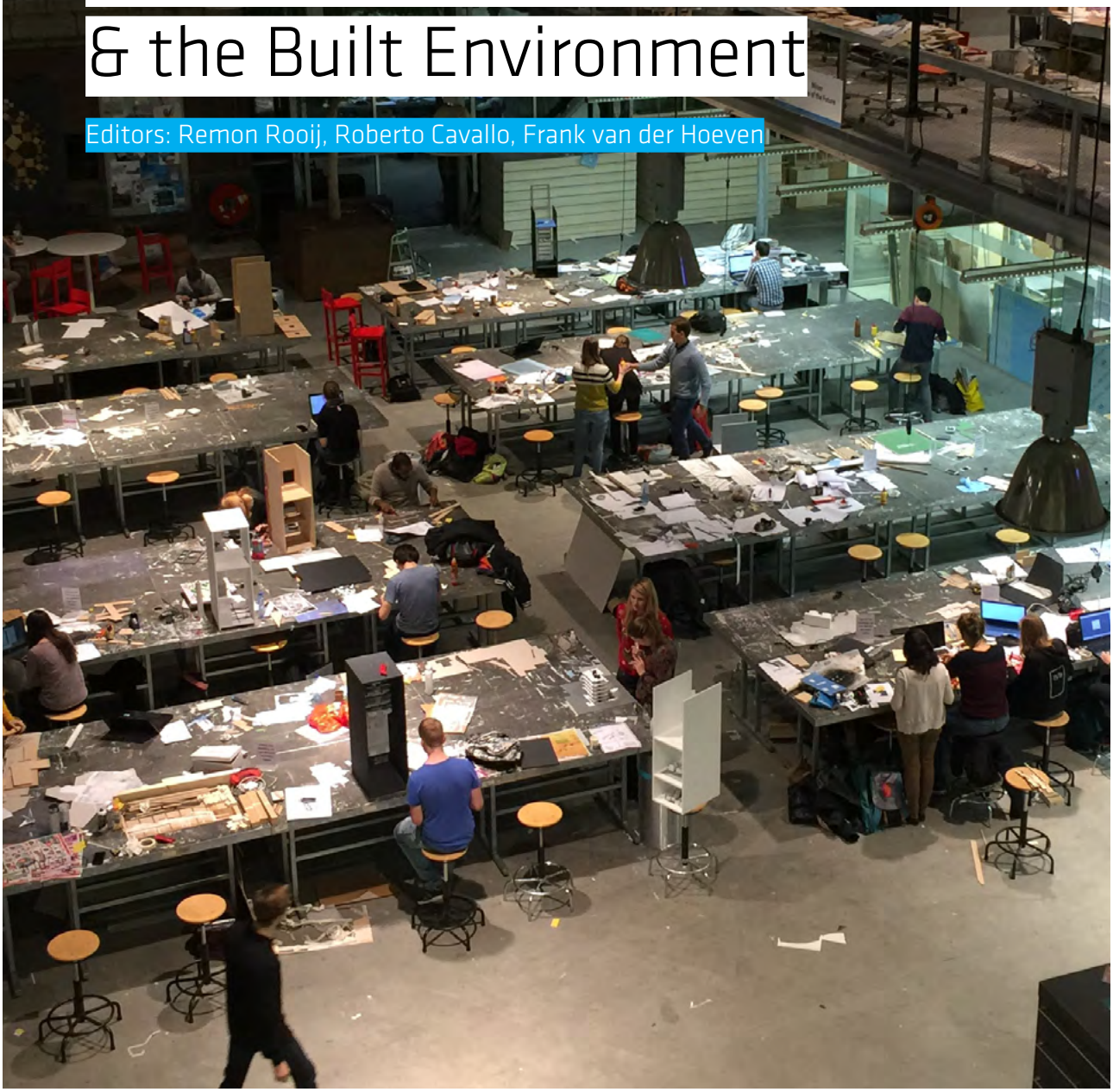
Teaching Architecture

Insights from TU Delft – Research on Education Innovation in Architecture & the Built Environment

Editors: Remon Rooij, Roberto Cavallo, Frank van der Hoeven



Towards transdisciplinary urbanism education

Lessons learned from two elective courses

Claudiu Forgaci [1] **and Birgit Hausleitner** [1]

[1] *TU Delft, Faculty of Architecture and the Built Environment, Department of Urbanism*

