Design research, architectural research, architectural design research: An argument on disciplinarity and identity

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This paper studies the relationship between design and architectural research and questions whether these can be viewed as separate disciplines. It presents an historical review of how this relationship has changed over 40 years. Several interventions, including research assessment, provide a motive to identify architecture as a discipline, however locating a unique 'architectural' element continues to be problematic. This argument advances this debate noting that recent changes, understanding design as movement for societal change and the involvement of non-academics (researcher/practitioners) in practice-based research, open up new epistemic vantage points. In particular it is at the intersection of architectural design research (ADR) and detailed design studies of architects at work that new ways of constructing architectural and designerly knowledge emerge.

The claim that design is a discipline in its own right (Cross, 1982) marked a distinct point in the history of design research. It was a departure from the Design Methods movement's search for underlying universal structures (for a science of design), instead arguing that design has its own ways of knowing (Archer 1979a,b). Design has its own epistemics in the construction of a new understanding of a design situation. At the time, in 1970−80s, many architects in academia were prominent in the design research community promoting this view. However, as we approach the end of the second decade of the twenty-first century (almost 40 years later) although many researchers study architectural design, it is less clear what architectural research's relationship is with design research. While the act of design is central to architecture and research into architectural design might be viewed as a sub-set of design research, the relationship between 'design research' and 'architectural design research', as we will examine, is more nuanced and fluid. As Cross has recently re-stated, "*[T]he challenge for design research − [is] to help construct a way of conversing about design*

that is at the same time both interdisciplinary and disciplined. We do not want conversations that fail to connect across disciplines, that fail to reach common understanding, and that fail to create new knowledge and perceptions of design. It is the paradoxical task of creating an interdisciplinary discipline" (Cross, 2019). This paper presents an argument on disciplinarity, drawing attention to different motivations for constructing disciplinary boundaries in design and architectural design research. Through a review of literature and events that have both shaped and define a shifting landscape, this paper will examine whether there are substantive differences between 'design research' and 'architectural design research'.

The paper is organised as an historiography (historical review), tracing areas of design and architectural design research with reference to leading academics, journals and events over three periods in time: during the 1980s, the 1990s government intervention in research, and developments in the twenty-first century. While it may be too strong a claim to say that these eras mark paradigm shifts in a Kuhnian sense (that is, where previous understandings of the construction of knowledge continue until they are succeeded; Kuhn 1970), it is by observing changes over time that a patterned landscape of different fields of design and architectural research emerge (as well as underlying motivations for their formation). It is Guba and Lincoln's understanding of a paradigm as a way of addressing the world according to a set of fundamental beliefs, or 'worldview' (Guba and Lincoln 1994, pp. 105−117), that more appropriately suggests that different paradigms operate in design research at any one time (Büchler, Biggs, & Stahl, 2009). Indeed, it is by examining shifts in methodological orientation over time that we can comment on similarities and differences, and whether 'design research' and 'architectural research' can be considered to have distinct scientific research programmes (Lakatos 1978). The argument will begin to disambiguate between strong, epistemic arguments for disciplinary independence and political identity motivations for distinction between 'architectural research' and 'design research'. It will do this by drawing attention to disrupters − e.g., government structural interventions − that have changed the research landscape, as well as more recent changes that have led to: first, expansion in understanding 'design' as an agent for societal change, as part of an engaged research agenda; and second, the different ways that 'practice' and practice-based research open up new epistemic debate.

1 Design and architecture, a common ground

In the 1980s several important arguments and perspectives on design research led to a distinct understanding of the nature of design, which was different from the previous generation's Design Methods movement. The Design Methods movement was underscored, primarily, by scientism, where the methods and epistemology were driven by the orthodoxy of replicable

experiments. In contrast the line of research enquiry posed by the next generation of design researchers shifted from questions of efficiency and effectiveness to themes including the nature of design competence and studies of design expertise (summarised in Cross, 2004) (although efficiency questions still persist in some fields of design research). Studies of the nature of design led to understanding that design has its own 'way of knowing', a way of knowing how to understand a design situation from a 'designerly' perspective (Cross, 1982). Design has its own epistemics, in how new knowledge and understanding in-the-moment of a design situation is constructed. This 'way of knowing' is different from the logico-deductive construction of knowledge in the positivistic Cartesian sciences and also different from the humanities. There were new research questions to ask that required a re-orientation and shift in methodological focus.

