volume 17 _2025
N° _2

SAJ

serbian architectural journal

SUSTAINABLE USER-ORIENTED HOUSING FOR THE ELDERLY

_2025_2

Serbian Architectural Journal is published in Serbia by the University of Belgrade - Faculty of Architecture and distributed by the same institution / www.saj-journal.org

For informations, please e-mail at saj@arh.bg.ac.rs or write to the following address.

Send editorial correspondence to:
Serbian Architectural Journal
Faculty of Architecture
Bulevar Kralja Aleksandra 73/II
11 000 Belgrade, Serbia

ISSN 1821-3952
e-ISSN 2787-1908

Cover photo
Milan Ristic, M. Arch. / Digital edit of original sketches by Igor Rajkovic, December 2025.

volume 17 _2025
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PUBLISHER:

University of Belgrade - Faculty of Architecture, Belgrade

CIRCULATION:

100

PRINTING:

Copy World bsk, Belgrade

volume 17 _2025 Nº _2

ISSN 1821-3952
e-ISSN 2787-1908

Izlazi tri puta godišnje (Published three times a year).

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Guest Editors: **Vladimir Lojanica & Michiel Smits**

SUSTAINABLE USER-ORIENTED HOUSING FOR THE ELDERLY

Agility and Systems Thinking: Navigating Complexity for Sustainable Housing in Aging Societies

Designing housing for older generations is no longer a matter of incremental improvement; it is one of the defining challenges of our time. As populations age and expectations for independence and dignity rise, these needs collide with sustainability imperatives and rapid technological change. The result is a design space filled with uncertainty, interdependencies, and competing priorities. Rittel and Webber (1973) called these “wicked problems,” and housing for the elderly fits the description perfectly: there are no simple answers, and every decision reshapes the problem itself.

In this reality, agility becomes more than a buzzword, it is a survival skill. Agile design is about responsiveness, iteration, and learning as you go (Butt et al., 2025). It means using tools like Design Sprints and Kanban boards to prototype quickly, gather feedback, and adapt. In architecture and urban planning, technologies such as Building Information Modelling (BIM) and digital twins allow designers to simulate scenarios and test ideas before committing resources (Russo et al., 2025). These approaches help us keep pace with changing user needs and environmental conditions, ensuring that solutions remain relevant and resilient.

Education plays a critical role in this transformation. Tomorrow's professionals will work in environments that are dynamic and unpredictable. They need more than technical skills, they need the ability to think systemically, collaborate across disciplines, and embrace uncertainty. Ramsay et al. (2024) argue that pedagogical agility is key: project-based learning, visual mapping tools like Miro, and scenario-driven exercises help students make sense of complexity and engage in co-creation (SchianoPhan et al., 2022). Embedding systems thinking into curricula prepares them to anticipate ripple effects and design holistically (Stefaniak et al., 2025).

Research must evolve alongside education. Traditional models often isolate technical components, missing the bigger picture. Agile research approach (such as design-based inquiry and participatory action research) enables iterative development in real-world contexts (LópezAlcarria et al., 2022). These methods generate actionable insights while staying connected to practice, bridging the gap between theory and application (Butt et al., 2025). By working with users and practitioners, research becomes a driver of innovation rather than a distant observer.

Ultimately, navigating complexity is not about eliminating uncertainty, it is about learning to work with it creatively and responsibly. This calls for a design culture that values flexibility, systemic thinking, and collaboration. It demands educational environments that encourage experimentation and research methodologies that embrace iteration. By integrating agile tools and mindsets into design and pedagogy, we can create housing solutions that honour both sustainability and human dignity (Ramsay et al., 2024).

This special issue invites contributions that explore frameworks for agile, user-centred housing design; pedagogical innovations that teach adaptability and systemic thinking; and research approaches that foster iterative, collaborative knowledge creation. We seek work that demonstrates how agility can transform design education and practice in response to the complex realities of aging societies (Butt et al., 2025; LópezAlcarria et al., 2022).

Together, we can shape a future where housing for the elderly is not only sustainable but deeply human.

Guest Editor: Dr.arch.ir. Michiel Smits

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ACKNOWLEDGEMENTS

Funding

This research was supported by the European Union, grant no. 2022-1-FI01-KA220-HED-000090135 (funding period 2022-2025). Introducing User-driven design and agile development skills in the case of sustainable service housing for elderly (sUser). Co-funded by Erasmus +. (https://suserproject.org/)

Conflicts of Interest

Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

original research article
UDC 378.147::72.01

admission date 03 11 2025
approval date 16 12 2025

NAVIGATING COMPLEXITY IN DESIGN EDUCATION: A HOLISTIC PEDAGOGICAL APPROACH WITH THE DESIGN CHALLENGE NAVIGATOR

ABSTRACT

Contemporary design education faces the challenge of equipping professionals to navigate increasingly complex innovation problems. While design thinking, systems thinking, and agile methodologies are each established in education, they are seldom systematically combined to address socio-technical challenges coherently. To address this gap, we present the Design Challenge Navigator (DCN), an educational toolkit designed to help learners critically assess complexity, structure their design processes, and build competencies for sustainable, user-centred interventions. Grounded in a holistic pedagogical approach, the DCN supports future designers in integrating iterative development, stakeholder participation, and systems awareness. To examine its relevance and transferability, we gather insights from coaches and educators who apply the DCN across varied educational environments. By analysing their perspectives, this research contributes to design education, demonstrating how integrated, practice-oriented tools can enhance interdisciplinary learning and prepare future professionals for complex, sustainability-oriented innovation challenges.

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KEY WORDS
DESIGN EDUCATION
DESIGN THINKING
SYSTEMS THINKING
LEARNING MATERIALS

1. INTRODUCTION

Solving complex design problems is inherent to the domains of design and innovation. It is therefore not surprising that understanding the underlying creative processes and searching for efficient and effective methods of problem solving is not uncharted territory in these domains. From Horst Rittel and Melvin Webber's groundbreaking contribution "Dilemmas in a General Theory of Planning" (Rittel & Webber, 1973) to Nigel Cross's "Designerly Ways of Knowing" (Cross, 2006) or Tim Brown's "Change by Design" (2009): the list of those who have analysed the approach to solving complex design problems and have developed applicable methods for their effective solving is long.

In the current field of design and innovation, design thinking has become an established method for the exploratory and iterative development of human-centred products and services, as well as business models. Design thinking is nowadays also widely taught and applied at business schools as a method for tackling complex business challenges (Lattemann et al., 2020). However, as the method became more widespread, its limitations also became more apparent, and design thinking, originally hailed as the "next big thing" (Ideo.com, 2025), has lost some of its original glory. There are references indicating that its implementation in universities and businesses is not without pitfalls (Sparwald, 2022; Freudenthaler-Mayrhofer & Sposato, 2017). Other authors argue that the strength of design thinking lies more in psychologically empowering participants than in providing a blueprint for solving complex problems (Roth et al., 2022). However, future professionals must be given the skills they need to solve complex problems, since the landscape of current challenges is no longer characterised solely by problems that can be more or less clearly delineated from one another, but rather by intertwined complex issues such as the environmental crisis, increasing disinformation, rapidly advancing technologies, and demographic changes (Jones & Ael, 2022; Statista Research Department, 2024). Modern challenges appear on a socio-technical spectrum. Solutions of different orders can tackle such challenges. While designing artefacts, products, or services as a solution to a given challenge is comparably limited in its complexity, changing organisational

structures, or pushing social transformation and policymaking are more complex endeavours (Buchanan, 1992; Jones & Ael, 2022). Unfortunately, in many cases, designer training still does not adequately prepare them for the complexity of the innovation challenges they will face (Kretschmer, 2014). However, tackling design challenges, especially more complex ones, has long since ceased to be the sole responsibility of a single domain. In fact, complex design and innovation challenges nowadays require interdisciplinary and transdisciplinary collaboration. The level of expertise in applying processes and methods, however, often varies considerably across different domains. Particularly in the context of adult education (e.g. MA, Executive MBA), where students with widely differing backgrounds regularly work together, this can pose a significant hurdle to successful teamwork. It is therefore essential to adopt systematic, practice-oriented approaches to training to enable future professionals to tackle the full range of current and future challenges in design and innovation.

There are structured and relatively easy-to-use toolkits for defined aspects of innovation processes (and for defined domains) that can be used to master innovation challenges. For the development of business models, for example, there is the Business Model Navigator, developed primarily at the University of St. Gallen (businessmodelnavigator.com). Its goal is to foster business model innovation via a structured approach. From the field of design, specifically from ideo, one of the largest design agencies globally, comes designkit (designkit.org). With the help of tried-and-tested methods, it aims to make the user-centred design approach as easy to apply as possible. And when it comes to implementing eco- or sustainable design principles in product design, a variety of toolkits and method kits are available. Examples include the Sustainable Design Cards from the Design School Kolding (sustainabledesigncards.dk) and the ecodesignkit from the German Federal Environment Agency (ecodesignkit.de). These examples are representative of a range of other available tools and method kits of varying designs and user orientations.

However, there appears to be a gap in tools that are easy to use, even for inexperienced users, and which:

- address innovation challenges as holistic problems rather than from the perspective of individual domains.
- are methodically sound and easy to understand, guiding users along defined but also flexible paths to solutions.
- are capable of addressing all degrees of complexity of innovation challenges equally, including systemic challenges.

All these aspects are important for innovation training, and it seems that there is no educational toolset that reflects this. In response to these educational challenges, the Design Challenge Navigator (DCN) has been developed in collaboration of four European universities during the sUser project funded by Erasmus+. The DCN is an educational toolkit developed to help learners critically assess complexity, structure their design processes, and build competencies for sustainable, user-centred interventions. Its core concept and key features are briefly described subsequently. The analysis in this paper then draws on the practical application of the DCN by coaches and educators across varied educational environments. The focus is on gaining a better understanding of how DCN is used in practice and what advantages and disadvantages its use can entail. In the cases referred to for this analysis, the DCN was applied both in short-term learning environments as well as in projects that lasted up to several weeks.

2. TACKLING COMPLEX CHALLENGES WITH THE DESIGN CHALLENGE NAVIGATOR

The DCN is an educational toolkit. It is available both in physical form, based on the concept of classic board or card games, and in purely digital form, which enables online collaboration. It aims to systematise and facilitate the tackling of complex design challenges in design and innovation education, thereby making them more manageable.

2.1. Four Degrees of Complexity

Design challenges are inherently difficult to solve, and upon closer inspection, some challenges turn out to be quite complex endeavours, or even highly complex problems at a system level. For example, many of the current issues we face as societies fall into that category and are inherently "wicked" (Kolko, 2012). The term "wicked problems" characterises challenges that have no definitive formulation and therefore can´t be ultimately fixed; however, not properly addressing them results in negative consequences for society (Rittel & Webber, 1973). This requires continuous adaptation to changing conditions when finding solutions. Of course, not all design problems are so complex in nature. Traditionally, simpler and more graspable design tasks will always remain (Swanson, 2020).

TABLE 1. Four degrees of innovation challenges based on Meyer and Norman (2020).

Challenge Type	*Characteristics*	*Examples*
1st Degree	Challenges that require advanced professional skills.	• Creating a low-complex product for a very specific customer segment • Developing an advanced technological product
2nd Degree	Challenges that require dealing with the entire system and applying technical skills to this system.	• Developing advanced technological product or machinery plants or services that are experienced differently depending on the user group
3rd Degree	Challenges dealing with more complex systems that are strongly influenced by their surroundings, environment, local culture and political concerns.	• Developing systemic solutions for health care and the demographic shift • Developing systems for communities of different cultures
4th Degree	Challenges that require the processing of complex socio-technical systems.	• Challenges related to the Sustainable Development Goals

The DCN is intended to provide assistance in tackling this variety of design challenges, particularly for less experienced users, thanks to its ease of use. Depending on the complexity of the challenge, the DCN therefore initially distinguishes between two processes with a total of four different degrees of complexity. After initially defining the identified problem, seven criteria are used to assess the degree of complexity involved.

2.2. Different Approaches for different Degrees of Complexity

Understanding abstract concepts is easier when using familiar analogies we've experienced firsthand. The DCN uses such analogies by deliberately paralleling leisurely hikes and adventurous expeditions – just as an innovation challenge can be less complex or highly challenging (see Table 1).

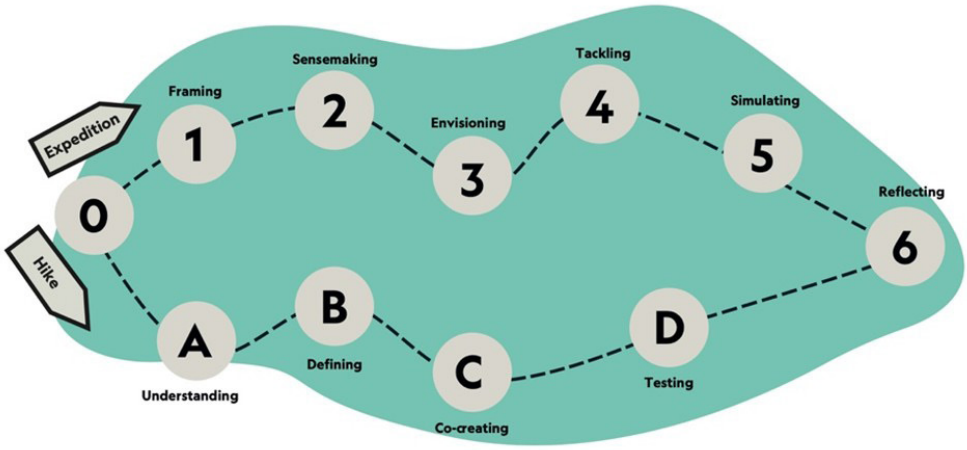

FIGURE 1. Design Challenge Navigator offers two processes

Literally everyone has been on a hike, and most of us probably have at least some idea of the challenges inherent to an expedition – some may even have mastered one. With the right strategy and equipment, hikes on low, grassy hills can usually be conquered without too much effort. It may not be easy, but we know how to do it. But of course, there are also moderately difficult hikes. At the other end of the spectrum are expeditions to 'rocky monsters', fearsome rock formations that perhaps no one has ever climbed before. Here, we have no choice but to face uncertainty, try out strategies and experiment. The success of our endeavour remains highly uncertain here – working with highly complex issues is therefore much more like an expedition than a hike. But of course, some expeditions are not quite as demanding. Depending on the complexity level of the innovation challenge, the DCN therefore offers two different processes: "hikes" and "expeditions" (see Table 2).

2.3. Navigation Map

The *Navigation Map* is the central component of the DCN. This is where the methods chosen by students during their innovation journey are placed, and the design process is built step by step. To create an analogy, we have illustrated challenges of varying complexity with mountains of varying difficulty. Just as one cannot climb every mountain with the same equipment and approach, one cannot tackle every challenge with the same methodology and tools. A lower mountain (1st and 2nd degree challenges - "hikes") and a higher, steeper mountain (3rd and 4th degree challenges - "expeditions") are shown on the navigation map. The respective processes are marked along a route of the respective mountains. Along each process step, the trainees have placeholders for cards where they can place the methods used in the respective step.

