Designing for Change: Exploring Open Design Strategies in Architectural Design

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While sustainability is increasingly considered a core topic in architectural design curricula, the dominant focus is still on technical and environmental aspects. Yet how the built environment becomes part of people's (future) everyday living matters greatly. Its ability to meaningfully change along with uses, users and contexts is an important measure of sustainability. Taking into account use-related aspects, however, requires finding ways to deal with the uncertainty and complexity that this invites into design processes.

Searching for approaches that acknowledge this uncertainty and complexity in how we teach and study design, we explored the value of weaving an open design approach into architectural education. We looked at attempts in industrial design engineering, specifically open-ended design and open script design. These strategies aim to bring into view the dynamic with which products become part of real environments that are ever-changing and unpredictable.

We adopted an action research approach: in a compulsory course on actual topics we involved master students in architectural engineering as researchers to explore these strategies' value and applicability in architectural design. The course module was offered twice. From the first iteration, reported on elsewhere, we learned that open design formalizes a mode of thinking that is latently present to students in their education and design work and connects to sustainability. In this paper we report on the second iteration and further explore this connection. Analysis of students' work shows that they adopt a relational perspective, viewing sustainability as a quality of the relations between the built environment and its users. And that on a practical level, working with these strategies incites normative and future thinking in students' spatial analyses—core competencies in sustainability literacy. The major challenge we see towards the future lies in moving on from applying strategies to developing a sustainability mindset.

INTRODUCTION

A major question designers face today is how to take up their responsibility in creating more sustainable living environments. That the answer is not straightforward is illustrated by the fact that design is seen as both part of and responsible for environmental and ecological problems,[1] and yet capable of proposing solutions.[2] Besides dual, design's role is indirect: through design one may influence but never determine sustainability outcomes. Sustainability poses complex systemic socio-technical problems often described as 'wicked'.[3] One common way of dealing with this wickedness is to avoid it by focusing solely on technical and environmental aspects of sustainability,[4] i.e., aspects designers have nominal control over. For example, when considering 'sustainable building', one might tend to think of 'energy neutrality', 'recyclable materials', 'non-toxic paints', etc. Yet, these are only part of the story. Less often we think about how the built environment becomes part of people's (future) everyday living. But think of how the covid-19 pandemic changed how space is used and the consequences of those changes towards sustainability.[5] Considering such use-related aspects during design, however, invites considerable complexity and uncertainty into design processes.

While upcoming approaches like *life cycle assessments* and *circular building* offer more systemic views, in architectural education, and other engineering fields, the focus on sustainability remains mainly techno-centric.[6] At the same time recognition grows that design and spatial development need more holistic approaches to sustainability that also take into account social and behavioural aspects[7]. Besides in academia and education, this recognition also appears in new spatial policies—e.g. Flanders and the Netherlands push towards 'bottom-up', 'participative' and 'local' in the design and development of space.[8] However, both the development and the implementation of concrete strategies that consider use-related aspects of sustainability are still in an explorative phase. This is where our study fits in.

Our general aim is to (1) sensitise students to the social dimension of sustainability and (2) contribute to design strategies that help them engage with sustainability on a more human-centric level.

We see opportunities in open design, a recurrent idea in design research[9] and architectural theory.[10] Common in work on open design is that it views design as an ongoing process which extends into use. It points at the pivotal role of users as

