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RTD in landscape architecture: a first State of the Art

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The discussion regarding the relation of design and research in landscape architecture started somewhat later than in other design disciplines. But the past decade has shown a sharp rise of publications on 'research through/by design(ing)' (RTD). The literature has now reached a level of richness that enables a review of the State of the Art and a differentiation of types of contributions to the discourse. We reviewed more than 200 publications (scientific journal papers, conference papers, PhD theses, MSc theses and others) on RTD in relation to landscape architecture and closely related disciplines. The review shows that a rather small portion of the publications deals with RTD a scholarly sense. The remaining portion of scholarly publications offered a useful base for further scrutiny. We categorised the relevant literature according to types of publications and the epistemological stances taken. Based on this categorisation we identified areas that need further research and thus sketched an agenda for further research on RTD in landscape architecture.

Landscape architecture; research through design; research by design; review

1. Introduction

Landscape architecture has developed from a professional discipline into an academic discipline in the past few years (Benson, 1998; Milburn & Brown, 2003; Milburn, Brown, & Paine, 2001; van den Brink & Bruns, 2014). As designing landscapes and urban environments tackles spatial concerns of various scales and a wide spectrum of issues from the natural and social realm, designing is a very complex activity. Therefore, landscape architecture embraces approaches such as 'evidence based' design. These approaches are based on research results from other disciplines (e.g. ecology or environmental psychology) and offer thorough legitimations of design decisions (Brown & Corry, 2011; Deming & Swaffield, 2011) in site-specific designs. 'Evidence based design' formed the major efforts in research related to landscape architecture for a long time. Most of this research would range under 'research on design' and 'research for design' when categorizing it according to Frayling's (1993) terms. This evidence was mainly produced by other disciplines and was of descriptive nature.

However, descriptive knowledge of a status quo is not sufficient to support design decisions that aim at future conditions of cities and landscapes. There is a need to develop more knowledge about projected new states of cities and landscapes and on how to assess them. Furthermore, more recently it also occurred that there is a need to generate knowledge that goes beyond the support of site-specific design. Designers in practice often find it difficult to translate 'evidence' from other disciplines into practical application, especially when knowledge is very abstract (Eliasson, 2000; Kantrowitz, 1985; Nassauer & Opdam, 2008). Additionally, in practice time constraints or simply the nature of assignments can make it hard for design professionals to find relevant evidence that can inform their designs. As a further consequence, this lack of evidence also makes it hard to assess design results on a reliable basis.

Due to this, designers ask for various kinds of design directives (guidelines, principles, prototypes and recommendations) to bridge this gap and, thus, to make knowledge easily applicable in design practice in different locations. Such design directives differ substantially from the ones developed in other disciplines as the scale and complexity of landscape architectural artefacts are unlike the ones designed in other disciplines such as in industrial design or architecture. These disciplines usually focus on smaller scale designs and more delimited design assignments. Furthermore, many landscape architectural assignments have to respond to a higher degree of unpredictability and thus need other types of design directives.
Plan analysis of existing precedents is a useful way to identify design directives, as results of design (realized plans) are an important source of knowledge and evidence of which planning and design principles function well or not. This type of knowledge can serve as the basis for future designs (Nijhuis & Bobbink, 2012). However to study design directives for entirely new conditions, rigorous research through design is required to explore the breadth of future design possibilities beyond the precedents. Apart from that, designers in practice are increasingly urged to legitimize their design decisions towards a critical public. This requires conscientious designing and rigorous testing of design alternatives.

These developments in the field lead to increased efforts in identifying landscape architecture's methods to combine research and design in common research processes in which the designs form the object of the inquiry. Usually these methods are termed 'Research by design' and 'Research through design(ing)' (RTD). They are research processes actively employing the act of designing. They are research methods 'native' to designers "that places the making of original creative work at the centre of the inquiry" (Carruth, 2015). RTD can help shaping the designing activities of landscape architecture as research methods. As a form of 'evidence based design', in RTD processes "designs are not made intuitively, but based on study (experimental design study), recording, examination and evaluation; an incremental process, where the former informs the latter in an iterative process" (Nijhuis & Bobbink, 2012). The design activities of landscape architecture can have two lines of outputs. One consists of meeting a design-led objective by directly addressing a concrete or site specific assignment. The other contribution can be the development of more generalizable knowledge for landscape architecture for practice. Akin to other design disciplines, designing in landscape architecture can thus produce relevant new knowledge provided it comes up with substantiated general learnings for future designs.

