BioDiveIn + GoCoLife: EcoSystemic Prototypical Urban Interventions Engaging Social and Environmental Systems

Marie Davidová 🆔 ᵃ * | María Claudia Valverde Rojas 🆔 ᵃ | Hanane Behnam 🆔 ᵃ

ᵃ University of Stuttgart, Cluster of Excellence IntCDC, Stuttgart, Germany
* Corresponding author: marie.davidova@intcdc.uni-stuttgart.de

ABSTRACT

BioDiveIn and GoCOLife are two of several interventions developed within COlife studios over 2022 and 23. These aim to lead towards transition towards Post-Anthropocene, engaging ecological aesthetics. BioDiveIn intervention is an installation that offers multiple species habitats, edible landscapes and water pools for bats, swifts, small-size birds, squirrels, insects and plants. The intervention serves as a touch point that is - leading to DIY recipes to multiply the installation andto spot-a-bee application for joining the citizen science on pollinators. This was gamified in GoCOLife intervention. An urban game application that is engaging people in biodiversity support, and reproducing the DIY recipes, amongst others. The interventions were codesigned through gigamapping and full-scale prototyping through experimental Systems Oriented Design (SOD) studio courses in winter and summer with students, invited experts and other stakeholders. The design processes resulted in DIY events, a launch with a gardening party to accommodate the plants in the prototype and the urban game application GoCOLife.

Keywords: more-than-human, prototypical urban intervention, gamification, gigamapping, prototyping, systems-oriented design.

INTRODUCTION

The discussion on a more-than-human perspective was brought up by posthumanist authors such as Dona Haraway and Bruno Latour (Haraway, 1991; Latour, 1993) and is discussed today by several authors (Clarke et al., 2019; Forlano, 2017). It integrates ecology and technology within systems thinking. Posthumanism is praxis; it has to be comprehensive in its contents as well as in the way such contents are explored (Ferrando, 2012). This article presents systemic research by design or systemic so-called practice-led research (Sevaldson, 2010), which integrates crafts (Vennatrø & Høgseth, 2021). Our work brings the notion of reflective practitioner (Schön, 1983) and the designerly way of knowing (Cross, 2011) into action through real-life codesign laboratory when the design is enacted in real life (Davidová, 2020c). There are symmetrically viable possibilities for practice-led research to incorporate a broader field of multiple practical ontologies. This might necessitate a shift in how craft science views practice: More than an aspect strictly adhering to human practitioners, the practice would need to be taken as an underlying epistemology for how phenomena (including practitioners themselves) are brought into being and are enacted through practice in multiple more-than-human lifeworlds. A consequence would be a need to centre analysis of practice within overlapping worlds of practice and agency (Vennatrø & Høgseth, 2021). This paper

presents work where practice and real life agency of present actors of the real life environment meet in action research. Action research is a systemic inquiry that is collective, collaborative, self-reflective, critical and undertaken by participants in the inquiry (McCutcheon & Jung, 1990). Within the framework of Ecological Aesthetics, Steiner states:

> We need to look around and see what else is alive. What plants grow in our neighborhood? Are they native or imported? The birds: do they migrate by seasons or stay put? Where do these flying creatures eat and mate? What other animals live around us? How about honey bees? Bees seem to like urban living. And us: How do we organise our communities, cities, and regions? What are our histories, our laws, our institutions? What do we believe in? (Steiner, 2019, p 34.).

As we navigate the complexities of urban living, it's crucial to reconnect with the natural world that surrounds us. Urban landscapes are teeming with life, urban-adapted species like honeybees thrive, underscoring the intricate balance of urban biodiversity. Yet, understanding and engaging with this biodiversity requires more than mere observation; it demands active participation and awareness of our role within these ecosystems. This project explores the fusion of ecological science and gamification through the BioDiveIn and GoCoLife interventions, aiming to enhance user experience and foster a deeper connection with urban nature. Cybernetician Gregory Bateson asked: "What is the pattern that connects the crab to the lobster and the primrose to the orchid, and all of them to me, and me to you?" (Bateson, 1979, p 8.)

Within the discussion on Ecological Aesthetics, part of Bateson's work can be summarised as trying to move our attention to the relationships and information and semiotics that make up ecologies, whereas conventional science tends to focus on material and energy as with physical systems (Sweeting, 2023 – personal correspondence). This paper shows how the two can be synergised together by incorporating elements of gamification to 'prototypical urban interventions' (Doherty, 2005), to engage users in a meaningful exploration of their environment and also educate and empower them to contribute to the sustainability of urban ecosystems. The tangible intervention is marked with a QR code that leads to an urban game for its own reproduction. This approach, grounded in the principles of systems-oriented design and participatory science, offers a novel pathway to enhancing urban biodiversity and fostering a more ecologically aware society.

The paper will discuss ecosystemic services of 'prototypical urban intervention' (Doherty, 2005) that aim to adapt buildings towards the transition to post-Anthropocene through tangible object and gamification, respectively, these interventions were developed through design studio teaching in winter semester 2022-2023, and summer 2023 at the Faculty of Architecture and Urbanism, at University of Stuttgart. It follows a previous intervention, POL-AI (Davidová, Fischer, et al., 2022), installed on the same wall. You can follow the data in the referenced datasets (Davidová, Behnam, et al., 2024; Davidová, Teye, et al., 2024; Davidová, Valverde Rojas, et al., 2024). The concept of the post-Anthropocene does not exclude the human being as a fundamental component but takes the latter as a departing point to frame wider contemporary needs and issues and to support a call for action to envision and shape the future (M. R. Canina et al., 2021), where humans and other species live together in synergy (Davidová, 2020a). The term ecosystemic services differs from the commonly used 'ecosystem services' (Davidová, 2020c). Whilst ecosystem services or eco-services are defined as the goods and services provided by ecosystems to humans (Troy et al., 2010), ecosystemic services are non-anthropocentric. The last decade has witnessed the expansion of design space to include the epistemologies and methodologies of more-than-human design (MTHD).

Design researchers and practitioners have been increasingly studying, designing for, and designing with nonhumans (Coskun et al., 2022). In this paper, we discuss both. We combine design methodologies for and with. The interventions are first codesigned with humans (designing for). However, when the ecosystem is intervened, the interventions are codesigned with the overall ecosystem within so-called 'real life codesign laboratory' (Davidová, 2020c).