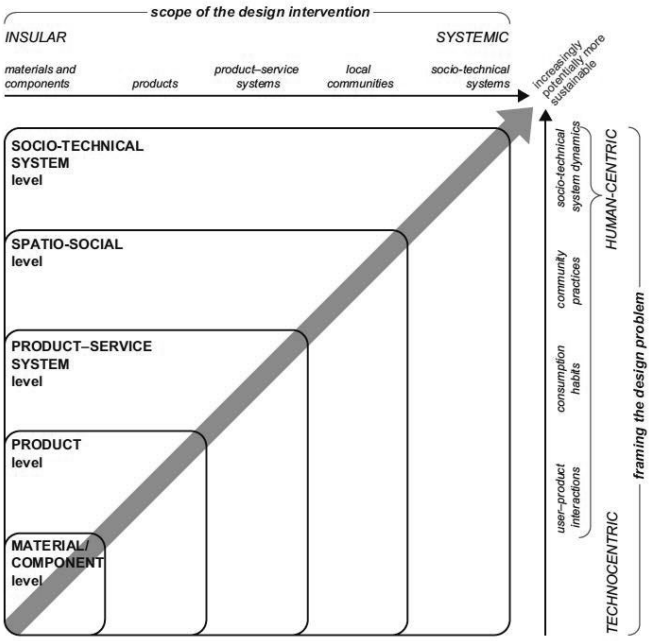


Figure 1. Design for Sustainability framework by Ceschin and Gaziulusoy © (2019, p.144)

'unselfconscious or everyday designers',[11] thereby redistributing roles and responsibilities between designers and users in shaping design outcomes and consequences.

We are not the first to connect open design and sustainability; several of the above cited works offer sustainability as a rationale. Open design and sustainability mainly connect through the idea of resilience.[12] Assumedly a certain degree of openness allows a design to meaningfully adapt to, and thus survive, varying and unknown future needs and contexts. So far in architectural design, implications of open design for practice—what exactly openness pertains to—remain largely abstract. In other design fields, particularly human-media interaction (HMI) and industrial design engineering (IDE), discussions on open design recently received new impulse,[13] resulting in concrete practice-oriented strategies. We focus on two strategies specifically: open-ended design[14] and open script design.[15] Both aim to bring into view the dynamic with which products become part of real (end-use) environments that are ever-changing and unpredictable.

In order to explore the hypothesis that open design strategies may also have value for architectural design and education, we offered an 'open design' module in the context of a compulsory course on actual topics in the architectural engineering program at KU Leuven. So far the module was offered twice. The first iteration, reported on elsewhere,[16] focused on the relevance and value of open design strategies for architectural design. We learned that they formalize a mode of thinking that is implicitly present in students' education and design work, and connects to the theme of sustainability. In this paper we report on the second iteration which focuses more in detail on the applicability of open-ended and open script design and their potential to further develop sustainable design in architectural education.

BACKGROUND

Over the past decades sustainability came to be increasingly considered as a core topic in design curricula, which is and has been approached in different ways. In their *Design for Sustainability* (DfS) framework, Ceschin and Gaziulusoy[17] plot different ways of engaging sustainability in design. At one end of the spectrum, approaches engage with sustainability on an insular and techno-centric level; at the other end, on a systemic and human-centric level (Figure 1).

This builds layers of complexity in sustainability problems, extending the focus from materials to products and human-product interactions; to product-service systems and user behaviours; to what Ceschin and Gaziulusoy identify as the socio-spatial level, which considers how products are embedded in and affect community practices; and finally to socio-technical systems which focus on how higher level societal needs (e.g., mobility and nutrition) are fulfilled. With these layers of complexity, sustainability becomes an increasingly wicked problem. While approaches located in the top-right corner offer greater opportunity for sustainability, they also entail much more uncertainty and less control over outcomes. This also means that they do not necessarily produce more sustainable outcomes.

OPEN-ENDED AND OPEN SCRIPT DESIGN AS SUSTAINABILITY APPROACHES?

Open-ended and open script design both were developed in the field of IDE. Although rooted in different backgrounds, respectively second order cybernetics, and social constructivism, they both recognize that mutual shaping occurs when products and (non-)human actors interact. This mutual shaping can be seen as an ongoing conversation built through tangible feedback, which unfolds in time and—being hardly predictable—is rarely considered during design processes. Both strategies are proposed as a possible approach to bring into view and/or facilitate the conditions for this conversation to happen.