RTD methods developed quite rapidly during the past decade although it seems that often the term 'research' was used in quite random ways. In order to build a sound academic discourse on 'Research through design' in landscape architecture it is now time to take stock of the developments, identify the academically relevant literature and discover the main strands in these developments. Consequently, the main objective of this paper is to explore the State of The Art of RTD in landscape architecture based on the research questions:

1. What are the studies using 'Research by design' or 'Research through design(ing)' methods in landscape architecture and related fields?

2. In how far do these studies qualify as 'Research through design' in a scholarly sense?

What kinds of RTD literature can we differentiate (e.g. epistemological level, design case studies) and to which worldview approaches by Creswell (2011) would they fit?

2. Brief theoretical framework: basic concepts of 'design' and 'research'

As this review aims at developing design research theory in landscape architecture further, a range of terms needs to be defined. These terms will also guide the selection and discussion of relevant studies in our literature review. Many different definitions exist for 'research' and 'design' but, in this context, we will use the terms as introduced by Glanville (2015) since his terminology is widely used in the design research discourse. Glanville concluded that 'research' in the academic sense means a rigorous and in-depth search for answers to research questions and to conclude with new knowledge (which can also be embodied in an artefact). To sketch the wide range of approaches to 'research' we need to specify the concepts behind different ideas of scholarly research.

To define 'research' in a scholarly sense will use the well-established framework of Creswell (Creswell & Plano Clark, 2011). Creswell describes four substantially different worldviews within research: (post)positivist, constructivist, transformative/participatory and pragmatic. These worldviews guide the choice of research methods. The research methods within the (post)positivist paradigm entail mainly quantitative methods that are used to measure an objective reality and are common in the classical sciences. Methods within the constructivist paradigm are of a qualitative nature and support the search for (individual) meanings and interpretations of reality. Transformative/ participatory research methods explore reality together with (members of) society. The latter two worldviews are common in the social sciences, arts and humanities. In the pragmatic approach, the choice of methods is guided by the research questions and consists of a mixture of the first three worldviews. These four approaches to research described by Creswell are transferable to 'research through design' in landscape architecture (Lenzholzer, Duchhart, & Koh, 2013). Lenzholzer, Duchhart, & van den Brink (2017) suggested that most RTD in landscape architecture should belong to the 'pragmatist' approach but it is not clear if this assertion can be supported by the RTD studies conducted in landscape architecture so far.

Glanville (2015) also differentiated 'design' as a noun and as a verb (see also Steinitz, 1995). 'Design' as a noun is the outcome of the design process in which a product, i.e. the design, is projected (and sometimes also implemented). 'Design' as a verb means the active projecting of future environments or objects, for instance through drawings or other representations. In landscape architecture the verb 'design' means giving three-dimensional form and function to urban, peri-urban or rural landscapes. The scale, natural and societal context and the resulting complexity of landscape architectural designs are very different from other design disciplines. Landscape architectural design focuses on creating 'contexts' whereas other disciplines such as industrial/product design or architecture focus on designing single objects.
The 'design' action within research (thus the meaning as a verb) can form part of the research process itself, as opposed to analysing finished designs, in the sense of a noun (post hoc).

3. Methods

To answer our research questions we conducted reviews and analyses of the literature. We gathered the available literature in English language for landscape architecture and the closely related disciplines of urban design and planning.