1. METHODOLOGY

1.1 Gigamapping: a codesign tool and prototyping

Both BioDiveIn and GoCoLife were co-created within the studio course COLife: More-than-Human Perspective to CoDesign. Several types of codesign processes where related stakeholders and discipline representatives were involved. This covered sociologists, an ecologist, an ecologist NGO representative, and neighboring high school and hotel representatives. In both cases, first, the students mapped their own individual personal universes in so-called minimaps (Davidová, 2020d, 2014). By presenting them to each other, they seek to develop empathy and understanding. While doing that, they started relating their minimaps in one collective gigamap, searching for a synergetic proposal. This was performed digitally in the Miro platform (Miro, 2023). For the codesign workshops, the work-in-progress gigamaps were printed out on a big board to easily engage with the stakeholders. These easily found their spot for their own personal intervention, being presented with the gigamap by the students. In BioDiveIn, we combined digital and analogue technics of gigamapping and prototyping and finalised them with real-life installation and a DIY workshop at a local high school. GoCOLife resulted in an interactive urban game, relating a mobile application that was connected to the physical space of a biodiverse urban environment and engaging the people to study the installation from the previous semester and DIY its recipes in their own homes. For both, the gigamapping methodology was the same. The challenge with designing for new fields is the lack of information, knowledge, experience, and skills that are specific to the area. To address this, we have developed a very fast learning process conducted in a designerly way through gigamapping. These learning processes help designers achieve an overview and single out areas where support from insiders and experts would be needed (Sevaldson, 2022). The gigamapping, in our case, is always accompanied by prototypes to develop rich and tacit knowledge (Davidová, 2017). First, the students created their minimaps about their own personal perspectives on the project in Miro, stating what responsibility they would like to take. Thus, they obtain deep knowledge within the field of their interest while having an overview of all the fields of other students because they have to collaborate during the course. After creating and presenting the minimaps and personal interests to each other, they started putting their minimaps on one board, searching for relations amongst each other, and interpreting them. The fact that they present the minimaps to each other generates an empathy whilst they are getting to understand that each of them has a different universe. This has often a form of storytelling, a well-known technique to emphasise emotions (Sagar et al., 2023). Empathy is commonly defined as the ability to step into another's shoes and observe reality through someone else's eyes and feelings. To be empathic means understanding feelings, points of view, experiences that are part of another person's life (Villari, 2021). By relating their personal universes, they start to understand what we can do together. This brings comprehensive communication to the stakeholders who intervene with their personal perspectives.

One person was responsible for the overall graphic design and organisation of the gigamap (see Figure 1 and Figure 2). This is important for the stakeholder stage when the maps need to be more organised and become messy again due to the interaction. However, the whole team collaborated on this codesign process. For the codesign with stakeholders, the gigamap was printed out. The students presented them with every single topic and organisation so that they could quickly orient themselves and find their position. They would then draw into the printed gigamap. I.e. in practice, templates are used for the clients to orient themselves (Paulsen & Rom, 2014). The gigamap was accompanied by models and prototypes (see Figure 3a). This engaged the attention and better understanding. Working with tangible objects supports the interaction. The Miro gigamap gets then updated with the findings. Sevaldson critiques the overdesigning and ordering in the gigamaping (Sevaldson, 2013). However, we discovered that this ordering was necessary for participation when the stakeholders were only able to pop in and out for a limited time. They struggled to respond to the maps in a messy stage and presented disappointment. Therefore, the messy and ordered state appeared in feedback loops, which is typical for many design processes in research by design (see Figure 3b). Therefore, it is important to create a methodology for current situations being improvisational rather than dogmatic, as also suggested by Sevaldson (Sevaldson, 2013). Creativity is a requirement for the Post-Anthropocene era. It helps to face complexity and move toward just and inclusive digital and sustainable transformation (M. Canina et al., 2021). Our approach is unique because it is based on improvisation, being always in conversation with the current situation. Improvisation requires immediate creativity in the moments when things do not go as planned or when there is a better opportunity to appear. Our project is employing a lot of flexibility. We have to be ready that some stakeholders prefer to draw and some storytelling and that they are often busy.

The gigamap in Figure 1 shows the final output of the prototyping studio and was submitted in the winter semester after the intervention was already placed into the real life laboratory to interact with the ecosystem. As you can see, the synergetic design of the intervention was placed in the middle, surrounded by the circles that represent the minimaps. They are being developed throughout the rest of the paper. The gigamap zooms in and out while introducing different lenses, as suggested by Sevaldson (Sevaldson, 2018). Here it is achieved by multiple participation of both, the students and the transdisciplinary stakeholders.
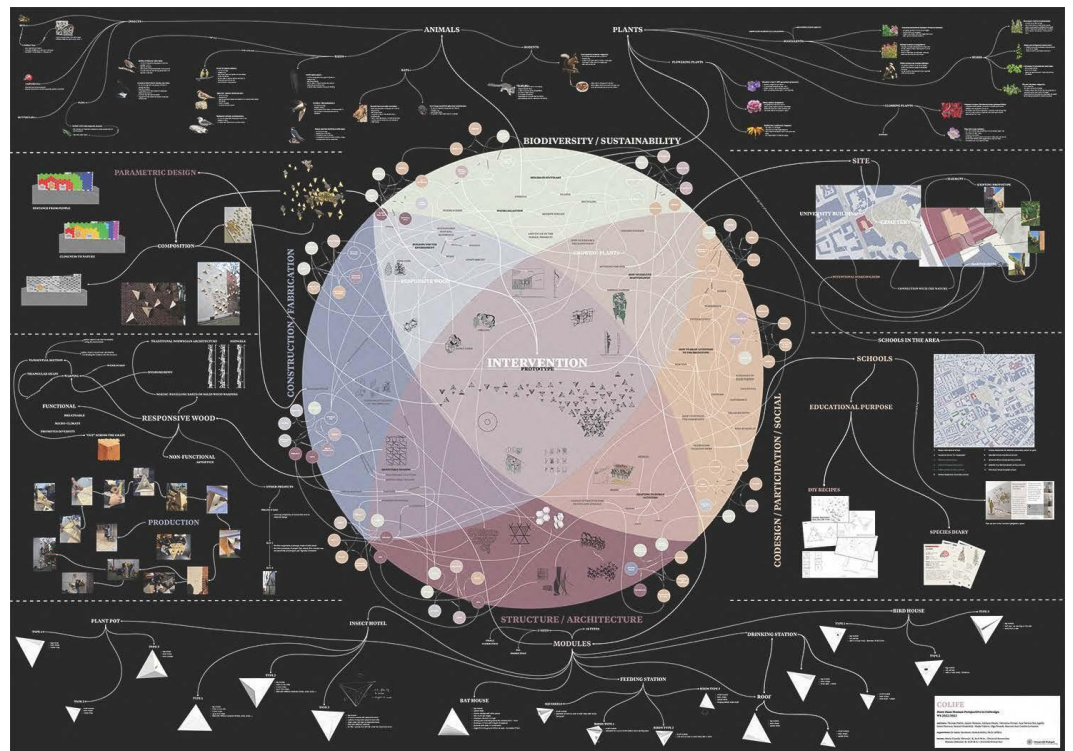
Figure 1: BioDiveIn Gigamap (COLife Studio 2023)