From this common understanding of the new field of design research cracks began to emerge. At the time Bill Hillier and Adrian Leaman were unusual, adopting a different stance from the majority of architectural researchers who were active in the design research community. When design research was marking its own field of knowledge, Hillier and Leaman (1976) were proposing architecture as a discipline, where the study of the built environment can arise naturally from the activity of architecture. This attempt to separate architecture from design research was notable as leading architects and mathematicians engaged in the new field of computing research from within the design research community (e.g. Philip Steadman, George Stiny working on foundational CAD and shape grammar research). These fields of research, which now might be viewed as niche, have developed their own specialist journals (*Nexus* founded 1999, *Environment and Planning* series launched in 1969 and *Automation in Construction* in 1992) and were at the time core to design research. Mathematical reasoning and design cognition provided the methodological foundation for these fields. Within what was a very broad landscape of design research, some specialisation and the marking of formative research territories around methodology started to emerge. Hillier and Leaman's actions led to the formation of new research fields, in space syntax and building performance studies, which can now be understood as early initiatives to define lines of research enquiry that were specifically architectural.

The argument on disciplinarity that is put forward in this paper is informed by first-hand experience when I became engaged in these debates, working on a series of research policy agenda setting projects in the 1990s. The initial project was an Engineering and Physical Sciences Research Council (EPSRC) commission, to map the built environment research landscape at research-active UK universities (Lansley, Luck & Lupton 1994). At the time the UK Government was questioning its investment in research and the pathways from research to industry. Rogers' model of the diffusion of innovation as a behavioural process was dominant, where innovation and novelty were considered

to follow social pathways from university research to industry (Rogers 1995). The research project was able to illustrate that the exchange of knowledge and innovation occurred in both directions (Lansley, Luck & Lupton 1995). The EPSRC research was followed by a Royal Institute of British Architects (RIBA) Research Endowment project, which extended the number of schools of architecture visited, as well as the depth and range of architectural research that was studied. The first ConstructIT research agenda adopted the delphi forecasting method I used when assisting UK Technology Foresight Exercise (Betts, Luck, & McGeorge, 1999). Unwittingly, I was part of a number of commissions that fed into reform strategies that triggered debates about research in universities in the United Kingdom in 1990s. This was a time of significant change. It is this experience and exposure, as part of the design research community and as an architect conducting research in a built environment school that adds depth to this view across a broad design and architectural research landscape.

The EPSRC and RIBA studies of research ongoing at schools of architecture drew attention to research excellence in established fields. First, in architectural history and theory, applying research methods from history, visiting and examining buildings in situ. Architectural theory was at the time immersed in the post-modern discursive turn. Second, in building science, where building performance, heating and lighting research was often conducted by physicists engaged in normative experimental science. Third, studies of buildings in culture and society were conducted through humanities and social sciences. Environmental design research was underscored by environmental psychology research methods, which already had an established conference series, EDRA Environmental Design Research Association and the journal *Environment and Behaviour,* launched in 1969. The project also revealed pockets of research excellence in research groups in pre-1992 universities. The clustering was around key individuals leading a field of research. The research methods that were applied in architectural research, with few exceptions, originated in other disciplines: from physics, philosophy, history and psychology (the fascination with research methods from geography, social sciences and science and technology studies was yet to happen).

The overlap of design studies research and architectural research in the 1990s was arguably most prominent in Bryan Lawson's research programme at Sheffield University (Lawson 1994, 2004; Lawson and Loke 1997). It was in the teaching of professional practice and management that many schools of architecture began to engage in discussions of architectural practice. However, at the time, many schools were yet to recognise the potential of architectural design in practice as a form of research (indeed, this was before the so-called 'practice-turn'). Although design skills were being developed in the studio, design, as a research subject, was only acknowledged at a few schools of

architecture. It is an understanding of how design as a research subject unfolds over several decades that will be traced through this argument.

In the next section we move from an era when the discipline of design included design studies of architecture, to a period when structural changes in the UK research landscape began to open up a space and motivation for disciplinary differentiation. Changes that occurred initially in the UK research landscape have had repercussions in other parts of the world.

