Beyond the Paper Trail: Challenging Traditional Outputs in Design Research

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Abstract

We live in a world bloated with data yet starved for wisdom (Kapu'uwailani Lindsey, 2012). As sustainability challenges grow increasingly complex, the limitations of traditional, data-centric research approaches become apparent. This paper argues that the transition towards sustainability necessitates not just technological innovations, but a fundamental ontological shift in how we structure knowledge claims. Modernist systems of values in research, characterised by control, reductionism, and quantification (Latour, 1993), often marginalized tacit knowledge, indigenous ways of knowing, and intuition. Specifically, this paper advocates for the adoption of Research through Design (RtD) (Frayling, 1994; Zimmerman et al., 2007) as a methodological paradigm that bridges the gap between quantifiable data and the lived, context-sensitive realities that are vital for sustainable futures. Finally, we discuss the types of research outputs needed to support this shift, moving beyond traditional peer-reviewed papers and bibliometric quantification towards a more holistic and impactful approach to knowledge production.

introspection; design research; academic outputs; tacit knowledge; intuition

In this secular age of interconnected digital datafication, the quantification of human experience into neatly labelled boxes has become the dominant mode of knowledge production (Mayer-Schönberger & Cukier, 2013). This shift towards data-driven and evidence-based understanding of the world around us has been an integral part of modernity and has brought about significant advancements in various fields, including design research. However, as we confront the complex, interdependent challenges of sustainability, it becomes increasingly clear that this domination of scientific approaches is a symptom of the problem. The reduction of knowledge to measurable and siloed units often overlooks the tacit, embodied, and experiential forms of understanding that are essential to address the interconnected crises of late-stage modernity (Boehnert, 2018).

This paper explores the limitations of modernist epistemologies that prioritise data over the richness of human experience. It argues for a rethinking of research paradigms, particularly within design research, to integrate tacit knowledge, indigenous ways of knowing, and introspection into the matters of concern and ways of producing scholarly outputs in the context of design research. In this paper, the adoption of Research through Design (RtD) (Frayling, 1994; Zimmerman et al., 2007) as a methodological paradigm that can bridge the gap between quantifiable data and the lived realities is argued. The paper also questions what types of research outputs can better reflect this approach, moving beyond traditional academic textual formats towards more holistic and designerly forms of knowledge dissemination.

The Datafication of Knowledge: A Modernist Legacy

Datafication refers to the transformation of various forms of knowledge, behaviour, and human experience into quantifiable data (van Dijck, 2014). This process is facilitated by technologies such as sensors, algorithms, and big data analytics, which enable the continuous and granular capture of information. As a result, datafication has become a dominant paradigm in fields ranging from business and marketing to healthcare and governance. Naturalistic materialism, an ideology that is linked to the physical sciences (Hick, 2002), seems to be the only belief system that is compatible with them (Taylor, 2007). As an ideology, naturalistic materialism aims to understand the whole of the natural existence through the application of the scientific method and mould it to human needs. This ideology posits that the "values-free" physical universe constitutes the totality of existence, and, thus, any metaphysical consideration such as ethics or aesthetics that cannot be addressed by the scientific method does not have any merit (Tillich, 1952; Taylor, 2007).

The values embedded in datafication—control, reductionism, quantification and replicability—are hallmarks of modernist thought and even they though they have been refuted (Gödel, 1931; Heisenberg, 1927) these values have shaped research practices across disciplines, leading to an overreliance on data as the primary source of knowledge. In design research, this has manifested in the widespread adoption of methodologies that prioritise measurable outcomes, often at the expense of more qualitative, context-dependent forms of understanding. This reductionist approach tends to overlook the complexity and interdependence of systems, leading to solutions that tend to focus on the symptoms over the underlying malady. While data-driven methodologies have their merits, they are inherently limited in their ability to address the full complexity of human experience and the interrelated challenges of sustainability. This fragmentation can lead to a narrow focus on specific metrics, overlooking the broader context in which these metrics are situated. For example, in environmental sustainability research, a focus on carbon emissions alone might neglect other critical factors such as biodiversity, social equity and justice, the relevance of local cultural practices or metaphysical notions that are integral to the human condition.