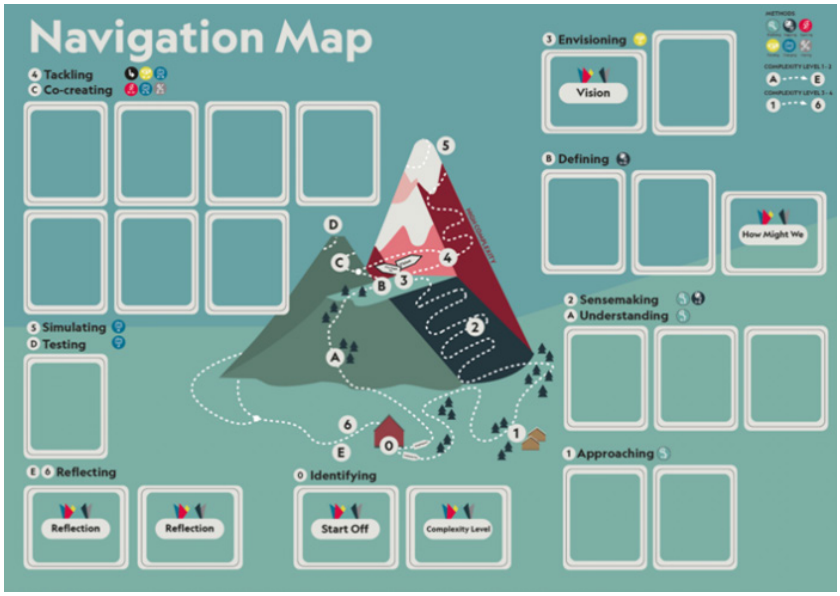

FIGURE 2. The Navigation Map enables students to build their innovation journey

2.4. Method Cards

The DCN offers a total of 40 method cards. Each card contains a brief description of the method, a step-by-step implementation guide, an overview of the time required to apply the method, the human and material resources

required, and a recommendation on which methods could be implemented before and after. Furthermore, the cards provide an assessment of whether the method is more suitable for the "hikes" or the "expeditions". Generally, the methods are divided into the following six groups: *Exploring*, *Mapping*, *Sparking*, *Changing* and *Tackling*.

TABLE 2. Overview of method types (Source: Authors' own creation).

Method type	*Explanation*	*Selected methods*
Exploring	Methods that are suitable for collecting information	Trend analysis, contextual interviews, service safari
Mapping	Methods that are suitable for visualizing and clustering information to make sense of it	Actors map, affinity diagram, persona, location mapping
Futuring	Methods that assist in envisioning an alternative future	Three horizons, design fiction, system value proposition
Sparking	Methods that are suitable for gathering inspiration, generating and selecting ideas	Analogies, brainwriting, biomimicry, dot voting
Changing	Methods that assist in creating and testing a sustainable solution	Leverage strategy, design for behavioural change, living labs
Making	Methods that are suitable to prototype or visualize an idea	Sketching, paper prototype, digital mock-up

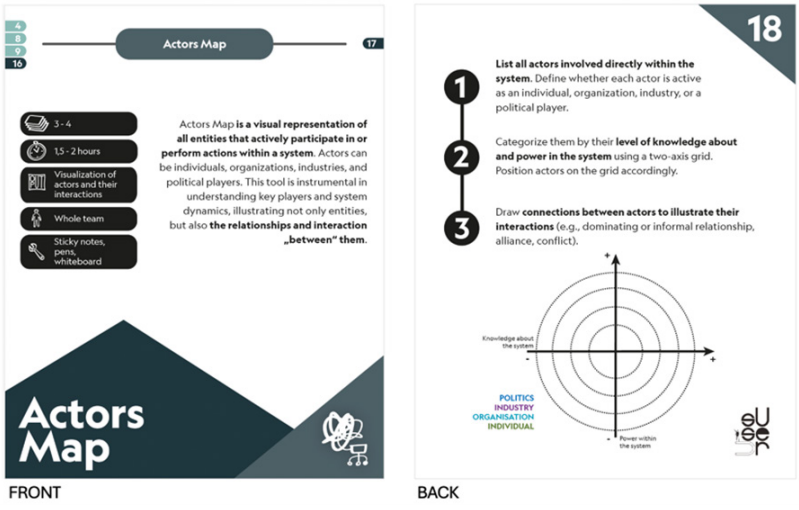

FIGURE 3. The DCN offers a selection of 40 methods enabling students to navigate through challenges of different complexity.

2.5. Statement Cards

Statement cards are writable cards that encourage the innovation team to discuss and reach an agreement at certain points in their process. There are five types of statement cards: *Start Off*, *Complexity Level*, *How Might We Statement*, *Vision Statement* and *Reflection*.

TABLE 3. Overview of statement cards (Source: Authors' own creation).

Statement card	*Explanation*
Start Off	The *Start Off* card asks the innovation team to formulate their innovation challenge in one sentence based on the project briefing they have got
Complexity Level	The *Complexity Level* asks the innovation team to determine the level of complexity by rating seven questions on a scale from "low" to "high" based on the knowledge they currently have.
How Might We	The *How Might We* statement builds the foundation of their idea generation on lower complexity levels.
Vision	The *Vision* statement builds the foundation for envisioning a preferred future on higher complexity levels.
Reflection	At the end of their Innovation Journey, *Reflection* cards should encourage the innovation team to self-critically scrutinize both their innovation process and their solution and to openly address any weaknesses.

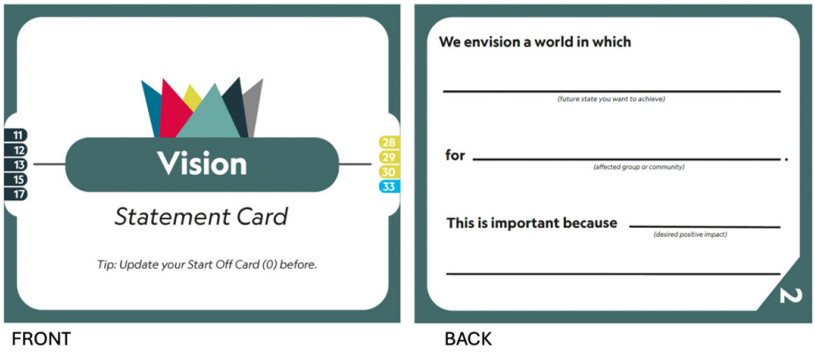

FIGURE 4. Example of a statement card (Source: Authors' own creation).

2.6. Navigator

Within the innovation team, there must be agreement on when a process step is complete, and the next phase can begin. To facilitate this discussion, we introduced the *Navigator* - a playing figure that is moved to the next process step on the navigation map after each step is completed.

3. PRACTICAL APPLICATIONS OF THE DCN

Over the past year, the DCN has been applied and tested in various educational settings across several European universities. To examine its use in practice, data were collected from six educators at European universities through an online questionnaire with open-ended questions (see Attachment 1). The dataset comprises seven cases that differ in duration, application context, and the intended use of the DCN. Table 4 provides an overview of the collected cases.

TABLE 4. Overview of the DCN applications (Source: Authors' own creation).

Case	*Context*	*Duration*	*No. of participants*	*Educator code*	*Purpose*
Case 1	Disruptive event workshop	3 hours	29	A	Inspire to use *Making* & *Changing* cards
Case 2	Public space redesign	2 hours	8	A	Create a design or research plan
Case 3	Biobased materials in build environment	3 workshops	12	B	Create a research plan with more unconventional methods
Case 4	Innovation project (service design)	2,5 months	15	C, D	Introduce a structured approach to innovation projects
Case 5	Design project	1,5 months	14	E	Structure the early phases of a design process
Case 6	Innovation project (service design)	3 days	14	D	Introduce a structured approach to innovation projects
Case 7	Design for circular economy	1 – 3 months	18	F	Scaffold design process and support independent teamwork

Across the seven cases, two main dimensions characterising the applications became evident: purpose and learner experience. First, the DCN can be applied either as an inspirational tool in short formats (e.g., workshops) or as a process-guiding framework in extended courses. Second, applications differ between novice learners with limited design training and experienced learners who are already familiar with design thinking principles and processes.

The intersection of these dimensions results in four potential patterns of use (Table 5). Empirically, three of these patterns were represented in the collected data. There were no cases in which the DCN was used as an inspirational tool for novice students, as the format and structure of the material do not readily support this type of application.

TABLE 5. Overview of the DCN applications (Source: Authors' own creation).

Learner experience / Purpose	*Novice students*	*Experienced students*
Inspiration	-	Case 1 – 3
Process-guiding	Case 4 - 6	Case 7

3.1. DCN as inspiration for experienced students

Cases 1 to 3 illustrate the application of the DCN as an inspirational tool in short-term learning settings. In these cases, the DCN was used to broaden students' methodological repertoire and to support reflection on alternative approaches within the design process. All three applications were aimed at students who were already familiar with design thinking principles and process. Consequently, the DCN was not introduced as a comprehensive process framework but rather as a stimulus for exploring new ways of structuring or enriching existing project work.

In *Case 1*, the DCN was integrated into a three-hour workshop conducted as part of a *Disruptive Events* minor programme. The workshop focused on climate- and migration-related challenges and took place at the end of the semester. Students worked in groups using selected *Making* and *Changing* cards to develop ideas and refine their concepts.

In *Case 2*, the DCN within a two-hour interdisciplinary workshop on the redesign of public space. Students used the DCN canvas and card set to develop a concise design or research plan. Although the limited time frame required close facilitation, participants were able to work largely autonomously after a brief introduction. Despite the short duration, the DCN helped participants navigate their approach to the project more systematically. The educator A observed that "the DCN really helped the students to navigate their design approach a little bit more structured," and that the different methods "inspired them to think out of the box and try new things." The DCN instructions were not explained in either of these cases.

Case 3 illustrates how the DCN was employed in a series of three workshops within a course on *Biobased Materials in the Built Environment*. Here, the toolkit was used selectively to stimulate deeper exploration of material-related questions. Students had prior experience in material research but tended to use rather conventional or desk research methods. By introducing the DCN, the educator encouraged them to focus on one specific aspect of their projects and to combine different research techniques, such as interviews and material testing. As a result, students achieved a "more profound level

of knowledge about that material" and "broadened their research skills", as noted by educator B. Across these three cases, the DCN proved effective as a means of methodological inspiration and structured reflection. The short-term, exploratory use of the toolkit enabled students to approach familiar design challenges from new perspectives and to experiment with alternative methods.

3.2. DCN as a process-guiding tool for novice learners

Cases 4 to 6 demonstrate the application of the DCN as a process-guiding framework in courses aimed at students with limited prior knowledge of design methods. In these contexts, the DCN was used to guide learners step by step through a complete innovation process.

In *Case 4*, the DCN was integrated into a 2.5-month innovation project in the field of service design. The participating students had little experience with design processes. The course combined input from the educators and group work, with the DCN serving as the main framework for project execution. Students were guided through each stage of the process, and the educator pre-selected methods from the DCN cards that match the course objectives. For these methods, the educator provided additional supporting materials (e.g., in-depth explanation, examples). The educator C noted that "the students needed general guidance and received input at the beginning of each stage, such as preselecting the tools." As the course progressed, students began to understand "how an innovation project can be structured, and which stages are necessary to move from a problem to a tested result", as explained by educator D. The DCN thus supported both learning methods and process awareness. However, the educator also observed that beginners often felt overwhelmed by the large number of tools available and that several methods - particularly the Statement and Reflection cards - required additional attention.

In *Case 5*, the DCN was applied in a 1.5-month design project within a master's programme. Although participants had some familiarity with creative methods, their experience in applying structured design processes was limited. The DCN was used primarily to frame the *Understanding* and *Defining* phases. The educator provided an introductory session explaining the logic of the DCN. Once the process became familiar, the teams were able to work independently. According to educator E, "less experienced students in particular found it easier (and faster) to follow the process." The educator, however, identified a need for a clearer and more accessible tool to determine the appropriate complexity level for each project.

In *Case 6*, a three-day intensive *Innovation Bootcamp* was conducted with Executive MBA participants who were new to design but brought substantial professional experience from other domains. The DCN served as the main framework for project execution. After an input session on design thinking and introduction of the DCN, the rest of the work time was dedicated to group work with short input sessions on a particular phase and its methods. Participants selected their preferred tools after each input session and then debriefed them with the educator. The facilitator (educator D) observed that "even though students were new to the design discipline, they really appreciated the clear guidance of the navigator" and that "the process became clearer, and they could afterwards map which tools belong to which phase." The DCN thus enabled the participants to quickly gain an overview of the design process and to connect specific methods to distinct stages of problem solving.

Across all three novice cases, the DCN functioned as a pedagogical scaffold that helped learners externalise and manage the design process. It supported systematic progression, provided orientation, and built confidence in applying methods.

3.3. DCN as a process-guiding tool for experienced learners

Case 7 demonstrates how the DCN can also serve as a process-guiding framework for more experienced learners who already possess a basic understanding of design methods and processes. In this course on *Design for Circular Economy*, students worked once a week over a period of one to three months. The DCN was introduced at the beginning of the course to structure the overall design journey and to support independent teamwork.

The educator followed the design thinking process - drawing on the double-diamond and Stanford models - and integrated the DCN to guide the application of methods in each step. The toolkit was used both for group discussions and as a planning aid when choosing suitable methods for project phases. Educator F reported that the DCN "supported and helped students to go through the design process more structured, detailed and appropriate." The educator also noted that the DCN allowed them to "work more independently," reducing the need for continuous teacher supervision. At the same time, several participants commented that the logic of the complexity levels and some of the card descriptions required clarification and that a short face-to-face introduction was necessary for full comprehension.

4. DISCUSSION AND OUTLOOK

The cases presented in this paper demonstrate that the DCN can be effectively used both as an inspirational tool for experienced learners and as a process-guiding framework for novice or experienced student cohorts. Its flexible structure allows educators to tailor its use to different time frames and learning objectives - from short workshops to semester-long projects.

Across all implementations, two factors proved decisive for successful application: adequate preparation by the educator and a clear introduction to the DCN's underlying logic. Most educators choose to preselect methods to present to students, some even preparing additional materials on these methods to support the smoother implementation of the projects. In the longer projects where the DCN was used as a process-guiding tool, additional introduction of the DCN material was needed. However, while the DCN provides detailed materials, students rarely engaged with the written instructions or guidebook when a lecturer explained the process in person. This observation suggests that students rely primarily on educators' verbal and visual cues rather than on self-study of the materials.

In its present form, the DCN was tested before the release of the supporting digital videos and Miro templates. As a result, several educators called for clearer explanations, additional examples, and ready-to-use templates to simplify implementation - particularly for novice users. The new digital resources may therefore address many of these needs and further enhance independent use.

Overall, the DCN has shown to foster structured thinking, reflective practice, and methodological confidence among students. Short-term applications encourage creative exploration and method diversity, whereas long-term implementations build process literacy and autonomy, especially in multidisciplinary teams. As the analysed case studies show, the materials help address the previously identified gap by allowing users to tackle innovation challenges holistically rather than merely individually, guiding them through the process, and enabling them to address challenges at different levels of complexity. Yet for educators, successful use of the DCN depends on balancing structure and flexibility: providing sufficient guidance at the outset while allowing teams to navigate the process independently thereafter.

Although positive effects were observed across all DCN application cases, a long-term study with comparison groups (with and without DCN application) would be required to provide more detailed information about the longer-term impact of the DCN.

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NOTES

Attachment 1 – Questionnaire for educators

Context & background

- Which subject, course, or project did you use the Design Challenge Navigator (DCN) in?
- How long was the project or course where DCN was applied?
- How many participants were involved?
- How do you estimate the participants' experience with methods and design processes in comparable projects/courses (before using DCN)?
- How did you organise or teach this course/project before using the DCN?

Use of the DCN

- Which part of the DCN did you use?
  - At which level of complexity was the Project?
  - Which stages / process steps were applied in your context?
- How did you integrate the DCN into your teaching or coaching process?

Usability & support

- How independently were students able to use the DCN materials? Did they need continuous guidance, or could they work autonomously?
- How clear and understandable were the DCN instructions and materials? Did you need to provide additional resources or explanations? If yes, what and when?
  - If yes, what kind of materials or support did you add?