2 *Government intervention in research*

The UK Government revised its approach to research funding, which activated debates linked to the research quality Research Assessment Exercises (RAE) in 1992. The debate started on how creative art practices — architecture being one— might be assessed as research. Architectural research was included in three units of assessment (UoA) in the 2001 RAE: built environment; history of art, architecture and design; and art and design (Rendell 2004), that is, in combination with design research in two units of assessment. The RAE can be viewed as a structural change that disrupted the ways that research was understood and how it is now conducted.

The Arts and Humanities Research Board (AHRB) became a legally independent organisation in 2001 (The Guardian 2001) and was another structural change. The AHRB was a funder of research studentships, providing support for the next generation of design research scholars. The AHRB also began to question similarities and differences between Art, Design and Architecture research. "*The professional disciplines of art, design and architecture have many differences but all share a tradition of situating learning and scholarship in a professional practice setting. 'Practice-led research' can be thought of as a natural extension of this principle since many academics in these fields see practice as the natural arena for enquiry and the methods of practice as methods of enquiry*" (Rust, Mottram & Till 2007). Several aspects of 'practice' become important in research, including the study of (design) practices and how, methodologically, to study practice (using which methods).

For the design community the RAE research assessment exercise, on reflection, may be considered to have acted in its favour. It prompted debate concerning the different ways design research contributes to new knowledge, leading to discussion of the differences between research *for design* and *through design* as well as research *into design* (Frayling 1993). Design's strength was that it already had a community of researchers. There was increased interest in becoming a member of the Council of the DRS Design Research Society. The design research community already had an international conference series and established peer-reviewed journals (*Design Studies*, *Design Issues* etc), and

new ones were introduced, indicating growth and specialisation within a research field (noted by Cross, 2019).

Within schools of architecture the RAE engendered interest in establishing new journals (with discussion of the scope of new journals at the Martin Centre, Cambridge University, at York School of Architecture, *arq Architectural Research Quarterly* 1995 and *Environments by Design* at Kingston 1996). Indeed, in architecture it was recognised: "[t]*here is no single published ranking system agreed internationally, rather different academic groups regard certain journals and publishers to have more status than others — it is here that the disciplinary differences that lie buried within the term 'arts and humanities' start to surface, concerning, for example, different paradigms of knowledge and research methodologies in social science and visual arts practice*" (Rendell 2004).

The introduction of the RAE provided a motive for schools of architecture to promote their research activities (as funding follows quality performance). Peer-reviewed journals can be viewed as an indicator of a sustained research programme (Lakatos 1978) and/or reflect a paradigm war within a field (Gage 1989). There was, however, a problem: architectural research was not ranked as highly as other built environment, positivistic science in RAE 2001. "*The diversity of methods and complexity of output types, combined with the composition of UoA 33 [the unit of assessment for Built Environment research], led to results that many feel did not properly reflect the strengths of architectural design, particularly practice-led research. This methodology essentially disenfranchised a significant part of the community from the RAE process to the detriment not only of the community, but to the credibility of the process itself*" (Rendell 2004).

Architectural research needed to develop its unique 'architectural' identity. The view that Rendell (2004) presents is that architectural research is a complex subject area, which involves a number of disciplinary procedures, including the specific practice of architectural design. Rendell goes on to suggest that if a discipline is defined by a system of rules or a method of practice then architecture is not a discipline. However, if it is defined as a field of study containing a number of disciplinary approaches with a shared object of investigation then architecture could be defined as a subject. It continues to be debated whether architecture is unique as a subject because of the particular combination of disciplinary approaches it comprises, or are any of these disciplinary approaches in themselves considered unique? Till debunks several myths (Till 2008). In the next section we probe further what might be a unique architectural element and find that 'design' plays a prominent position.

3 Further developments – new articulations of 'design' and 'practice'

The research landscape changes and adapts to many influences. Two changes in particular have influenced how design and architectural design research are viewed in the twenty-first century. The first is expansion in understanding what 'design' is and how design can change the world through engaged research. The second concerns 'practice', in the different ways that practice-based research is conducted. Both concepts are central to debates on how new knowledge is constructed and how disciplines are defined.