During the 20th century, the rise of computing and information technology further accelerated the process of datafication. With the advent of digital technologies, nearly every aspect of life—social interactions, personal habits, health metrics, and even emotional states—began to be captured as data. The growth of the internet and the proliferation of digital devices have turned datafication into a pervasive force, affecting not only individual behaviours but also organisational and societal structures. We have witnessed the rise of the "quantified man", a digital twin woven from the threads of all the digital traces our daily entanglements leave on the cyberspace, an aberrant homunculus pretending to be us.

While datafication offers powerful tools for analysis and decision-making, it also presents significant ethical and epistemological challenges that warrant critical examination. These challenges are particularly evident in fields like neuroscience, where the validity of research methodologies has profound implications for our understanding of human cognition and consciousness. For instance, in neuroscientific research using functional magnetic resonance imaging (fMRI), there exists a fundamental methodological limitation: it is impossible to collect brain imaging data from subjects who are unaware they are being observed (Rose, 2016). This observation bias creates a significant epistemological problem—how can we claim to understand "natural" brain functioning when the very act of measurement alters the phenomenon being measured? This example illustrates not just a technical limitation but a deeper philosophical challenge to the positivist paradigm that underlies much of contemporary data-driven research.

Similarly, in the realm of social media analytics, the quantification of human interaction through metrics like engagement rates, sentiment analysis, and influence scores creates representations that are often divorced from the actual lived experiences they purport to measure. What appears as objective data is in fact highly constructed and shaped by the platforms' architectures, algorithmic priorities, and commercial imperatives (van Dijck & Poell, 2013). These systems don't simply measure social reality; they actively shape it, creating feedback loops that influence behavior in ways that further reinforce the metrics themselves.

With these considerations in mind, we can identify three primary limitations of a purely data-centric approach to design research:

Loss of Context and Meaning: Data-centric approaches often strip away the context in which data is generated, leading to a loss of meaning. For example, the datafication of social interactions through social media platforms reduces the richness of human communication to metrics such as likes, shares, or follower counts. This reduction overlooks the subtleties of interpersonal relationships, the cultural significance of certain behaviours, and the emotional underpinnings of communication.

Oversimplification of Complex Phenomena: Complex systems are often nonlinear, dynamic, and sensitive to initial conditions. Datafication tends to oversimplify these systems by focusing on measurable aspects while ignoring the less tangible but equally important factors. In medicine the novel ‘quantified man’ can have a wide array of health metrics yet what they mean or how they interplay is a blind spot of medicine leading to very dangerous medical (mal)practices.

Ethical and Epistemological Implications: The emphasis on data can lead to ethical concerns, such as the potential for surveillance, privacy violations, the commodification of personal information and even tailor made targeted misinformation campaigns. Moreover, by privileging data over other forms of knowledge, datafication risks perpetuating a narrow, technocratic view of the world that marginalises alternative ways of knowing. Finally the ownership of this data is a deeply political issue as corporations that aggregate this data have powers beyond those held by most state actors.

These limitations of datafication in knowledge production have particular significance for design research, which must often navigate complex, socially situated challenges that resist reductive quantification. To address these limitations, we must reconsider not only our research methodologies but also our understanding of what constitutes valid knowledge in design contexts. This necessitates a turn toward epistemological frameworks that acknowledge and value forms of knowledge that have been marginalized under the modernist paradigm, including tacit, indigenous, and experiential ways of knowing.