To answer research question 1 we conducted a literature search in Google Scholar. As the discourse on RTD is rather recent in landscape architecture, we chose this database because it offers a broader selection of literature (including conference papers, MSc and PhD theses or book chapters) that could be relevant for this study. We accessed Google Scholar in March 2017, set out combined search terms and related them with Boolean operation "AND" to find precise matches. The fixed search terms were to be found either in the title, keywords or text body fields, but not in quoted

literature or literature descriptions, figure captions, indices, footnotes, as parts of author descriptions or affiliations. The first combination of terms we studied was “research by design” AND “landscape architecture”. The term “research by design” has been in use for some time and we expected a broad set of results. The yield using this combination of terms was indeed very extensive. A first quick scan of the literature yielded under search term “research by design” revealed that much of the literature would not meet the criteria needed for answering research question 2. Hence, we narrowed the search of terms to “research through design” and “research through designing” in a next stage of literature search in Google Scholar. In turn, we broadened the field to which RTD can be associated (“urban design”, “public design” and “landscape planning”).

To answer research question 2, we analysed the literature found in terms of contents and of how far the addressed studies met the requirements of scholarly quality as indicated in the theoretical framework above. Assessing the scholarly quality of the conducted ‘research’ was based on two sets of criteria. Either the publications had to display a sound embedding in the literature about from other design research fields or they had to follow the classical setup of research in the RTD. This involves: the existence of clearly formulated research questions, a rigorous assessment of different design alternatives or scenarios, and the drawing of conclusions going beyond site-specific learnings. Literature that did not meet these criteria was excluded from further consideration.

To answer research question 3, we further analysed the remaining publications on their contents in order to derive different types of publications dealing with RTD ‘avant la lettre’ in landscape architecture, and to identify the considered worldview according to Creswell (Creswell & Plano Clark, 2011).

4. Results and discussion

Overall, our literature review of RTD studies in landscape architecture and related fields showed the existence of a large array of studies that offered us a wealth of material for further scrutiny. In the following paragraphs we will address and discuss the results from this literature review for each research question.

Research question 1

The literature search to answer research question 1 (‘What are the studies using ‘Research by design’ or ‘Research through design(ing)’ methods in landscape architecture and related fields?’) yielded 222 publications. This number of publications is far larger than we had expected and it indicates how quickly the Research by/through design terminology has found its way into landscape architecture publications. We noticed that the majority of contributions to the literature come from a rather small amount of countries or regions: Scandinavia, Germany, Netherlands, United Kingdom, USA, Australia and New Zealand. This shows similarities with the RTD discourse in industrial and HCI design (Stappers & Giaccardi, 2017) and might be attributable to a multidisciplinary RTD discourse within the respective regions. We observed that many publications are not from landscape architecture per se but from other somehow related disciplines which might also be influenced by this multidisciplinary RTD discourse. All results of the literature search can be found in appendix (appendix can be obtained via communicating author).

Research question 2

In general, the different search steps yielded some publications that did not strictly match the combined search terms or they did not occur at all in the suggested links. Even though the search terms were precisely determined, it appeared that some search terms were used in a different context in the literature suggested by Google Scholar. The literature associated to these cases was not taken into consideration for further analysis under research question 3. During the second iteration with new search terms, in many cases the search terms either did not appear in the actual texts or were actually related to a different field (e.g. interior design, architecture, human computer

interaction, science philosophy). Also, many texts did not address structure, methods and outcomes of RTD processes. Also these texts were excluded from further analysis under research question 3.

The results from scrutinizing all these publications to answer research question 2 ('In how far do these studies qualify as 'Research through design' in a scholarly sense?') shows an interesting picture (see results of this search in appendix, right column). From the 222 publications, we found actually only 59 publications (about one fourth) dealt with RTD in a strict sense as delineated in the scholarly literature. It did not matter if these studies ranged under the search terms "research by design" or "research through design"- the ratio was about the same in both cases. The approximately three quarters of the publications we found that would not match the scholarly criteria showed some commonalities.