Learning effects & outcomes

- What were the most notable learning effects from using the DCN? (e.g., skills, mindset, Methods)
  - How do you estimate the output, improvement, engagement, passion, etc., etc…?
  - To what extent did students improve in handling complex, interdisciplinary challenges?
- Compared to previous iterations of the course (without DCN), how did outcomes differ? (in terms of Project results, collaboration, student Engagement, learning Outcomes)

Reflections and Future Improvements

- What worked particularly well with the DCN?
- What challenges did you face when using the DCN?
- What would you change or improve in the DCN or its implementation?

original research article
UDC 378.147::5/6(492)

admission date 03 11 2025
approval date 16 12 2025

EVALUATING THE DESIGN CHALLENGE NAVIGATOR IN BUILT ENVIRONMENT EDUCATION

ABSTRACT

In response to the increasing complexity of challenges in the built environment, this study evaluates the Design Challenge Navigator (DCN), board-game-like design toolkit created to develop future competencies among students in higher education to help them tackle the full spectrum of contemporary challenges. Developed within the ERASMUS+ sUser project, the DCN bridges conventional Design Thinking with a systems-thinking approach and structured methodologies applicable at varying levels of complexity. Using a mixed-methods approach, the DCN was tested across three educational contexts at Avans University of Applied Sciences in the Netherlands. This involved students from Construction Engineering, Civil Engineering, and Spatial Development. The findings indicate that the DCN encourages students to explore new methods, helps them structure and understand their process, and motivates them to follow a more user-driven approach. However, the study highlights the importance of tutor guidance, since the methodology can be complex to understand. And it highlights the importance of early integration into the curriculum to ensure the effectiveness of the DCN. Although the findings suggest that the DCN is a promising tool for educational purposes, further research is needed to validate its effectiveness amongst a larger student population and various project types.

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KEY WORDS
FUTURE COMPETENCES
DESIGN CHALLENGES
COMPLEXITY
BUILT ENVIRONMENT
TEACHING MATERIAL
HIGHER EDUCATION

1. INTRODUCTION

Education systems worldwide are increasingly challenged to prepare graduates for a rapidly evolving professional landscape (Groenier et al., 2025; Pelgrim et al., 2022). Beyond technical proficiency, students must cultivate adaptive expertise, resilience, and the ability to navigate uncertainty (Locklear & Fleener, 2022). This requires embedding pedagogical strategies that foster critical thinking, collaboration, and systemic awareness. For instance, integrating sustainability principles into design curricula ensures that learners consider the deep interconnectedness of environmental, social, and economic dimensions (Azmi, Wahid, Azman, & Jayus, 2024) (Ahmad et al., 2023). Moreover, the rise of digital transformation and globalisation amplifies the complexity of design challenges, demanding holistic approaches that transcend disciplinary silos (Bui & Nguyen, 2023) (Cowin, 2021).

As in many other industries, the built environment sector faces increasingly complex challenges. While less complex challenges can often be addressed through traditional problem-solving strategies such as Design Thinking, which have been widely integrated into curricula across disciplines, highly complex challenges require approaches grounded in systems thinking and complexity theory (Dorst, 2019) (Roth, Rau, Globocnik, & Neyer, 2022). Future professionals must therefore be able to characterise the type of challenge they face to apply an appropriate mindset and tailor a suitable problem-solving strategy (Gotthardt, Roth, & Kretschmer, 2024).

Since this is often a non-trivial task, Gotthardt, Roth, and Kretschmer (2024) introduced the *Design Challenge Navigator* (DCN) as part of the ERASMUS+ funded project sUser. The DCN is an innovative design toolkit for higher and professional education that playfully supports students in identifying the most suitable problem-solving strategy for the challenge at hand. This paper builds on initial trials conducted during a summer school in Tilburg (NL) with a diverse group of bachelor's and master's students, as well as a three-day innovation bootcamp with EMBA (Executive Master of Business Administration) participants. As part of this research, the effectiveness of the DCN was examined both qualitatively and quantitatively with students in the

built environment across three educational contexts at Avans University of Applied Sciences. The sample included bachelor's students from Construction Engineering, Spatial Development and Civil Engineering. The curriculum consists of compulsory modules and elective modules in which students tackle urgent issues relating to making the built environment more sustainable and future-proof, such as circularity, biobased materials, energy transition, flooding and drought, urban densification, and housing shortages. This study provides additional insights into the application of the Design Challenge Navigator across various educational contexts and academic disciplines, thereby contributing to ongoing research on how to make complex modern challenges in education more manageable and to empower students to identify their scope for action.

1.1. The Design Challenge Navigator

The Design Challenge Navigator (DCN) is a board-game-like design toolkit that bridges conventional Design Thinking with systems approaches, making it applicable to a wide range of design challenges in education. It aims to support professionals in designing roles across disciplines in choosing suitable tools and methods for the problem they are facing. Thereby, the material distinguishes between four levels of complexity for which it provides two design processes. Lower-complexity challenges (Levels 1 and 2) are addressed with the "hike", and higher-complexity challenges (Levels 3 and 4) are tackled with the "expedition". While the "hike" follows an established design thinking structure, the "expedition" adopts a systemic design perspective, requiring greater investment in analysing and visualising complex systems before thinking of solutions (Gotthardt, Roth, & Kretschmer, 2024).

The central component of the DCN, the Navigation Map, is where users place selected methods and gradually build their design process throughout the innovation journey. The DCN includes forty method cards outlining each method's steps, required time and resources, related methods, and suitability for either the "hike" or "expedition" process. Furthermore, the thirteen writable statement cards encourage innovation and help teams discuss ideas and agree on decisions during key moments of their process. The application of the learning toolkit is visualised in Figure 1. The entire set is available both physically and virtually (Gotthardt, Roth, & Kretschmer, 2024).

The first application in 2024 targeted eighteen bachelor's and master's degree students with diverse backgrounds during an international summer

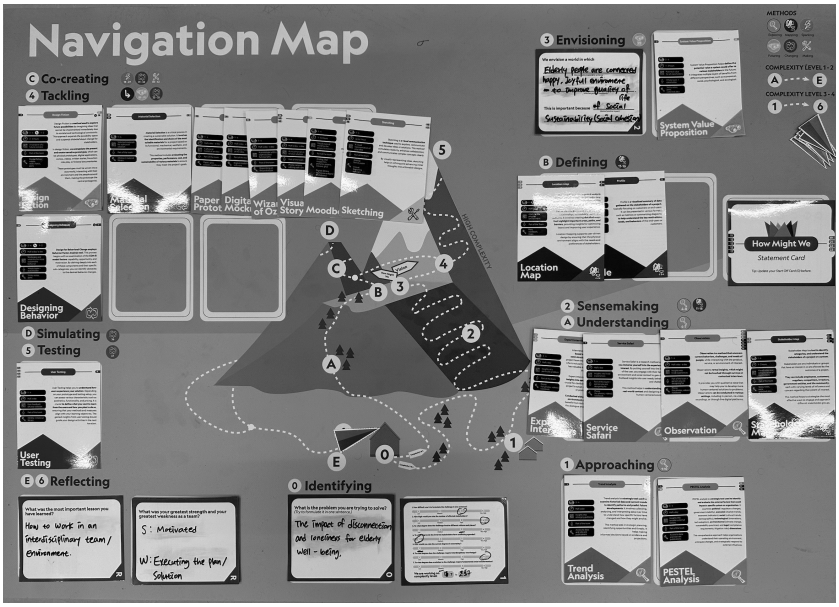

FIGURE 1. The Design Challenge Navigator during application. Method and statement cards are placed on the Navigation Map. (Source: Author)

school in Tilburg and fourteen EMBA students at an innovation boot camp. These initial applications identified several valuable insights into the use of the Design Challenge Navigator (DCN) in these two educational settings. First, the integration of physical learning aids, such as a tangible card set, significantly enhanced student engagement and enjoyment by making the learning process more interactive and game-like. This aligns with similar research that highlighted the positive effects of physical, playful teaching materials (Su, Cheng, & Lin, 2014). Second, the DCN improved team communication by providing a shared framework that structured discussions, aligned priorities, and thereby saved time. Third, it effectively supported students in planning and executing their design processes, empowering them to break complex challenges into manageable steps and boosting their confidence. Fourth, while the DCN provided valuable structure, more experienced students and professionals found it somewhat restrictive, highlighting the need for greater flexibility and a clearer emphasis on the iterative nature of the design process. Finally, the DCN fostered critical innovation skills, helping students to analyse challenges more deeply, reflect before ideating, engage meaningfully with stakeholder feedback, and adopt a more experimental mindset toward problem-solving (Gotthardt, Roth, & Kretschmer, 2024).

Previous results are promising but do not sufficiently cover different educational contexts or a wide spectrum of disciplines. This research addresses this gap. As part of this study, the DCN was applied and evaluated in three different educational contexts in the field of the Built environment at the Avans University of Applied Sciences.

2. METHODOLOGY

This study employed a mixed-methods approach, combining quantitative and qualitative data to provide comprehensive insights into the effectiveness of the Design Challenge Navigator (DCN) at Avans University of Applied Sciences, Academy for Sustainable Built Environment. Quantitative measures reveal general patterns, while qualitative feedback captures learners' nuanced experiences of the methodology. This combination of these methods is especially valuable in design education, where outcomes often include emotional engagement and self-reflective aspects that cannot be reduced to numbers. Future research could build on this work by incorporating longitudinal designs to examine the sustained impact of DCN integration on professional competencies methodology (Creswell & Plano Clark, 2017) (Dawadi, Shrestha, & Giri, 2021).

The DCN was implemented and assessed across three distinct educational contexts within Avans University of Applied Sciences:

2.1. Interdisciplinary Minor: Drowning Cities

The first evaluation took place within the interdisciplinary and international minor program Drowning Cities. This program aims to teach students about the interconnectedness of cultural and socio-economic factors in flood-prone areas. Students developed innovative design solutions for water-related challenges in Ho Chi Minh City from construction engineering and civil engineering perspectives. The DCN was used as a practical toolkit to support the students' design processes and to help them choose methodologies that fit the steps of the process and that they had not used earlier in their studies. A survey, adapted from a previous instrument used during the Erasmus+ Summer School in Tilburg (Gotthardt, Roth, & Kretschmer, 2024), was distributed to 16 students, with 4 responses collected (N = 4). Additional feedback was collected in a regular annual evaluation of the course where the DCN was implemented. Some students (N = 7) mentioned the DCN specifically in the annual evaluation.

2.2. Multidisciplinary Bachelor Project

The second evaluation was conducted during a 20-week multidisciplinary project involving third-year bachelor students working on a spatial development challenge. The aim of the project was for students to redevelop an urban area which was perceived as unattractive and uncomfortable by the municipality of ‘s Hertogenbosch and residents of the surrounding buildings. In week seven, students participated in a three-hour workshop using the DCN as a reflective tool to assess their design process thus far and plan forward using the methodologies embedded in the DCN. A focus group discussion (N = 8) was held to evaluate the workshop and gather in-depth student perceptions. This qualitative method was chosen to uncover nuanced insights and validate the relevance of the survey instrument (Mansell, Bennett, Northway, Mead, & Moseley, 2004) (Zhou, Zhou, & Machtmes). Following the workshop, students were asked additional questions regarding their continued use of the DCN methodologies throughout the remainder of the course (N=2).

2.3. Minor Program: Disruptive Events

Based on findings from the focus group in the Multidisciplinary Bachelor Project, an adapted survey was developed and administered in a third context: the interdisciplinary minor *Disruptive Events*, where students conducted research projects on migration and climate change. Although the DCN was not used during the research phase, it was introduced in a reflective workshop at the end of the course. Students used the DCN’s digital canvas and method cards to evaluate their research process and gain insight into what they would do differently when initiating another iteration. The survey was distributed to 28 students, with 15 responses collected (N = 15).

3. RESULTS

The evaluation of the Design Challenge Navigator (DCN) across three educational contexts revealed a positive reception among students, particularly regarding its card-based methodology, its role in supporting complex problem-solving and design thinking and the collaboration between students from different backgrounds.

3.1. Perceived Usefulness of the DCN Cards

Survey responses indicated that the majority of students (N = 13) found the DCN cards to be a valuable medium for gaining knowledge on complex

problem-solving. Most students (N = 9) reported that the cards enhanced their understanding of the design process and the steps to take. Furthermore, the majority of students (N = 11) agreed that the methodological explanations provided on the cards were clear. However, some students (N = 8) reported understanding the theoretical intent of the cards but required further guidance to apply them effectively, for example, from tutors, particularly during short workshops.

This need for support was echoed in the group discussion, where most participants (N = 6) stated that they would not have been able to effectively use the DCN during a short workshop without tutor guidance. These outcomes point to the critical role of guided instruction in ensuring students can meaningfully engage with the unfamiliar design methodologies the DCN provides.

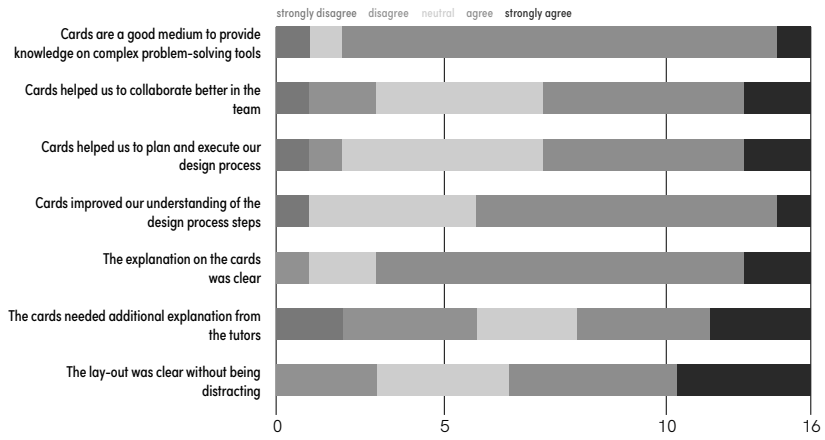

FIGURE. 2. Survey responses on the DCN cards (Source: Author)

3.2. Collaboration and Process Structuring

All participants in the group discussion (N = 8) agreed that the DCN facilitated a more constructive and collaborative design process. However, survey responses were more varied: while seven students agreed or strongly agreed that the DCN improved collaboration, five remained neutral, and three expressed disagreements in this manner. This divergence suggests that the perceived impact of the DCN on teamwork may be context-dependent or influenced by individual preferences and existing group dynamics.

Additional feedback from students in the *Drowning Cities* and *Multidisciplinary Bachelor Project* programs emphasised the DCN's role in promoting an iterative approach to the design process rather than a linear progression. These reflections suggest that the DCN may support deeper engagement with design thinking principles when integrated into longer-term projects.

3.3. Digital Environment and Usability

All students from the *Disruptive Events* program and four participants from the *Drowning Cities* program engaged with the DCN via a digital Miro canvas. While the concept of a digital environment was well-received (N = 14), technical limitations significantly affected usability. Students reported difficulties in copying and editing the canvas, which led to confusion (N = 6) and hindered their design process (N = 4). Two of the students from the Disruptive Events minor program mentioned the explanatory videos embedded in the digital canvas specifically as helpful (N=2). These findings underscore the importance of reliable digital infrastructure and intuitive interface design when implementing online learning tools.

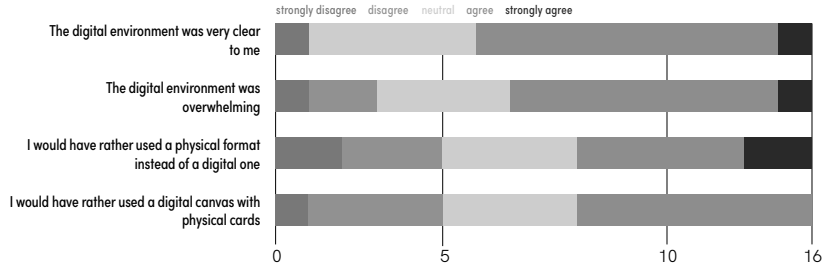

FIGURE 3. Survey responses on the digital environment (Source: Author)

3.4. Contextual Fit and Methodological Relevance

For some students (N = 4), the DCN methodology did not align well with their specific assignments, limiting its applicability in their design process. This suggests that while the DCN offers a flexible framework, its effectiveness may depend on careful alignment with course objectives and project scopes.