Regarding the specific strategies, open-ended design, as a design outcome, is defined as intentionally suboptimal, error-friendly, unfinished, wabi sabi, contextual and context-dependent. This 'unfinishedness' regards just those aspects that are context-dependent and cannot be fully imagined during design. In order to identify these aspects during design processes open-ended design proposes, 10 lenses to focus on change.[18] Each lens asks designers to adopt a different viewpoint to analyse the same phenomenon in order to learn about its complexity.[19]

PAPER

Open script design builds on the idea of 'scripts',[20] the idea that through anticipations of use and assumptions about the world, designers implicitly or explicitly build in use-prescriptions in artefacts' materiality. Thinking in terms of scripts invites designers to consider products in their capacity to direct human action. Thinking in terms of 'openness' invites them to consider how these products (and thus their scripts) are also continuously transformed in use to meaningfully fit their users' lives.

For both strategies sustainability is an important rationale underlying their development. Sustainability, like *any* design outcome and/or consequence, is viewed as a quality of the relations between products and (non-)human actors. This locates these strategies, so we argue, among systemic and human-centric approaches in the DfS.

METHODS

In order to contribute to strategies in architectural design that support a more comprehensive view on sustainability we set up a form of action research (AR). AR originated within social sciences and has had a strong presence in educational research,[21] but has also been successfully applied in design research.[22]

AR is a process of inquiry conducted by and for those taking the action. Instead of presenting the open design strategies as 'fixed knowledge', asking students to 'simply' apply them, we engaged them as researchers to critically explore these strategies' value and applicability in the context of architectural design. Through cycles of planning, acting and reflecting, AR seeks to improve knowledge (c.q., of open design (strategies); sustainable architectural education) of those involved in the inquiry (c.q., students; researchers/ teachers) which leads to actions (c.q., new design practices; ways of teaching). Reflections on these actions in turn lead to new understanding and open up new areas of inquiry.

PLAN: MODULE SET-UP

To learn about doing and reporting on scientific research, students had to write a scientifically sound paper with direct relevance to an actual topic in their field, based on their own (limited) research. The course offered several parallel modules each corresponding with an actual topic.[23] We developed a module around open design. Each module was introduced in a 2-hour introductory lecture, after which students were invited to short-list their topic preference. These short-lists informed the assignment of topics.[24] The first iteration 12 (out of 56) students listed open design as first choice, of whom 11 were assigned the topic. The second iteration 9 (out of 58) students listed open design as first choice, all of whom were assigned the topic.

The introductory lecture introduced the general topic of open design. Open-ended and open script design were framed as two strategies developed in the field of IDE that fall under this broad topic. Their introduction relied on theoretical explanation and presentation of case studies/ examples that highlight the phenomenon of openness in design. Note that we did not explicitly introduce these strategies as sustainable design strategies.

The introductory lecture was followed by three seminars in which students received both individual and collective feedback on their ongoing work. These seminars centred on the abstract (specific topics, research design), structure (literature study, progress of their fieldwork), and results and discussion (analysis).

In a three-step assignment we asked students to:

1. select a building or (urban) space they had designed earlier during their studies;
2. select and (qualitatively) study the use of (a) similar building(s) and/or space(s) through the lens of open-ended or open script design
3. reflect, based on their fieldwork, on their own design in terms of openness.

To support their research students were given access to ten core articles as mandatory reading material[25] and additional literature for deepening knowledge.

ACT: FIRST TO SECOND ITERATION

In the first iteration students worked with the general idea of open design rather than a specific strategy. We supported this high-level approach as we wanted to learn about open design's value and relevance in architectural design. In the second iteration, however, we wanted to zoom in on applicability; on what students need from the strategies in order to bring into view the complexity of socio-technical relations. Therefore we asked explicitly to choose and work with one of both strategies.

Furthermore, in the first iteration students explicitly linked open design to sustainability: they noted the high societal relevance of open design thinking and how it supports new ways of approaching (design) problems. In our analysis of the second iteration this link became a more explicit area of inquiry.

REFLECT: MATERIALS AND METHODS

To learn about these strategies' applicability, we collected the students' written work and invited them to partake in a focusgroup interview immediately after the oral exam. While students' final papers were at the centre of our analysis, we also had access to their intermediary work and data logs. From the 9 students who completed the module, 8 worked with open script design. The focusgroup interview served as a complementary source of data to learn about motivations

behind choices and increase our study's internal validity. Only 2 students participated.