We found many examples of 'research by/through design' for all kind of participatory designs, in which it was not clearly stated what the research question was (e.g. Gutmane & Schreurs 2012, Brand et al 2014, see appendix). Other typical projects that are called 'research by/through design' are evidence based designs (e.g. Zhou & Bonenberg 2016, see appendix) but they did not test artefacts nor generate new insights. Furthermore, we found several reports of designs lacking an evidence basis (e.g. Ware 1999, Waegemaeker 2016, Szakel 2014, Ziemelniece 2013, see appendix) and that are described as 'research by/through design'. Many Master thesis projects can be found amongst projects not explaining what the 'research' entails (e.g. Zhao & Xiaoqing. 2015, Keddeman 2011, see appendix) and it became clear that various Master programmes coined their design thesis projects 'research by/through design' without strictly delimitating the term 'research'. Several publications that used an undefined interpretation of 'research' referred to the contentions of architect Peter Downton: "design is a way of inquiring, a way of producing knowing and knowledge; this means it is a way of researching." (2003, p. 2).
In all these projects, it was either not made explicit what the research questions were, nor which different design options were chosen and why. These studies often did not provide a broader set of new insights going beyond site-related learnings. Generalizable conclusions were therefore mainly meagre or absent. We acknowledge the different merits of many of these 'research by/through design' projects. However, we tend to agree with Janssens (2008) who had already criticized the misuse and inflationary use of the term "research by design", and its devaluation as a truly academic research method. This idea is supported by Schreurs and Martens, who posited: *To label every design as research is not wrong by definition, but it is neither very helpful. 'Research by design' then is on its way to obliterate itself: it tends to become meaningless as an analytical category! Thus, shouldn't we feel uneasy as well when every design becomes research?* (2005). Interestingly, Peter Downton (whose quote mentioned above is often misused) actually also laments the misappropriation of the term 'research': "to speak the speak ... and claim that design is research. Without reflection this means nothing" (2003, p.126). Amongst the publications that did actually meet the criteria to be RTD 'avant la lettre' we observed that a large amount originated from other disciplines than landscape architecture. This indicates the paucity of RTD literature within the discipline itself and points to the need to establish the concepts of RTD more firmly in the methodological discourse of landscape architecture.

Research question 3

To answer research question 3 'What kinds of RTD literature can we differentiate?' we further analysed the literature. We were able to identify a set of different types of publications. In the first place, an obvious difference exists between publications dealing with RTD on a methodological meta-level and publications describing RTD related to specific cases. The results are summarized in Table 1.

The meta-level of RTD knowledge is represented by studies on a more abstract/general dimension, on the nature of RTD and ways of conducting it. The meta-level publications can be subdivided into two types. One type entails abstracted science philosophical/epistemological reflections on RTD and

draws methodological conclusions. These types of studies are denoted in Table 1 by 'meta-level: methodology'. The other type comprises reflections on and abstractions of different implemented RTD cases. These are denoted in Table 1 by 'meta-level: case studies'.

The other types of publications dealt with concrete cases of RTD in which new insights were generated that provided findings of general relevance or validity. Within this set of publications we distinguish three types of studies. The first and quite common type was site-specific RTD, in which various design alternatives are thoroughly tested against several variables. Peleman and colleagues explained it as follows: *a set of options is tested under certain conditions, in a particular terrain or region, before the outcome of these tests are translated into numbers, regulations, plans or recommendations for a policy. They form a kind of catalogue of alternative solutions that meet the expectations of the initial assignment* (Peleman, Pelger, & Braudel, 2015). The results were thus region- or site-specific designs. Also more general learnings were distilled from the region- or site-specific design process and shared with a wider public. These were often textual, general design recommendations. These types of studies are denoted in Table 1 by 'practical RTD: site-specific'.

The second type of practical RTD studies deals with developing generalizable design objects such as prototypes or spatial design guidelines (see Prominski, 2017; Stappers & Giaccardi, 2017): knowledge that becomes 'embodied' in the design artefact (Cross, 1999). These types of studies are denoted in Table 1 by 'practical RTD: generalizable prototype'. The third type of practical RTD studies aim at creating new procedural knowledge about design processes. In these studies, the 'how' prevailed over the 'what'. Such knowledge is often of paramount interest for participatory design processes in which types and moments of communicating designs need to be carefully timed. These types of studies are denoted in Table 1 by 'practical RTD: generalizable procedure'.

We were also able to allocate the worldviews (Creswell & Plano Clark, 2011) used in the different RTD studies. We connected the worldviews to the five different types of studies on RTD (see Table 1) and found remarkable relations.

In the category 'meta-level: methodology' we observed a predominance of pragmatist approaches. This is a necessary choice as many approaches have to be embraced in meta-studies. However, we also noticed that many publications in this category were not explicit about the choice for a pragmatic approach. In the category 'meta-level: case study' we mainly found constructivist and pragmatist worldviews. Interestingly, the (post) positivist view was underrepresented although it usually constitutes the majority of scientific knowledge production.