The Marginalisation of Wisdom

What happens to traditional ways of knowing such as tacit knowledge, indigenous ways of knowing, wisdom and intuition? These are critical elements of human understanding that are often overlooked or marginalised in scientific models as they do not fall into the traditional labels for our data driven hermeneutic models. These forms of knowledge share several characteristics: they are embedded in experience, context-sensitive, and difficult to formalise through the reductive, data-centric approaches dominant in modern scientific inquiry or even language. As we increasingly recognize the limitations of quantifiable, data-driven methods—especially in addressing complex,

interdependent challenges like sustainability—it becomes crucial to integrate these overlooked dimensions into contemporary scholarship. This section argues for the importance of these forms of knowledge in design research, illustrating how their marginalisation impedes our ability to address nuanced and context-specific problems, and proposes pathways for reintegrating them into research practice.

Tacit knowledge (Polanyi, 1958) refers to the implicit, subconscious or embodied knowledge that individuals acquire through experience and practice, and that is impossible to be codified or communicated. This type of knowledge is deeply embodied, involving skills, intuition, and practical know-how that may not be readily verbalised. In many fields, including design, engineering, and craft, tacit knowledge is foundational to expertise yet it is rarely valorised. In the context of scientific research, tacit knowledge plays a critical role, particularly in the processes of hypothesis generation, problem-solving, and interpretation of results. Researchers often rely on tacit knowledge when making intuitive leaps or recognizing patterns that are not immediately apparent through data analysis alone.

The marginalisation of tacit knowledge in research can lead to the undervaluation of the experiential, intuitive, and context-dependent aspects of inquiry. For instance, in fields like design research, where the process of making and iterating is central to knowledge production, the traditional emphasis on written outcomes and quantifiable data fails to capture the richness of the design process. As a result, important insights generated through hands-on experimentation and reflection may be overlooked or inadequately represented in research outputs.

In this discussion of tacit knowledge, we begin to see the contours of a deeper critique of modernity's dominant epistemological framework, one that overemphasises reductionism and control. This reductionist, left-brain approach to knowledge—emphasising control, quantification, and fragmentation—has been the hallmark of modernist thinking. While this mode of inquiry has given us tremendous technological and industrial advancements, it has simultaneously alienated us from more integrative, holistic ways of knowing that most pre-modern cultures have long embodied.

John Ehrenfeld critiques the modern fixation on growth, efficiency, and technological fixes as shallow approaches to sustainability. He argues that the industrial mindset reduces ecological and social systems into manageable parts, thereby flattening the depth and interconnectedness of human and non-human life (Ehrenfeld, 2019). This emphasis on control and efficiency reflects the left-hemisphere-dominant thinking that Iain McGilchrist (2019) describes in ‘The Master and His Emissary’. According to McGilchrist, the left hemisphere is concerned with categorization, abstraction, and manipulation of the world, leading to a fragmented understanding that can see only parts, not wholes.

Indigenous ways of knowing emphasise interconnectedness and wholeness, recognizing the inseparability of humans from their environment (Smith, 2012; Battiste, 2002). These systems align with the right-hemisphere mode of understanding, which sees the world as an integrated whole, full of relationships and context-specific knowledge that cannot be reduced to data points. Indigenous knowledge systems do not compartmentalise the world; instead, they offer a holistic framework where people, ecosystems, and the cosmos are in constant, reciprocal interaction. This contrasts sharply with the modern scientific approach, which often seeks to control nature by breaking it down into parts that can be measured, predicted, and manipulated.

The notion of pluriversal thinking (Escobar, 2018) offers a critical framework for reimagining design practices in a way that honours this complexity. Escobar argues for decolonizing design by moving beyond the universalism inherent in Western scientific paradigms. Modernist design (Ewen, 1988; Margolin, 2015) often seeks to impose a single, "correct" solution to complex problems, ignoring

the multiplicity of ways of knowing and being that exist across different cultures and ecosystems. Pluriversal thinking, by contrast, embraces a world of many worlds—where different knowledge systems, including indigenous ones, are recognized as valid and valuable in their own right. By adopting a pluriversal approach, design can become more attuned to local contexts, relationships, and the wisdom of the people and environments it seeks to serve.