The gigamap in Figure 2 shows the GoCOLife urban game final output gigamap submitted in the summer semester. It was finalised after the game design was completed. This gigamap is multicentered, engaging across multiple topics when the game intervention is oscillating and intervening amongst them in the form of feedback loops. This is probably because the game was built on top of the initial intervention design.
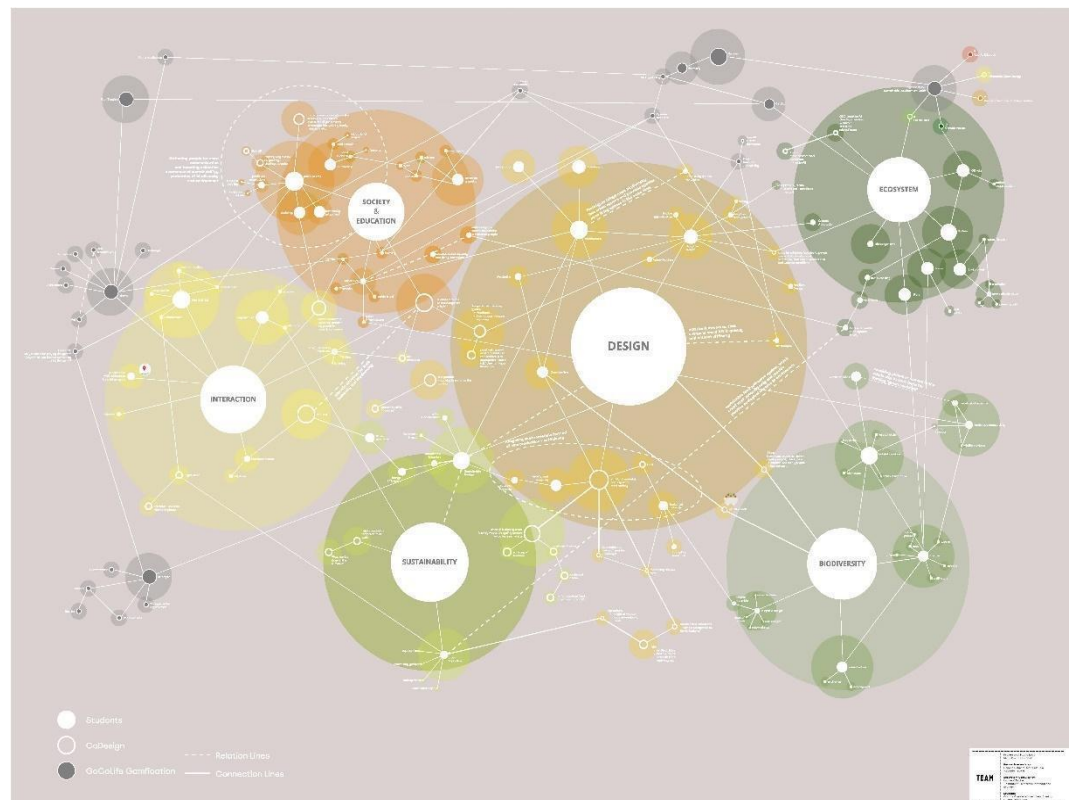
Figure 2: GoCOLife Gigamap (Summer COLife 2023 Design Studio)

Figure 3a shows a codesign session with an ecologist where the printed-out gigamap is accompanied by physical prototypes. The prototypes clearly communicate the design idea

whilst they are placed in the context of the gigamap. After the initial presentation and conversation, the ecologist draws into the gigamap, referring to the species analysis and species habitats in reference to the prototypes' design. This analogue gigamap is then the basis for updating the digital one.

The process consisted from codesign workshops with multiple stakeholders as well from the codesign sessions with the stakeholders who could not make it to the workshop or were needed in the later stage. Figure 3b shows an early codesign workshop. Early codesign workshops are very important as we can get critical information at the early stage. However, these workshops are very demanding on communication as the initial gigamaps are messier than the later ones, and the stakeholders are often confused and struggling to find their place on the map. Some stakeholders do not hesitate to draw; some prefer storytelling. For those who do not draw, the students are drawing what is being said. Therefore, this workshop Is more inclusive.

Figure 3 from left to right: a) CoDesign Session with Gigamap and Prototypes (Photo: Behnam 2022); b) CoDesign Workshop with Printed Gigamap (Photo: Valverde 2022)

2. EXTRACTING DIY RECIPES FROM PROTOTYPING

Simultaneously, DIY recipes (see Figure 4) were cocreated for the public to reproduce the installation BioDiveIn. When the installation was installed, QR codes leading to the recipes on the author's blog (Davidová, 2023) were placed on the installation, which served as a 'touch point' (Clatworthy, 2011). Therefore, the installation becomes generative. Also, a QR code leading to a citizen science application spot-a-bee (Cardiff University & University of Glasgow, 2021) was placed on the prototype. This application helps us to collect data for training image recognition to recognise whether the pollinators are pollinating. Several public engagement events were arranged to increase the audience, such as two Girls' Days prior to the studio (see Figure 5a), a Workshop with Dillmann Gymnasium (see Figure 5b) or a community gardening event at the prototype's opening (see Figure 6). At the gardening event in spring 2023, the community participated in cocreating the prototypes by planting plants in them within the real life codesign laboratory. To reproduce the DIY recipes was further on supported by the GoCOLife urban game.

Figure 4 shows a slide from the BioDiveIn analogue DIY booklet that was designed in IKEA like recipes for various biodiversity support installations. Please download the booklet as well as the later parametric files from the dataset (Davidová, Valverde Rojas, et al., 2024).

5. step

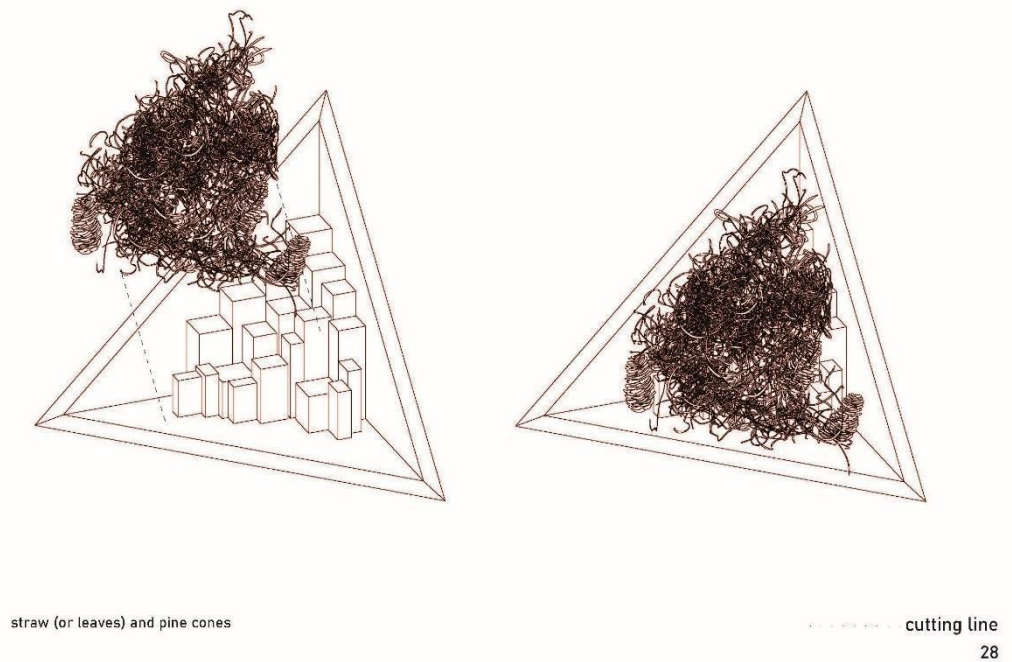straw (or leaves) and pine cones

cutting line

28

Figure 4: A page from Analogue DIY Recipe Booklet (Winter COLife 2023 Design Studio)

Figure 5a shows the Girls' Day workshop. Girls' Day is a collective celebration in Germany, where workshops for primary and high school girls are provided by universities to engage them in university studies and research. This is due to incredibly high sexism in German academia.