3.5. Skill Development and Methodological Exploration

The majority of respondents (N = 8) reported that the DCN helped them critically examine the status quo and reflect on their own values and perceptions. Additionally, nine students indicated that the tool supported their ability to identify and communicate potential points for intervention. Notably, students in both the group discussion from the Multidisciplinary project and post-course evaluations from the Drowning Cities course (N = 13) stated that the DCN encouraged them to explore unfamiliar methodologies, with four specifically noting an increased use of user-driven approaches. These outcomes suggest that the DCN fosters methodological diversity and supports the development of reflective design practices.

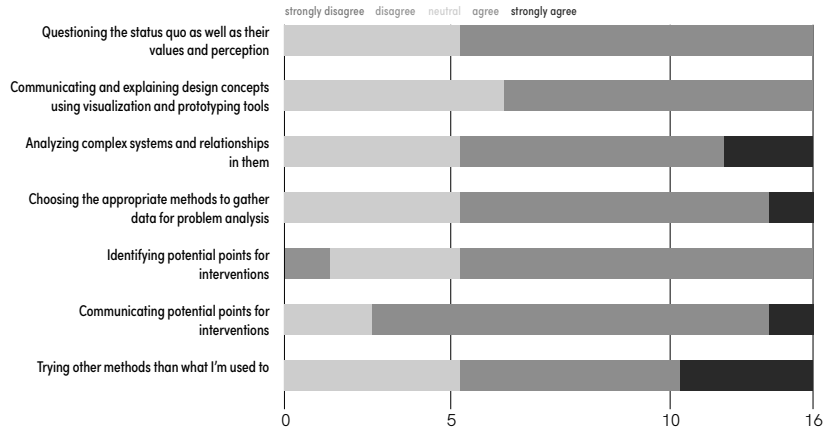

FIGURE 4. Survey responses on improved skills (Source: Author)

4. CONCLUSION AND DISCUSSION

Integrating the DCN into the curriculum of higher education programs helps to operationalise the combination of the principles of systems thinking and design thinking together (Meadows, 2008) (National Academies of Sciences, Engineering and Medicine; Health and Medicine Division; Board on Global Health; Global Forum on Innovation in Health Professional Education, 2018). This combination should help students address wicked problems from different disciplines. However, scaling these efforts remains challenging and requires strong institutional support for faculty training and infrastructure. Looking ahead, co-creating localised DCN versions with industry partners could enhance relevance and authenticity."

This study evaluated the implementation of the Design Challenge Navigator (DCN) across three educational contexts at Avans University of Applied Sciences, Academy of the Sustainable Built Environment. The findings suggest that the DCN has the potential to enhance student learning in complex, multidisciplinary design challenges, for multiple-week courses, as well as short workshops. Findings suggest that it fosters reflective thinking and collaborative problem-solving. Furthermore, it motivates students to implement more iterative design principles and a more user-driven approach.

The majority of students responded positively to the DCN's card-based methodology. The survey and group discussions reported improved understanding of the design process and increased ability to identify and communicate intervention points. The cards were perceived as clear and useful, though nearly half of the respondents indicated a need for additional explanation, highlighting the importance of tutor guidance, especially in short workshops.

Student feedback on the digital environment was mixed. While the concept of a digital canvas and the tool's layout were appreciated, technical limitations emerged during the workshops, including the inability to edit or copy the tool. These technical limitations negatively impacted usability and perceived effectiveness.

Importantly, students reported that the DCN encouraged them to explore unfamiliar methods and adopt more user-centred approaches. This aligns with the pedagogical goals of the programs involved, which emphasise sustainability, interdisciplinarity, and real-world engagement.

Overall, the DCN appears to be a promising tool for supporting design education in higher education settings. However, its effectiveness depends on thoughtful integration into the curriculum, adequate tutor support, and reliable digital platforms.

The findings of this study suggest that the Design Challenge Navigator (DCN) holds promise as a pedagogical tool for supporting design thinking and collaborative problem-solving in higher education. Students responded positively to the DCN's card-based methodology, reporting improvements in their understanding of design processes and increased engagement with unfamiliar and user-driven methods. However, the interpretation of these results must be situated within the methodological constraints and potential biases inherent in the study design.

4.1. Sample Size and Generalizability

The small sample size (N = 24) limits the statistical power and generalizability of the findings. While the mixed-methods approach provided rich qualitative insights, the quantitative data should be interpreted with caution. Future studies with larger and more diverse cohorts are needed to validate these preliminary findings and explore variations across disciplines and learning contexts. Comparing the results of this study with those of other studies on the implementation of the DCN in other contexts might yield different results.

4.2. Self-Selection Bias

Participation in the survey was voluntary, introducing the possibility of self-selection bias. Students with strong positive or negative may have been more inclined to respond, potentially skewing the data. This bias may have amplified both enthusiasm and criticism and should be considered when assessing the overall effectiveness of the DCN.

4.3. Timing of Implementation

In the Disruptive Events program, the DCN was introduced late in the course, which may have constrained its impact. Students reported that the tool was helpful for reflection and structuring their process, but its late introduction limited opportunities for iterative use. This suggests that the timing of implementation is critical to maximising the DCN's pedagogical value. Embedding the DCN earlier in the curriculum may allow students to engage more deeply with its methodologies and integrate them into their workflow..

4.4. Technical Constraints and Platform Usability

The digital environment used to host the DCN, Miro, was a source of frustration for many students. Technical limitations, such as restricted editing capabilities, negatively influenced user experience and may have confounded perceptions of the DCN itself. These issues highlight the importance of reliable and intuitive digital platforms when using design tools in educational settings. Without adequate technical support, even well-designed pedagogical frameworks may fail to achieve their intended outcomes.

4.5. Contextual Fit and Adaptability

Some students reported that the DCN methodology did not align well with their specific assignments, suggesting that contextual fit is a key determinant of effectiveness. While the DCN offers a flexible framework, its successful implementation requires thoughtful adaptation to the learning objectives, project scope, and disciplinary context. This finding underscores the need for educators to critically assess when and how to integrate such tools into their teaching practice.

5. RECOMMENDATIONS

To optimise the educational impact of the DCN, additional reflective components could help. The integrated reflection cards could be a first way to do this, but should then be integrated between the step phases of the methodology. The digital environment might facilitate analytic purposes that would provide opportunities to be more responsive to users' needs. Additional research on how to arrange the analytics and adaptivity of the digital tool would be helpful. Based on the findings of this study, and the studies that have been done at the other sUser project partners, several recommendations can be made to enhance the implementation and effectiveness of the Design Challenge Navigator (DCN) in higher education settings:

Introducing the DCN at the beginning of a course or project cycle would allow students to engage with its methodologies more iteratively and meaningfully. Early integration can support deeper learning and provide students with a structured framework for navigating complex design challenges throughout their process. The DCN was first tested during a week-long summer school (Gotthardt, Roth, & Kretschmer, 2024), which shows more effective engagement with the tool. This was also the case for the students who were allowed time to work on their projects after they were introduced to the DCN.

The need for additional clarification reported by students could be more easily addressed if more time is allowed to work with the DCN. During a short workshop, the guidance and clarification needed to understand the tool could take up time that would otherwise be available to work with the methodologies the DCN offers. When working on longer courses and introducing the DCN early, the time needed to get to know the tool would be less of a problem.

To maximise the relevance and impact of the DCN, the objectives of the course should be well-aligned with the methodologies in the tool. The first aim of the DCN was to help students design Sustainable Elderly Service Housing. However, it was developed to improve agile and user-driven methodologies and systems thinking for students in a broad spectrum of complex challenges. The DCN was tested at Avans in courses where students were addressing complex challenges, however, the original aim, to help students design Sustainable Elderly Service Housing was not tested within Avans. To understand if the DCN works for courses with this objective within Avans, additional research would be needed. .

Additional research should be conducted among larger, more diverse student populations. It was now only tested among third- and fourth-year bachelor students but should be evaluated among first- and second-year students as well to gain deeper insight into the DCN’s effectiveness and adaptability.

Ackowledgement

This work was made possible through the generous financial support of the Erasmus+ program. The research presented in this paper is part of the sUser project, which was funded by Erasmus+. We gratefully acknowledge their contribution in enabling collaborative, user-centred research aimed at fostering inclusive and sustainable design practices.

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original research article
UDC 378.147::5/6(480)

admission date 03 11 2025
approval date 21 12 2025

EXPLORING THE HIDDEN POWER OF VISUAL THINKING: DEVELOPMENT OF A WORKSHOP FOR STUDENTS

ABSTRACT

Housing for the elderly has become a pressing issue where the challenges of aging populations and sustainable development collide. These challenges can be met by integrating ecological, social, economic, and cultural perspectives into user-centred design. Such interdisciplinary settings highlight wicked problems: complex, shifting issues that resist clear solutions. Cognitive limitations, including restricted working memory and difficulty grasping hidden interdependencies, further complicate sensemaking. This article presents the development of a workshop within the sUser – Introducing User-driven Design and Agile Development Skills in the Case of Sustainable Service Housing for Elderly – project exploring the potential of visual thinking in practice. Visual thinking uses sketches, diagrams, and other visual forms to offload cognitive demands, reveal patterns, and build shared understanding. The workshop emphasises that visual thinking is a natural human ability, unrelated to drawing skill, and demonstrates simple methods for structuring complexity and fostering collaboration. The findings suggest that visual thinking is a versatile cognitive strategy, valuable not only in interdisciplinary design for sustainable elderly housing but also as a general aid for reasoning across domains.

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KEY WORDS
VISUAL THINKING
COGNITIVE OFFLOADING
COMPLEX PROBLEM-SOLVING
SHARED UNDERSTANDING

1. INTRODUCTION

Designing sustainable housing for an aging population is a key societal challenge of the twenty-first century. As people live longer and seek to remain independent, living environments must support accessibility, safety, ecological responsibility, affordability, and social connection. No single field can address these aims alone. Instead, designers, policymakers, care providers, residents, and families must jointly negotiate priorities—an endeavour characteristic of what Rittel and Webber (1973) defined as a wicked problem. This complexity deepens when ecological goals, cultural expectations of aging, financial constraints, and diverse user needs intersect. Choices about location, materials, governance, and services create ripple effects across domains, requiring ongoing reframing rather than fixed solutions. From a design perspective, this aligns with Buchanan's (1992) view that design practice is well-suited to engage with indeterminate problems.

At the same time, such complexity collides with the limits of human cognition. Modern work demands that individuals manage multiple variables and interdependencies, yet working memory remains tightly constrained. As Logie (2011) notes, interference and distraction further reduce our ability to maintain a systems-level overview, making it difficult to reason through multifaceted challenges. One way to mitigate these limits is through externalisation—placing thoughts into visible form so they can be organised and shared. Humans reason through interaction with notes, diagrams, tools, and colleagues; making ideas visible allows them to be inspected and developed more effectively. This also aligns with Hutchins's (1995) account of cognition as distributed across individuals and artifacts. In collaborative design contexts such as sustainable elderly housing, visualisations also serve crucial social and creative functions. Shared sketches, maps, and diagrams help participants align understanding, question assumptions, and negotiate priorities. Even rough drawings can prompt reinterpretation and iteration, reflecting what Schön (1983) describes as a "conversation with the situation."

The present article builds on these insights to argue that visual thinking should be recognised not merely as a tool for communication but as a practical cognitive strategy that individuals can learn, apply, and refine. Our emphasis is not on artistic skill or graphic design, but on the tangible competencies that emerge through making ideas visible. When participants sketch, diagram, map, or model concepts, they practice skills that help them structure information,

explore alternatives, and reason more effectively about complex situations. In the context of sustainable elderly housing, these skills become especially valuable. Visual externalisations enable practitioners to break down intricate systems into manageable components, compare options side by side, and trace relationships that are difficult to grasp in purely verbal discussion. As participants experiment with simple visual tools—such as quick sketches, causal maps, journey diagrams, or layered overlays—they develop an ability to notice patterns, identify gaps, and articulate assumptions that might otherwise remain implicit. These hands-on practices strengthen situational awareness and support more informed decision-making.

Just as importantly, visual thinking cultivates collaborative abilities. Shared drawings and diagrams provide multidisciplinary teams—designers, policymakers, care professionals, and residents—with a common reference point for negotiation. Working together around a sketch helps participants listen, challenge, and build on each other's ideas more effectively. This practice develops skills in facilitation, co-creation, and boundary-crossing communication, making complex discussions more inclusive and productive. To support the development of these practical competencies, we report on a workshop format designed to introduce visual thinking as an accessible practice for participants with no prior drawing experience. The workshop focuses on simple, repeatable techniques that can be applied in real projects, encouraging participants to use visual tools as part of their everyday problem-solving. We also outline how this format is being expanded into an online MOOC, allowing learners to develop and deepen these skills at their own pace while engaging with examples, exercises, and collaborative tasks that mirror real-world design challenges.

2. THEORETICAL BACKGROUND

Before turning to specific mechanisms, it is important to define what is meant here by visual thinking. The term is used in many ways, ranging from graphic communication and artistic expression to design sketching and modelling. In this article, visual thinking is defined narrowly as the use of visual and spatial representations to support cognition and reasoning. It refers to externalising thought in sketches, diagrams, maps, and other spatial forms to augment human cognitive processes. Visual thinking in this sense is not primarily about communication design or aesthetic quality, but about providing cognitive scaffolds that extend working memory, reveal patterns, and enable individuals and groups to process complex information more effectively.

2.1 Wicked problems and cognitive limits

The concept of wicked problems offers a valuable lens for understanding the design challenges of sustainable elderly housing. Rittel and Webber (1973) describe such problems as resisting definitive formulations, lacking stopping rules, and allowing only better or worse outcomes. Buchanan (1992) later argued that wickedness is inherent to design because it unfolds in open, evolving situations where goals and meanings shift. In elderly housing, ecological targets, regulations, cultural expectations, and user needs interact in unpredictable ways, meaning each intervention reframes the problem space and requires iterative, abductive thinking.

This wickedness intersects with human cognitive limitations. Working memory: the system responsible for maintaining and manipulating information—constitutes a central bottleneck in reasoning (Logie, 2011). Klingberg (2008) shows that it is fragile, easily distracted, and quickly overloaded when many interdependencies must be monitored. As a result, even experienced practitioners can struggle to maintain a coherent systems-level overview in real-world conditions marked by interruptions and competing priorities. The consequence is a tendency toward oversimplification or fixation on only part of the problem.

If wicked problems demand integrative reasoning, then working-memory limits pose a fundamental challenge. Researchers therefore emphasise the importance of external supports (notations, diagrams, and other cognitive scaffolds) to augment mental processing.

2.2 Extended mind and distributed cognition

The extended mind thesis (Clark & Chalmers, 1998) maintains that cognitive processes can extend into the environment when individuals reliably couple with external artifacts. If a notebook, smartphone, or diagram performs the same functional role as internal memory or inference, it becomes part of the cognitive system. From this perspective, external aids are not peripheral add-ons but constitutive elements of thought. Sketching, listing, or arranging sticky notes does not merely document ideas—it shapes the thinking process itself. This principle, that cognition emerges through interactions with the environment, is summarised in Figure 1.