The integration of indigenous knowledge systems, with their emphasis on wholeness and relationality, provides a pathway for overcoming the limitations of reductionist, data-centric approaches in design. Rather than viewing design as a purely technical problem to be solved through optimization and efficiency, we can begin to see it as a process of co-creation, rooted in context, experience, and relationality.

Research through Design: An Alternative Paradigm

Research through Design (RtD) has emerged as a significant methodological paradigm in design research that challenges the dominance of purely data-driven approaches (Frayling, 1994; Zimmerman et al., 2007). Unlike more traditional research methodologies that emphasize objective, quantifiable data collection and analysis, RtD focuses on the process of designing itself as a form of inquiry and knowledge generation. This approach recognizes that design activities—making, prototyping, experimenting with materials, and reflecting on these processes—can yield valuable insights that might not emerge through conventional research methods.

RtD is concerned with the generation of knowledge through the act of designing itself. The central tenet of RtD is that designing is a form of inquiry, where the creation of artifacts—whether they be products, systems, or services—serves as a way of investigating complex, real-world problems. This approach enables designers to engage with these challenges in ways that are responsive to their specific contexts, using the design process as a means of both problem-framing and problem-solving.

The methodology is particularly valuable in addressing what Rittel and Webber (1973) termed "wicked problems"—complex, ill-defined problems that resist straightforward solutions. Sustainability challenges, social justice issues, and other systemic problems often fall into this category, making RtD an increasingly important approach in contemporary design research aimed at addressing these critical areas. By emphasizing process, context, and reflection, RtD offers a way to navigate complexity that complements and extends beyond the capabilities of purely data-driven approaches.

Crafting scholarship

Craft plays a critical role in practice-based design research because it embodies a form of knowledge that is deeply rooted in experience, materiality, and context (Nimkulrat & Groth, 2024; Sennett, 2008). Unlike abstract knowledge forms that can be detached from their environments, craft is inherently situated, involving a deep engagement with materials, tools, and processes. This makes it an ideal medium for exploring the tacit dimensions of design—those aspects of knowledge that are difficult to articulate but are essential to the design process.

Tim Ingold's notion of "making" as a way of knowing (2013) is central to understanding the value of craft in design research. Ingold argues that making is not just about producing objects but about learning through doing, where the act of creation is intertwined with the development of knowledge. Craft, in this sense, is a form of embodied cognition where the designer's hands, tools, and

materials are all active participants in the knowledge-making process. This perspective shifts design research from a purely intellectual activity to one that is grounded in the material realities of practice.

Polanyi (1958) famously argued that "we know more than we can tell," referring to the tacit dimension of knowledge that is often unarticulated yet crucial for skilled practice. Tacit knowledge in design research manifests through the craftsperson's hands-on engagement with materials and processes, where much of what guides decision-making is intuitive, drawn from years of embodied experience. This unspoken, non-verbal knowledge is especially vital in situations of uncertainty and unpredictability—the essence of Pye's workmanship of risk (1968)—where the designer must rely on their ingrained skill and sensitivity to context.

David Pye's concept of the "workmanship of risk" is particularly relevant to understanding the role of craft in Research through Design (RtD), especially in relation to tacit knowledge. Pye distinguishes between two types of workmanship: the workmanship of risk, where the quality of the outcome depends on the maker's skill and the unpredictability of materials or processes, and the workmanship of certainty, where the outcome is predetermined and guaranteed by mechanisation or rigid processes.

In the context of craft-based RtD, the workmanship of risk aligns with the way tacit knowledge is engaged during the design process. As designers work with unpredictable or uncertain outcomes, they must draw on their embodied, intuitive knowledge to navigate and respond to these challenges. This process requires a high degree of reflection-in-action (Schön, 2017), where designers adapt their approach based on immediate feedback from the material or tool at hand. The risk inherent in this process reveals the limitations of pre-planned, purely theoretical models, underscoring the importance of craft and improvisation in practice-based research.