We gladly opened a collaboration with the Dillmann Gymnasium gardening group (see Figure 5b), where the students led the workshop by DIYing our recipes on their own biodiverse garden. However, the parts were preproduced as the gymnasium doesn't have a carpenter workshop. The intervention was successful, and the prototypes are still flourishing in their garden.
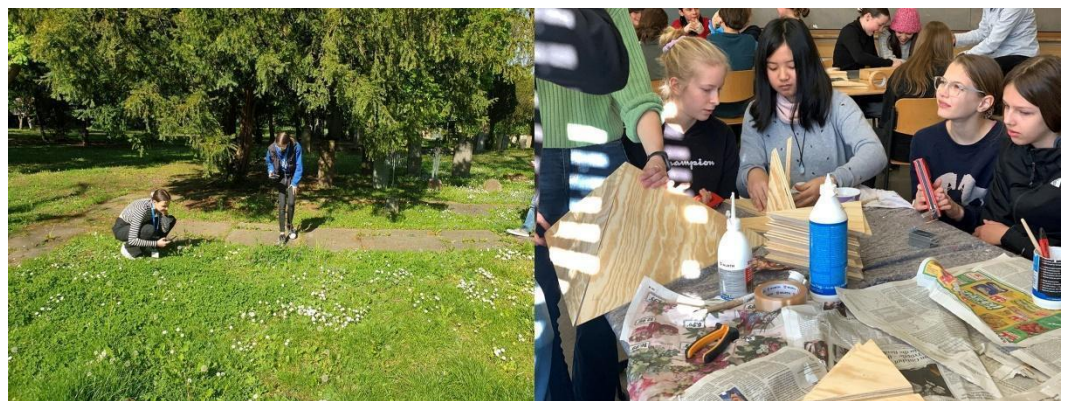
Figure 5 from left to right: a) Girls Day Teaching the Girls to Use Spot-a-Bee Application (Photo: Davidová 2022); b) Testing the DIY recipes through a workshop with Dillmann Gymnasium. (Photo: Behnam 2023)

The intervention opening at Figure 6 shows the prototypes' cocreation of the community by gardening. This is the welcome party into the real life codesign laboratory when the overall ecosystemic community takes part in the codesign. Multiple stakeholders from the community or engaged interest groups took part in this community event, which was supported by the neighbourhooding hotel by the reception and technological facilities. The hotel also takes care of watering the plants. The DIY recipes' and the applications' QR codes are engraved into the

prototypes. Such community gatherings help us to promote them to a wider audience. This has been later on supported by the GoCOLife urban game that was leading the gamers in front of the prototypes, that are othrwis in not so publicaly exposed locations in order to support biodiversity.

Figure 6: Community Gardening Event at BioDiveln Opening (Photo: Behnam 2023)

Other design tools were developed along with gigamapping to test the feasibility and suitability of different design concepts for urban intervention. The students combined parametric and digital models, which are computer-based simulations that can be manipulated and adjusted (Woodbury, 2010), with craftsmanship skills and used physical models and prototypes, which are tangible representations of their ideas that can be tested and refined (IDEO.ORG, 2024). Such skills are critical for intuition and tacit knowledge (Davidová, 2017, 2020a) and practice reflection in action (Schön, 1983). We also applied the 'learning by doing' approach, which is a pedagogical strategy that emphasises hands-on

experience and reflection (Kolb, 1984), to train each other to build the products and test the DIY potentiality, which is the possibility of reproducing the intervention by using simple and accessible materials and techniques.

Then, the studio outcome's modules got reparametrised by combining the use of computational design with specific parameters of DIY recipes (i.e., size, numbers, etc.) in order to develop a generative design system (Sequin, 2005) of their alternatives (see Figure 7). The parametric design enables the DIY recipe to be generative and optimised according to the different preferences of different species. This reparametric "DIY" is also dedicated to users with digital fabrication tools (CNC machinery) and basic knowledge of Rhinoceros and Grasshopper (Davidová, 2023), which enable users to express themselves through the design thinking approach. This actually means that these DIYs include tools, information, inspiration, and preliminary designs from the designer's point of view (Hoftijzer, 2017).
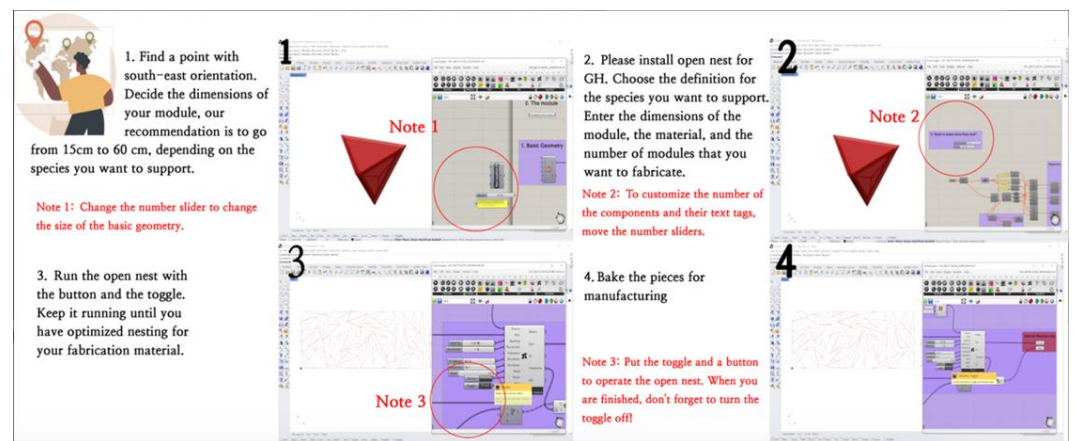

Figure 7: Rreparametrising the DIYs receipes. (Recipe: Valverde 2023 in Davidová, 2023)

Therefore, we offer different DIY recipes and public interaction with different difficulties for multiple stakeholders. In this case, the parametric recipes are for makers communities, whilst the analogue for people with access to basic workshops. The blog also offers recipes that are approachable to children, including what they can do on the kitchen table from the materials they find in the park. Such a combination approaches different communities, including age, facilities, skills, and price, being inclusive.

3. GAMIFICATION: A GAMIFIED TOOL FOR ENGAGING THE COMMUNITY

In the next studio course COLife, we worked on developing an urban game called GoCOLife (COLife Studio Summer 2023, 2023) in the adjacent biodiverse cemetery. In 1974, Richard D. Duke (Duke, 1974) proposed "Gaming as the Future's Language," which can sensitise and stimulate a hypothetical world to the people, giving them an immersive experience with the power to change the dynamics of the complex system. According to this, we employ gamification as a significant tool to drive user engagement in reproducing the DIYs. In this semester, through a gamification strategy, the students aimed to design the interaction by using elements and mechanics of game design in a non-game environment to bring on certain behaviours in individuals that enhance their motivation and engagement in reproducing the DIY recipes (Sailer et al., 2017). Through the studio, we explored the fields of interaction design and service design through online and analogue outcomes, social events and DIY participation. We deployed gamification as a gamified tool, whose main focus was to explore

how the quality of life within urban environment can be enhanced through the gamification and interaction with more-than-human elements within the environment. It semphasises the importance of community-driven value creation from the bottom up to improve the quality of life in urban settings, this approach aligns with the emerging paradigm of system-oriented, more-than-human-centered collaborative design, which semphasises the significance of co-creating with users and stakeholders to foster sustainable and socially inclusive solutions (Manzini, n.d.). The goal of GoCOLife mobile game is to learn about biodiversity and have a great time exploring nature and it serves as a gamified tool for engaging with more-than-human elements in the environment and encouraging community participation (Davidová, Sharma, et al., 2022).

We started the design studio teaching by gigamaping, filling it with the visions of various stakeholders. These stakeholders represented different communities, and through discussion and extension of an initial map, they combined ideas and design aspects into a collective gigamap. To better understand the interaction within this process, we deployed multiple eye-tracking glasses to track the creation of the gigamap from start to end. This enabled us to capture gaze distributions that reflect visual attention, social interaction, and engagement with the map.

Students and stakeholders from various communities and disciplines synergized minimaps into one collective gigamap, merging individual and collective ideas and design aspects. This collaborative and transdisciplinary effort integrates systems-oriented design, architecture, visualisation, and eye tracking research.

