Architectural skills through design thinking: designing elderly housing with universal and human-centred design principles

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ABSTRACT: Architectural education must evolve to prepare students for the complex challenges of contemporary design. This study explores the integration of design thinking (DT) into architectural education, focusing on fostering key skills. The research examines the application of DT in the Design Study: Housing Architecture for the Elderly course, which has been conducted from 2015 to the present in the Faculty of Architecture at Wrocław University of Science and Technology (FA-WUST), Poland. This course is designed for second-degree (Master's level) students who have already obtained an engineer architect degree and are expanding their knowledge in designing for the elderly, incorporating principles of universal design and human-centred design. The study employed an observation protocol to track students' key behaviours throughout the design process, focusing on metrics, such as empathy toward users, creativity, adaptability to complex challenges, critical thinking and collaboration. The research encompasses observations from three semesters of the course, providing an analysis of the development of these skills.

Keywords: Design thinking, architectural education, user-centred design, aging populations

INTRODUCTION

The digital revolution, combined with the challenges of climate crisis, economic shifts and social issues, has profoundly impacted the architectural profession. The dynamic changes in everyday life, the effects of human activity on the natural environment and the resulting social transformations demand a multidisciplinary approach from architects.

Consequently, contemporary labour market presents numerous challenges for young architects. Architectural education must be structured to help young professionals meet these challenges through preparation for design across all scales - from city and neighbourhood planning (macro-scale), to buildings and development complexes (meso-scale), to interiors, objects and details (micro-scale). At the same time, education should foster creative competencies within the engineering environment while enriching knowledge with humanistic content, including historical and social considerations.

As architecture is considered a profession of public trust, architects must develop a deep sense of responsibility for the impact of their designs, alongside sensitivity to the surrounding environment and empathy toward future users. The education of architects is a constant topic of discussion among academics and practitioners, underscoring its significance and the ongoing need to develop new solutions. This importance is further emphasised by both these discussions and the evolving regulations that govern the education process in architecture schools in Poland.

In response to these challenges, design thinking (DT) has emerged as a methodology that effectively addresses the complex problems architects encounter. DT provides a structured yet adaptable framework that promotes empathy, fosters creativity and encourages iterative problem solving. By integrating DT into the architectural education process, future architects are equipped with the tools necessary to tackle design problems in ways that are innovative and responsive to the needs of society.

THE AIM OF THE STUDY AND METHODOLOGY

The aim of this study is to evaluate the practical benefits of the design thinking method in enhancing students' design skills, specifically within the context of designing for the elderly.

The research explores how DT principles can be integrated into architectural education by investigating the Design Study: Housing Architecture for the Elderly course, conducted from 2015 to the present, with analyses focusing on

student work over three semesters. An observation protocol was developed to track students' key behaviours throughout the design process. The primary metrics evaluated include students' empathy toward users, creativity in design solutions, adaptability to complex challenges, critical thinking and collaboration. Observations were conducted at key design stages. Notes taken by tutors documented student interactions, group dynamics and individual contributions. Additionally, student project materials, such as sketches, prototypes and brainstorming notes, were collected. These materials were reviewed to identify patterns and themes in skill development over the course of the study. Finally, triangulation was applied by combining insights from observations, documentation and final projects, providing an assessment of problem-solving and teamwork skill development in students participating in the course (Figure 1).