Abstract

Although some degree of multi- or interdisciplinarity has been inherent in urbanism education, today, the skills and knowledge for transdisciplinary work are increasingly required from graduates facing the challenges of sustainable urban development in the field. In this article, we show how the master's programme in urbanism at TU Delft has been tackling this challenge, and we discuss what further steps may be required to achieve the full potential of transdisciplinary education. We present two cases – both elective design courses from the Department of Urbanism – to identify (1) challenges of multidisciplinarity, (2) elements of the current educational setup that contribute to interdisciplinarity, and (3) the potential improvements to transdisciplinary learning. The two cases, both part of research projects carried out in collaboration with practice, show essential features of education that can strengthen the education-research-practice nexus underpinning transdisciplinary practices for sustainable urban development.

Keywords

Interdisciplinarity, transdisciplinarity, research-drive education, design-driven research

COVER FIGURE Participants working on their projects during the I-SURF workshop, by C. Forgaci, 2020

1 Introduction

Master's-level courses in urbanism at TU Delft are context-driven and multi-scalar, aiming to capture the social, environmental, and spatial complexity of the urban environment (Nijhuis et al., 2016). As such, the programme includes multidisciplinary work and some level of interdisciplinarity and transdisciplinarity (Klaassen, 2018). A multidisciplinary approach means that different disciplines work within their own frames and methods on the same task (Davoudi, 2010), while interdisciplinary work involves the integration of knowledge, working mainly with frames and methods between disciplines on the definition of a (design or planning) task (Sands, 1993, as cited in Davoudi, 2010). The Department of Urbanism comprises six sections: urban design, spatial planning and strategy, landscape architecture, urban studies, environmental technology and design, and urban data science. It also includes staff members from different disciplines. Each of the six sections contributes to different parts of the master's programme, and together, they form a multidisciplinary learning environment in which students become aware of the multiplicity of views and interactions among the different disciplines involved.

Moreover, with a growing emphasis on sustainable development and societal challenges, such as health and well-being, food and energy security, resource efficiency, sustainable mobility, and climate adaptation, the courses of the master's programme in urbanism have been progressively reaching out to practitioners for real-world assignments and expert input from a variety of fields. Likewise, research conducted in the department on various topics has become increasingly integrated with educational activities. This setup is a precondition for the teaching-research-practice nexus (Schneider et al., 2017) required for transdisciplinary practices underlying sustainability, but it has yet to be developed from an educational perspective.

Students are exposed to this environment at different stages throughout the master's programme. The quarterly studios and accompanying theory, methodology, and technology courses teach students how to deal with assignments of increasing complexity and the communication and collaboration skills needed for interdisciplinary work. During the graduation year (second year of the master's programme), basic multidisciplinarity is ensured as students must choose two mentors, each from a different section of the department. Depending on the thematic focus of each graduation studio, a series of lectures and workshops are offered to the students early in the graduation year.

All in all, the actual level of multi- or interdisciplinary work varies across the different stages of the master's programme, and evidence of the effectiveness of current practices is scarce. Multidisciplinarity and the first attempts at interdisciplinary work are mainly integrated into the learning objectives of elective courses. In these courses, students from multiple educational tracks, namely urbanism, architecture, landscape architecture, and industrial ecology, work together in teams on one project. In our view, the setup of such elective courses has proven effective in developing skills leading to interdisciplinary solutions and, thus, can give insight into how transdisciplinarity could be attained.

In this article, we look at two such elective courses and aim to scaffold the knowledge and practices required for transdisciplinary education in urbanism by answering three questions:

1. What challenges must be considered in a multidisciplinary learning environment?
2. What course setup and learning components nurture interdisciplinary work on projects?
3. How could urbanism education support and contribute to transdisciplinarity?

In what follows, we briefly position this article in the transdisciplinary education literature. Then, we describe the two elective courses and briefly summarise the main findings. We conclude with a discussion about challenges and opportunities in developing effective transdisciplinary education.

2 Transdisciplinarity and urbanism education

Multidisciplinarity involves combining more than one discipline in a study without any necessary interaction between those disciplines. Interdisciplinarity establishes a certain level of interaction between the disciplines involved, but it remains limited by its disciplinary focus and its goal – to reach consensus. Transdisciplinarity overcomes that limitation by placing the emphasis outside disciplinary boundaries (Sands, 1993, as cited in Davoudi, 2010) on real-world problems (Brandt et al., 2013). As such, it focuses on *articulating* rather than reconciling disciplinary perspectives (Ramadier, 2004).