Our research investigates how these disciplines can contribute to understanding codesign processes and methodologies through design and systems thinking. Driven by a curiosity to apply eye-tracking methodology, we explored interaction processes during the workshops and how participants engage with the gigamap. We equipped participants with eye-tracking glasses to record their visual attention over time to address this. This way, we could capture gaze distributions indicating visual attention, social interaction, and interaction with the map. Through this approach, we aim to explore new ways to better understand codesign processes (see Figure 8a).

At the end of the semester the design studio included a workshop of cultural probes (tangible outcomes) (see Figure 8b) and communication platforms that facilitate engaging experiences. Actually, probes are "collections of evocative tasks meant to elicit inspirational responses from people – not comprehensive information about them, but fragmentary clues about their lives and thoughts" (Gaver et al. 2004). The studio also contemplated the register of user interaction with the outcomes through behavioural tracking technologies (see Figure 9).

Figure 8 from left to right: a) Gigamapping Workshop of CoLife Project (Photo: Behnam 2023); b) CoLife Workshop: Cultural Probes held by Valverde 2023. (Photo: Behnam 2023)

Following the workshop, two instructors and the students participated in a gaming test (see Figure 10) In order to facilitate participant feedback, we also gave them access to a journey map sheet (see Figure 11), where they could note any issues or challenges that they encountered while playing the game, as well as potential improvements. Subsequently, we employed the Word Cloud generator (MonkeyLearn, 2021) to assess the most frequent feedback and suggestions obtained from the journey sheets in order to refine and advance GoCOLife based on them (see Figure 12).
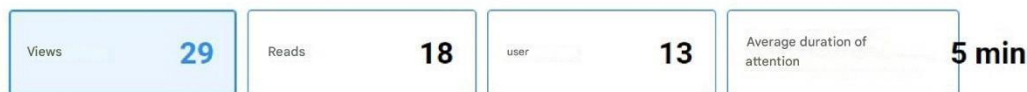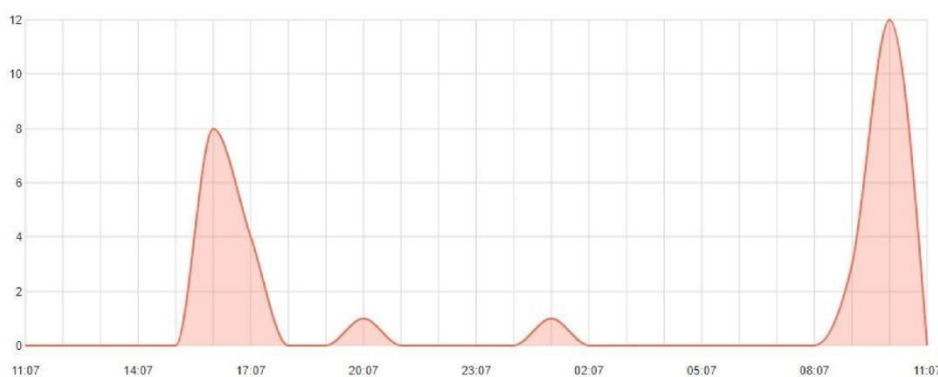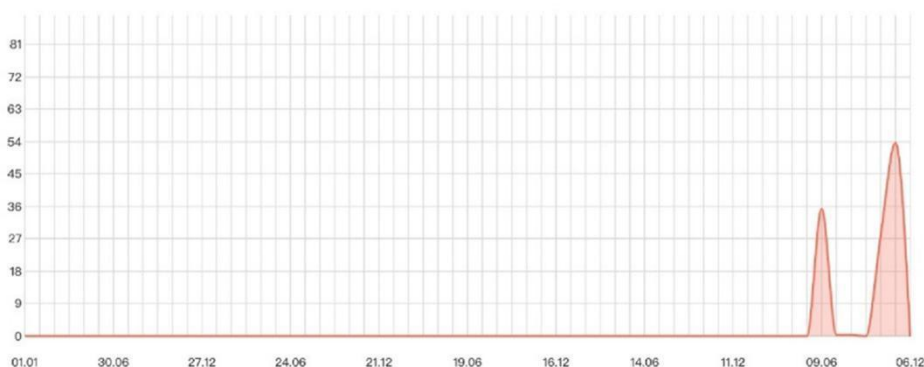

Figure 9: Visualization of user engagement metrics collected through behavioral tracking technologies during the *GoCoLife Game App* project in the Summer COLife 2023 Design Studio. The graphs display the number of views, reads, unique users, and average duration of attention for two different engagement periods.

Davidová, M.; Rojas, M. C. V.; Behnam, H. (2023). BioDiveln + GoColife: EcoSystemic Prototypical Urban Interventions Engaging Social and Environmental Systems. *Strategic Design Research Journal*. *Volume 16,* number 03, Sept – Dec 2023. 368-386. DOI: 10.4013/sdrj.2023.163.07

Figure 10: Test the GoCoLife with the students in a real environment, in the adjacent cemetery (Summer COLife 2023 Design Studio) (Photo: Behnam 2023).
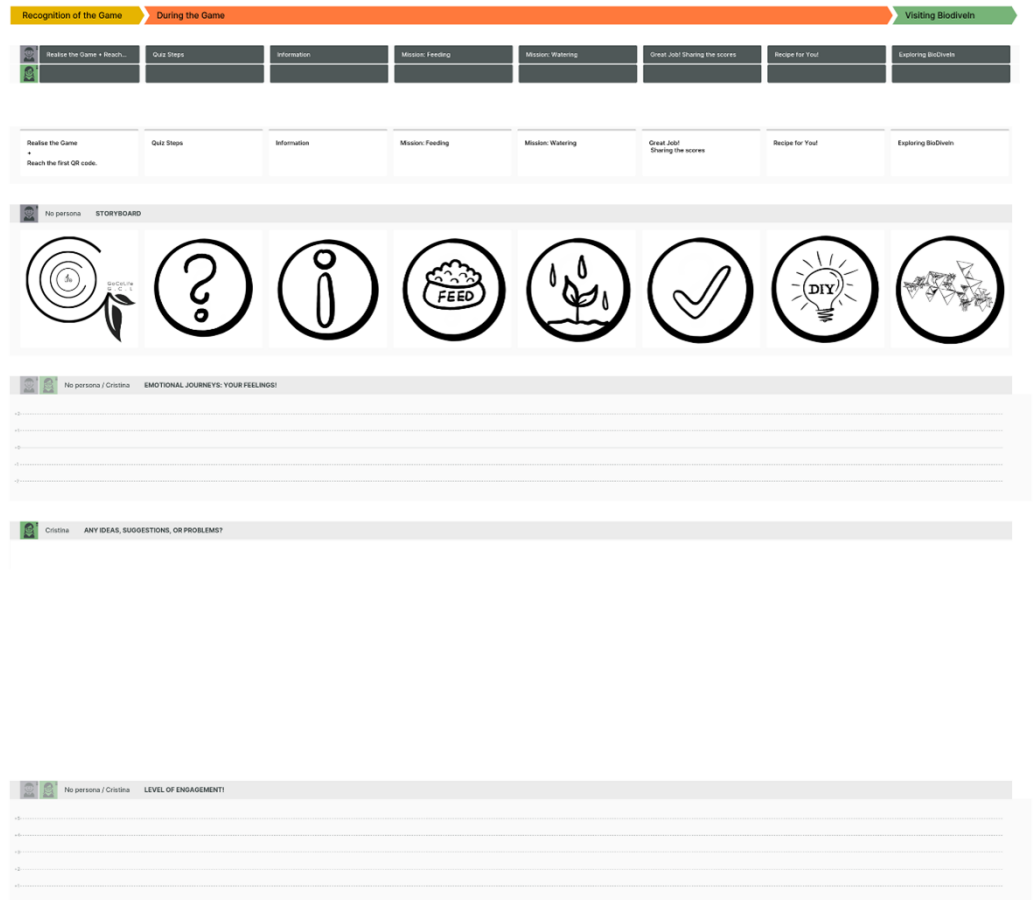
Figure 11: Journey map created using the Smaply tool to outline participants' experiences during the GoCoLife Game App project in the Summer COLife 2023 Design Studio. The map includes phases such as recognition, engagement during the game, and exploring biodiversity, along with emotional reflections, suggestions, and levels of engagement.