On closer inspection of the practical RTD studies in relation to the worldview/research approach, some clear relationships can be identified. When examining 'practical RTD: site-specific' we mainly found studies that used a (post) positivist or a pragmatic approach. Constructivist and participatory cases were underrepresented. The underrepresentation of participatory approaches might be attributable to the fact that almost all the studies embracing participatory approaches can be found amongst the studies 'practical RTD: generalizable procedure'. The 'practical RTD: generalizable prototype' studies tended to focus on (post) positivist approaches. The relative absence of other worldviews is surprising, especially in the light of the rise of 'co-creation' processes in which participatory research plays a major role. The studies that range under the 'practical RTD: generalizable procedure' type tend to use a participatory approach more than the other types. The relative absence of constructivist approaches in the practical RTD cases might stem from the academic contexts in which these studies were carried out. The design schools that are embedded in a scientific context devote more attention to methodology. Given the prevalence of (post) positivist approaches used in these environments they tend to follow that tradition of thought.

Table 1 Academically sound literature on RTD in landscape architecture

Author, year, title	**Category of publications**	**Worldview according to Creswell**

Fischer, 2008, Landscape architectural research: Inquiry, strategy	meta-level: methodology	constructivist
Janssens, 2008, Critical Design – The Implementation of 'Designerly' Thinking to Explore the Futurity of Our Physical Environment	meta-level: methodology	constructivist
Coombes, 2011, Unfamiliar terrain: From the paradox of intervention to paradoxical intervention	meta-level: methodology	constructivist
Clark & Widding, 2005, A Student, A Product, A Process: A Fresh Look at Concept Design Games and the Habraken Tradition	meta-level: methodology	constructivist
de Jonge & van der Valk, 2010) Bridging the gap between knowledge and action	meta-level: methodology	constructivist + participatory
Huybrechts & Hendriks, 2016) Counterfactual scripting: acknowledging the past as a resource for PD	meta-level: methodology	constructivist + participatory
Norrie & Abell, 2016, Collaborative Design Research: Linking universities with government policy-makers	meta-level: methodology	participatory
Prominski, 2017) Design guidelines	meta-level: methodology	pragmatist
Schreurs & Martens, 2005, Research by design as quality enhancement	meta-level: methodology	pragmatist
Deming & Swaffield, 2011, Landscape architectural research: Inquiry, strategy, design	meta-level: methodology	pragmatist
Dankl, 2015, The paradox of design methods: Towards alternative functions	meta-level: methodology	pragmatist
Lenzholzer et al., 2013, Research through designing' in landscape architecture	meta-level: methodology	pragmatist
Lenzholzer et al., 2017, The relationship between research and design	meta-level: methodology	pragmatist
Lenzholzer, 2013, 'Science'and'Art'in landscape architecture knowledge production	meta-level: methodology	pragmatist
Duchhart, 2011, An annotated bibliography on 'research-by-design' (ontwerpend onderzoek)	meta-level: methodology	pragmatist
Downton, 2003, Design research	meta-level: methodology	pragmatist
Roggema, 2016, Research by Design: Proposition for a Methodological Approach	meta-level: methodology	pragmatist
Nijhuis & Bobbink, 2012; Design-related research in landscape architecture	meta-level: methodology	(post) positivist
Jonge, 2009, Landscape architecture between politics and science: an integrative perspective on landscape planning and design in the network society	meta-level: case study	constructivist + participatory
Barnett, 2000, Exploration and discovery: a nonlinear approach to research by design	meta-level: case study	constructivist
Lenzholzer & Brown, 2016, Post-positivist microclimatic urban design research: A review	meta-level: case study	(post) positivist
Peleman et al., 2015, When the Mayor Calls the Designe	meta-level: case study	constructivist
de Zwart, 2008) Designing Waterland: Strategies for a Contested Arcadia	meta-level: case study	constructivist
Nijhuis, Stolk, & Hoekstra, 2017, Teaching urbanism: the Delft approach	meta-level: case study	constructivist
Howard & Somerville, 2014, A comparative study of two design charrettes: implications for codesign and participatory action research	meta-level: case study	participatory