3.1 Design's responsibility in societal change

Design is acknowledged to have a social purpose and design approaches inform ways of policy making, for example, UK Government Cabinet Office (Kimbell 2015). The things that are now understood to be designed include policy, interactions, services, environments as well as the artefactual 'stuff' with which design is routinely associated. In design research situated design studies, sustained systematic enquiry and external engagement are closely entwined. Now social innovation, grass-roots activism and public engagement are acknowledged as pathways to new knowledge and lead to changes in society. User-publics engage in research as experts, as 'professionals of the everyday' (Meroni, 2007, p. 127). Government investment increasingly supports research that is embedded in practice, as well as research that leads to longer-term impact and change in everyday practices. This change in perception of what 'design' is opens up a space for activities that are conducted by non-academic researchers to be valued as part of a research process. It expands the realm of activities and practices that are associated with design research. It also extends the boundaries of the discipline of design and the domains in which design research operates.

This shift in perception reflects the view that engaged design research can have direct impact on the world and not just in research settings, amongst an academic elite. The location of research also changes, leaving the laboratory and moving into the field (a methodological subject discussed by Rendell (2011), pp. 172–177 in architecture and by Koskinen et al. (2011) in design). This migration is different from design research studies 'in the wild' where design researchers observe what takes place in real-world settings, such as the workplace. Instead it invites practice-based research, that is, research that is conducted through practice (through direct actions, activities and practices that take place in practice/the field) as well as research that studies human practices. This form of engaged research takes place at different scales, for example, in living labs, urban laboratories and at a more local scale on individual projects with a community.

This impetus for social change through design has a lineage. Tony Fry, John Thakara, Ezio Manzini and others led critical philosophical inspection of design for politics, sustainability, ethics, design futures and intercultural design theory. This criticism of design was often published in the journal *Design Philosophy Papers* and continues in the journal *She-ji*. Architecture's social change agenda has been advanced most prominently through fields such as participatory design (e.g. through Henry Sanoff's research programme, Teddy Cruz initiatives, and in education at Sheffield School of Architecture (Luck 2018) as well as shifts in perspective that reflect global concerns and grand challenges (Fraser 2018)). In architecture, the *ARENA Journal of Architectural Research* (AJAR) *"seeks to include every conceivable form of architectural research … ranging from the most scientific through to the most creative … unifying innovative design-based and practice-based research with the more traditional methods of architectural research"* (Fraser, 2016). AJAR addresses what is acknowledged to be problematic - how to publish PhD by design work (Fraser, 2013). AJAR promotes an holistic view of architectural research, in a similar way to the broad coverage of design in the journal *Design Studies* (Cross, 2019) (a discipline with inter-disciplinary coverage).

In this shifting landscape we next consider how practice-based approaches have changed the boundaries of design research and architectural research.

3.2 *Practice-based design research*
The form of research that has been most recently debated is practice-based research (practice-based design, practice-led, design-based research and research *through* design). Practice-based research has a variety of meanings: *"The expression, 'practice-led', does not describe a single set of ideas about research … Its value is to indicate research practices, emerging from Art, Design & Architecture (ADA) and other creative disciplines, that complement methods of enquiry adopted from the humanities and sciences"* (Rust, Mottram & Till 2007).

In research through design, researchers apply design practice methods to see the new problems that are produced (Zimmerman, Forlizzi, & Evenson, 2007). "[R]*esearchers make prototypes, products, and models to codify their own understanding of a particular situation and to provide a concrete framing of the problem and a description of a proposed, preferred state. Designers focus on the creation of artifacts through a process of disciplined imagination, because artifacts they make both reveal and become embodiments of possible futures"* (Forlizzi & Zimmerman, 2008). Research through design however has been criticised for being fuzzy, lacking strong theory to guide its practice or guidelines on how to proceed (Koskinen, Zimmerman et al., 2011, p. 5). Introducing a new word, knowingly, to avoid difficulties with existing concepts, "*the term 'constructive design research' refers to design research in which construction, be*

it *product, system, space or media-takes centre place and becomes the key means in constructing knowledge ... there are dozens of good examples. For this reason, we explicate practice rather than try to define a field with concepts as big as design and research*" (Koskinen, Zimmerman et al., 2011, pp. 5−6).