This *pragmatic* and *relational* approach to disciplinary knowledge allows for the emergence of ideas, concepts, and solutions that are not the purview of a single discipline. It is pragmatic because it recognises that there are a multitude of possible realities subject to interpretation, of which only some interpretations might prove relevant for the assignment at hand. It is relational due to the construction of a network of interrelations, interdependencies, and articulations of different fields of knowledge to allow for the emergence of transdisciplinary knowledge. Moreover, transdisciplinarity extends the focus of interdisciplinarity on professional knowledge to non-specialists' knowledge, and, as such, it is more appropriate for processes that require complex stakeholder involvement (Klaassen, 2018) and co-creation (Rooij & Frank, 2016).

In a transdisciplinary approach, education, research, and practice must be interlinked (Schneider et al., 2017). Education provides a testing ground for practice and research while benefiting from practical and multidisciplinary input from those other two domains. Urbanism education, with its integrative and multidisciplinary character and its extensive use of high cognitive levels in teaching and learning, is particularly apt to fulfil that role. To show *how* that is or could be achieved, we examine two cases of urbanism teaching that involved interdisciplinary work.

3 Learning from two cases

The two cases presented in this article are design-driven research projects that are notable in their attempts to involve students in research and to create an interdisciplinary learning environment. Both projects employ a testing methodology in which students design while using a predetermined method or instrument (subject to testing): *a set of design instruments* for sustainable riverfronts in the I-SURF project (Forgaci & Timmeren, 2021) and *a pattern language* developed as part of the Cities of Making (CoM) project (Hill, 2020).

In addition to supporting designers in achieving a design outcome of a certain quality, the methods and tools of the two projects are designed to articulate knowledge across disciplines. Thus, the students test

the effectiveness and usability of the method or instrument presented, *as well as* its capacity to facilitate inter- or even transdisciplinary work. In this article, we summarise the latter for both cases. We look at findings from the two cases to identify (1) challenges encountered in bringing different disciplines together, (2) components of the learning setup that nurture interdisciplinary work, and (3) the potential for transdisciplinarity. To facilitate comparison, we structured the description of each case into task and methods (input) and process and outcome (output).

3.1 Case 1: Instruments for Sustainable Urban Riverfronts (I-SURF)

The I-SURF research project (2019–2020), initiated at TU Delft in partnership with the Amsterdam Institute for Advanced Metropolitan Solutions (AMS) and the city of Amsterdam, tackled issues of urban environmental and ecological degradation through a set of four design instruments for river space design previously developed at TU Delft (Forgaci, 2018). The instruments, tested, elaborated, and refined through design workshops and participatory sessions in Amsterdam (Figure 1), were meant to aid designers, planners, decision-makers, and stakeholders in developing spatial interventions for social-ecological integration.

FIGURE 1 Participants working on their projects during the I-SURF workshop, by C. Forgaci, 2020.

Task and methods

As part of the I-SURF project, a one-week design workshop was organised to test the instruments in different riverfront locations in Amsterdam. Prior to the workshop, data collection instruments

(questionnaires, handouts) and a workshop plan (website, scheduling, site visits) were prepared. During the workshop, data were collected on the use of the instruments and the quality of the outcome. Besides being set up as a data collection environment for research, the workshop had an additional educational component. It was meant to teach participants how to design social-ecologically integrated urban riverfront areas.

The workshop was open internationally to master's and post-master's students, PhD candidates, and young professionals. For master's students from TU Delft, the workshop was offered as an elective course with an additional post-workshop assignment. In order to complete the course, students enrolled in the elective had to prepare a critical reflection of 1,000 words about their experiences in and of the workshop. In their reflections, the students were asked to include answers to a set of questions about the instruments, the design approach of the workshop, working in a multidisciplinary team, and the impact of the workshop on their learning trajectories.

Process and outcome

The workshop participants tested the I-SURF instruments and provided data about their usability, ease of use, and effectiveness. By actively participating in the I-SURF data collection process, they also improved their knowledge of the role of research in the design process. The design assignment helped them better understand how to integrate spatial and environmental qualities in the design of riverfront urban areas. They had the chance to work in teams with other participants from different disciplines, cultures, and levels of knowledge. The workshop simulated a complex real-world environment and aimed at providing a comprehensive disciplinary approach. Moreover, participants engaged in a reflective task as part of the workshop setup and the elective course assignment.