Bäckman, Liao, Marttila, & Oguz, 2012, Designing early community engagement for the revitalization of suburbs: Experiences in Kannelmäki	Meta-level: case study	participatory
Meyer & Nijhuis, 2013, Delta urbanism: planning and design in urbanized deltas–comparing the Dutch delta with the Mississippi River delta	meta-level: case study	pragmatist
Montague, 2013, Reflective Practice in Urban Design	Meta-level: case study	pragmatist
Meyer & Nijhuis, 2016, Designing for Different Dynamics: The Search for a New Practice of Planning and Design in the Dutch Delta	meta-level: case study	pragmatist
Felix, Torpus, & Wiedmer, 2009, Negotiating reality	meta-level: case study	pragmatist
Gampfer, 2012, Reality Design and Slow Prototyping as Methods in Sustainability Education	meta-level: case study	pragmatist
Carruth, 2015, Infrastructural urbanism that learns from place	meta-level: case study	pragmatist
DiSalvo, Jenkins, & Lodato, 2016, Designing Speculative Civics	meta-level: case study	pragmatist
Korsgaard, Hansen, Basballe, Dalsgaard, & Halskov, 2012, Odenplan: a media façade design process	meta-level: case study	pragmatist
Kosunen & Hentilä, 2015, Assessing Climatic Impacts through the Lifecycle of an Urban Environment	meta-level: case study	pragmatist
Boekel & Neven, 2008, Landscape and the energy transition	practical RTD: site-specific	constructivist + (post) positivist
Hermens, 2015, Research by Design on a Sustainable Form of Agriculture for the Krimpenerwaard	practical RTD: site-specific	constructivist + (post) positivist
Eriksson & Wideström) The virtual culture house–shaping the identity of a public knowledge institution	practical RTD: site-specific	participatory
Hines, 2014, Submerge: Urban Surface Adaptations	practical RTD: site-specific	pragmatist
Zakariya, 2011, Fleeting feast: mapping and accommodating temporary markets	practical RTD: site-specific	pragmatist
Flanagan, 2011, Addington 2041-a platform for change	practical RTD: site-specific	pragmatist
Wilschut, Theuws, & Duchhart, 2013, Phytoremediative urban design: Transforming a derelict and polluted harbour area into a green and productive neighbourhood	practical RTD: site-specific	pragmatist
Blondia & De Deyn, 2012, Infrastructure Design as a Catalyst for Landscape Transformation: Research by Design on the Structuring Potential of Regional Public Transport	practical RTD: site-specific	(post) positivist
Bobbink, 2009, Design with Water in Dutch Low Land Cities	practical RTD: site-specific	(post) positivist
Marques & de la Fuente, 2012, A sustainable landscape for Arnhem	practical RTD: site-specific	(post) positivist
Rice, 2010, Retrofitting suburbia: is the compact city feasible?	practical RTD: site-specific	(post) positivist
Schork, Burrow, & Minifie, 2009, A Workbench for Emergent Urbanism and Architectural Form	practical RTD: site-specific	(post) positivist
Fischer, Zöllner, Hoffmann, Piatza, & Hornecker, 2013, Beyond information and utility: Transforming public spaces with media facades	practical RTD: generalizable prototype	participatory
Lenzholzer, 2012, Research and design for thermal comfort in Dutch urban squares	practical RTD: generalizable prototype	(post) positivist

Lenzholzer, 2011, An optimized model for a thermally comfortable Dutch urban square	practical RTD: generalizable prototype	(post) positivist
Huijben, Transform Weather for Cycling	practical RTD: generalizable prototype	(post) positivist
Blaauw, 2016, Visualizing energy flows in urban microclimates	practical RTD: generalizable prototype	(post) positivist + participatory
Gregorowicz-Kipszak, 2015, Rethinking Social Impact Assessment through Urban Design: Towards designerly evaluation with a socio-form approach	practical RTD: generalizable procedure	Constructivist
Huang & Xu, 2012, Parametric Urban Design exPloration in a graDUate Design stUDio	practical RTD: generalizable procedure	(post) positivist
Backhaus, Dam, & Jensen, 2012, Stormwater management challenges as revealed through a design experiment with professional landscape architects	practical RTD: generalizable procedure	participatory
Roggema, Martin, & Vos, 2014, Governance of climate adaptation in Australia	practical RTD: generalizable procedure	participatory
Faber, 2014, Landscape architects at the beginning of a participatory process: making use of landscape architect's design skills to start a discussion	practical RTD: generalizable procedure	participatory
Mathew, 2014, Interactive Placemaking: Creativity and User Experience at Urban Installations	practical RTD: generalizable procedure	participatory

