of theory (i.e. theories are new things in the world that are created through research). The desire for research to be objective can obscure the ways in which it is designed, leading to what Nobel prize winning biologist Peter Medawar (1963/1996) criticizes as the fraudulent structure of conventional scientific papers. Yet, even scientific objectivity is something that is the result of design, and so not in and of itself objective in status (see also Sweeting, 2022). The experimenter tries to avoid affecting the situation they are studying, and to do this takes careful experimental design. For instance, in social science, leading questions need to be avoided as otherwise insights will reflect the experimental situation rather than what the experimenter is trying to understand. For Glanville (1981/2014, p. 111), with honest reflection over how research is undertaken in practice, one may recognize an underlying pattern of design across all disciplines (regarding the central role Glanville sees for honesty, see also Glanville, 2004; Hohl, 2016; Jonas, 2018). While Archer's framework positions design as one mode of doing research amongst others, Glanville's concern with how research is designed shifts the question of design's relationship to research to a different logical type: a different kind of question about research rather than one kind of research amongst others. Thinking of design's relationship with research through this lens, design has both its own place (now as a form of meta-position or meta-question) and a deep connection to all other disciplines, including its own designerly practices.

Understanding research through the lens of design in this way has the advantage that the designer is no longer in the position of an uncritical end user of the outcomes and methods of other disciplines. By learning to understand how research works in terms of its design, the designer can draw on their existing understanding of design to understand, critique, and design research methods. Moreover, rather than thinking in terms of distinct paradigms of design research, the design researcher can understand the relations between design and research in a project as one of the things they are designing. As with any other design question, the relation between design and research can be configured in multiple ways that in turn lead to different consequences. Rather than juxtaposing designerly modes of research with conventional academic disciplines, the question for the design researcher is how to design the research as a whole—which methods to use, how different approaches can be integrated together, and so on. Here design becomes a container, within which may be found many different potential relations between design and research activity. There will be good reason in some situations to design linear, separate relationships between design and research, and because these relationships can themselves be designed, they can be designed so that they do not distort design. Similarly, tacit and reflective modes of knowledge production can be designed in ways that present repeatable and shareable insights that can be integrated within wider research agendas.

A further advantage of thinking of research in terms of its design is that it offers ways for designers to become more critical about their use of research. If research is understood as a form of design activity, then researching into design has the potential to take a reflexive form, with research into design giving insights into (the design of) research. Glanville's own thinking focused on designerly approaches towards epistemological questions (Glanville, 2006, 2006/2014), but the idea that design can inform research can be thought of more broadly. If research is a form of design activity, then the critiques one might make of design also apply to research. For instance, criticisms of scientific objectivity as privileging dominant standpoints (e.g. Harding, 2015) or obscuring responsibility (Foerster, 1992) can be understood as part of a wider context of criticizing design in political and ethical terms. Such criticisms are especially pertinent given the social consequences that follow from biases in data feeding through into the designed world (see e.g. Costanza-Chock, 2020; Criado Perez, 2019). One can ask what worlds one makes (and should make) in research in much the same way as in design.

A curriculum for understanding (how to design) research

Encountering research in the context of design is not straightforward, especially within taught postgraduate programs that are practical, professional, and vocational rather than purely academic in

focus. Research can seem like something 'other' to the rest of students' studies, which can be intimidating. Moreover, there are various ambiguities in how design relates to research, as both terms can mean several things and can relate to each other in different ways. While one could clarify the relation between research and design by defining it in a specific way and introducing a selection of established methods for students to follow, this approach does not cover the multiple possibilities of design research practice and so is limiting as an approach to education for a transdisciplinary context. Yet, to seek clarity in theoretical terms can be something of a detour from students' concerns and interests, becoming overly abstract and exacerbating the sense that research is something other. The idea that research is a form of design activity does not need to be approached theoretically, however.

Glanville's argument about the relation between research and design is usually taken in explanatory terms as a contribution to the disciplinary basis of design research, being of particular relevance in projects and topics where there is a desire to find mutual ground between design and other fields (e.g. Fischer, 2014, 2019; Jonas, 2018; Krueger & Besenecker, 2019; Sweeting, 2017). In this section, we outline a different approach, where Glanville's analogy is enacted (not just explained) within a curriculum to form an accessible entry point for design students in understanding research. In short, if research is (thought of as) a form of design activity, then it is possible for students to re-position their growing understanding of, and ability in, design as a way of understanding and doing research. This approach shifts the focus away from questions of how to follow the conventions of established methods, and towards understanding what follows from these and other methodological choices.