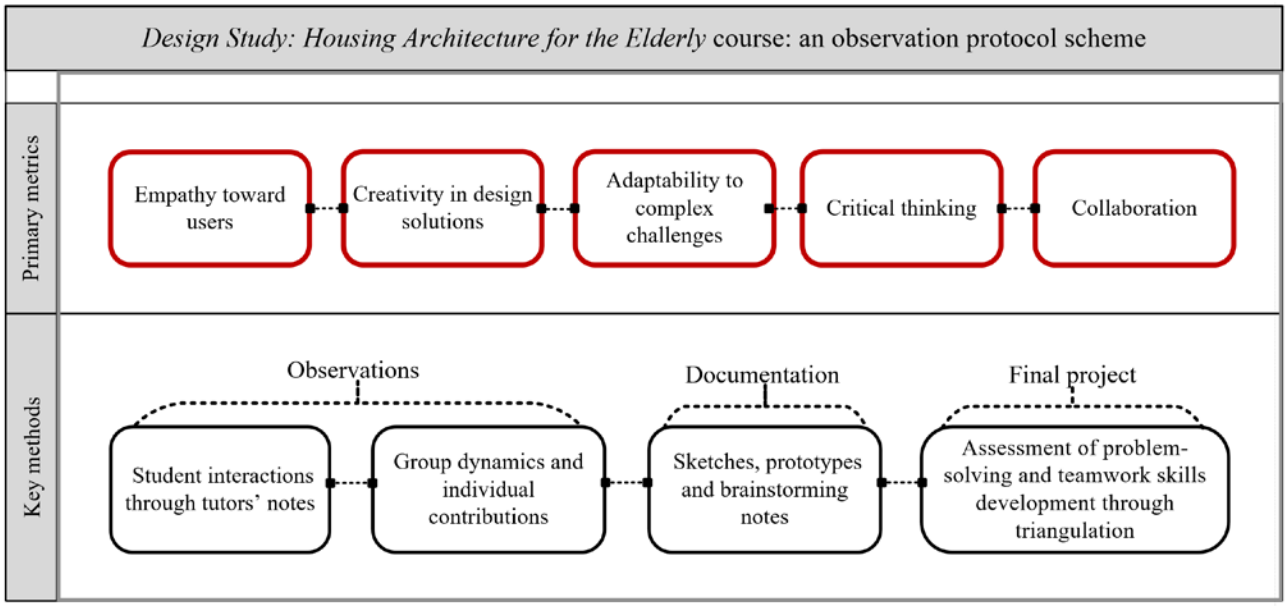

Figure 1: An observation protocol scheme for the *Design Study: Housing Architecture for the Elderly* course.

THE STATE OF THE RESEARCH AND THE RESEARCH GAP

Design thinking has become an increasingly prominent methodology in engineering education in various contexts. Kamrowska-Załuska and Parteka explored the role of DT in the education of future architects, emphasising its ability to integrate design and planning processes through iterative cycles that allow students to address complex issues in urban and spatial planning [1]. Similarly, Lüley highlights the importance of non-linear design thinking in architectural education, noting its adaptability to dynamic design challenges and its focus on sustainability and user needs [2]. Interdisciplinary approaches to DT have also been explored, with Turlíková et al presenting a case study that demonstrates how DT fosters collaboration between business and design students to address future societal challenges [3].

Pusca and Northwood further emphasise the versatility of DT, showing its application across various fields of engineering to enhance critical and creative thinking, making it a powerful tool for solving open-ended problems [4]. Furthermore, the integration of DT into environmental engineering education has been illustrated by Léger et al who demonstrated its effectiveness in addressing local environmental challenges [5]. In the realm of on-line education, Phunaploy et al developed an on-line DT-based instructional model, aimed at promoting creative skills development in digital learning environments [6].

However, despite the growing body of research on the application of DT in various educational contexts, there exists a gap in studies that explore how DT can address social challenges in architectural design. Specifically, limited research has been conducted on how DT can be used to develop design solutions for vulnerable populations, such as the elderly. This study seeks to bridge this gap by integrating DT into hands-on architectural education, fostering a deeper understanding of social responsibility within the design process.

DESIGN THINKING AND HUMAN-CENTERED DESIGN

The traditional architectural design process is linear, adhering to strict typologies and relying on preconceived spatial organisations, solutions and tectonic systems. This linear approach is one-way, locking architects into decisions made at the outset of the design process. Often constrained by formal and structural limitations rooted in functionalist and modernist traditions, this standardised approach can lead to spatial outcomes that are restricted, resulting in architecture or urban planning of limited quality. In contrast, the human-centred design (HCD) method offers a cyclical process that emphasises continuous improvement and modifications, encouraging designers to question initial decisions as they move forward [7]. This non-linear approach opens new pathways for understanding contemporary sustainable design and driving innovation.