FIGURE 2 Participants discussing one set of patterns during the elective run as part of the CoM research project, by B. Hausleitner, 2020.

3.2 Case 2: Patterns for Cities of Making (JPI Urban Europe)

The Cities of Making (CoM) project was about understanding the conditions for a (re-)integration of manufacturing in European cities (Hill, 2020). The (re-)integration was approached via three pathways – space, people and networks, and material and technology (Hausleitner et al., 2022). These pathways are related to three disciplines – spatial design, sociology, and industrial ecology.

The project elaborated a co-creation instrument – a pattern language – to create affordances for urban manufacturing. A pattern language is an instrument that presents systems of solutions (Alexander et al., 1977; Salingaros, 2000) and can integrate solutions (patterns) of multiple disciplines and actors. The strength of the pattern language is that it shows how patterns (individual solutions) are interconnected.

Task and methods

As part of the CoM project, a two-week elective design course with master's students from urbanism, architecture, landscape architecture, and industrial ecology was organised at three sites in the region around Rotterdam. It tested the applicability of the pattern language in multidisciplinary settings and examined whether it supports the development of interdisciplinary solutions. The course focused on each dimension of the project for one day in the form of design workshops accompanied by introductory lectures and site visits. The course ended with an integrated design, presented to and reflected upon by key stakeholders of the design sites.

Data to evaluate the use of the instrument was collected in questionnaires filled out by each student at the end of each session. The evaluation included questions regarding the clarity of the pattern cards, the usefulness of the pattern application to achieve an interdisciplinary developed plan, and the effectiveness of the instrument to achieve a consensus for the design.

Process and outcome

The students participating in the course tested the application of the pattern language and provided feedback on the daily design process. They learned to work in a multidisciplinary setting by developing the project and negotiating solutions from different disciplines, gradually gaining transdisciplinary skills. The development of a transdisciplinary plan was framed by an iterative process of designing and developing solutions and reflections, a process supported by the provision of patterns embedded in the different disciplines. Each sub-theme was placed centrally for one day, and all students from the different disciplines had to work jointly with the patterns from this discipline to derive a plan. At the end of the day, each group had to reflect on opportunities, shortcomings, and challenges that appeared through the application of the set of patterns provided for the day. This process was repeated with the patterns of the different disciplines as a starting point. Finally, the plans developed each day were compared in another round of discussion, testing, and assessment, concluding in an integral plan shaped by the limitations and opportunities each specific frame provided.

During the course, the students became aware that they design differently depending on their professional training, even when they have easy access to the needs of other disciplines. Besides becoming acquainted with the specific method, the students also gained knowledge of the disciplinary solutions required for facilitating urban manufacturing within their chosen field and how these are linked to the solutions found in other disciplines. They thus became aware of how research is embedded with design.

4 Main findings

The two cases took place in comparable multidisciplinary settings, testing research-based design instruments in workshops of similar length, followed by an evaluation of these instruments. Although the student group sizes were rather limited due to the courses being short electives, the first indications of transdisciplinary learning are noteworthy.

The experience of conducting the workshops and the outcome of the evaluation forms show two main challenges when bringing different disciplines together. In the CoM elective, students with different disciplinary backgrounds attended at a similar rate. However, in the I-SURF elective, the number of designers enrolled was considerably higher than that of non-designers. This finding implies that students not studying design might not perceive the elective as suitable for their education or that the administrative hurdles of reaching students from different disciplines are too strong.

Second, the end product of the I-SURF elective was clearly related to the spatial design disciplines. Students who were not from design-related fields viewed this spatial design focus as 'incomplete', and designers were more comfortable creating a drawing as the final output. Within the design disciplines, those participants with a less specialised focus could integrate solutions from other disciplines more easily than others. The non-design participants mainly contributed in terms of expert input or illustrating their input more abstractly in a diagrammatic way, which the designers then translated into the plans.