Reflection and Introspection in RtD

The iterative nature of RtD allows for continuous reflection and adaptation, as designers respond to the evolving conditions of the design context. This aligns with Donald Schön's concept of "reflection-in-action," which emphasises the importance of reflective practice in professional work.

Introspection, or the examination of one's own thoughts, feelings, and actions, has become an increasingly important method in practice-based design research (Xue & Desmet, 2019). In the context of RtD, introspection allows designers to reflect on their personal experiences, emotions, and intuitions as they engage with the design process. This introspective dimension of design research is critical for accessing tacit knowledge—those aspects of knowing that are difficult to articulate but are nonetheless essential to the creative process.

Donald Schön's concept of "reflective practice" (2017) provides a theoretical foundation for understanding the role of introspection in design research. Schön argues that professionals in fields such as design engage in a form of reflection-in-action, where they are constantly adapting their methods and approaches in response to the challenges they encounter. This reflective process is not merely a rational analysis of the problem at hand; it is also an introspective engagement with one's own practice. Designers, like other reflective practitioners, must draw on their tacit knowledge—gained through years of experience, intuition, and embodied practice—to navigate the complexities of their work.

In practice-based design research, introspection serves as a tool for uncovering these tacit dimensions of knowledge. By reflecting on their own experiences and thought processes,

designers can gain insights into the ways in which their personal history, values, and emotions shape their design decisions. This introspective engagement allows for a deeper understanding of the design process, as it reveals the often-hidden factors that influence design choices.

Method	Description	Application in RtD	Documentation Forms
Reflective Journaling	Systematic recording of design process, decisions, and personal reflections throughout the iterative cycles of making	Captures the temporal evolution of design thinking, material engagement, and tacit knowledge mobilization	Written journals, annotated sketches, photographic documentation with reflective annotations
Critical Incident Analysis	Focused reflection on pivotal moments or transformative instances within the design process where significant insights emerged	Identifies key decision points, epistemological ruptures, and their ontological implications for design knowledge	Narrative accounts, visual timelines, diagrammatic representations of critical junctures
Collaborative Reflection	Structured dialogic engagement between design team members about methodological processes and emergent outcomes	Surfaces multiple interpretive perspectives, intersubjective understanding, and collective knowledge construction	Recorded conversations, collaborative conceptual maps, co-created visual artifacts
Auto-ethnography	Self-reflective examination of personal experience situated within broader socio-cultural and material contexts	Connects individual design practice to wider socio-cultural factors, political economies, and historical contingencies	Personal narratives, contextual artifacts, relational documentation of embodied practice
Material Dialogues	Systematic documentation of interactions and "conversations" between designer and materials during the making process	Captures embodied knowledge, material agency, and the co-constitutive relationship between maker and material	Process photography, material samples, sequential documentation of material transformations

Table 1: Comparison of Reflection Methods in RtD

This table illustrates various reflection methods employed in RtD processes, demonstrating the range of approaches researchers use to document and analyze their introspective engagement with design practice. Each method offers different insights and can be documented through various forms, creating a rich tapestry of research outputs that extend beyond traditional academic papers.

Rethinking Research Outputs in Design Research

To fully realise the potential of RtD and similar approaches, we must reconsider the types of research outputs that are valued within academia. Practice-based outputs, such as design artifacts, prototypes, and installations, are central to RtD (Durrant et al., 2017). These outputs embody the knowledge generated through the design process and provide tangible evidence of research findings.

While traditional academic outputs like peer-reviewed papers and conference presentations remain valuable for disseminating research findings, they often fail to capture the full richness of design research, particularly the tacit, embodied, and experiential dimensions. This section explores alternative forms of research outputs that can better reflect the nature of knowledge generated through RtD and related approaches.