The document analysis involved appraising and synthesising the data contained in the papers and data logs, which we organised into major themes, categories and case example through content analysis. Although not following a strict method, we were informed by QUAGOL,[26] a guide for qualitative data analysis primarily directed at analysing interviews.

RESULTS

STUDENTS' UNDERSTANDING OF OPEN DESIGN

Students applied the strategies to a wide range of cases and across different scales: from particular spaces and their interiors, over (social) housing and public buildings (schools, railway stations) to urban design and even urban water management. They were able to grasp the idea of open design in general and the strategies in particular, which is clear from their definitions and explanations. Interestingly some students explain open design by connecting it to sustainability, e.g.:

> [The goal [of open scripts] is to make architects question the abstract user for whom they design and how their design imposes or prohibits certain uses for certain users. Open scripts are thus a matter of sustainability but also of social inclusion and emancipation.]

The association with sustainability also shows in the specific focus students adopted. For example, one student worked around his design of a public square (Figure 2) and focused on the square's role in social cohesion framing his research in the context of an individualizing society and the need for more compact cities—a focus that was not explicitly foregrounded in the original project.

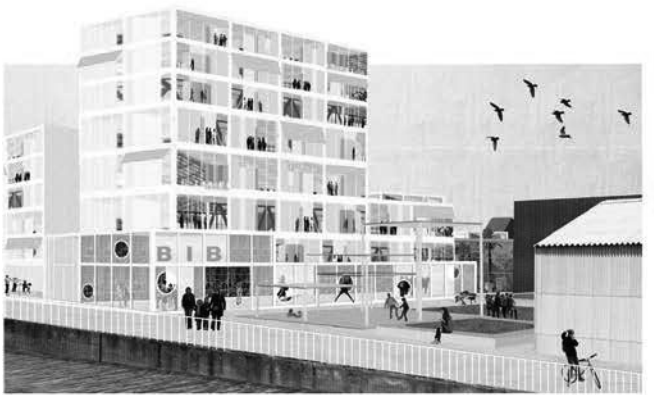
Students' understanding of open design also shows in their case selection. To be able to reflect on the square's role in social cohesion, the abovementioned student studied the use of two city squares in Leuven (Figure 3). He selected these squares because of their similarities in terms of location, and differences in terms of the openness/directiveness regarding their design and use.

Regarding design, he notes the open and bottom-up character of the Damiaanplein's recent renovation in which the neighbourhood was much involved and contrasts this with the Quinten Metsysplein's monument-status, which (should) prevent(s) its users from intervening. Regarding use, he discusses the Damiaanplein's movable elements; specifically the sitting elements which do not prescribe particular ways of sitting and may even invite other activities like play. This unlike the Quinten Metsysplein's fixed traditional benches, on which he observed people to sit and interact in similar ways:

> [When people were sitting on the benches, they were used according to the script: a normal sitting posture with legs besides each other.]

Students' understanding of open design is also present in the kind of reasoning in their spatial analyses. Typical for this kind of reasoning is the human-centric focus: students see openness and directiveness not as a property of the spaces/objects themselves, but as a quality of the relations between them and humans.

This is particularly clear in the work of two students who explicitly differentiate flexibility and openness. One of them does so through studying facades. Using the façade of a shoe store, he explains that flexibility is often focused on as a property of the architecture-object, i.e., an object is flexible or not regardless of who uses it (Figure 4). This façade can be said to be flexible, given that the shutter can be open or closed. Openness is something different, according to this student, and depends on who interacts with the object. The shutter-facade is not open for passers-by and consumers as they cannot intervene.