5. Conclusion

This first stock-taking of the RTD studies in landscape architecture and related fields has yielded an array of studies presented as RTD. Our review of the State of the Art showed, however, that a large part of the publications found would not fit the academic scope of RTD and that the misuse of the term 'research' is rather frequent. Similar inflationary use of terms has been reported in other design disciplines. Research in landscape architecture might end up stepping into the same trap. The young academic discipline of landscape architecture runs the risk of discrediting itself as a proper research discipline. This is a development to be prevented with all means. Assigning landscape architecture an academically sound RTD methodology based on existing research frameworks can take this discipline to the same level of other well-established research disciplines. To build a widely acknowledged basis in landscape architecture RTD, we suggest to found the term 'research' on the well-established methodological research framework by Creswell (Creswell & Plano Clark, 2011) and address its underlying epistemology and worldviews ((post) positivist, constructivist, participatory and pragmatist). Yet, we also see a growing body of literature on RTD that displays an encouraging countermovement by fulfilling academic standards.

A large part of this literature is devoted to creating general frameworks of RTD in landscape architecture in a philosophical sense ('meta-level: methodology'). We noticed that many publications in this category followed a pragmatic approach but that their authors were not explicit about this choice. This phenomenon points towards a lack of embedding studies in the research methodological literature. We suggest that landscape architecture scholars who teach PhD and MSc students make themselves more thoroughly acquainted with research philosophy and methodology to be able to guide young researchers' methodological choices in an optimal way.
In the category 'meta-level: case study' constructivist and pragmatist worldviews prevailed. Interestingly, the (post) positivist view was underrepresented although it constitutes the majority of science production. It might therefore be necessary to enhance studies with a (post) positivist approach to state good or typical examples of such studies.

We detected a lack of literature describing how RTD should be carried out in a more practical sense: what should the methodological strategies be in actual RTD projects? Reporting of practical RTD projects and their specific methodological choices needs enhancement to fill this knowledge gap.

In detail, we noticed that site specific RTD and practical RTD for prototypes tended to focus on post-positivist approaches. Both need an enrichment of constructivist approaches, for instance artistic research in landscape architecture. Such approaches that focus on the creation part rather than the analysis part in design processes can be crucial. They can help to develop entirely new and exploratory research and to formulate novel design hypotheses that can form leaps of design knowledge in landscape architecture.

In general, further research should focus on identifying and describing good examples of RTD practice to support design researchers in academia and design professionals practice with a solid frame of reference. Pragmatist research is generally already well represented in the literature. However, we noticed that most authors did not substantiate their choice for this approach which might be attributable to a lack of knowledge or interest in epistemological issues. But as landscape architecture is embedded in different research traditions it is necessary to take clear stances.

A limitation of our study is that only the available digital literature in English language was taken into account that uses the specific vocabulary as mentioned before. However, there are also useful analogue standard works on the topic available in different languages and/or have similar intentions but use more general wording. These have been excluded for the sake of academic rigour but should be taken into account in further research, too.

RTD in landscape architecture holds the power to move the design professionals' ideas from mere personal musings to consistent visions for the future based on evidence-based knowledge. Without proper RTD it is not possible to develop new artefacts — both in an academic or non-academic context. To put it with Sanders and Stappers (2014), "use making to anticipate the future" is paramount. We need to anticipate future landscape and urban environments able of dealing with great challenges such as climate change or socio-economic shifts. Especially climate change makes RTD necessary — more than ever — in order to find new integrated design and research solutions and to provide design professionals with applicable knowledge as soon as possible.

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