Constructive design research attempts to "*bring design into the middle of the research*" (Koskinen, Zimmerman et al., 2011 xiii). Indeed, "*instead of posing research questions and then finding answers, in much design research the process operates through generative modes, producing works at the outset that may then be reflected upon later*" (Rendell 2013). This way of constructing new knowledge is propositional. Working through aesthetic and material concerns in propositional ways in one situation, to produce conceptual models for theorising and generating new possibilities in others (Ivarsson and Nicewonger 2017).

This is an inductive, grounded way of constructing knowledge through artistic and creative design activities and practices. Indeed, "*Characteristic of artistic research is that art practice (the works of art, the artistic actions, the creative process) is not just the motivating force for the subject matter of research, but that this artistic practice - the practice of creating and performing in the atelier or the studio − is central to the research process itself. Methodologically speaking, the creative process forms the pathway (or part of it) through which new insights, understandings and product come into being*" (Borgdorff, 2011). Creative practices invite 'unfinished thinking', where the artistic knowledge seeks not so much to make explicit a form of knowledge production but rather provides a pre-reflective, non-conceptual content (Borgdorff, 2011). Rendell (2013) observes that architectural design researchers will investigate ideas through the production of work first, and then consider the larger field to argue how the particular knowledge they have created is original.

The logic for this way of constructing knowledge has been advanced through critique of the theory and epistemics of arts and creative practices research (Biggs and Karlsson 2011). It is understood that design practice can illustrate, demonstrate, prove or explore theoretical constructs and contribute to the generation of knowledge (Büchler et al., 2009). From this understanding Biggs and Büchler propose that in architecture, design practice is an alternative research paradigm. Practice-led research therefore provides a promising vantage point from which to probe what is uniquely 'architectural' in architectural research.

3.3 *What is uniquely 'architectural' in architectural research?*
In design research's formative years it was questioned what is 'the vacant plot' and how to go about the 'naming of parts' (Archer 1979a,b). In the twenty-first century, 'design' is viewed as architectural research's 'vacant plot'. Indeed Hillier and Leaman claimed architecture as a discipline, where the study of

architecture arises from the activity of design (Hillier and Leaman 1976). Similarly, for Lawson, architectural research is grounded in the work/activities of architectural design and the "*extent the work can drive the field forward*" (Lawson 2002). However, given that there are numerous design studies that have examined (theoretically and methodologically) architectural design work in practice (Lloyd 2003; Luck 2012) what is the unique position that a study of design might take through architectural research?

There are certainly research methods that have arisen from the study of architecture. Space syntax is a form of spatial analysis that is analytically different from design research's shape grammars. What seems to be under-developed are research questions and methods that get to the heart of 'architecture', to claim architecture as a strong research discipline (Lakatos 1978). Rendell proposes that central to the subject of architecture is architectural design, a particular mode of practice-led research whose disciplinary specificity cannot be found in other types of practice or design, which makes architecture unique as a subject and as a discipline (Rendell 2004). There continues to be a need to develop research questions and methods that are specific to architectural knowledge.

3.3.1 The design - architecture's different sense of what 'design research' entails

There is a particular sense in which the term 'design' is used in architecture. Architects often speak of 'the design' as a reference to the design work (project, building, detail, scheme) in progress. Getting to the heart of 'the design' to arrive at what is 'architectural' within it is core to architecture as a professional practice.

It is suggested that architects' acts of designing generate specific new knowledge, as "each design is an answer to a set of questions and circumstances that are unique, and so every design is 'research'" (Weinstock 2008). Weinstock comments on how this form of *design research* exploration and experimentation in a design process, is different from *scientific research* that sets out to systematically test a hypothesis. He champions *architectural design research*, which positions architects and design at the centre of the research.

3.3.2 Architectural design research ADR

"[A]*rchitectural design research can be described as the processes and outcomes of enquiries and investigations in which **architects** use the creation of projects, or broader contributions towards design thinking, as the central constituent in a process which also involves the more generalised research activities of thinking, writing, testing, verifying, debating, disseminating, performing, validating and so on*" (Fraser, 2013, pp. 1–2 my emphasis). This description resonates with Berdoff's (2011) previously mentioned understanding of the creative process

as a motivating force for the research, as well as the pathway through which new insights, understandings come into being.