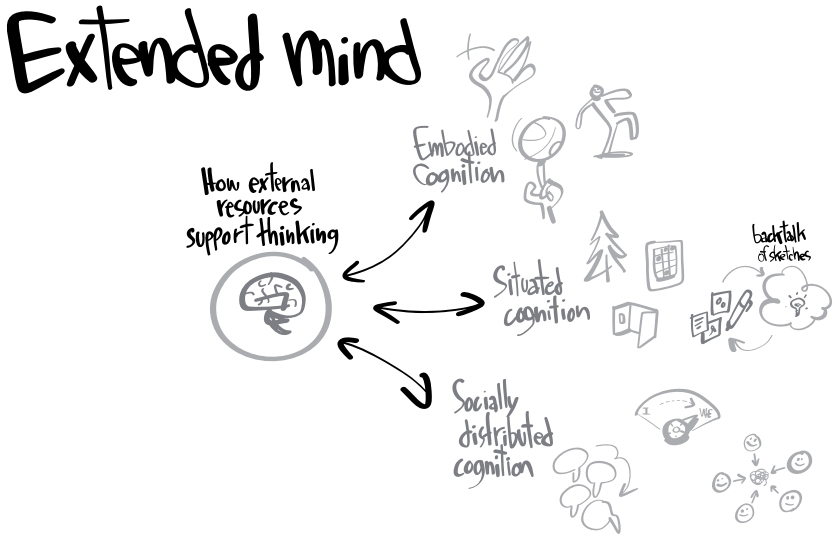

FIGURE 1. Extended mind theory explains how external resources support cognition. This illustration, adapted for the workshop, visualises a commonly used interpretation of the framework, which distinguishes embodied, embedded, and distributed processes (Clark & Chalmers, 1998; Paul, 2021).

This view is reinforced by distributed cognition (Hutchins, 1995), which demonstrates how real-world problem-solving depends on coordination among people, artifacts, and representational media. Hutchins's studies of ship navigation showed that no single individual carried the entire cognitive load; instead, cognition emerged from the system as a whole. In design and innovation, the same principle applies: diagrams, sketches, and models act as "public representations" that synchronise attention, support partial understandings, and enable joint solutions.

Together, extended and distributed cognition underscore that externalisation is fundamental rather than optional. Cognitive artifacts stabilise thoughts, reduce reliance on limited working memory, and enable collective reasoning—justifying visual thinking as a core design method.

2.3 Working memory subsystems and cognitive offloading

Cognitive psychology explains why externalisation is so effective. Working memory consists of specialised subsystems: the phonological loop for verbal material, the visuospatial sketchpad for visual-spatial content, and

a central executive that coordinates them (Logie, 2011). Each subsystem has strengths and limits. The phonological loop excels with sequential information but overloads quickly, while the visuospatial sketchpad processes multiple relations in parallel yet also has finite capacity. Visualisations are powerful because they shift information into the visuospatial system, easing demands on the verbal channel and rendering complex structures more manageable.

Cognitive offloading refers to shifting cognitive demands from internal systems to the external environment (Risko & Gilbert, 2016). Writing a number relieves the phonological loop; sketching a map externalises spatial relations that would otherwise tax the visuospatial sketchpad. Offloading does more than conserve resources: once information is external, perceptual and inferential processes—such as grouping, analogy, or pattern detection—can act on it. Thus, offloading both preserves working memory and expands the operations available to the thinker. This process is illustrated in Figure 2.

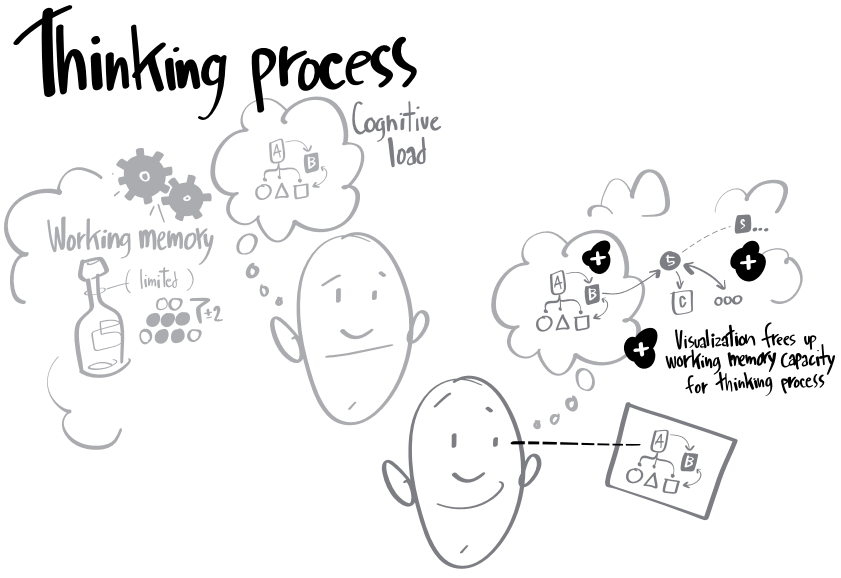

FIGURE 2. Visual thinking relieves the bottleneck of working memory by externalising mental content. This schematic, adapted from workshop materials, illustrates how sketching reduces cognitive load and frees resources for reasoning (Logie, 2011; Klingberg, 2008; Risko & Gilbert, 2016).

Dehn, Kaufman, and Kaufman (2015) further stress that interventions should accommodate subsystem-specific limits. Visual scaffolds can support those with verbal memory difficulties, while verbal structuring can assist those with visuospatial challenges. For design practice, the implication is clear: visualisations provide a versatile means of redistributing cognitive load across modalities.

2.4 Dual coding and grounded cognition

Two theoretical perspectives explain the enduring benefits of visual externalisation. Dual coding theory (Paivio, 2014) posits that verbal and nonverbal representations operate in distinct but interconnected systems. When information is encoded both verbally and visually—as when designers sketch while discussing—each channel reinforces the other, improving memory and comprehension. Research supports this: multimodal learning environments outperform unimodal ones (Moreno & Mayer, 2007).

Grounded cognition (Barsalou, 2008) adds that concepts draw on sensorimotor simulations rather than abstract, amodal codes. Thinking about "balance" recruits motor systems; thinking about "brightness" engages visual areas. Visualisations are effective, therefore, not because they arbitrarily symbolise ideas but because they resonate with perceptual mechanisms that mirror the structure of the concepts. Sketches and diagrams thus enable richer, more embodied cognitive engagement.

Together, dual coding and grounded cognition show how visual thinking enhances memory and understanding by activating complementary perceptual and conceptual systems.

2.5 Visual thinking as cognitive scaffolding

Tversky (2011) highlights how visualisations differ from linear language. While language unfolds sequentially, diagrams exploit spatial properties—proximity, alignment, direction—to encode relations in parallel, thereby reducing cognitive load. Experimental findings support this: visual processing excels when multiple elements must be considered simultaneously (Deryalar, 2022), and visual working memory tends to encode higher-order structure rather than isolated items (Brady & Alvarez, 2011). Effective diagrams leverage these tendencies by organising information into meaningful patterns.

Visualisations also promote active engagement. Bobek and Tversky (2016) found that learners who created their own visual explanations achieved better comprehension than those who only studied the provided materials. The act of sketching forces individuals to externalise, organise, and refine their understanding. In design, Goldschmidt (2003) showed that sketches often yield more information than was intentionally placed in them, as ambiguous marks prompt reinterpretation. Schön (1983) conceptualised this as reflection-in-action, a dialogue between designer and sketch that drives creative discovery.

2.6 Visual thinking in collaborative contexts

Beyond individual cognition, visualisations play a crucial role in collaboration and co-design. Kälviäinen (2025) documents how visual tools such as journey maps, empathy maps, and stakeholder diagrams help diverse participants articulate perspectives, set problems, and explore solutions collectively. Visuals act as boundary objects: flexible enough to accommodate different interpretations yet structured enough to anchor joint work. Gustafsson (2023) adds that artifacts used in strategy work confer neurocognitive advantages by directing attention, eliciting emotion, and supporting memory when groups build meaning together. In workshops, even low-fidelity visuals can transform abstract debates into concrete interactions, enabling participants from diverse backgrounds to co-create shared understanding.

These findings underscore the dual nature of visual thinking: it is both an individual cognitive aid and a social practice. As individuals, we use sketches to offload memory and reveal patterns; as groups, we use them to align mental models, negotiate trade-offs, and foster inclusion. This dual role is particularly salient in wicked problems, where both cognitive and social complexity are high.

2.7 Summary and critical perspectives

The theoretical perspectives reviewed here point to a shared conclusion: visual thinking acts as an extension of the mind. When ideas are externalised into stable, structured forms, individuals can move beyond the limits of working memory, draw on perceptual and embodied systems, and open up forms of inference that are difficult to achieve mentally. At the same time, shared visuals support collective sensemaking, offering groups a way to navigate the shifting, contested landscape of wicked problems. Drawing on extended mind theory, working memory research, dual coding, and grounded cognition, visual thinking emerges not as a stylistic preference but as a central strategy for reasoning and design.

Even so, these approaches have their critics. The extended mind thesis (Clark & Chalmers, 1998) has been challenged for casting too wide a net; if every interaction with artifacts counts as cognition, the concept risks losing its force. Rupert (2010) argues that only tightly integrated processes should qualify as genuinely cognitive, reminding us that for visual thinking, what matters is not simply the presence of diagrams but the ways they are reliably woven into reasoning.

Dual coding theory (Paivio, 2014) also faces questions about its generality. Although the distinction between verbal and visual codes is useful, real cognitive activity often draws on additional affective, motor, and social systems. Research on multiple representations shows that combining visuals and text can sometimes hinder learning when the effort of integrating them exceeds cognitive resources (Schnotz & Bannert, 2003).

Grounded cognition (Barsalou, 2008) expands the picture by highlighting embodied simulations, yet its claims remain contested as well. Mahon and Caramazza (2008) argue that activation of motor or perceptual areas during concept use does not prove that concepts are constituted by embodiment. Instead, they suggest that abstract representations may coexist with sensorimotor activations, complicating stronger interpretations of grounding.

Scholars have also cautioned that cognitive offloading is not without drawbacks. Norman (1993) notes that external artifacts can mislead or oversimplify, while Risko and Gilbert (2016) warn that outsourcing memory may reduce internalisation or foster dependence. In wicked problem contexts, where all visualisations simplify, diagrams can obscure as much as they illuminate.

Taken together, these critiques refine rather than weaken the argument for visual thinking. They remind us that the value of sketches, maps, and diagrams lies not simply in their production but in how they are embedded in cognitive and social activity. This underscores the need for workshops and pedagogical interventions that help students and professionals use visual thinking reflectively and effectively. By situating practice within a nuanced theoretical landscape, we can avoid both uncritical enthusiasm and dismissive scepticism and cultivate visual thinking as a flexible, context-sensitive cognitive strategy.

3. WORKSHOP APPROACH AND ILLUSTRATIVE OBSERVATIONS

In the context of sustainable elderly housing – and, more broadly, university courses dealing with complex systems – a need was identified for practical means to build shared understanding and frame problems productively. As a response, a visual-thinking workshop was developed with the aim to (1) introduce the concept in a non-intimidating way, (2) explain why visual externalisations support cognition, (3) demonstrate that the method is a skill everyone already has, regardless of drawing ability, and (4) offer simple ways to externalise and visualise one's own thinking.

3.1 Initial perceptions and barriers

Introducing visual thinking to students proved paradoxical. On the one hand, it is something almost everyone has already practised informally without naming it; on the other, presenting it under an official-sounding term made some participants assume it was a wholly novel, unfamiliar method. This tension shaped early reactions. To illustrate the core idea, that visual thinking is a form of externalising thought consistent with the extended mind thesis, a simple exercise was used. Students were shown a long word and asked to count its syllables. Many instinctively resorted to using their fingers. This behaviour was then highlighted as an example of cognitive offloading, showing that visual thinking operates on the same principle: making structures explicit outside the head so they can be more easily managed and understood.

3.2 A skill everyone already has – and the myth of drawing skill

Visual thinking is not an exotic or unfamiliar practice but a skill that everyone already uses in everyday life. People routinely externalise thought through lists, notes, reminders, or casual doodles. These simple artifacts are not judged for their appearance but valued for their function: they make mental content visible, stable, and easier to manage.

Against this backdrop, one recurring barrier in the workshop was the persistent belief that visual thinking requires drawing skill. Many participants assumed that to visualise thinking meant to draw well and thus evaluated their output by artistic standards. This misconception required deliberate effort to dispel. The workshop stressed that visualisations are tools for thought, not artworks to be assessed aesthetically. Just as no one evaluates a reminder note for penmanship, sketches should be judged by their cognitive utility rather than by their artistic quality.

It is also worth noting that visualisation is not restricted to drawing. People routinely use physical props and digital tools to externalise thought: Lego bricks, post-it notes, modelling clay, Miro or MURAL boards, whiteboards, or even rearranged objects on a table (Tversky, 2011). Each of these offers tactile or spatial cues that help people perceive and reorganise complexity. However, in our workshop we focused on sketching because it is fast, universally accessible, and flexible: paper and pen are always near at hand. Sketching also uniquely supports the use of metaphor and analogy – for example, drawing arrows to indicate causality or containers to suggest categories – something that other materials make harder to improvise in real time.

3.3 Ways to visualise thinking

Mental content can take many forms: networks of interrelated ideas, hierarchical structures, temporal sequences, spatial arrangements, or qualitative and quantitative values. Externalising these structures visually helps make them tractable. In the workshop, a set of simple tips was compiled to highlight that the aim was not polished diagrams but working artifacts that participants could manipulate as the process unfolded as part of their reasoning.

Perspectives from complexity thinking reinforce this approach. Beeler (2020), writing from a practitioner's perspective, notes that making sense of complexity requires choosing and layering representations that illuminate various aspects of a system, rather than expecting a single view to suffice. Classic frameworks such as Wurman's LATCH (Location, Alphabet, Time, Category, Hierarchy) and Gray's (2012) reflections on organising information provide practical heuristics: they suggest multiple ways to order and map content so that relationships become visible. These approaches align closely with the workshop aim of equipping participants with flexible strategies to make sense of their own complex ideas. Covert (2014) similarly emphasises that clarity is created when relationships are surfaced rather than hidden.

3.4 Workshop dynamics

Many participants initially overestimated the complexity of the practice, which led to hesitation and a stream of "Am I doing it right?" questions. The guiding principle we emphasised was simple: a visualisation is right when it helps you see relationships, options, and next moves more clearly than before. In practice, small constraints (thick markers, limited space, short time boxes, deliberately rough examples) reduced perfectionism and encouraged contribution.

3.5 Multi-level role of visual thinking

Previous research highlights that visual thinking operates at multiple levels. At the individual level, it supports one's own reasoning by externalising and structuring ideas, which in turn makes them easier to revisit, refine, and iterate (Schön, 1983; Goldschmidt, 2003). At the group level, shared visuals function as boundary objects that help align perspectives and build collective sensemaking (Kälviäinen, 2025; Gustafsson, 2023). Finally, visualisations also act as communicative artifacts, conveying insights to wider audiences beyond the immediate design team. This multi-level role of visual thinking is illustrated in Figure 3.

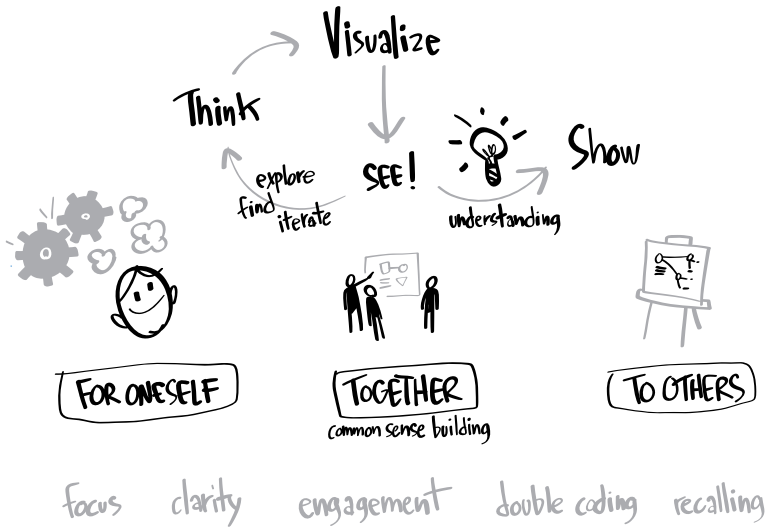

FIGURE 3. Visual thinking operates at multiple levels: supporting individual reflection, enabling collective sensemaking, and facilitating communication to others. This workshop illustration summarises the multi-level role of visualisations as cognitive scaffolds, resonating with research on visual explanations and shared understanding (Tversky, 2011; Kälviäinen, 2025; Gustafsson, 2023).