The example discussed here is a module titled 'Research Practices', which is taken by students across several degree courses at the University of Brighton, predominantly MArch Architecture, MA Interior Design, MA Sustainable Design, and MA Architectural and Urban Design.[1] These courses all involve research but approach it with different expectations, with some more academic and others more vocational or professional in character. Most students take the module in their first semester of study, while for MArch students it opens the final phase of their professional studies, which (in Brighton's program) is designed to be open-ended and research oriented. The module is worth 20 of the 60 credits studied in the semester. Cohorts generally have a mix of different age groups and cultural backgrounds, with individuals bringing varied expertise from previous study and practice, and interests in a range of design specialisms (or none at all). To illustrate the variety of students, examples include graphic designers interested in the design of policy and community engagement, an experienced ceramicist working with concepts of end of life, a communication designer working with embodied understandings of the sea, and an architecture student working for disability justice, while other students see research primarily in terms of developing ideas and gathering information for direct application in design projects.

The module begins with a relatively simple task. Working in small groups where not everyone knows each other, students are asked to have dinner together. They may either do this by cooking a meal that they have not cooked before, or by visiting a restaurant that no one in the group has previously been to. Students who are not able to participate for any reason can do a version of the activity by cooking a new recipe for themselves, family, or friends. Because this exercise requires new experiences and insights, it involves various activities that can be discussed in terms of both design and research. Students need to ask various questions of each other, such as dietary requirements, budget, food preferences, available time, travel arrangements, and so on. They draw on various information sources such as website reviews,

[1] The initial development of this module was by Kate Cheyne and Karen Jaschke. The first iteration of the module ran in 2018-2019, taught by Jaschke, Katy Beinart, and Sarah Stevens. From 2019 onwards, the curriculum has been further developed along the lines discussed here. The curriculum design has been led by Ben Sweeting with input from Sally Sutherland, Jessica Melville-Brown, Kristen Bullivant, Jordan Whitewood-Neal, and Queenie Clarke.

cookbooks, and family recipes. This exercise plays a number of roles. First, students spend some time getting to know each other, mixing between courses. For many of the students, this activity happens during their first few weeks on the course and so is part of settling into this new context. Second, the exercise helps demystify research by situating its otherwise strange terminology in the familiar context of food. For instance, it is possible to follow up the activity by discussing the use of source material by thinking about why one trusts a particular cookbook, the process of peer review through a discussion of when one might trust online reviews of restaurants, and to introduce the ideas around method by reflecting on the role of a recipe in making a meal. Third, the exercise provides a lived example that students can use throughout the module, locating theoretical questions about research in this shared experience before bringing them into direct relation with their ongoing design work.

A key follow-up discussion to the dinner exercise is over the difference between thinking of research in terms of information gathering versus creating new insights. Most students tend to initially associate research with the necessary preparation for the dinner to happen, gathering information about each other, restaurants, ingredients, and recipes. Through discussion, the idea is seeded that new insights are created through the event of the dinner too. Conversation amongst the group creates new connections and shared understanding; one learns about one's source material (cookbooks, review websites, recipes) by using them and experiencing their outcomes; and new experiences of food might lead to trying (or avoiding) other new dishes. This discussion introduces the notion that design and research are present across multiple layers of the situation—that research has been undertaken to design an event through which further research could be conducted, and so on. This idea is expanded and deepened in subsequent sessions.