While Fraser's definition positions architects as the agents of ADR, Megahed considers that architecture researchers also use the creative process for critical enquiry in which design is a central part of the research (Megahed 2017). While on one hand ADR opens up a space for the activities of non-academics (practitioners) to be valued as research, on the other, this reinforces a view that architects alone have unique insight into what is 'architectural'. Indeed, it is the atelier tradition that has been most transformed, seeking opportunities for 'design research' whilst simultaneously developing a professional practice (Weinstock 2008). While advanced practices, such as Fosters and Zaha Hadid Architects, often establish connections with universities though research, they also lead their own research enquiry through design. The Design Research Laboratory programme (AADRL) at the Architectural Association was a forerunner, making several important moves: by acknowledging design research as part of an architectural design process and by seeing the potential of the studio as a design research laboratory, where the design exploration of students meet practitioners who are leading architects of experimental form (Schumacher 2010). Bringing practitioners into the studio as part-time tutors is routine in most schools of architecture. In theory it is a model for a full knowledge creation cycle that builds the field and the practice (Friedman 2000). However, practitioners have different design competence, degrees of experimentation in their design practice and variable understanding of what constitutes research. This brings into question how valid, in general, is the argument that practitioners' everyday, routine design practices can be viewed as research.

In an attempt to bridge a gap between practitioner design research and academic models of research Leon van Schaik has developed a framework for PhD by project (design work). It is the act of critical reflection on practice that aims to distinguish design in practice from design research whilst in practice. In the programme architects reflect on their work but do not stop practicing (Blythe & Schaik, 2013, pp. 53−70). Three categories of reflection-in-practice research were defined (reflection *on*, *in* and *for*). Some very familiar design studies questions are raised as they "*bring to the surface evidence about what designers actually do*" (Blythe & Schaik, 2013, pp. 53−70). The research that involves *reflection on*, when practitioners 'recall' aspects of earlier projects, is a mode of enquiry that is similar to design research on the theme of analogical reasoning. Research that involves *reflection in* and *reflection for* practice overlaps with design studies research of architects' designing. Although the framework may be novel in architectural research, there is already a body of design research that maps onto each of these categories. Given these overlaps, this mode of PhD enquiry does not mark out a territory that can be considered as uniquely architectural.

4 Implications for design studies

In response to the question that drives this paper, whether there are substantive differences between design research and architectural design research, the answer is yes, or could be yes. This response is contingent on architectural design research being viewed in its most-strict sense, as research solely conducted by practitioners. There is, however, a more fluid interpretation that opens up debate at the boundary of these research fields.

This review is sympathetic to the motivations for schools of architecture to assert architecture as a research discipline that is distinct from design. Changes in the UK research landscape, including the RAE, provided a financial and political motive to define a stronger identity for architectural research. Epistemically, however, neither design nor architectural research exists as a monolithic instrument of epistemology but as a multitude of approaches based on the different traditions. This argument has shown that it is not only epistemic positioning that asserts the nature of a discipline but also the construction of an identity for a field of research.

There is an identity issue for architectural research as its methods are plural and diverse. Research fields and fiefdoms emerge over time, as we have seen, around academic journals and conference series. It is not that one methodological approach supersedes another in design or architectural research, as new methods and theory coexist alongside previously dominant fields of research. There are major and minor paradigm wars, where for example, the methods used to study design have shifted from positivist, to cognitivist, to discursive, then turning to practice and more recently acknowledging embodied and experiential understanding of the world we all inhabit. Research in all of these forms is still undertaken.

Design is core to architectural practice. There is one view that characterises architectural design research ADR as research that is specific to architecture, as it is undertaken by practitioners -architects are the researchers, researching design through their practices. From this perspective ADR is core to developing the practice and conception of architecture as a discipline. There is a more plural sense of ADR where the researcher observes and reflects on new understandings of design but is not necessarily a practitioner. In either case what is distinctive about ADR is its constructive and generative contribution to new knowledge through design. ADR has a different epistemological logic from the Cartesian sciences and the humanities where a research question is proposed first. It can be empirically ground in a single case that can generate theory (Ivarsson and Nicewonger 2017) to build themes within a general research programme (Friedman 2000).