3.7 Limitations

Findings reflect a particular case within elderly-housing design and rely on facilitation by experienced visual practitioners. Visualisations can oversimplify or privilege certain structures; therefore, they should be combined with verbal and quantitative representations and iterated with stakeholders. Practical constraints (time, materials) must also be managed; however, low-fidelity tools kept costs minimal in our setting.

4. DISCUSSION

The workshop pilots described in this article should be understood as early explorations rather than systematic studies. Their primary aim was to test how the theoretical rationale for visual thinking – particularly its grounding in extended mind theory and cognitive offloading – could be translated into a practical learning format. As such, the observations reported here are anecdotal and facilitation played a significant role. Still, they provide useful indications of how visual externalisation might support both individual reasoning and group sensemaking in complex design contexts.

One recurring suggestion from the pilots was that visualisations can lower barriers to participation. Even when sketches were rough and provisional, they provided a shared canvas that participants could interact with and add to as the process unfolded. This aligns with prior research highlighting how external representations act as boundary objects and scaffolds for collective reasoning (Kälviäinen, 2025; Gustafsson, 2023). Rather than serving as finished products, the sketches functioned as cognitive tools – lists, diagrams, or spatial arrangements – that allowed participants to make their thinking visible and negotiate ideas with others.

Another indication was that visualisations helped participants manage complexity. When issues were discussed verbally, conversation often circled abstractly around competing concerns; when ideas were externalised as diagrams, patterns and relationships became more tractable. This resonates with theoretical accounts of how the visuospatial sketchpad processes multiple elements in parallel, relieving the bottlenecks of linear verbal reasoning (Logie, 2011). Although these impressions are not definitive findings, they suggest that the mechanisms described in cognitive theory are visible in practice, even in short workshop exercises.

At the same time, several limitations became clear. The pilots relied heavily on skilled facilitation, and the outcomes may not generalise without such support. Visualisations inevitably simplify, and there is always a risk that certain perspectives become privileged while others are obscured. Materials and time were limited, which constrained the range of methods that could be tested. Most importantly, no systematic data were collected, so conclusions must remain tentative. These caveats underline the need for further development and structured evaluation.

The workshop is intended as a stepping stone toward a MOOC course on visual thinking. Translating the format into an online environment raises

new challenges: spontaneous sketching is difficult to replicate digitally, and assessment of drawings cannot realistically focus on quality. Nevertheless, digital platforms offer opportunities for self-assessment, peer comparison, and collaborative annotation, which can preserve the core pedagogical principle of making thinking visible. Future iterations should therefore experiment with lightweight digital tools while retaining the focus on visualisations as cognitive scaffolds.

Taken together, these reflections highlight both the promise and the open questions surrounding visual thinking as a pedagogical and design method. The theoretical background provides a strong rationale, and the pilots suggest that practice resonates with theory. Yet the work is only beginning; systematic study, long-term implementation, and adaptation to diverse contexts are needed. For now, the main conclusion is modest but significant – visual thinking is a skill participants' already use in everyday life, and when framed as a cognitive aid rather than an artistic exercise, it can be cultivated to support reasoning and collaboration in complex problem spaces.

5. SUGGESTIONS FOR FUTURE RESEARCH

The promising insights outlined above point to several avenues for further developing visual thinking theory as well as its practices. Although workshops and theoretical arguments suggest that externalisation scaffolds reasoning, these exploratory efforts raise as many questions as they answer. A systematic study is needed to consolidate visual thinking as a cognitive strategy and refine its applications across contexts. Particularly promising directions include design practice, education, and innovation, where targeted studies can clarify how making ideas visible extends cognition and supports social interaction, while also addressing critiques from cognitive theory (Clark & Chalmers, 1998; Rupert, 2010).

In design practice, research should examine how visual thinking functions as part of professional reasoning. While sketching and diagramming are long-standing design tools, empirical evidence is still needed to explain their cognitive contributions. Building on the extended mind thesis, scholars could investigate when sketches become tightly integrated into designers' thinking (Clark & Chalmers, 1998). Cognitive offloading theory predicts benefits in such cases, as diagrams should relieve memory load and enable operations such as pattern recognition or analogical mapping that mental computation alone cannot achieve (Risko & Gilbert, 2016). Controlled studies comparing

design problem-solving with and without sketching could track differences in solution quality or cognitive load. The phenomenon of sketches "talking back" to their creators further warrants study, since ambiguous drawings can trigger novel insights (Goldschmidt, 2003; Schön, 1983). Such research would validate visual thinking as a core design method and offer guidance for maximising the utility of externalisations.

In education, longitudinal and controlled studies are needed to evaluate the effects of teaching visual thinking on learning and problem-solving. Dual coding theory suggests that learning improves when verbal and visual encoding are combined (Paivio, 2014), while prior work confirms that generating diagrams enhances comprehension and recall (Bobek & Tversky, 2016; Moreno & Mayer, 2007). Grounded cognition perspectives further predict benefits from engaging sensorimotor experiences (Barsalou, 2008). Research could compare groups learning complex concepts through visual–spatial methods versus traditional approaches, while applying process-tracing tools such as sketch analysis or eye-tracking. Collaboration across education, psychology, and technology would be valuable in scaling interventions, particularly online. As suggested by the MOOC pilots, digital tools may support collaborative annotation and peer feedback, helping to preserve the principle of making thinking visible.

In innovation and collaboration, research should explore how visual thinking facilitates group cognition in multi-stakeholder contexts. Wicked problems, such as sustainable housing, require shared understanding across diverse participants (Rittel & Webber, 1973; Buchanan, 1992). Visual artifacts are believed to serve as boundary objects, aligning perspectives and externalising tacit knowledge (Kälviäinen, 2025; Gustafsson, 2023). Comparative studies of team tasks with and without structured visual methods could measure outcomes such as idea diversity, consensus speed, and solution quality. Longitudinal work in organisational or community projects could examine how sustained visual practices shape innovation culture. Interdisciplinary collaboration will be essential to link cognitive mechanisms with practical outcomes.

Across these domains, future research must remain critically balanced. While extended cognition, dual coding, and offloading theories highlight clear advantages (Clark & Chalmers, 1998; Paivio, 2014; Risko & Gilbert, 2016), critiques remind us that externalisations can oversimplify or bias reasoning (Norman, 1993; Schnotz & Bannert, 2003). Clarifying when visual thinking genuinely extends cognition – and when it misleads – will be key to refining it into a nuanced theory and a transferable skill that supports individual reasoning, collective sensemaking, and the tackling of contemporary wicked problems.

6. CONCLUSIONS

Making things visible is not a cosmetic step but a cognitive strategy. By offloading thought into space, visual thinking extends capacity, reveals structure, and builds shared understanding – preconditions for progress on wicked problems. The workshop pilots illustrated this vividly: when participants externalised their ideas, hesitation often gave way to engagement, and shared canvases enabled connections that verbal discussion alone tended to obscure. These observations align with theories of extended cognition and dual coding, showing how externalisation taps into complementary cognitive systems.

The implications extend beyond the classroom. In collaborative and participatory contexts, visual artifacts serve as boundary objects that align perspectives and foster inclusion, echoing Gustafsson's (2023) emphasis on artifacts in strategy work and Kälviäinen's (2025) findings on co-design. Thus, visual thinking should be recognised not only as an individual aid but also as a social practice that supports joint sensemaking and ownership of outcomes.

In the future, the trajectory is toward scaling. A MOOC course will translate these ideas into a curriculum that combines theoretical grounding with structured exercises for making thinking visible. While the digital environment cannot fully replicate the immediacy of in-person workshops, it offers learners opportunities to practice visual thinking in accessible ways and to reflect on its role in their reasoning.

In sum, visual thinking is both an ancient and a contemporary practice: from tallies and cave paintings to post-its and digital canvases, humans have long externalised thought to extend their minds. What is new is the recognition that this is not peripheral but central to learning, design, and collaboration. The challenge ahead is to cultivate visual thinking more deliberately – as a transferable skill for individuals, as a facilitative practice in groups, and as a method for tackling the wicked problems that define our age.

Ackowledgement

Authors want to thank European Union (Erasmus+ KA220 Higher education) and Finnish National Agency for Education for co-funding the User - Introducing User-driven design and agile development skills in the case of sustainable service housing for elderly project. Thanks belong also to the personnel of sUser project in Austria, Finland, Netherlands and Serbia for a fruitful collaboration and support.

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original research article
UDC 728.1-053.9
728:502.131.1

admission date 03 11 2025
approval date 16 12 2025

VALUE-BASED PROGRAMMING FOR SUSTAINABLE ELDERLY HOUSING: INSIGHTS FROM THE SPASCAPES FRAMEWORK

ABSTRACT

The demographic shift toward aging societies demands innovative methodologies for designing sustainable and user-oriented elderly housing. This Perspective article introduces a value-based programming approach grounded in the spascapes framework, developed through research on spa settlements. Historically, spa settlements combined health, leisure, and community, offering spatial models that resonate with contemporary needs of aging populations. The spascapes framework identifies six interrelated landscape dimensions (hydrothermal, therapeutic, cultural-historical, urban, ecological, and recreational) that together define holistic environments of care and wellbeing. By translating these dimensions into a value-based programming matrix, this article proposes a structured methodology for architectural programming that aligns user values with design decisions. Each dimension is reframed as a core value (e.g., health, wellbeing, belonging, accessibility, sustainability, and social interaction), linked to specific design implications and measurable indicators. This approach not only provides a heuristic tool for developing adaptable, inclusive, and sustainable housing but also bridges heritage-based spatial knowledge with contemporary architectural practice. By integrating spascapes into programming, spa settlements can be reinterpreted as prototypes for sustainable elderly living, offering lessons for future housing policies, community models, and interdisciplinary educational practices.

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KEY WORDS
AGING SOCIETIES
ELDERLY HOUSING
ARCHITECTURAL PROGRAMMING
VALUE-BASED DESIGN SPASCAPES

1. INTRODUCTION

1.1. Aging, Sustainability, and the Need for New Housing Models

The demographic shift towards aging societies represents one of the most profound structural transformations in Europe. According to Eurostat's (2023) *Ageing Europe* report, the proportion of people aged 65 and above will continue to increase substantially, reshaping demands on housing, urban infrastructure, and social services. These dynamics are recognized at the highest policy levels. The European Commission's (2021) *Green Paper on Ageing* frames demographic change as a societal challenge that requires innovative housing solutions, highlighting the need for adaptable dwellings, smart homes, and multi-generational living models to prevent isolation and support independence. Urban policy frameworks further stress the centrality of age-inclusive development. The New Leipzig Charter (European Commission, 2020) calls for transformative urban approaches that ensure the inclusivity of all generations, while the European Innovation Partnership on Active and Healthy Ageing (EIP on AHA, established in 2011) (European Commission, 2015) emphasizes digital and environmental adaptation as critical enablers of sustainable aging. Complementing these, the *Age-friendly Environments in Europe* handbook (WHO & European Commission, 2017) provides detailed domains for policy action - including housing, outdoor environments, and mobility - anchored in universal design and aging-in-place strategies. At the intersection of sustainability and demographic change, the UNECE (2020) Policy Brief on Ageing focuses on sustainable and smart cities, identifying housing, public space, and mobility as core priorities. Legal frameworks such as Article 31 of the European Social Charter (Kenna, 2024) establish the right to adequate housing as a binding obligation, explicitly extending protection to elderly persons. Meanwhile, sectoral reports such as the Housing Europe (2021) Observatory's *Ageing Well at Home* document the practical challenges housing providers face in adapting both dwellings and services to aging populations.

Despite this robust policy landscape, significant gaps persist. Research highlights fragmentation between housing, health, and social care sectors (Houben, 2001) and uneven territorial responses across regions (European Parliament, 2013). Studies of age-friendly cities demonstrate the potential of municipalities as "social laboratories" (Green, 2013), yet also reveal the difficulties of scaling up such initiatives. From the perspective of architecture

and urbanism, a critical gap emerges: while policy documents articulate *what* needs to be achieved, they seldom provide methodological tools for translating values such as health, dignity, and community into concrete spatial and design decisions. The lack of frameworks that systematically connect user values with programming and design outcomes limits the ability to anticipate and shape environments that genuinely support sustainable aging. Addressing this methodological gap is essential for developing housing models that are not only technically adaptable and environmentally sustainable, but also deeply user-oriented and responsive to the lived realities of older populations.

1.2. Paper Outline

Building on the identified policy and research gap - namely, the lack of methodological tools that systematically translate user values into architectural and urban design decisions - this paper introduces *spascapes* as an innovative framework to address the challenges of sustainable elderly housing. Derived from ongoing research on spa settlements (Milovanovic et al, 2025), *spascapes* integrates six interrelated landscape dimensions: hydrothermal, therapeutic, cultural-historical, urban, ecological, and recreational. These dimensions represent not only the environmental and spatial characteristics of spa settlements but also a set of values that can inform future-oriented housing solutions for aging populations. The central aim of this paper is to demonstrate how the *spascapes* framework can be operationalized through value-based architectural programming. By reframing each of the six spascapes dimensions as a core value - health, wellbeing, identity, accessibility, sustainability, and social interaction - this study proposes a programming matrix that connects abstract values with tangible design implications and measurable indicators. In doing so, it offers a heuristic tool that bridges the gap between policy aspirations and design practice, enabling more user-centered, adaptable, and sustainable housing models for the elderly.

The paper is structured as follows. First, it revisits the historical role of spa settlements as spatial laboratories for health and community living. Second, it outlines the conceptual framework of *spascapes* and its six landscape dimensions. Third, it introduces the value-based programming matrix as a methodological contribution, illustrating how values can be translated into design implications for elderly housing. Finally, the paper discusses broader implications for architectural education, participatory design, and policy, positioning spa settlements as prototypes for reimagining sustainable housing futures for aging societies.

2. SPA SETTLEMENTS AS SPATIAL LABORATORIES

Spa settlements represent unique spatial laboratories where the intersections of health, heritage, and community life unfold across multiple scales. Historically developed as destinations for therapy, regeneration, and social interaction, these settlements embody a distinctive profile that combines environmental assets with social and cultural dimensions. In many countries with a socialist legacy, spa settlements continue to function as primary destinations for elderly populations, offering a concentration of health services, affordable accommodation, and familiar social environments. This demographic profile reinforces their role as living observatories, where the everyday practices and spatial needs of older citizens are not abstracted but visibly enacted in the urban fabric. At the same time, spa settlements constitute critical eco-social environments. They integrate natural resources (thermal and mineral waters, forests, landscapes) with built infrastructure and public space typologies, producing spatial patterns where therapeutic, cultural, and social functions converge. As such, they form observatory frameworks for understanding how ecological sensitivity, social care, and community-based living can be spatially mediated. This dual nature, (1) as elderly-oriented environments and (2) as eco-social contexts, positions spa settlements as critical laboratories for decoding the values that can be anticipated in architectural and urban design processes for sustainable housing futures.