Figure 12: Revising GoCoLife by generating word cloud out of the journey sheets. (Summer COLife 2023 Design Studio)

4. CONCLUSION

Eight out of the ten Earth Systems Boundaries have been exceeded on a global level (Rockström et al., 2023). Recently, many species are adapting to life in the cities; for other species, cities lie on their critical migration paths (Spotswood et al., 2021). However, our cities did not develop with a more-than-human perspective (Davidová & Zímová, 2018). We are recently facing Anthropocene Extinction. That is a current ongoing event in which a large number of living species are threatened with extinction or are going extinct because of environmentally destructive human activities (Wagler, 2023). Therefore, we need to adapt our cities to coliving with other species.

The patterns of biodiversity changes in cities are now fairly well established, although diversity changes in temperate cities are much better studied than cities in other climate zones. Generally, plant species richness often increases in cities due to the importation of exotic species, whereas animal species richness declines. Abundances of some groups, especially birds and arthropods, often increase in urban areas despite declines in species richness (Faeth et al., 2011). This is because some species adapt more easily, and others do not find suitable habitats or food. Therefore, our intervention focuses on these.

It is politically difficult to agree on courses of action, such as reducing living standards, and there are ethical difficulties in doing so because of the intersection with social and global injustices (Sweeting, 2022). In the quest for sustainable urban living, finding socially attractive solutions to environmental challenges is paramount. Our exploration of service design and technology, exemplified by the BioDiveIn and GoCOLife interventions, demonstrates the power of gamification in engaging communities with urban biodiversity projects.

 There are various approaches to service design and technology (Suoheimo et al., 2023). Our approach is experimental in its nature. The gigamapping codesign with invited stakeholders worked well with the printed gigamap and tangible objects because they are tangible and at hand on the table. This is also due to the clear presentation of the students, who navigated the stakeholders through every topic and explained with tangible prototypes. The integration of storytelling is critical in these processes because it supports empathy. It is important to print out the gigamap for both the team as well as for the incoming people. If we worked with the Miro map over all the processes, the stakeholders would get lost and lack orientation in the digital tool. This was proven during the COVID-19 pandemic when we tried to do similar workshops in Miro with the Synergetic Landscapes Unit at the Welsh School of Architecture (Davidová, Sharma, et al., 2022). It is always critical to be a good improvisator with the methodology, whatever situation comes. While methods could be fixed, methodologies and tools are flexible, and one has to muddle through the process. Muddling through the methodology and playing around with tools is our approach to be in generative conversation with the situation. We do not believe in reductionist science perspectives of reproducibility of outputs. Every situation, ecosystemic community and location, is unique, and the situation of codesigning is, in this case, ongoing and generative. Therefore, we are in line with methodological pluralism in Systems Oriented Design (SOD) (Fitzpatrick et al., 2024), mixing multicentered experimental methods, tools and media.

It is also important to point out that SOD integrates more tools than just gigamapping. Social interaction is being developed during the project also within the 'real-life codesign laboratory' (Davidová & Zímová, 2020). Also by integrating gamification elements, we not only enhance

the user experience but also create educational opportunities that deepen understanding of ecological issues (Bitrián et al., 2021; Zaharia et al., 2022). This approach has proven effective in fostering community engagement, as evidenced by increased participation in citizen science initiatives and a more profound appreciation of urban ecosystems. The successes and learnings from these interventions underscore the potential of gamification to bridge the gap between ecological awareness and action, providing a blueprint for future urban biodiversity projects.

For now, it is observed that we have visitors and downloads for the DIY recipes on our blog (Davidová, 2020b) through QR codes. Also, the spot-a-bee application now has many visitors from Stuttgart and Germany in general. However, we are aware that the environmentality of such technologies presents different challenges to politics, engagement, and ethical choices (Perera, 2023). Through the placement to real-life codesign, we answer a lot of ethical questions through participation (Sweeting, 2018). Though this research is very small in scale, specified in the community of central Stuttgart, we believe it is scalable. New interventions are planned based on the ecological research in the location. For future research, we plan to introduce a more-than-human economy so that the pollinators can be paid for the pollination, and you can be paid for reproducing the DIY recipe.

The prototypical urban interventions could serve as a valuable resource for gaining a deeper understanding of the behavioural patterns of various species. This also means that the prototypes develop over time. By analysing factors such as occupancy rates, nesting preferences, and the types of species supported, we can extract design parameters that can be used to optimise the design of future biodiversity supporters. During the observation period from May to July 2023, several wild species were observed in the designed layout provided by BioDiveIn (see Figure 13). We performed an ecological check in March 2024. Multiple habitats were discovered. For the full list, please see the published dataset (Davidova et al., 2024). This suggests that the interventions were successful in supporting biodiversity and attracting a diverse range of species. However, also many plant species died on our installation in its higher parts. This was due to the participation on the gardening event, as many of the participants did not have gardening skills. The plants were replanted in March 2024. Please see the above-mentioned dataset for the report on the first and second species planted. As we continue to monitor and adapt these interventions, the evolving data on species interactions within our urban installations will further refine our strategies, ensuring that our cities become thriving havens for biodiversity. Through gamification, we can transform the challenge of urban ecological sustainability into an engaging, educational, and collaborative endeavour, paving the way for a future where humans and nature coexist in harmony (Özden et al., 2023).

Figure 13: Diverse species observed in BioDiveIn intervention from May to July 2023, including wild bee nests, a white-coated bumblebee, and wild meadow plants (photo: Valverde, 2023)

REFERENCES

Bateson, G. (1979). *Mind and Nature: A Necessary Unity* (Issue June). E.P. Dupton.