The module is structured in three phases. The initial phase is organized around a series of seminars, with themes building week by week. An early session focuses on the many possible relations that artefacts can have to research. One example that is discussed is a map, an artefact that can be an object of study for researchers and a design constraint for designers; that is produced through research and design activities; and which can be used for undertaking research or design. Maps resonate with students' own work (mapping can be used in various ways to explore the context of a project) and everyday life (planning a journey), while various maps of the world can be discussed in terms of historic research activities. The discussion of maps leads to the next session, which focuses on the standpoints (Harding, 2015) research is undertaken from and the difference this makes to the insights that are created through it. For instance, what idea of the world does a particular projection of the world map embody? What standpoint do you occupy in your own designing and researching? Who is included and excluded from different modes of researching and designing? In turn, this leads to a session discussing design and research in relation to systemic questions, such as the differences made by implicit boundary judgements in design and research. Each of these sessions lasts around two hours and comprises a talk, a breakout session, and a wrap up. Between each session, students complete two or more readings and a short practical exercise (often a diagram). They reply to the readings with a summary or questions, and post these and the practical work on a message board so that they can see and respond to each other's interpretations. They also receive a reply to each post from a member of staff to support their understanding and their use of academic conventions. The readings cover a mixture of literature from within and beyond design, introducing students on each of the courses to discourses beyond their specific field. Typically, different students will find different sessions and activities more helpful to them than others, and they are encouraged to explore these avenues further.

The middle phase of the module is less structured. One session is focused on disciplines, with presentations from students' course leaders who discuss the role of research on that course and more generally in their field. We find this session fascinating to listen to, revealing (expected) similarities but also subtle differences in terminology and agenda. Another session concentrates on methods, with students focusing on some specific ways of doing research. Working in groups, students explore

selections taken from Milton and Rodgers (2013), whose book has accessible summaries of various methods, including mundane activities such as searching the internet, conventional research methods such as interviews and surveys, and less usual techniques, such as roleplay and bodystorming. When the module has been run in person, students play out these techniques in a performative way in the class. The aim of this session is not to learn about these methods per se, but to deploy some of the critical insights from early classes. What standpoints and boundary judgements are implicit in these different approaches? What does a particular method help you see and do, and what does it obscure? What relations between design and research does a particular method assume? The last session of this phase is called 'Intentionally Left Blank,' referencing Bruce Mau (1998). This session is designed to make explicit the incompleteness of the module, that it is not possible for everything to be covered, reinforcing the idea that to practice design research is not simply the selection of one or more approaches from a finite list. Students submit questions in advance for this session, giving staff some time to prepare. Questions typically include specific requests to cover a particular topic (such as needing to know how to run a focus group), theoretical questions arising from previous discussions, practical questions about submitting research ethics applications, and queries about the module assessment, which is introduced around this time.

The final part of the module is oriented around the assessment task, with tutorials in small groups and a peer review session. The assignment uses a three-part structure, combining text (3000 words) and visual work, through which students locate some of the themes introduced earlier in the module with respect to their own work. The overarching question is to explore how the ways in which one does research (how it is designed) have consequences for the scope and status of the insights that research activity generates. Students choose an example of research from their own experience, which can be ongoing work in their studio modules, or an assignment from earlier studies or experience in professional practice. They first describe how they did this research. That is, rather than focusing on the content, they describe how the process worked as research, to the extent that it did. In the middle section, students develop a critique of this research process: What did doing research this way help them see and do, and what did it obscure? This section can focus on how to address practical limitations, but it can also be more political, exploring the (usually) privileged stance of the designer and researcher. Lastly, students respond to their own critique by suggesting (and sometimes beginning) new ways forward. The assessment is designed to focus on how well students evaluate the example of research not on the sophistication of the research process itself, making it equally accessible for students at different stages of their journey as researchers.

The overall structure of the module could be summarized as using familiar examples of everyday life and design practice to scaffold advanced discussions of what it means to design and conduct research in different ways, which in turn reflect back to the contexts of design and the (design of the) everyday. The theoretical basis for this is founded on Glanville's argument about design and research, which is one example of the sort of transdisciplinary analogy that is a feature of cybernetics more generally. While Glanville's ideas feature in the module, explanatory theory is in and of itself only of minor benefit to the students' learning. Instead, the module curriculum looks to enact this analogy, with students locating thematic discussions within and through their experiences. As well as enabling theoretical insights to arise from within the situated contexts of practice, this process also (with at least some students) allows a reversal of the conventional theory-to-practice relationship, with theoretical investigations taking their starting points from considering previous actions in new ways (c.f. Glanville, 2014). There are many different benefits and implications of methodologically embodying cybernetic analogies in this way. By reflecting on the work of students who take the module, we can understand further how this impacts their (and our) research and studies.