In both cases, four main course components of the learning setup proved relevant to nurturing interdisciplinary work. First, the participants worked in multidisciplinary groups, maximising their backgrounds and levels of expertise. Second, the students were guided by experts from different fields through lectures and feedback during the design process. Third, the design instruments provided in both electives already integrated knowledge from different disciplines and were created in a transdisciplinary way. This course design allowed the participants to relate the individual solutions from within their own field to knowledge from other disciplines. The fourth point is related to the teaching process and the cognitive capacity of the participants, hence their level of education and experience in multidisciplinary settings. While the more experienced participants could directly test and apply multiple solutions simultaneously, the less experienced participants benefited from the stepwise increase in complexity. In the two-step process, the participants could first draw the solutions from the perspective and interpretation of their own discipline. This second step helped the participants use drawing as a joint language understand the spatial implications of the different disciplines to adjust the final plan in a way that integrated different needs.

5 Discussion and conclusions

Our findings reveal several challenges and opportunities that can inform future efforts in achieving transdisciplinary teaching and learning. The learning outcomes in educational settings involving multiple disciplines should include products relating to all disciplines involved. This integration would allow students of all backgrounds to contribute equally, using products relevant to their own discipline, and with designers making a meaningful impact. That way, a more holistic final product could be achieved. In urban development, we can imagine that these projects could include the formulation of development policies, adaptations in planning law, and budget plans.

From the course components that contribute to interdisciplinarity, we notice the need for acknowledging the different means of communication or representation of the disciplines involved. Understanding their means of communication is critical to effective interactions among the disciplines. While spatial designers communicate mainly via spatial design drawings, industrial ecologists communicate via abstract diagrams, and many other disciplines communicate via different types of texts. Developing a common language that considers all these different means of communication is vital in transdisciplinary work and education.

Overall, the coupled research and design setup of the two cases and the involvement of experts and decision-makers who provided input to the students during the workshops indicate potentially fertile ground for a transdisciplinary approach to design education. In our academic and practical experience, the most challenging component of the teaching-research-practice nexus is the mismatch between the timeframes and paces of research and practice. In contrast, education-research and education-practice collaborations are more likely to be fruitful. We conjecture that, in addition to its effectiveness in serving as a testing ground for research and practice, education can play *a key mediating role* between research and practice. This finding presents both an opportunity and a challenge. It is an opportunity as education might receive increasing attention and resources from the other two domains. The challenge concerns transdisciplinary learning, which requires a wider set of skills and knowledge from beyond the field of urbanism.

Those skills and knowledge, some of which were mentioned in the previous section, can be summarised in the three categories of *systems thinking*, *empathy*, and *metacognition* (Tejedor et al., 2018, as cited in Orozoco-Messana et al., 2020) at the intersection of *methodological groundedness* and *epistemological agility* (Haider et al., 2018), which are required for sustainability scholarship and practice. Although these indicators of transdisciplinary learning were not recorded at the time of the workshops, and hence, firm conclusions cannot be drawn, a few observations can be made in retrospect.

In both cases, systems thinking was embedded in the definition of the instruments to be tested (e.g. helping users identify cross-scalar interdependencies or synergies and conflicts between different urban systems). In their feedback and reflections, students mentioned that understanding those systemic features was among their most important takeaways. Empathy was stimulated through group work in which participants were prompted to have a constructive and critical attitude towards each other. To that end, the development of communication and collaboration skills was facilitated in the teaching process. Metacognition was stimulated through reflection sessions and discussions about the meaning of different aspects of the content and learning process. The feedback and reflection sessions sought a balance between solid argumentation (methodological groundedness) and the ability to easily navigate an ill-defined problem space (epistemological agility).

The two cases presented in this article hint towards the next steps in developing better ways to teach transdisciplinarity in urbanism education. Confronted with the broader transdisciplinarity literature, we raised questions that require further research into more extensive, full-quarter-length courses in which transdisciplinary learning is explicitly involved as a learning objective and in which the indicators of transdisciplinarity presented in this section are recorded systematically. Other emergent forms of teaching and learning, such as the MSc MADE programme of the AMS Institute in Amsterdam, heavily involved in Urban Living Labs of the city of Amsterdam, could provide further insight into the potential and challenges of educating the next generation of urbanists.

Acknowledgements

The authors would like to acknowledge the colleagues who have coordinated and co-taught the elective courses. For the I-SURF project: workshop team members Nina Bohm, Anca Ioana Ionescu, and Marina Višić; project supervisor Arjan van Timmeren; lecturers Marjolein van Esch, Frans van de Ven, Anne Loes Nillesen, Saskia de Wit, Sybrand Tjallingii, Saline Verhoeven, and Peter van Veelen; guest tutors Agate Kalnpure, Daniela Maiullari, Daniele Cannatella, and Leo van den Burg; as well as city representatives Eric van der Kooij, Roy Berents, Maurits de Hoog, Stephanie Snellenberg, and Ron van Heusden. For the Cities of Making project, team members: Victor Munoz Sanz (TU Delft); lecturers: Adrian Hill (Latitude), Han Meyer (TU Delft), and Ben Croxford (UCL London).