Practice-Based Outputs

Design artifacts, prototypes, and installations are central to RtD. These outputs embody the knowledge generated through the design process and offer tangible evidence of research findings. Through exhibitions and installations, researchers can engage with wider audiences, offering public interaction that fosters deeper understanding.

The 'Things of Design' group has explored these alternative outputs through a series of workshops at CHI conferences (Jenkins et al., 2016-2022), demonstrating how physical artifacts can communicate complex research insights in ways that traditional papers cannot. These workshops have shown how artifacts can serve as boundary objects between different disciplines and stakeholders, facilitating dialogue and knowledge exchange across traditional academic boundaries.

In their seminal work, Koskinen et al. (2013) recognize three spaces for RtD engagement: the lab, the field, and the gallery. Each of these spaces offers different possibilities for showcasing research outputs and engaging with audiences. The gallery, in particular, provides an opportunity to present design artifacts in a way that invites contemplation and interaction, allowing viewers to engage with the research through direct experience rather than merely reading about it.

Pictorials and Visual Documentation

Pictorials are visual-dense documents that combine photographs, sketches, diagrams, and other visual artifacts from the design process. This format has gained recognition in venues such as the ACM Designing Interactive Systems (DIS) conference, which has established a dedicated track for pictorials as legitimate research contributions (Blevis et al., 2015).

Unlike traditional papers that prioritize text, pictorials embrace the visual nature of design practice, offering a way to communicate tacit and embodied knowledge that might be difficult to express in words alone. They can show the evolution of a design, document the material exploration process, and capture the aesthetic and experiential qualities of artifacts in ways that text cannot.

Introspective Methods

Autoethnography, journaling, and narrative inquiry represent introspective methods that provide personal accounts of the design process. These approaches have gained recognition in fields such as HCI and design research as legitimate ways of generating and communicating knowledge (Ellis et al., 2011; Wright & McCarthy, 2018).

Autoethnography combines personal reflection with ethnographic research, allowing the researcher to document their lived experience during the creative process. This is particularly relevant in RtD, where tacit knowledge and personal engagement with materials, spaces, and communities play a crucial role. Journals and diaries can document the decision-making and reflective processes of designers, capturing insights not easily conveyed through other formats.

What distinguishes these introspective methods from simple reflection is their systematic and rigorous approach to self-examination, situating personal experience within broader theoretical and cultural contexts. This rigor ensures that introspective outputs contribute meaningful knowledge to the field rather than serving merely as personal documentation.

Experiential Outputs

Experiential outputs focus on documenting and communicating the lived experience of interacting with design interventions. These might include diary studies of user experiences, immersive documentation of design environments, or interactive demonstrations that allow others to engage directly with the research findings.

These forms are particularly valuable in fields like user experience design, where interactions with products or systems evolve over time. Experiential outputs reveal how users and designers adapt to and interact with design interventions, providing dynamic insights beyond one-time observations.

Wakkary et al. (2018) demonstrate this approach in their work on "material speculation," where they create artifacts that embody philosophical concepts and place them in everyday contexts for extended periods. The documentation of these long-term interactions provides insights that would not be captured through traditional research methods or outputs.

Research Output Type	Example	Key Characteristics	Contribution to Knowledge
Design Artifact and long term engagement	"Tilting Bowl" (Wakkary et al., 2018)	Physical computational artifact placed in domestic environment for extended phenomenological engagement	Embodied philosophical concepts through lived experience, challenging instrumental human-technology relations