Impact on subsequent projects

In this section, we discuss some of our observations as teaching staff regarding how the Research Practices module has impacted work in the rest of students' studies. The timescale of these observations

covers cohorts of postgraduate students at the University of Brighton between 2019 and 2022. We have noticed impacts on modules that co-occur in the same semester, subsequent modules and pathways, and what is taken away when leaving the course and institution.

Engaging with conversations about the design of research has enabled stepping back (even further) from the object of attention than many students may be used to. At times, the unusual approach of the module has led to confusion for some students. Nevertheless, this stepping back has generated a valuable focus on design processes and practices as relational and situated, complementing the attention given to the content and outcomes of design that is central to other modules. This focus facilitates a reflexive situating of oneself within a highly individual research context, which many students articulate in their work in other modules. Some find this a comfortable journey, especially those more accustomed to engaging theory in their work. For students whose research involves practice in varying ways, the module allows them to wrestle with their understanding of how practice may be theory and vice versa. The focus of the module affords students the opportunity to articulate and situate their work in broader contexts, developing skills that are critical to translating design research as a valuable scholarly practice within and outside of the discipline and institution.

Outside the module, students engage with a broad range of self-identified projects, ranging in aims and outputs. This work could be pragmatic, concept-driven, or understood through making. The module generates a specific site for understanding and collective discussion away from the common presupposed separation between people as creative practitioners and people as thinkers and researchers. This lack of disconnect is most noticeable for the students with approaches led by their design practice. By framing research and design in this way, the module also plays a role in breaking down any perceived division between research and everyday life. Students are more able to discuss nuances within projects or observations as there is less disconnect between research being 'over there' while I am 'over here'.

Being exposed to a questioning approach about whether, how, or when design and research coincide supports a rigorously critical research approach. Students establish how the work on subsequent modules fits in the world as design, research, and design research. As students progress through the module, it is notable how they become empowered with the tools and language to describe what they do as research and why they do it. Students can take their work and the work of their peers seriously as research and speak to each other as such. The value of this confidence and articulation reaches well beyond the scope of the courses or institutions. Students have gone on to work in professional research capacities or as designers within research teams.

As facilitators of this module, we create a site for our own learning through relationships, planning and responding to ourselves (including our hunches and feelings), each other, and the group. An effort is made to avoid hierarchy between staff and students and between lecturers who are unavoidably institutionally hierarchically positioned. One impact of this learning could be increased reflexivity of design and design research pedagogy for staff involved in the module. As some teaching staff are researching at MRes and PhD level, much like all students taking the module, they can become more confidently able to articulate the relations between design and research in their theses, while their open questions about design research provide a more accessible environment for students than established researchers whose ideas about design research are more fully formulated.

Overall, the learning within this module opens opportunities and possibilities beyond the module, the course, and the institution. Understanding research as, or, and design, and having the language and

theoretical frameworks to articulate their individual position adds robustness to project work in other modules. Developing work in this way means that students and staff can work on projects open to alternative futures within their project work and for them as individual practitioners, academics, or professionals.

Conclusion: Enacting cybernetic transdisciplinarity

The module curriculum described in this paper is not the only way of introducing research to designers. In developing it, we recognize that more conventional framings of design and research have their own strengths. The advantages of the approach we have taken are both pedagogic and critical. Pedagogically, introducing research through the lenses of design and the everyday avoids positioning it as something other to the rest of students' studies, supporting their engagement with research by building on existing experiences. In turn, this supports the integration of research with design studio in other modules and develops criticality in understanding and using research outcomes and methods.

The main limitations of the module curriculum come from the meta-position it takes. This stance can be disorienting for some students, especially early in the semester. It also means it is not possible to introduce specific research methods in much detail. Both of these limitations are acknowledged explicitly in module sessions. Those students who struggle initially with the approach have generally been able to use the middle and later phases of the curriculum to work their questions through, for instance by focusing directly on the challenge of encountering wider framings of design work in postgraduate studies compared to their previous experiences. The lack of detail in presenting specific methods is, we think, unavoidable given the range of student work the module supports, although it is possible for specific techniques required by students to be covered within their other modules.