The I-SURF project was funded by NWO under grant number 438.18.L54. Cities of Making has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857160 in the framework of the JPI Urban Europe ERANET Cofund Smart Urban Futures (ENSUF) Call.

References

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). *A pattern language: Towns, buildings, construction*. Oxford University Press.

Brandt, P., Ernst, A., Gralla, F., Luederitz, C., Lang, D. J., Newig, J., Reinert, F., Abson, D. J., & Von Wehrden, H. (2013). A review of transdisciplinary research in sustainability science. *Ecological Economics, 92*, 1–15. https://doi.org/10.1016/j.ecolecon.2013.04.008

Davoudi, S. (2010). Planning and interdisciplinarity. In A. Geppert & G. Cotella (Eds.), *Quality issues in a changing European higher education area* (pp. 33–35). AESOP Planning Education No 2. Association of European Schools of Planning.

Forgaci, C., & Timmeren, A. van (2021). *I surf - Instruments for sustainable urban riverfronts*. Retrieved 23 April 2021, from https://www.verdus.nl/project/i-surf/

Haider, L. J., Hentati-Sundberg, J., Giusti, M., Goodness, J., Hamann, M., Masterson, V. A., Meacham, M., Merrie, A., Ospina, D., Schill, C., & Sinare, H. (2018). The undisciplinary journey: early-career perspectives in sustainability science. *Sustainability Science*, *13*(1), 191–204. https://doi.org/10.1007/s11625-017-0445-1

Hausleitner, B., Hill, A. V., Domenech, T., & Muñoz Sanz, V. (2022). Urban manufacturing for circularity: Three pathways to move from linear to circular cities. In L. Amenta, M. Russo, & A. van Timmeren (Eds.), *Regenerative territories*. GeoJournal Library, vol 128. Springer. https://doi.org/10.1007/978-3-030-78536-9_5

Hill, A. V. (Ed.). (2020). *Foundries of the future: A guide to 21st century cities of making*. With contributions by Ben Croxford, Teresa Domenech, Birgit Hausleitner, Adrian Vickery Hill, Han Meyer, Alexandre Orban, Víctor Muñoz Sanz, Fabio Vanin, and Josie Warden. TU Delft Open.

Klaassen, R. G. (2018). Interdisciplinary education: a case study. *European Journal of Engineering Education*, *43*(6), 842–859. https://doi.org/10.1080/03043797.2018.1442417

Nijhuis, S., Stolk, E., & Hoekstra, M. (2016). *Teaching urbanism: the Delft approach. Proceedings of the ICE - Urban Design and Planning, 170*(3), 96-106. Article 1600013. https://doi.org/10.1680/jurdp.16.00013

Orozco-Messana, J., de la Poza-Plaza, E., & Calabuig-Moreno, R. (2020). Experiences in transdisciplinary education for the sustainable development of the built environment, the ISAlab workshop. *Sustainability*, *12*(3), 1143. https://doi.org/10.3390/su12031143

Ramadier, T. (2004). Transdisciplinarity and its challenges: The case of urban studies. *Futures*, *36*(4), 423–439. https://doi.org/10.1016/j.futures.2003.10.009

Rooij, R., & Frank, A. I. (2016). Educating spatial planners for the age of co-creation: the need to risk community, science and practice involvement in planning programmes and curricula. *Planning Practice and Research, 31*(5), 473–485. https://doi.org/10.1080/02697459.2016.1222120

Salingaros, N. A. (2000). The structure of pattern languages. *Architectural Research Quarterly*, *4*(2), 149–161. https://doi.org/10.1017/S1359135500002591

Schneider, P., Folkens, L., & Busch, M. (2018). The teaching-research-practice nexus as framework for the implementation of sustainability in curricula in higher education. In W. Leal Filho (Ed.), *Implementing sustainability in the curriculum of universities: Approaches, methods and projects* (pp. 113–136). Springer International Publishing. https://doi.org/10.1007/978-3-319-70281-0_8