Raymond Loewy's famous statement, *Design is too important to be left to designer*s, underscores the need to involve end-users in the design process, taking their expectations into account [8]. This approach is embodied by methods, such as design thinking (DT), service design (SD), inclusive design (ID) and, more broadly, human-centred design (HCD). All of these methods are non-linear and emphasise collaboration with future users, from the research phase through to testing and feedback. These approaches excel at fostering innovative solutions through creative problem solving. As defined, *Design Thinking refers to design-specific cognitive activities that designers apply during the process of designing* [9].

While the DT method is particularly popular in the business world - spanning sectors, such as commerce, services, industry, medicine, sports and media - it is interesting to note that its origins lie in architecture. The methodology is deeply rooted in architectural design processes, first formally introduced in Peter G. Rowe's 1987 publication, *Design Thinking* [10]. Rowe outlined problem-solving strategies, methods, tools and techniques that could be employed by teams of architects and urban planners. His seminal work, updated in 2017 as *Design Thinking in the Digital Age*, laid the groundwork for the widespread adoption of DT. The method was further refined by Stanford University's Institute of Design, which developed the current DT model consisting of five stages: empathy, definition, ideation, prototyping and testing [11] (Figure 2).

All stages should involve the participation of diverse groups of future users, as diversity is essential. Including previously marginalised groups, such as the elderly or disabled, brings valuable insights, information and inspiration that benefit society as a whole [12]. This method is particularly suited for teaching architecture, where understanding the needs and challenges of users, along with the staff and processes within buildings, is crucial. In this way, DT completes its full circle, originating from the architectural design process, gaining recognition in the business world, and returning to architectural education as a structured approach that prioritises user needs. The method's popularity, accessibility and wealth of available materials and tools make it highly attractive for teaching architectural design.

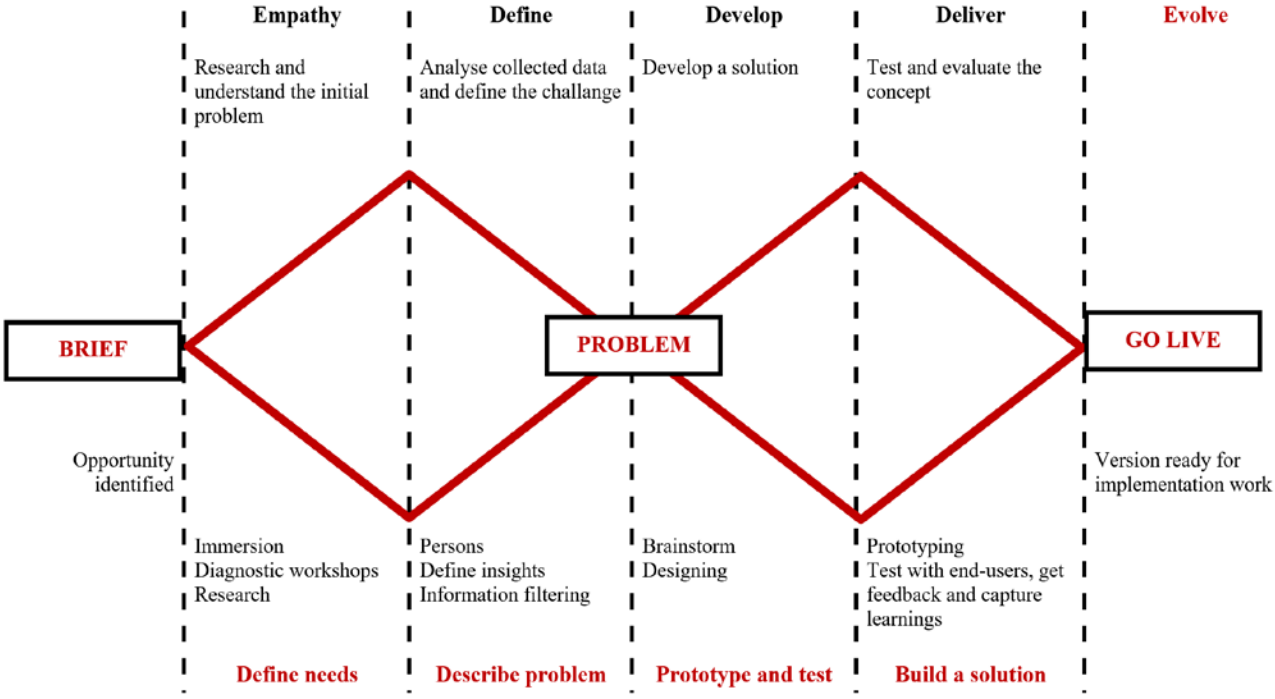

Figure 2: Double diamond framework for design thinking.