Another aspect of the module curriculum that we see as important is not about design research per se. The practices we have developed in the module can be thought of as folding back to inform some of the ideas that have underpinned its development. The module is premised on an example of cybernetic analogy—that research can be thought of as (if it is) a kind of design activity. Like much of cybernetics, the module focuses on general principles (the design of research) rather than specific details (training in particular methods). It does not do so primarily via explanatory theory, however. While theoretical ideas are introduced through readings and talks, these are only part of the pedagogic approach. The analogy is developed largely through students enacting it in their learning, with new concepts developed through reflecting on familiar experiences, in turn allowing for the familiar to be reflected on in new ways. This approach situates what would otherwise be abstract theory within contexts of practice and experience. As with cybernetics' analogy building in other contexts, it is important not to conflate the domains of design and research in the process of connecting them. The point is not that design and research are the same thing, but that thinking of them in terms of the other can be a way of integrating them in practice and interrogating their differences. Maintaining distinctions while making analogies can be pedagogically challenging (it is this aspect of the curriculum in which we have most development still to do), but it also presents opportunities. Analogies between different situations can lead to new insights and critical questions, helping envision different possible futures. Such an approach could be taken up in design research, but also offers a pattern that could be followed more generally in cybernetics, making its transdisciplinarity more situated, accessible, and critical as a way of transforming the present.

Acknowledgements

We would like to give thanks to all students that have taken the Research Practices module, and to all colleagues who have worked on the module. Thank you for sharing our journey with such patience, commitment, and enthusiasm. We are also grateful to AHRC Design Star who provide Sutherland's research training and funding, and to the Radical Methodologies Research and Enterprise Group (RaMREG) at the University of Brighton for being a critical team. The development of the curriculum

presented here has been deeply influenced by Ranulph Glanville, who was Sweeting's doctoral thesis supervisor, but differs from Glanville's own teaching practice, which was much less structural in character. Key influences on the early development of the module include an undergraduate design theory curriculum developed by Michael Hohl and Mathilde Scholz (2020), presented by Hohl at the 2019 ASC conference in Vancouver, BC, Canada, and the framing of design research developed by Thomas Fischer (2019), presented at the same conference.

Reference list

Archer, B. (1979). Design as a discipline. *Design studies, 1*(1), 17-20. https://doi.org/10.1016/0142-694X(79)90023-1

Ashby, W. R. (1964). *An introduction to cybernetics*. Methuen. (Original work published 1956)

Candy, L., Edmonds, E., & Vear, C. (2021). Practice-Based Research. In L. Candy, E. Edmonds, & C. Vear (Eds.), *The Routledge International Handbook of Practice-Based Research* (pp. 27–41). Routledge. https://doi.org/10.4324/9780429324154

Costanza-Chock, S. (2020). *Design Justice*. MIT Press.

Criado Perez, C. (2019). *Invisible women: Exposing data bias in a world designed for men*. Random House.

Fischer, T. (2014). Scientific research into designing, while doing justice to designing. *Architectural Science Review, 57*(4), 240-248. https://doi.org/10.1080/00038628.2014.958128

Fischer, T. (2019). A theory of (and for) enquiry. In T. Fischer & C. M. Herr (Eds.), *Design Cybernetics: Navigating the New* (pp. 247-262). Springer International Publishing. https://doi.org/10.1007/978-3-030-18557-2_14

Foerster, H. von. (1992). Ethics and second-order cybernetics. *Cybernetics and Human Knowing, 1*(1), 9-19.

Glanville, R. (1999). Researching design and designing research. *Design Issues, 15*(2), 80-91. https://doi.org/10.2307/1511844

Glanville, R. (2004). Desirable Ethics. *Cybernetics and Human Knowing, 11*(2), 77-88.

Glanville, R. (2006). Construction and design. *Constructivist Foundations, 1*(3), 103-110. www.univie.ac.at/constructivism/journal/1/3/103.glanville

Glanville, R. (2014). Acting to understand and understanding to act. *Kybernetes, 43*(9/10), 1293-1300. https://doi.org/10.1108/K-07-2014-0147

Glanville, R. (2014). Design and mentation: Piaget's constant objects. In *The black boox: Living in Cybernetic Circles* (Vol. 2, pp. 231-237). Edition echoraum. (2006) (Reprinted from Originally published as a journal article in the 'zero' issue of The Radical Designist, 2006.)