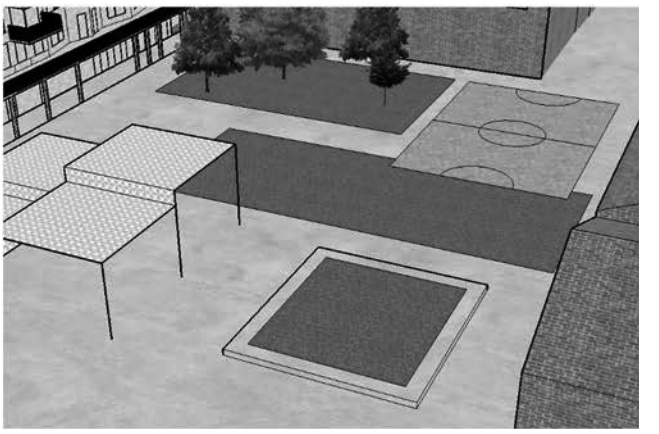


Figure 2. A City Square, original design by Nand Baeten, Siemen Clerckx, Felix Creemers and Pieter-Jan Vandenwijngaert ©.

Figure 3. Google streetviews images of the Damiaanplein (left) and Quinten Metsysplein (right) in Leuven, Belgium.

Figure 4.Mano store façade, Leuven, Belgium. Sam Neel ©

Figure 5. OPEK cultural centre Leuven, Belgium. Lina Decraemer ©

But it is open for the shop-employees who can control the shutters and thereby when and whether people can enter.

NO DEFINITIVE SOLUTIONS

Related to adopting a relational perspective, we see normative thinking emerging in the students' work. They reflect on *when, where, why* and *for whom* openness is a value. Inherently their papers discuss conflicting needs between different users and situations, or conflicts between individual users and communities. E.g., the student who analysed squares observed that the openness of the Damiaanplein's sitting elements is appreciated by young people, but less suitable for older people, assuming that the latter value sitting support over 'creative sitting'. He furthermore highlights a conflict between individual use and the community: people park their cars on the Damiaanplein against traffic regulations. This might be convenient for individual users, yet for the community he believes this to be undesirable.

Interestingly, he sees a role for design to navigate and settle such tensions. In the third step of the assignment he goes so far as to propose a re-design of his original square design, about which he writes:

> [The lay-out of the square should allow different activities, but it should not lead to the parking of cars as on the Damiaanplein.]

Here he hints at the need to design the square such that it (materially) prevents the parking of cars.

Related to this normative thinking, all but one student acknowledge that openness is not an intrinsic design goal. A student who studies cultural buildings, provides several examples where she believes too much openness leads to underuse (Figure 5):

> [A design can sometimes be too open for interpretation, so there is a risk that the space will not be used. […]The benches in the OPEK passage spaces reveal that they are also intended for waiting and perhaps even for lingering.

> Due to the further lack of furniture, this space is not cozy enough to actually stay there for a while.]

Students write about 'tuning openness' and 'balancing openness and script'. Interestingly, one student analysed the use of spaces he observed in terms of wanted/unwanted and intended/unintended outcomes. Reflecting on his own design, he used this matrix (albeit not structurally) to discuss possible scenarios that may unfold in its different areas, thus moving on from discussing ideal outcomes to also considering the possibility for his design to develop in unforeseen and unwanted ways:

> [There is also the issue that not every user has a positive influence on the design. When users start to misuse the design it can lead to neglect, vandalism, littering, anti-social behaviour and so on. So to take this into account, the designer needs to try to give the script an openness to the wanted behaviour and a closedness to the unwanted behaviour.]

He continues to emphasize the importance of design iterations and continuous reflection in the process of tuning openness and rooting out unwanted behaviour. This illustrates his realization that an open script design strategy, as he describes here, does not necessarily lead to desired outcomes, but that establishing desired outcomes is a continuous process which extends into use.

We also recognize this in other students' work. For example, the student analysing squares observed how the Damiaanplein's openness invites both wanted and unwanted use. He likes that the movable elements were at some point pushed to the side to create a pop-up terrace and how they allow users to create micro-climates – e.g., following the shade on hot summer days. But he dislikes that the lay-out was at times chaotic leading to impoverishment and littering. His re-design seeks 'a good balance between openness and script' and foresees both fixed and movable sitting elements (Figure 6). This way he hopes to prevent chaos, but still encourage users to intervene in the space according to their needs.