Bitrián, P., Buil, I., & Catalán, S. (2021). Enhancing user engagement: The role of gamification in mobile apps. *Journal of Business Research*, *132*, 170–185. https://doi.org/10.1016/J.JBUSRES.2021.04.028

Canina, M., Bruno, C., & Efremenko, T. (2021). Post-anthropocentric creativity: new skills for a just digital transition. In M. R. Canina, C. Bruno, & T. Efremenko (Eds.), *From Human-centered to More-than-human Design and beyond. Exploring the transition* (pp. 131–153). https://library.oapen.org/bitstream/handle/20.500.12657/53634/9788835132585.pdf?sequence=1&isAllowed=y

Canina, M. R., Bruno, C., & Efremenko, T. (2021). From Human-centered to More-than-Human-Design. In M. R. Canina, C. Bruno, & T. Efremenko (Eds.), *From Human-centered to More-than-human Design and beyond. Exploring the transition.* FrancoAngeli. https://series.francoangeli.it/index.php/oa/catalog/book/749

Cardiff University, & University of Glasgow. (2021). *Spot-a-bee.* http://www.spotabee.buzz/ https://eprints.gla.ac.uk/258168/

Clarke, R., Heitlinger, S., Light, A., Forlano, L., Foth, M., & DiSalvo, C. (2019). More-than-human participation: Design for sustainable smart city futures. *Interactions*, *26*(3), 60–63. https://doi.org/10.1145/3319075

Clatworthy, S. (2011). Service innovation through touch-points: Development of an innovation toolkit for the first stages of new service development. *International Journal of Design*, *5*(2), 15–28. https://www.ijdesign.org/index.php/IJDesign/article/view/939

COLife Studio Summer 2023. (2023). *GOCOLIFE - Let the fun begin! | Interacty project*. https://interacty.me/projects/d4d916f6b1a8609b

Coskun, A., Cila, N., Nicenboim, I., Frauenberger, C., Wakkary, R., Hassenzahl, M., Mancini, C., Giaccardi, E., & Forlano, L. (2022). More-than-human Concepts, Methodologies, and Practices in HCI. *Conference on Human Factors in Computing Systems - Proceedings*. https://doi.org/10.1145/3491101.3516503

Cross, N. (2011). *Design thinking: understanding how designers think and work*. Berg Publishers.

Davidová, M. (2017). Systemic Approach to Architectural Performance: The Media Mix in the Creative Design Process. *FormAkademisk - Research Journal of Design and Design Education*, *10*(1), 1–25. https://doi.org/10.7577/formakademisk.1713

Davidová, M. (2020a). Cocreative roles, agencies and relations in post-Anthropocene: the real life gigamaps and full-scale prototypes of SAAP. *Strategic Design Research Journal*, *13*(2), 185-212. https://doi.org/10.4013/sdrj.2020.132.06

Davidová, M. (2020b). *Systemic Approach to Architectural Performance*. Wordpress. https://systemicapproachtoarchitecturalperformance.wordpress.com/

Davidová, M. (2020c). Synergy in the systemic approach to architectural performance: The integral multi- and cross-layered agencies in eco-systemic generative design processes of the post-anthropocene. *FormAkademisk - Research Journal of Design and Design Education*, *13*(2), 1–30. https://doi.org/10.7577/formakademisk.3387

Davidová, M. (2020d). Multicentred Systemic Design Pedagogy Through Real-Life Empathy: Integral and Inclusive Practice-Based Education in the Research-by-Design Context. *FormAkademisk - Research Journal of Design and Design Education*, *13*(5), 1–26. https://doi.org/10.7577/formakademisk.3755

Davidová, M. (2023). *Systemic Approach to Architectural Performance – Blog*. Wordpress. https://systemicapproachtoarchitecturalperformance.wordpress.com/

Davidová, M. (2014). Generating the Design Process with GIGA-map: The Development of the Loop Pavilion. In B. Sevaldson & P. Jones (Eds.), *Relating Systems Thinking and Design 2014 Symposium Proceedings* (pp. 1–11). Oslo School of Architecture and Design. https://rsdsymposium.org/generating-the-design-process-with-giga-map-the-development-of-the-loop-pavilion/

Davidová, M., Behnam, H., Valverde Rojas, M. C., Guerriero, C., Yeh, H., Huang, J., & Köse, M. (2024). *COLife_02 - Gigamap and Game Design* (V1 ed.). DaRUS. https://doi.org/doi:10.18419/darus-3985

Davidová, M., Fischer, L. K., & Teye, M. (2022). POL–AI: Leveraging Urban EcoSystem. In C. May, B. Sweeting, P. Jones, & G. Matic (Eds.), *Relating Systems Thinking and Design (RSD11) 2022 Symposium* (pp. 1–11). Systemic Design Association. https://rsdsymposium.org/pol-ai-leveraging-urban-ecosystem/

Davidova, M., Porqueddu, E., Behnam, H., Valverde Rojas, M. C., Zímová, K., Gazdová, K., Sweeting, B., Goodbun, J., Perera, D., Sadler, S., & Hüthofer, S. (2024). *COLife_04 - Multi-Scale More-than-Human Atlas Gigamaping, Ecosystem Mapping and CoDesigning* (V1 ed.). DaRUS. https://doi.org/doi:10.18419/darus-4123

Davidová, M., Sharma, S., McMeel, D., & Loisides, F. (2022). Co-De|GT: The Gamification and Tokenisation of More-Than-Human Qualities and Values. *Sustainability*, *13*(20), 1–20. https://doi.org/10.3390/SU14073787

Davidová, M., Teye, M. T., Fischer, L. K., Valverde Rojas, M. C., Behnam, H., Guimaraez di Stasi, M., He, M., Hildebrandt, H., Chau, W. M., Pittiglio, A., Asa, P., Kuo, C. C., Blagojevic, E., Hillebrecht, R., Hillemanns, T., Schaal, M., Spielvogel, M., Sweeting, B., Goodbun, J., & Perera, D. (2024). *COLife_00 - Gigamap and Fabrication Data* (V1 ed.). DaRUS. https://doi.org/doi:10.18419/darus-3981

Davidová, M., Valverde Rojas, M. C., Behnam, H., Fischer, L. K., Fadini, T., Haueise, J., Hauke, A., Florescu, M., Ferrari, V., Ros, A. P., Vujovic, N., Knutelsky, S., Wosiak, O., & Candìa, M. (2024). *COLife_01 - Gigamap and DIY Files* (V1 ed.). DaRUS. https://doi.org/doi:10.18419/darus-3983

Davidová, M., & Zímová, K. (2018). COLridor: Co-Design and Co-Living Urban Adaptation. *FormAkademisk - Research Journal of Design and Design Education*, *11*(4), 1–30. https://doi.org/10.7577/formakademisk.2647

Davidová, M., & Zímová, K. (2020). COLreg: The Collective Regenerative Region. In P. Jones (Ed.), *Relating Systems Thinking and Design (RSD9) 2020 Symposium* (pp. 1–14). Systemic Design

Association. https://rsdsymposium.org/colreg-the-collective-regenerative-region/

Doherty, G. (2005). Prototypes in Pinkenba. *Nordes 2005 - In the Making*, *1*(1), 1–5. https://doi.org/10.21606/nordes.2005.056

Duke, Ri. D. (1974). Toward a General Theory of gaming. *Simulation and Games*, *5*(2), 131. https://doi.org/0803973233

Faeth, S. H., Bang, C., & Saari, S. (2011). Urban biodiversity: patterns and mechanisms. *Annals of the New York Academy of Sciences*, *1223*(1), 69–81. https://doi.org/10.1111/J.1749-6632.2010.05925.X

Ferrando, F. (2012). Towards a PostHumanist Ecology. *Frame: Journal For Literary Studies*, *15*(1), 9–18. http://www.tandfonline.com/doi/abs/10.1080/13825577.2014.917005

Fitzpatrick, H., Luthe, T., & Sevaldson, B. (2024). Methodological Pluralism in Practice : A systemic design approach for place- based sustainability transformations. *CONTEXTS: The Systemic Design Journal*, *2*(April), 1–42. https://doi.org/10.58279/v2003

Forlano, L. (2017). Posthumanism and Design. *She Ji: The Journal of Design, Economics, and Innovation*, *3*(1), 16–29. https://doi.org/10.1016/J.SHEJI.2017.08.001

Haraway, D. (1991). A Cyborg Manifesto: Science, Technology and Social-Feminism. In *Simians, Cyborgs and Women: The Reinvention of Nature* (pp. 149–181). Routledge.