Glanville, R. (2014). Why design research? In *The Black Boox: Living in Cybernetic Circles* (Vol. 2, pp. 111-120). Edition Echoraum. (1981) (Reprinted from Design, science, method: *Proceedings of the 1980 Design Research Society conference*, edited by Robin Jacques and James Powell, 86-94. Guildford: Westbury House, 1981.)

Harding, S. (2015). Objectivity for sciences from below. In F. Padovani, A. Richardson, & J. Y. Tsou (Eds.), *Objectivity in Science: New Perspectives from Science and Technology Studies* (pp. 35-55). Springer International Publishing. https://doi.org/10.1007/978-3-319-14349-1_3

Hohl, M. (2016). Rigor in research, honesty and values. *Constructivist Foundations, 11*(3), 585-586. https://constructivist.info/11/3/585.hohl

Hohl, M., & Scholz, M. (2020). Acting cybernetically: Practicing design theory and theorising design practice as a participatory learning journey. *Cybernetics & Human Knowing, 27*(1).

Jonas, W. (2018). Some additional remarks on rigor and/or relevance in design research. In M. Erlhoff & W. Jonas (Eds.), *NERD - New Experimental Research in Design*. Walter de Gruyter GmbH.

Krippendorff, K. (2021). *A critical cybernetics* The Art and Science of the Impossible: The 65th Annual Meeting of the International Society for the Systems Sciences, Online.

Krueger, T., & Besenecker, U. C. (2019). Design-based research in relation to science-based research. In T. Fischer & C. M. Herr (Eds.), *Design Cybernetics: Navigating the New* (pp. 137-151). Springer International Publishing. https://doi.org/10.1007/978-3-030-18557-2_7

Mau, B. (1998). Incomplete manifesto for growth. Retrieved 20 June 2022, from https://brucemaustudio.com/projects/an-incomplete-manifesto-for-growth/

Mead, M. (1968). The cybernetics of cybernetics. In H. von Foerster, J. D. White, L. J. Peterson, & J. K. Russell (Eds.), *Purposive Systems* (pp. 1-11). Spartan Books.

Medawar, P. (1996). Is the scientific paper a fraud? In *The strange case of the spotted mice and other classic essays on science* (pp. 33-39). Oxford University Press. (1963) (Reprinted from *The Listener*, *70*, 12 September 1963)

Milton, A., & Rodgers, P. (2013). *Research methods for product design*. Laurence King Publishing.

Rittel, H., & Webber, M. (1973). Dilemmas in a general theory of planning. *Policy Sciences, 4*, 155-169.

Sadokierski, Z. (2020). Developing critical documentation practices for design researchers. *Design Studies, 69*, Article 100940. https://doi.org/10.1016/j.destud.2020.03.002

Snow, C. P. (1959). *The two cultures and the scientific revolution*. Cambridge University Press.

Sutherland, S. (2019). Eating mothers: Milk matters. In *Expanding Communities of Sustainable Practice Symposium Proceedings 2018* (pp. 82-88). Leeds Arts University. https://lau.repository.guildhe.ac.uk/17576/

Sweeting, B. (2015). Cybernetics of practice. *Kybernetes, 44*(8/9), 1397-1405. https://doi.org/10.1108/K-11-2014-0239

Sweeting, B. (2017). Design research as a variety of second-order cybernetic practice. In A. Riegler, K. H. Müller, & S. A. Umpleby (Eds.), *New horizons for second-order cybernetics* (pp. 227-238). World Scientific. https://doi.org/10.1142/9789813226265_0035

Sweeting, B. (2020). Place as a reflexive conversation with the situation. In M. Butcher & M. O'Shea (Eds.), *Expanding Fields of Architectural Discourse and Practice: Curated works from the P.E.A.R. journal* (pp. 33-50). UCL Press. http://www.jstor.org/stable/j.ctv13xps41.6

Sweeting, B. (2022). Undeciding the decidable. *65th Annual Proceedings for the International Society for the Systems Sciences, 65*(1). https://journals.isss.org/index.php/jisss/article/view/3888

Wiener, N. (1961). *Cybernetics: Or, control and communication in the animal and the machine* (2nd ed.). MIT Press. (Original work published 1948)