NEED FOR STRUCTURE

Students approach the general working of open script design in a very similar manner, yet their concrete spatial analyses considerably differ. During the process most students struggled to find a structure for their analysis. They all touch upon different aspects of a design or levels on which it can be open, but the majority does so quite randomly. Making it difficult to draw coherent conclusions.

Interestingly three students did propose a specific structure. According to one of them, 'we can design for an unknown users by making a script more open or closed'. To this end he identified six categories of 'aspects that play with the openness of a design': communication, accessibility, convenience, flexibility, inclusivity, security and safety.

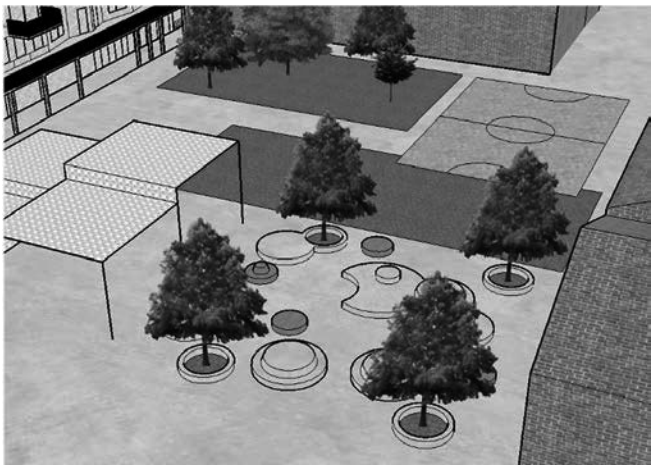


Figure 6. A city square, re-design by Felix Creemer©

The other two students differentiate social levels. The student analysing squares identifies what he calls 'openness on the smaller scale', discussing sitting elements and how users interact with them; and 'openness on the larger scale', discussing lay-out and which activities and practices (can) emerge. While he addresses yet another level, reflecting on the square's role in social cohesion, he himself does not include this in the proposed structure.

Another student distinguishes openness on a 'social cultural' and a 'functional' level. Regarding the former, she describes and analyses how buildings (materially) reinforce social structures, e.g., through spatially expressed user-hierarchies between artists, staff and audience. Regarding the functional aspects she focuses on how buildings/spaces allow or direct what activities can take place and how these take shape. She discusses, for example, how 'entering' unfolds in the different buildings she observes.

DISCUSSION AND CONCLUSION

Our study asked about how to sensitize students to the social dimension of sustainability; and more specifically how open design strategies can support a more comprehensive view on sustainability during design.

First, in terms of limitations we want to highlight that the students' assignment was not a design exercise. While students proposed interventions and some even made a re-design, what they did considerably differs from what they do in design studios. Inherently we have no ground to say anything about how these strategies work in such a setting. That being said, we learned from our module the value of reflecting on and revisiting a design from a new perspective; like Donald Schön[27] already showed years ago. In fact, we wonder whether

'revisiting previous designs' might be seen as an aspect of sustainable design education. Instead of focusing on creating something new, as is often the case in design studios, our exercise suggests it makes sense to revisit a design to study it from new angles. This could be an interesting way for design studio's to introduce actual topics, but also to sensitize students to the wicked, layered and continuous nature of design problems by casting fresh light on a design time and again. Such awareness of wickedness resonates with the aim of open design itself.

OPEN DESIGN > OPEN TEACHING?

We see more parallels between open design and our (action research) teaching strategy. The set-up of our module moves away from teacher-centred pedagogical paradigms in which teachers are dominant in transferring knowledge, and more closely aligns with student-centered pedagogy which attributes students a more active role through collaborative, problem and project-based learning methods.[28] Yet, we may even argue our set-up embraces and goes beyond student-centered pedagogy in that both teacher- and student-centered paradigms aim at transferring a (more or less) delineated body of knowledge. Involving students as researchers makes them part of the process of knowledge production itself. This may help to raise students' awareness that knowledge production (like design) is an ongoing process. Awareness of this continuous nature of both design and knowledge production we believe to be essential in sustainability literacy. Related, we found that action research offers an interesting way of dealing with the different time frames of research and teaching—research cycles being usually much longer than teaching ones.