The research literature underscores this multidimensional role. Studies on adaptive reuse and sustainable urban development highlight the innovative potential of European historic spa towns, particularly in addressing abandoned infrastructures and promoting place-based strategies (Fabi, Vettori, & Faroldi, 2021). From an economic perspective, spa destinations have been evaluated for their competitiveness and resilience, with studies emphasizing their capacity to adapt to crises and regional disparities (Bakucz, Pótó, & Köbli, 2016). Equally important are the social and cultural dimensions. Research in Hungary has linked spa towns to quality-of-life indicators, community well-being, and service provision for residents (Michalkó et al, 2021), while the HERA project on *The European Spa as a Transnational Public Space* (2019–2022) has framed spas as metaphors of mobility, exchange, and European integration. Geographic studies of therapeutic landscapes (Foley, Wheeler & Kearns, 2011) further reinforce the notion that spa environments carry contested but powerful meanings of health and place. Planning-oriented research illustrates how geological constraints, land use patterns, and development control mechanisms shape the evolution of spa towns (Gocmez et al, 2006; Papageorgiou & Beriatos, 2011). Finally, case studies such as Mórahalom in Hungary reveal the dynamic

potential of spa settlements as drivers of regional development and socio-economic transformation (Martyn, 2015). Taken together, these contributions demonstrate that spa settlements are more than tourist destinations or heritage landscapes: they are observatory environments where spatial, ecological, and social values converge. This makes them particularly valuable for architectural and urban research that seeks to derive principles for sustainable, elderly-oriented housing. By decoding their urban patterns and lived practices, spa settlements can serve as critical reference frameworks for developing value-based methodologies in architectural programming.

3. METHODS AND MATERIALS

This Perspective article builds upon a dual foundation. On one hand, it draws from the experiential framework of doctoral dissertation that investigates the role of architectural programming methodology in shaping spatial morphology (Milovanovic, 2022). On the other, it incorporates insights from broader research project SPATTERN dedicated to decoding urban patterns in spa settlements through the lens of *spascapes* as environmentally sensitive spatial constructs (Milovanovic et al, 2025). Together, these two strands enable the article to advance a conceptual framework that links theoretical, methodological, and applied perspectives, highlighting how programming and pattern-based analysis can jointly inform sustainable and user-oriented housing models for aging populations.

3.1. Value-based Programming Framework

Value-based programming in architecture represents a methodological shift from traditional problem-definition approaches towards frameworks that explicitly anchor design decisions in articulated values and their measurable indicators. While architectural programming historically emerged as a process of systematically defining needs and translating them into spatial requirements (Pena & Fock, 1969; Preiser, 1978; Sanoff, 1977), value-based programming emphasizes the prioritization of values as the primary drivers of design outcomes. This shift reflects broader debates in design theory concerning the handling of “wicked problems” in planning and architecture (Rittel & Weber, 1973), where complex societal needs cannot be addressed solely through technical specifications, but demand iterative frameworks that reconcile diverse stakeholder perspectives.

In this framework, values are not treated as abstract ideals but are systematically operationalized through the formulation of indicators. Indicators function as mediators between the conceptual and the tangible: they provide measurable or observable criteria through which values can be embedded in the design process (Preiser, 1983; Robinson & Weeks, 1983). For instance, a value such as "social wellbeing" may be linked to indicators concerning accessibility of communal facilities, frequency of social interactions, or the adaptability of shared spaces. This relational construction in-between value and indicator enables architectural programming to move beyond prescriptive checklists toward reflexive, participatory, and evidence-based design methods (Schön, 1984; Salama, 2017). Accordingly, the outcome is not a fixed set of requirements, but a dynamic and negotiable framework in which values guide design objectives and indicators provide the means to evaluate and iterate them. Such an approach reinforces the adaptability of the design process while ensuring that spatial morphology reflects user-centered and socio-ecologically grounded priorities (Ristić Trajković, Milovanović, & Nikezić, 2021).

3.2. Spascapes Dimensions

The six interrelated landscape dimensions that constitute the *spascapes* framework were derived from the SPATTERN project Compendium Development (Milovanović et al, 2025), where spa settlements were systematically examined through the lens of three overarching dimensions of urbanization: material transformation, territorial regulation, and everyday life. Each of these dimensions was further articulated through six thematic clusters that together captured the complexity of spa settlement development. It was through this multifaceted analytical process that the six *spascapes* dimensions - hydrothermal, therapeutic, cultural-historical, urban, ecological, and recreational - were identified. In the construct of *spascapes*, these dimensions now serve as the conceptual backbone for decoding values that can subsequently be operationalized within architectural programming and design processes. The concept of *spascapes* thus provides an integrative spatial framework composed of six interrelated landscape dimensions: hydrothermal, therapeutic, cultural-historical, urban, ecological, and recreational. Each of these layers functions as a distinct entity with specific spatial, functional, and symbolic qualities, while simultaneously intersecting with the others to form a multilayered palimpsest of landscape and settlement organization.

Methodologically, these dimensions are not treated as isolated categories but as broader matrices of values that articulate the different aspects of spa environments. They encompass natural foundations (hydrothermal resources,

ecosystems), cultural-historical layers (heritage, traditions), urban structures (built fabric, infrastructures), and socio-experiential components (therapeutic practices, recreational patterns). Their analytical strength lies in enabling the readability of values in space - both tangible and intangible - which can later be operationalized through indicators. In this respect, the spascapes dimensions can be understood as ontological value fields: they define the underlying logics of spa settlement organization while offering a conceptual framework for anticipating values relevant to design and planning. This provides a methodological foundation for extracting and systematizing values that will subsequently be linked to indicators in the results and discussion phases.

3.3. Intertwining Value-based Programming Framework with Spascapes Dimensions

The next methodological step lies in intertwining the Value-Based Programming Framework (Milovanović, 2022) with the six dimensions of spascapes (Milovanović et al, 2025). Within this research framework, the spascapes dimensions function as spatial carriers of values. Each of the six dimensions corresponds to a specific set of value categories - for example, (1) hydrothermal landscapes encapsulate values of natural resource use and atmospheric quality, (2) cultural-historical landscapes articulate values of identity and continuity, while (3) urban landscapes embody values of functional organization and accessibility. Through the lens of value-based programming, these values are systematically positioned within a matrix that structures their relationship to future indicators. This methodological intertwining establishes an interdisciplinary bridge between architectural programming and morphological-landscape analysis of spa settlements. The integration works in two directions: (1) on the one hand, values are grounded in specific landscape dimensions, while on the other, (2) the spascapes dimensions acquire an enhanced analytical capacity by being translatable into operational design parameters. Ultimately, this methodological integration generates a platform for developing value–indicator matrices as tools for design and planning, enabling the translation of complex spatial and ecological layers into actionable frameworks for sustainable and user-oriented elderly housing.

3.4. Research Protocol

As a research protocol, the methodological integration was carried out in several steps. In the first step, a clear correspondence was established between the values to be embedded within the programming matrix and the six landscape dimensions of the *spascapes* construct, which serve as the foundational categories. In the second step, the Compendium of Spa

Settlements was systematically examined, focusing on twelve identified role models of *spascapes* in Serbia. Through this analytical reading, two key outputs were generated: (1) design implications for elderly housing were derived, highlighting spatial qualities, organizational patterns, and environmental conditions relevant to sustainable and user-oriented living for aging populations, and (2) a set of possible indicators was identified, capturing measurable or observable aspects that could operationalize these design implications. At the intersection of design implications and possible indicators, a core value was defined for each *spascapes* dimension. These core values provide the conceptual focus that allows for the formulation of design principles, effectively bridging the descriptive analysis of spa settlements with the prescriptive logic of architectural programming.

4. RESULTS AND DISCUSSION

4.1. Matrix Constitution

The construction of the matrix is not a technical exercise of aligning dimensions with values, but rather a methodological act of translating spatial insights into design-oriented knowledge. It emerges from the Compendium Development of the SPATTERN project, where spa settlements were systematically examined through the lenses of material transformation, territorial regulation, and everyday life. These three interpretative frames provided the analytical depth for identifying how spa environments embody multiple layers of meaning and practice, which could subsequently be consolidated into the six *spascapes* dimensions (Table 1).

Within this framework, each dimension operates as a design lens through which values are revealed and translated into implications for elderly housing. For instance, the hydrothermal dimension - grounded in the material transformation of water infrastructures and climatic modulation - articulates the value of *health and regeneration*. Its design implications extend toward the integration of wellness facilities, therapeutic water, and climatic comfort, emphasizing the entanglement of material systems and human wellbeing. Similarly, the therapeutic dimension reflects everyday practices of care and embodied recovery, producing the value of *wellbeing*. Here, the implications stress multisensory environments, restorative gardens, daylight, and acoustic qualities as architectural mediators of health.

Spascape dimension	Core value	Design implication for elderly housing	Possible indicators
Hydrothermal	Health and Regeneration	Integrating wellness facilities	Number of wellness/therapy units, accessibility of facilities
		Therapeutic water integration	Proximity to springs/baths, water-based therapy availability
		Climate comfort	Indoor temperature/humidity balance, energy use for regulation
Therapeutic	Wellbeing	Multisensory environments	Comfort surveys, noise/light level monitoring
		Gardens and restorative outdoor spaces	Area of therapeutic gardens per resident, frequency of use
		Daylight access	Average daylight factor in dwellings, resident satisfaction
		Acoustic comfort	Acoustic measurements, user feedback on sound levels
Cultural-historical	Identity and Belonging	Adaptive reuse of historic structures	Share of reused heritage buildings, conservation compliance
		Heritage integration in new housing	Presence of heritage motifs/ materials in design
		Storytelling and memory spaces	Number of communal memory rooms/events, resident attachment surveys
Urban	Accessibility and Safety	Walkable access to services	Walkability index, average service distance
		Public transport connectivity	Distance to stops, service frequency
		Integrated services (health, retail, care)	Number of services within 500m, service diversity index
		Safety in public space	Crime statistics, perceived safety surveys
Ecological	Sustainability	Energy efficiency	Building energy performance ratings, renewable energy share
		Green-blue infrastructure integration	Green space per capita, stormwater retention capacity
		Biodiversity-friendly design	Species count, ecological quality indices
Recreational	Social Interaction	Shared communal spaces	Number of shared rooms, occupancy rates
		Intergenerational facilities	Programs/facilities shared across age groups, participation frequency
		Co-housing arrangements	Percentage of units in co-housing clusters, resident satisfaction
		Outdoor leisure infrastructure	Availability of walking loops, benches, usage rates

TABLE 1. Core Values and Design Implications of Spascapes Dimensions in Relation to Elderly Housing

The cultural-historical dimension, informed by territorial regulation and the long durée of heritage continuity, foregrounds the value of *identity and belonging*. Its implications point to adaptive reuse, heritage-sensitive integration, and storytelling spaces that allow design to embed memory and cultural reference. The urban dimension operates at the interface of territorial regulation and everyday urban life, generating the value of *accessibility and safety*. This translates into implications related to walkability, public transport provision, and the integration of essential services within spatial proximity.

The ecological dimension draws on material transformation and environmental regulation, articulating *sustainability* as its core value. Its design implications stress energy efficiency, green-blue infrastructure, and biodiversity-sensitive solutions that align housing for the elderly with broader ecological commitments. Finally, the recreational dimension, grounded in everyday life, emphasizes *social interaction* as a key value. Its implications include shared and intergenerational spaces, co-housing arrangements, and outdoor leisure infrastructures that support participation and active living.

By aligning the *spascapes* dimensions with the triadic framework of material transformation, territorial regulation, and everyday life, the matrix establishes a relational structure that bridges analytical categories with design perspectives. It demonstrates how the morphological and ecological realities of spa settlements can be reframed into programmatic logics that guide architectural decision-making. In this sense, the matrix is not only a representational tool, but also a heuristic device: it frames design as a process of value translation, in which spatial observations are systematically re-articulated into principles for sustainable and user-oriented housing for aging populations.

4.2. Matrix Elaboration

The following discussion provides an elaboration of the six identified *core values* that structure the programming matrix. The elaboration is intentionally two-fold. First, each subsection rearticulates the value as derived from the *spascapes* framework, connecting it to the design implications and possible indicators generated through the analysis of spa settlements as spatial laboratories. Second, each subsection extends beyond the spa framework, considering how the same values and indicators may be applied to elderly housing more generally. This two-tiered approach ensures that the matrix is not confined to the specificity of spa settlements but also demonstrates its relevance and transferability across broader architectural and urban design practices for elderly housing.

4.2.1. Natural Therapeutic Resource and Environmental Atmosphere

The hydrothermal dimension, rearticulated as the value of *health and regeneration*, emphasizes the role of natural therapeutic resources and climatic atmospheres as design drivers. In the context of elderly housing, this translates into design implications that prioritize the integration of wellness facilities, the accessibility of therapeutic water, and the modulation of climatic comfort. Possible indicators include the distance of dwellings to hydrothermal nodes, the

presence of water-related features in communal areas, and the quality of indoor thermal regulation. For architectural programming, this means embedding health-supportive infrastructures within everyday living environments, ensuring that the therapeutic logics of spa settlements are transposed into housing schemes.

More broadly, the value of *health and regeneration* can inform elderly housing design irrespective of proximity to hydrothermal resources. Here, indicators can extend toward the integration of indoor wellness technologies (Koch, 2001), natural ventilation systems (Liu et al, 2024; Serrano-Jiménez et al, 2020), or biophilic elements (Lee & Park, 2025; Elsafty, 2024) that simulate regenerative atmospheres. Such an approach allows architects to embed health-oriented design principles in diverse urban or rural contexts, where water-based therapies are not available but the ambition for climate-sensitive, restorative environments remains equally relevant.

4.2.2. Care, Recovery, and Embodied Healing Practices

The therapeutic dimension, articulated as *wellbeing*, derives from the everyday practices of care and embodied recovery that define spa settlements. For elderly housing, design implications focus on multisensory environments, therapeutic gardens, daylight provision, and acoustic comfort. Indicators include comfort surveys, daylight factors, and noise-level assessments. Through these, housing projects can operationalize wellbeing by creating restorative ambiences that extend care practices beyond healthcare facilities and into the daily lives of residents.

Beyond spa settlements, the value of *wellbeing* can guide elderly housing design through universal strategies such as age-sensitive ergonomics (Paiva, Ferrer & Villarouco, 2015; Villarouco et al, 2016), adaptable interior layouts (Pelsmakers & Warwick, 2022; Zhang et al, 2019), or neighborhood-level amenities supporting physical and mental health (Rosso et al, 2013). Indicators can include flexibility of room configurations (Magdziak, 2019), access to green micro-spaces (Ali, Rahaman & Hossain, 2022; Artmann et al, 2017), and promotion of a psychological sense of community (Zaff & Devlin, 1998). This widens the applicability of therapeutic design logics, positioning elderly housing as an everyday infrastructure of care rather than a specialized typology.

4.2.3. Identity, Memory, and Heritage Continuity

The cultural-historical dimension underpins the value of *identity and belonging*. Elderly housing, when informed by this value, must engage with memory, heritage continuity, and cultural storytelling. Design implications include adaptive reuse of heritage structures, integration of cultural motifs into new housing, and the provision of storytelling or memory spaces. Indicators include the share of heritage-sensitive interventions, presence of cultural programs, and resident surveys on place attachment.

Applied more generally, the value of *identity and belonging* may extend beyond historic environments to include design strategies that foster community identity (Zaff & Devlin, 1998) in contemporary contexts. Indicators can range from the integration of public art and community spaces to the co-creation of housing layouts with residents (Terkelsen et al, 2022). These strategies ensure that elderly housing fosters a sense of rootedness and belonging, even in newly built environments without direct heritage references.

4.2.4. Functional Integration and Accessibility

The urban dimension translates into the value of *accessibility and safety*, recognizing the importance of functional integration within broader urban systems. For elderly housing, implications include walkable access to everyday services, connectivity to public transport, and the integration of health, retail, and care facilities within proximate reach. Indicators range from walkability scores to service radius measures and perceived safety surveys.