Pictorial	"Soma Design – Intertwining Aesthetics, Ethics, and Movement" (Höök et al., 2018)	Visual-rich documentation of somatic design practices with theoretical annotations	Communicated embodied knowledge and aesthetic experiences that resist traditional textual representation
Autoethnographic Account	"Designing from Within: Autoethnography and Voice in Craft Research" (Mäkelä, 2007)	First-person narrative of ceramic practice situated within theoretical frameworks	Revealed tacit knowledge in craft process and its relationship to cultural identity formation
Interactive Installation	"Listening Cups" (Nimkulrat, 2012)	Textile artifacts with embedded audio components inviting multisensory engagement	Explored material knowledge through multi-sensory engagement, challenging ocularcentrism in design epistemology
Digital Portfolio	"Annotated Portfolios" (Gaver & Bowers, 2012)	Collection of thematically related artifacts with critical reflective annotations	Generated design knowledge through comparative analysis of artifact families and their theoretical implications
Video Documentation	"Traces of Everyday Life" (Mattelmäki, 2016)	Ethnographic video documentation of users interacting with design probes	Captured temporal, spatial, and embodied dimensions of user experience inaccessible through static documentation
Research Through Design Workshop	"Living with Data" (Pierce & DiSalvo, 2018)	Collaborative making sessions addressing sociotechnical controversies	Generated knowledge through collective meaning-making and material exploration of complex issues

Material Samples Archive	"Material Beliefs" (Kerridge, 2015)	Collection of biodesign material experiments with contextual documentation	Demonstrated knowledge generation through material exploration at the intersection of science and design

Table 2: Examples of Alternative Research Outputs in Recent Design Research

This table illustrates concrete examples of alternative research outputs from the design research literature, showing how these different formats have been used to generate and communicate different types of knowledge. Each example demonstrates a unique contribution that would have been difficult to convey through traditional academic papers alone.

By moving in these directions—practice-based outputs, pictorials, visual abstracts, introspective methods, and experiential outputs—design research can generate a richer and more nuanced understanding of its processes and findings. These diverse formats reflect the complexity and situatedness of design knowledge and challenge the traditional reliance on text-based outputs. They allow for the communication of both the intellectual and embodied dimensions of research, offering a more holistic approach to scholarly production.

Conclusion

In conclusion, diversifying academic outputs in Research through Design (RtD) and related approaches reflects broader shifts in epistemology, ontology, and methodology. The move toward practice-based artifacts, pictorials, and visual abstracts embraces multiple ways of knowing, including tacit, indigenous, and experiential knowledge. These outputs challenge traditional, text-based formats by capturing forms of knowledge that are contextually rich and rooted in lived experiences. This pluralistic approach values creativity and process, offering deeper insights that datafication and linear knowledge models often overlook.

Ontologically, these alternative outputs align with the situated and embodied nature of design research. RtD treats knowledge as emergent and context-specific, produced through interactions between designers, materials, and environments. Formats like prototypes, installations, and introspective methods such as autoethnography and journaling reflect the evolving and context-sensitive aspects of design practice. They offer a fuller account of how design knowledge is generated emphasising that knowledge is not static or universal.

Methodologically, these new forms of output enable a more flexible, iterative approach to knowledge generation. Pictorials, visual abstracts, and experiential forms bridge the gap between scientific rigour and creative exploration, allowing for the integration of inductive, deductive, and abductive reasoning. By embracing these formats, RtD combines scientific methods with creative processes, making design research both practically relevant and theoretically robust.

While some of these approaches exist in artistic research traditions, as noted by Latour's performance-based work (Latour, 2013) and platforms like the Research Catalogue, what distinguishes this paper's contribution is its specific focus on integrating these alternative outputs within design research methodologies. The paper provides a theoretical framework that connects these outputs explicitly to the epistemological and ontological foundations of Research through

Design, offering a structured approach to valuing and evaluating non-traditional research contributions in academic contexts.

In summary, aligning these alternative academic outputs with the four pillars of epistemology, ontology, axiology, and methodology supports a more holistic and inclusive research paradigm. This shift not only enriches the knowledge generated but also better equips scholars to address the complex challenges of the 21st century, particularly in areas like sustainability, human development, and social innovation.

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