When ADR is viewed in its more plural sense, ADR and design research overlap. It is at the intersection of atelier architecture with detailed design studies that the boundaries of design research and architectural design research are blurred. Arguably, it is as close an approximation to what architecture, as a pure form of design research, might look like. This is illustrated in the collaboration between SCI_ARC Southern California Institute of Architecture, ARCH5 with Jonas Ivarsson. Their research is a blend of epistemic perspectives, between Ivarsson's rigorous social science research, in conjunction with the highly experimental architectural work of ARCH5 architects. This exploration acknowledges that architectural design research can have "*less to do with the pragmatics of building a building and more to do with the innovation of research methods that will lead to the development of new forms of architectural expertise*" (Ivarsson and Nicewonger 2017). When inspecting the qualities of the generative outcomes from tampering with a CNC cutting of a block of wood, they comment on "*how experimental practices expand the frontiers of architectural knowledge*" and appreciate "*the knowledge producing practices of architectural researchers*" (Ivarsson and Nicewonger 2017). What is remarkable is that from a robust theoretical and methodological research position, they inspect unique moments of reflection to abstract theory. Theory that is taken forward in subsequent architectural practice and in research understandings of design in architectural practice. It is noteworthy that they recount this experiment in separate papers to express different disciplinary perspectives. In the second paper SCI-ARC takes the lead, examining "*architectural ways to knowledge*" (Gow, Ivarsson & Karlsson 2015).

This kind of collaboration and reportage on experimental architectural design research could be debated and published in journals such as *Design Studies*. It is a development from the inspection of the actions and practices of designers at work, which has been a significant theme of research published in *Design Studies*. Ivarsson and Nicewonger present an account of practice (with some empirical material) that is followed by critique/reflection on the materials. It also includes theorised reflection on practice and is therefore different from practitioners' own accounts of their design practice. It is this reflection on practice within a research argument that is encouraged within mainstream design research.

To conclude, this inspection of the changing interpretations of design, design research, architectural design research and practice has drawn attention to the fluid boundaries between design research and architectural design research. There continues to be debate on what architectural design research entails and there is fertile ground to reflect on what is distinct about architectural design knowledge.

Declaration of Competing Interest

I declare I have no conflict of interest in the submission of this research paper.

Appendix A. Supplementary data

References

Archer, L. B. (1979a). The three Rs. *Design Studies, 1*(1), 17−20.

Archer, L. B. (1979b). Whatever became of design methodology? *Design Studies, 1*(1), 17−20.

Betts, M., Luck, R., & McGeorge, D. (1999). Long-term IT research priorities. Strategic management of I.T. In *Construction. M. Betts* (pp. 331−362). Oxford: Blackwell Science Ltd.

Biggs, M., & Karlsson, H. (Eds.). (2011). *Routledge companion to research in the arts.* Abingdon: Routledge.

Blythe, R., & Schaik, L. (2013). What if design practice matters? Design research in architecture: An overview. In M. Fraser (Ed.). London: Ashgate.

Borgdorff, H. (2011). The production of knowledge in artisitc research. In M. Biggs, & H. Karlsson (Eds.), *Routledge companion to research in the arts* (pp. 44−63). Abingdon: Routledge.

Büchler, D., Biggs, M., & Stahl, L.-H. (2009). Areas of design practice as an alternative research paradigm. *Design principles and practices, 3*(2), 327−338.

Cross, N. (1982). Designerly ways of knowing. *Design Studies, 3*(4), 221−227.

Cross, N. (2004). Design expertise: An overview. *Design Studies, 25*(5), 427−441.

Cross, N. (2019). Editing Design Studies - and how to improve the likelihood of your paper being published. *Design Studies, 63*(July), A1−A9.

Forlizzi, J., & Zimmerman, J. (2008). The role of design artifacts in design theory construction. *Artifact, 2*(1), 41−45.

Fraser, M. (2013). *Design research in architecture: An overview.* London: Ashgate.

Fraser, M. (2016). A new deal for architectural research. *ARENA Journal of Architectural Research, 1*(1), 1.