Inherent to our approach is, however, not knowing 'where it will end', given that we don't have the answers we ask students to look for. Yet, here again is an interesting parallel with open design itself, which asks to acknowledge and let go of control over the outcomes.

OPEN DESIGN STRATEGIES IN SUSTAINABLE ARCHITECTURAL EDUCATION

While students struggled with the strategies' practical application, we see an interesting resonance between the structure that students imposed on their analysis and the Design for Sustainability framework.[29] This framework builds layers of complexity in sustainability problems by zooming out from single products and direct user-interactions to socio-technical systems and how a design is embedded in larger social and material structures. We see a similar build up in the structures students proposed to study openness. Particularly with regard to how spaces become part of micro- to macro-social processes: studying openness on the level of direct user-space/object interactions, e.g., how the sitting elements guide users' act of sitting; on the level of activities and the kind of practices a certain space is open to, e.g., creating a terrace but also parking and littering in case of the Damiaanplein; and on the level of social structures, e.g., the role of squares in processes of social cohesion in compact cities. This resonance, we believe, is an interesting pathway forward to further develop open design strategies in relation to sustainable design.

To conclude, our study shows that on a practical level students engage with the wickedness of sustainability's social dimension and more generally the social role of design. We see it in the normative and scenario/future thinking that is present in their work. Brundiers et al.[30] mark these ways of thinking key competencies in sustainability literacy. They underline the importance of investing in them to empower students to become effective in contributing to sustainability problem-solving. They also point out that these competencies are not naturally developed in teaching-learning settings but require targeted and ongoing attention. While study suggests that working with open design strategies incites normative and future thinking, it is difficult to assess students' level of awareness that applying these strategies does not necessarily lead to more sustainable outcomes, but that both their application and outcomes need to be seen as learning processes. And that their value lies in brining into view complexity, uncertainties, values and value conflicts that are at play. Developing such awareness is where we believe the main future challenge lies in moving towards sustainability literacy. As we ultimately want students to move on from applying strategies to developing a sustainability mind-set.

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21. Greenwood, D, and M. Levin. Introduction to Action Research. 2455 Teller Road, Thousand Oaks California 91320 United States of America: SAGE Publications, Inc., 2007.; Kemmis, Stephen, Robin McTaggart, and Rhonda Nixon. The Action Research Planner: Doing Critical Participatory Action Research. Springer Singapore, 2014.
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23. Actual topics 2018–2019: media architecture, open-ended design, buildings and energy, sustainable cities and architecture and history.
24. There are two limitations in the assignment of modules: students are excluded from a module if it is taught by the supervisor of their master thesis (in case of the open-ended design module: the third author), or by the titular of certain elective courses (in case of the open-ended design module: inclusive design).
25. *Mandatory literature core:* Framing open design through theoretical concepts and practical applications(Bakırlıoğlu and Kohtala 2019); Meta-design (Fischer and Giaccardi 2006); Designing 'moralized' products (Jelsma 2006); RE:definitions of use (Redström 2008); Unselfconscious interaction (Wakkary, Desjardins, and Hauser 2016); Aspects of everyday design (Wakkary and Maestri 2008). *Mandatory open-ended design*: Observed decay (DeSilvey 2006); Open-ended design (Ostuzzi 2017, 101–41); Designing for social interaction in open-ended play (Valk, de, Bekker, and Eggen 2015); From design for one to open-ended design (Ostuzzi et al. 2017). *Mandatory open script design:* The de-scription of technical objects (Akrich 1992); Where are the missing masses? (Latour 1992); Social engagement in design (Stam 2016, 80–144); Design and the domestication of information and communication technologies (Silverstone and Haddon 1996)
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