More broadly, *accessibility and safety* become fundamental criteria for any elderly housing project, regardless of location. Indicators may extend to digital accessibility (Ellison-Barnes et al, 2021), integration of smart mobility services (Jachan et al, 2021), or new neighborhood planning strategies that promote mixed-use accessibility (Park, Lee & Kim, 2013). The emphasis shifts from embedding housing into existing spa-centered urban cores to creating universally accessible environments that empower elderly populations to remain active and independent.

4.2.5. Environmental Resilience and Sustainability

The ecological dimension is articulated as the value of *sustainability*, where environmental resilience becomes a central criterion for housing design. Elderly housing informed by this dimension must address energy efficiency, green-blue infrastructures, and biodiversity-sensitive strategies.

Indicators include energy performance ratings, proportion of renewable energy integration, and biodiversity indexes. Outside spa settlements, sustainability-oriented elderly housing can operationalize resilience by incorporating passive design strategies, circular material use, and localized food or energy production. Indicators may include lifecycle carbon assessments, material reuse ratios, and energy self-sufficiency levels. In this way, the ecological dimension reframes elderly housing not only as environmentally adaptive but also as an active contributor to sustainable urban and regional systems.

4.2.6. Everyday Leisure and Active Wellbeing

The recreational dimension produces the value of *social interaction*, focusing on everyday leisure and active wellbeing as indispensable to elderly life. Design implications highlight shared communal spaces, intergenerational facilities, co-housing arrangements, and outdoor leisure infrastructures. Indicators include participation rates, community activity frequency, and occupancy rates of shared amenities.

Applied more generally, the value of *social interaction* can inspire diverse housing models that embed everyday leisure in contexts ranging from dense cities to rural peripheries. Indicators might extend to digital participation platforms, neighborhood-level cultural programming, or flexible interior spaces adaptable to both solitary and collective activities. In this way, elderly housing can transcend its basic residential function to become a socially performative infrastructure fostering interaction, exchange, and active living.

4.3. Dual Layered Application of Core Values

The discussion developed in Section 4.2 has demonstrated that the six identified *core values* can be read and operationalized in two distinct yet complementary ways. On the one hand, they are grounded in the analytical framework of spa settlements and the *spascapes* construct, where values emerge from the interplay of material transformation, territorial regulation, and everyday life. On the other hand, their design implications extend beyond this framework, offering generalizable insights for elderly housing typologies in diverse urban and territorial contexts.

To capture this duality, the following table presents a two-layered synthesis: for each core value, design implications and indicators are shown first in relation to *spascapes*, and then reinterpreted for broader application across elderly housing practices.

This comparative structure highlights both the situated specificity of spa settlements as spatial laboratories and the transferable potential of values and indicators across different design settings (Table 2).

Core Value	Within the Spascapes framework	Beyond the Spascapes framework
Natural Therapeutic Resource and Environmental Atmosphere	Hydrothermal dimension linked to *health & regeneration*; design implications: integration of wellness facilities, accessibility to therapeutic water, climate comfort; indicators: distance to hydrothermal nodes, indoor thermal regulation, water-based communal features	Health-oriented design even without hydrothermal resources; integration of indoor wellness technologies, biophilic elements, natural ventilation; indicators: air quality, presence of restorative spaces, resident health satisfaction
Care, Recovery, and Embodied Healing Practices	Therapeutic dimension rearticulated as *wellbeing*; design implications: multisensory environments, gardens, daylight, acoustic quality; indicators: comfort surveys, daylight factor, noise assessment	Wellbeing operationalized through adaptable layouts, age-sensitive ergonomics, neighborhood-level care hubs; indicators: flexibility of rooms, access to micro-green spaces, availability of community health services
Identity, Memory, and Heritage Continuity	Cultural-historical dimension reframed as *identity & belonging*; design implications: adaptive reuse, heritage-sensitive integration, storytelling and memory spaces; indicators: share of heritage-sensitive interventions, cultural programs, place-attachment surveys	Applied to new environments through co-created housing designs, public art, cultural programming; indicators: community participation rates, perceived cultural recognition, social cohesion indices
Functional Integration and Accessibility	Urban dimension articulated as *accessibility & safety*; design implications: walkability, public transport, integrated services; indicators: walkability scores, service radius, safety surveys	Universal application in all housing contexts; design implications: digital accessibility, smart mobility, mixed-use neighborhood planning; indicators: accessibility audits, ICT integration, multimodal service availability
Environmental Resilience and Sustainability	Ecological dimension reframed as *sustainability*; design implications: energy efficiency, green-blue infrastructures, biodiversity-sensitive design; indicators: energy performance ratings, share of renewables, biodiversity indexes	Extended to broader ecological strategies: passive design, circular material use, localized energy/food systems; indicators: lifecycle carbon assessment, material reuse ratios, self-sufficiency levels
Everyday Leisure and Active Wellbeing	Recreational dimension reframed as *social interaction*; design implications: shared communal spaces, intergenerational facilities, co-housing, outdoor leisure infrastructures; indicators: participation rates, community activity frequency, shared space occupancy	Broadened to diverse contexts: digital participation, flexible interiors, neighborhood-level leisure/cultural programs; indicators: digital engagement rates, adaptability of spaces, frequency of cultural events

TABLE 2. Dual-Layered Matrix of Core Values: Spascapes Framework vs. Broader Elderly Housing Applications

5. CONCLUDING REMARKS

This study has shown that spa settlements, when reframed through the spascapes framework, provide a powerful reference for designing sustainable and user-oriented elderly housing. By translating six interrelated landscape dimensions into a value-based programming matrix, the research demonstrates how abstract notions such as health, wellbeing, belonging, accessibility, sustainability, and social interaction can be systematically connected to design implications and measurable indicators. The essential interpretation is that elderly housing cannot be approached solely through technical or demographic adjustments, but requires a methodological reorientation where values explicitly guide architectural programming and spatial decisions. Placed within the broader landscape of European policy frameworks and scholarly debates, this study both confirms and extends existing knowledge. It aligns with EU and WHO calls for age-friendly, inclusive, and adaptable environments, yet it goes further by operationalizing these aspirations into a systematic design tool. The strength of this approach lies in its twofold articulation: (1) first, through the situated lens of spa settlements as spatial laboratories, and (2) second, through its broader applicability to diverse elderly housing contexts. While the framework's reliance on case-specific knowledge from spa environments may be seen as a limitation, it also acts as a testing ground that exposes values otherwise overlooked in conventional housing research. Unexpectedly, this dual reading of spa settlements not only reveals design strategies for elderly housing but also reshapes how heritage, ecology, and community can be integrated into architectural programming. In summary, this article advances a value-based programming methodology that positions spascapes as a conceptual and practical bridge between heritage-informed environments and future-oriented housing models. Its significance lies in demonstrating how architectural programming can become a dynamic process of value translation, enabling sustainable, adaptable, and dignified housing for aging populations. Moving forward, further research should test and refine the proposed matrix across different urban and rural contexts, exploring how indicators perform under varying cultural, economic, and ecological conditions.

Funding

This research was supported by the Science Fund of the Republic of Serbia, Grant No. 7408, Future Heritage of Spa Settlements: Digital Platform for Advancing Knowledge and Innovation in Urban Morphology Approach for Environmentally-Sensitive Development in Serbia—SPATTERN (https://spattern.org/).

Conflicts of Interest

The Science Fund of the Republic of Serbia had no role in the design of the study, in the collection, analyses, or interpretation of data, in the writing of the manuscript, as well as in the decision to publish the results.

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ABSTRACTS: SERBIAN

SNALAŽENJE U SLOŽENOSTI U PROJEKTANTSKOM OBRAZOVANJU: HOLISTIČKI PEDAGOŠKI PRISTUP UZ DESIGN CHALLENGE NAVIGATOR

Markus Kretschmer, Kristiana Roth

Savremeno projektantsko obrazovanje suočava se sa izazovom osposobljavanja stručnjaka da se snalaze u sve složenijim inovacionim problemima. Iako su dizajnersko razmišljanje, sistemsko razmišljanje i agilne metodologije utemeljene u obrazovanju, one se retko sistematski kombinuju kako bi se na koherentan način odgovorilo na socio-tehnološke izazove. Kako bi se ovaj jaz prevazišao, u radu se predstavlja Design Challenge Navigator (DCN), obrazovni alat osmišljen da pomogne studentima u kritičkom sagledavanju složenosti, strukturiranju svog procesa projektovanja i razvijanju kompetencije za održive intervencije orijentisane ka korisniku. DCN je utemeljen na holističkom pedagoškom pristupu i podržava buduće projektante u integrisanju iterativnog razvoja, učešća zainteresovanih aktera i sistemske svesti. Kako bi se ispitala njegova relevantnost i prenosivost, prikupljeni su uvidi mentora i edukatora koji primenjuju DCN u različitim obrazovnim okruženjima. Analizom njihovih perspektiva, ovo istraživanje doprinosi arhitektonskom obrazovanju, ukazujući na to kako integrisani alati zasnovani na praksi mogu unaprediti interdisciplinarno učenje i pripremiti buduće profesionalce za složene, održivo orijentisane inovacione izazove.

KLJUČNE REČI: EDUKACIJA U OBLASTI DIZAJNA, DIZAJNERSKO RAZMIŠLJANJE, SISTEMSKO RAZMIŠLJANJE, NASTAVNI MATERIJALI.

EVALUACIJA DESIGN CHALLENGE NAVIGATORA U OBRAZOVANJU U OBLASTI IZGRAĐENE SREDINE

Fenna Rooijakkers, Daniel Gotthardt

Kao odgovor na rastuću složenost izazova u oblasti izgrađene sredine, ovo istraživanje razmatra Design Challenge Navigator (DCN), edukativni alat za projektovanje u formi društvene igre, razvijen s ciljem unapređenja budućih kompetencija studenata u visokom obrazovanju i njihove sposobnosti da se suoče sa punim spektrom savremenih izazova. Razvijen u okviru ERASMUS+ projekta sUser, DCN povezuje konvencionalno dizajnersko razmišljanje sa sistemskim pristupom i strukturiranim metodologijama primenljivim na različitim nivoima složenosti. Primenom kombinovanog metodološkog pristupa, DCN je testiran u tri obrazovna konteksta na Univerzitetu primenjenih nauka Avans u Holandiji, uz učešće studenata građevinskog inženjerstva, saobraćajnog inženjerstva i prostornog razvoja. Rezultati ukazuju na to da DCN podstiče studente na istraživanje novih metoda, pomaže im da strukturiraju i razumeju sopstveni proces rada i motiviše ih da usvoje izraženije korisnički orijentisan pristup. Istovremeno, istraživanje ukazuje na značaj mentorsko-nastavne podrške, s obzirom na to da metodologija može biti složena za razumevanje, kao i na važnost rane integracije DCN-a u nastavni plan i program kako bi se obezbedila njegova efikasnost. Iako nalazi sugerišu da DCN predstavlja obećavajući alat u obrazovnom kontekstu, neophodna su dalja istraživanja radi potvrde njegove delotvornosti na većem uzorku studenata i kroz različite tipove projektnih zadataka.

KLJUČNE REČI: KOMPETENCIJE BUDUĆNOSTI, DIZAJNERSKI IZAZOVI, KOMPLEKSNOST, IZGRAĐENA SREDINA, NASTAVNI MATERIJAL, VISOKO OBRAZOVANJE.

ISTRAŽIVANJE SKRIVENE SNAGE VIZUELNOG MIŠLJENJA: RAZVOJ RADIONICE ZA STUDENTE

Petri Suni, Katariina Mäenpää

Stanovanje za starije osobe postalo je hitno pitanje na kojem se susreću izazovi starenja populacije i održivog razvoja. Ovi izazovi mogu se prevazići integrisanjem ekoloških, društvenih, ekonomskih i kulturnih perspektiva u korisnički orijentisano projektovanje. Takva interdisciplinarna okruženja ističu tzv. „wicked problems": složene, promenljive probleme koji odolevaju jednostavnim rešenjima. Kognitivna ograničenja, uključujući ograničenu radnu memoriju i teškoće u sagledavanju skrivenih relacija, dodatno komplikuju proces razumevanja. U ovom članku predstavljamo razvoj radionice u okviru projekta sUser – Introducing User-driven Design and Agile Development Skills in the Case of Sustainable Service Housing for Elderly, koja istražuje potencijal vizuelnog mišljenja u praksi. Vizuelno mišljenje koristi skice i dijagrame kako bi rasteretilo kognitivne zahteve, otkrilo obrasce i izgradilo zajedničko razumevanje. U radionici je naglašeno da je vizuelno mišljenje prirodna ljudska sposobnost, nezavisna od veštine crtanja, i demonstrira jednostavne metode za strukturiranje složenosti i podsticanje saradnje. Rezultati ukazuju na to da je vizuelno mišljenje svestrana kognitivna strategija, korisna ne samo u interdisciplinarnom projektovanju održivog stanovanja za starije osobe, već je upotrebljivost ovog alata vidljiva u različitim oblastima.

KLJUČNE REČI: VIZUELNO RAZMIŠLJANJE, KOGNITIVNO RASTEREĆENJE, REŠAVANJE SLOŽENIH PROBLEMA, ZAJEDNIČKO RAZUMEVANJE.

PROGRAMIRANJE ZASNOVANO NA VREDNOSTIMA ZA ODRŽIVO STANOVANJE ZA STARIJE OSOBE: UVIDI U OKVIR SPASCAPES

Aleksandra Milovanović

Demografske promene koje vode ka starenju društava zahtevaju inovativne metodologije za projektovanje održivog i korisnički orijentisanog stanovanja za starije osobe. Ovaj članak perspektive predstavlja pristup programiranju zasnovanom na vrednostima, utemeljen na okviru Spascapes, razvijen kroz istraživanje banjskih naselja. Kroz istoriju banjska naselja su predstavljala prostore za zdravlje, razonodu i zajednicu, nudeći prostorne modele koji odgovaraju na savremene potrebe u vezi sa starenjem populacije. Okvir Spascapes identifikuje šest međusobno povezanih dimenzija pejzaža (hidrotermalna, terapijska, kulturno-istorijska, urbana, ekološka i rekreativna) koje zajedno definišu holistička okruženja brige i dobrobiti. Prevođenjem ovih dimenzija u matricu programiranja zasnovanu na vrednostima, članak predlaže strukturiranu metodologiju arhitektonskog programiranja koja usklađuje vrednosti korisnika sa projektantskim odlukama. Svaka dimenzija je reinterpretirana kao osnovna vrednost (npr. zdravlje, dobrobit, pripadnost, pristupačnost, održivost i društvena interakcija), povezana sa specifičnim implikacijama za projektovanje i merljivim indikatorima. Ovaj pristup ne služi samo kao heuristički alat za razvoj prilagodljivog, inkluzivnog i održivog stanovanja, već i povezuje prostorno znanje zasnovano na nasleđu sa savremenom arhitektonskom praksom. Integracijom Spascapes okvira u programiranje, banjska naselja mogu se reinterpretirati kao prototipi održivog stanovanja za starije osobe, nudeći smernice za buduće stambene politike, modele zajednice i interdisciplinarne obrazovne prakse.

KLJUČNE REČI: DRUŠTVA KOJA STARE, STANOVANJE ZA STARIJE OSOBE, ARHITEKTONSKO PROGRAMIRANJE, PROJEKTOVANJE ZASNOVANO NA VREDNOSTIMA, SPASCAPES

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SAJ : Serbian architectural journal / editor-in-chief Vladan Đokić. - Vol. 1, no. 1 (2009)- . - Belgrade : University of Belgrade, Faculty of Architecture, 2009- (Belgrade : Copy World bsk). - 27 cm

Tri puta godišnje. - Drugo izdanje na drugom medijumu: SAJ. Serbian architectural journal (Online) = ISSN 2787-1908
ISSN 1821-3952 = SAJ. Serbian architectural journal
COBISS.SR-ID 172308748

ISSN 1821-3952