Hoftijzer, J. W. (2017). Implementing 'Design for Do-It-Yourself' in Design Education. *Springer Proceedings in Business and Economics*, 435–450. https://doi.org/10.1007/978-3-319-29058-4_34

IDEO.ORG. (2024). *Tools | IDEO.org*. https://www.ideo.org/tools

Kolb, D. A. (1984). Experiential Learning: Experience as The Source of Learning and Development. *Prentice Hall, Inc.*, *1984*. https://doi.org/10.1016/B978-0-7506-7223-8.50017-4

Latour, B. (1993). *We Have never been Modern*. Harvard University Press.

Manzini, E. (n.d.). Design in a changing, connected world 1 Design em um mundo conectado e em transformação. *Strategic Design Research Journal*, *7*(2), 95–99. https://doi.org/10.4013/sdrj.2014.72.06

McCutcheon, G., & Jung, B. (1990). Alternative Perspectives on Action Research. *Theory into Practice*, *29*(3), 144–151.

Miro. (2023). *Miro | Online Whiteboard for Visual Collaboration*. https://miro.com/app/dashboard/

Özden, S., Arslatürk, E., Senem, M., & As, İ. (2023). Gamification in Urban Planning - Experiencing the Future City. *Architecture and Planning Journal (APJ)*, *28*(3), 44. https://doi.org/10.54729/2789-8547.1239

Paulsen, A., & Rom, J. (2014). Professional application of Systems Oriented Design: Developments in practice. In B. Sevaldson & P. Jones (Eds.), *Relating Systems Thinking and Design (RSD4) 2014 Symposium*. Systemic Design Research Network. https://openresearch.ocadu.ca/id/eprint/2107/1/Romm_WorkingPaper_2014.pdf

Perera, D. (2023). Design Fictioning of a Second- Order Kind: Runaway Cybernetics, Futures of Work, Possibilities of Engagement. *Enacting Cybernetics*, *1*(1), 1–24. https://doi.org/10.58695/ec.3

Rockström, J., Gupta, J., Qin, D., Lade, S. J., Abrams, J. F., Andersen, L. S., Armstrong McKay, D. I., Bai, X., Bala, G., Bunn, S. E., Ciobanu, D., DeClerck, F., Ebi, K., Gifford, L., Gordon, C., Hasan, S., Kanie, N., Lenton, T. M., Loriani, S., … Zhang, X. (2023). Safe and just Earth system boundaries. *Nature 2023*, 1–10. https://doi.org/10.1038/s41586-023-06083-8

Sagar, P., Mahamuni, R., Agrawal, V., Darak, S., Jori, V., & Athavale, S. (2023). Designing Empathetic Service Experiences Using Storytelling Approach: A Case Study. *Strategic Design Research Journal*, *16*(1), 46–58. https://doi.org/10.4013/SDRJ.2023.161.05

Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, *69*, 371–380. https://doi.org/10.1016/J.CHB.2016.12.033

Schön, D. A. (1983). *The Reflective Practitioner: How Professionals Think in Action*. Basic Books.

Sequin, C. H. (2005). CAD tools for aesthetic engineering. *Computer-Aided Design*, *37*(7), 737–750. https://doi.org/10.1016/j.cad.2004.08.011

Sevaldson, B. (2010). Discussions & Movements in Design Research: A systems approach to practice research in design. *Form Akademisk*, *3*(1), 8–35. https://doi.org/10.7577/formakademisk.137

Sevaldson, B. (2022). *Designing Complexity: The Methodology and Practice of Systems Oriented Design*. Common Ground Publishing. https://doi.org/https://doi.org/10.18848/978-1-86335-262-8/CGP

Sevaldson, B. (2018). Beyond User Centric Design. In S. Barbero (Ed.), *Relating Systems Thinking and Design 2018 Symposium Proceedings: Challenging complexity by Systemic Design towards Sustainability* (pp. 516–525). Systemic Design Association. https://rsdsymposium.org/beyond-

user-centric-design/

Sevaldson, B. (2013). Systems Oriented Design: The emergence and development of a designerly approach to address complexity. In J. B. Reitan, P. Lloyd, E. Bohemia, L. M. Nielsen, I. Digranes, & E. Lutnaes (Eds.), *DRS // CUMULUS 2013* (Issue May, pp. 14–17). HIOA. https://doi.org/ISBN 978-82-93298-00-7

Spotswood, E. N., Beller, E. E., Grossinger, R., Grenier, J. L., Heller, N. E., & Aronson, M. F. J. (2021). The Biological Deserts Fallacy: Cities in Their Landscapes Contribute More than We Think to Regional Biodiversity. *BioScience*, *71*(2), 148–160. https://doi.org/10.1093/biosci/biaa155

Steiner, F. (2019). Toward an ecological aesthetic. *Socio-Ecological Practice Research*, *1*(1), 33–37. https://doi.org/10.1007/s42532-018-00004-0

Suoheimo, M., Trapani, P., & Miettinen, S. (2023). Historical Perspectives on Service Design and Technology. In U. Z. A. Hamid & M. Suoheimo (Eds.), *Springer Series in Design and Innovation* (Vol. 29, pp. 25–44). Springer. https://doi.org/10.1007/978-3-031-29306-1_3

Sweeting, B. (2018). Applying ethics to itself: recursive ethical questioning in architecture and second-order cybernetics. *Kybernetes*, *July*, 1–16. https://doi.org/10.1108/K-12-2017-0471

Sweeting, B. (2023). *Thoughts for your contribution - personal correspondence*.

Sweeting, B. (2022). Architectural Roots of Ecological Crisis. In B. Sweeting (Ed.), *Relating Systems Thinking and Design (RSD11) 2022 Symposium* (pp. 1–25). Systemic Design Association. RSD11_Sweeting_Architectural_roots_of_ecological_crisis

Troy, A., Bagstad, K., & Saah, D. (2010). Estimating Ecosystem Service Values in Southern Ontario. In *A Community on Ecosystem Services*. https://alus.ca/wp-content/uploads/2016/08/estimation-of-ecosystem.pdf

Vennatrø, R., & Høgseth, H. B. (2021). Craft as More-Than-Human: Practice-led research in a posthumanist perspective. *FormAkademisk*, *14*(2), 1–13. https://doi.org/10.7577/FORMAKADEMISK.4205

Villari, B. (2021). The empathic (r)evolution. Lessons learned from Covid-19 to design at the community, organization, and governmental levels. *Strategic Design Research Journal*, *14*(1), 187–198. https://doi.org/10.4013/SDRJ.2021.141.16

Wagler, R. (2023). Anthropocene Extinction. *AccessScience*. https://doi.org/10.1036/1097-8542.039350

Woodbury, R. (2010). Elements of parametric design. In *Routledge* (Vol. 1). Routledge. https://www.routledge.com/Elements-of-Parametric-Design/Woodbury/p/book/9780415779876?srsltid=AfmBOoruA9tiDSv_jlSzSuFyMeGV8P_ZaxY r7L-VwisRICuJqrvQXUYB

Zaharia, M., Edu, T., Zaharia, R., Torres-Toukoumidis, A., Vintimilla León, D., De-Santis, A., Carlos López-López, P., & Ángel Jorge Echeverri, D. (2022). Gamification in Ecology-Oriented Mobile Applications—Typologies and Purposes. *Societies 2022, Vol. 12, Page 42*, *12*(2), 42. https://doi.org/10.3390/SOC12020042.