Fraser, M. (Ed.). (2018). *Sir Banister Fletcher's global history of architecture.* London: Bloomsbury.

Frayling, C. (1993). Research in art and design. *Royal College of Art Papers, 1*(1), 1−5.

Friedman, K. (2000). *Creating design knowledge: From research into practice. IDATER.* Loughborough University.

Gage, N. (1989). The paradigm wars and their aftermath: A "historical" sketch of research and teaching since 1989. *Educational Research, 18*(7), 4−10.

Gow, M., Ivarsson, J., & Karlsson, U. (2015). *Architecture in the penumbra. The expanding periphery and the migrating center. L. Sheppard and D. Ruy.* ACSA Press.

Guba, E., & Lincoln, Y. (1994). *Competing paradigms in qualitative research. Handbook of Qualitative Research. N. Denzin and Y. Lincoln.* London: Sage Publications.

Hillier, B., & Leaman, A. (1976). Architecture as a discipline. *Journal of Architectural Research* 28−32.

Ivarsson, J., & Nicewonger, T. (2017). Design imaginaries: Knowledge transformation and innovation in experimental architecture. *Mind, Culture and Activity*(24), 1.

Kimbell, L. (2015). *Applying design approaches to policy making: Discovering policy lab*. Brighton: University of Brighton, AHRC.

Koskinen, I., Zimmerman, J., Binder, T., Redstrom, J., & Wensveen, S. (2011). *Design research through practice: From the lab, field and showroom*. Waltham: Elservier Inc.

Kuhn, T. S. (1970). *The structure of scientific revolutions*. Chicago: The University of Chicago Press.

Lakatos, I. (1978). *The methodology of scientific research programmes*. Cambridge: Cambridge University Press.

Lansley, P., Luck, R., & Lupton, S. (1994). *Construction research in UK universities: Accessibility, assessment and application*. Swindon: EPSRC.

Lansley, P., Luck, R., & Lupton, S. (1995). The organisation of construction research in British Universities. *Engineering Construction and Architectural Management, 2*(3), 179−195.

Lawson, B. (1994). *Design in mind*. Oxford: Butterworth-Heinemann Ltd.

Lawson, B. (2002). Design as research. *Arq: Architectural Research Quarterly, 6*(2), 109−114.

Lawson, B. (2004). *What designers know*. Oxford: Architectural Press.

Lawson, B., & Loke, S. M. (1997). Computers, words and pictures. *Design Studies, 18*(2), 171−183.

Lloyd, P. (2003). Designing in context. *Design Studies, 24*(3), 195−197.

Luck, R. (2012). Doing designing`: On the practical analysis of design in practice. *Design Studies, 33*(6), 521−529.

Luck, R. (2018). Participatory design in architectural practice: Changing practices in future making in uncertain times. *Design Studies, 58*, 139−157.

Megahed, Y. (2017). On research by design. *Arq: Architectural Research Quarterly, 21*(4), 338−343.

Rendell, J. (2004). Architectural research and disciplinarity. *Arq: Architectural Research Quarterly, 8*(2), 141−147.

Rendell, J. (2011). *Afterword: Working through the field :/. Architecture and field/work*. *S. Ewing*. London: Routledge.

Rendell, J. (2013). A way with words: Feminists writing architectural design research. Design research in architecture: An overview. In M. Fraser (Ed.) (pp. 117−136). London: Ashgate.

Rogers, E. (1995). *Diffusion of innovations*. New York: The Free Press.

Rust, C., Mottram, J., & Till, J. (2007). *Review of practice-led research in art, design & architecture*. Sheffield Hallam Unviersity.

Schumacher, P. (2010). *Architecture schools as design research laboratories. Total fluidity: Studio Zaha Hadid 2000-2010. Z. Hadid and P. Schumacher*. Wein/New York: Springer.

The Guardian. (2001). *Arts and humanities research board*. The guardian.

Till, J. (2008). Three myths and one model. *Building material, 17*, 4−10.

Weinstock, M. (2008). Can architectural design be research? *AD Architectural Design, 78*(3), 112−115.

Zimmerman, J., Forlizzi, J., & Evenson, S. (2007). Research through design as a method for interaction design. In *Conf. on Human Factors in Computing Systems*. ACM.