HCD and DT focus on people's needs, skills and behaviours, emphasising that good design begins with an understanding of psychology and technology. DT employs ethnographic methods to study users, which, in contrast to the slower, more methodical research of academic anthropologists, enables rapid assessment [13]. The range of topics and user groups architecture students must learn about often exceeds the time available during their studies.

Understanding the needs of end-users is particularly important for future architects, especially when designing for people with physical or cognitive limitations. Implementing accessibility principles requires both theoretical and practical knowledge of disabled users' needs. Theoretical knowledge can be gained from universal design principles, ergonomics, and design guidelines and standards. *Design without barriers requires understanding, sensitivity, and knowledge about the experiences of people with disabilities. (…) Empirical knowledge complements theoretical understanding, fostering phenomenological empathy and increased sensitivity* [14].

Another challenge to traditional models of architectural design is technological progress. The digital version of DT, along with advanced tools for analysing building performance, optimising free-form structures and innovating digital production, introduces greater complexity in the architectural field. This requires new competencies within the profession. The vast array of skills and knowledge needed to master design-support programs makes it difficult to

educate architects as *lone geniuses*. Instead, education should focus on preparing *collaborators* capable of working in multidisciplinary teams with specialists and consultants [15].

In the age of knowledge, where artificial intelligence aids in accessing information and complex programs facilitate rapid building design, teaching methods that emphasise empathy and lead the creative process become essential. The designer's role is to challenge the requirements, ensuring the right problems are being solved and that solutions are appropriate [13]. Understanding deep user needs, or insight, is just as crucial as learning about common issues faced by people with various physical or intellectual disabilities. Empathising through the DT process or cognitive workshops allows designers to better understand the challenges people face in the built environment.

DESIGN THINKING TOOLS AND METHODS IN *DESIGN STUDY: HOUSING ARCHITECTURE FOR THE ELDERLY* AND STUDENT WORKSHOPS

The design course in the Faculty of Architecture at Wrocław University of Science and Technology (FA-WUST), Poland, is based on the *research by doing* and *learning by doing* models. For several years, the course Design Study: Housing Architecture for the Elderly has been conducted at the Master's level, guiding students to create comprehensive projects that address one of the 21st century's greatest challenges, the aging population. The course emphasises both theoretical knowledge and design principles, focusing on universal design, while addressing the functional, cognitive and social needs of users. Design thinking tools and methods were integrated into the course to help students move beyond schematic thinking and foster innovative solutions.

Rather than providing ready-made functional programs or guidelines, students are given only an outline of required functions and must independently determine the detailed scope of the design based on the size of the selected plot. Initial determinations are informed by reviewing care centre examples from around the world. However, students are encouraged to avoid exploring new forms of habitation, and their selection of functions remains limited.

The course begins with a research phase centred on understanding user needs, progressing to problem solving and culminating in the final design. Students conduct research on end-users (desk research, questionnaires, proto-personas, empathy maps) to identify problems and needs specific to the social group they are designing for. This understanding enables the creation of thoughtful design programs with functional and aesthetic solutions tailored to the preferences of the target group. Proto-personas, or simplified representations of user groups, are developed as part of this process.

During the design preparation stage, students learn about modern trends in senior housing design, as well as architectural and technical solutions for the elderly and disabled. The course covers topics, such as universal design, cohousing, hybrid residential-service buildings and sustainable architecture. Students address challenges, working on a variety of projects ranging from the modernisation and reconstruction of existing buildings to new designs for specific sites or model solutions.

One of the projects presented involved converting prefabricated buildings into a residential complex for seniors (Figure 3). In Poland, large-panel architecture accounts for about 30% of the housing stock [16], and these estates remain attractive due to the abundance of public spaces and green areas. However, these structures, built several decades ago, do not meet current standards for elderly or disabled accessibility.

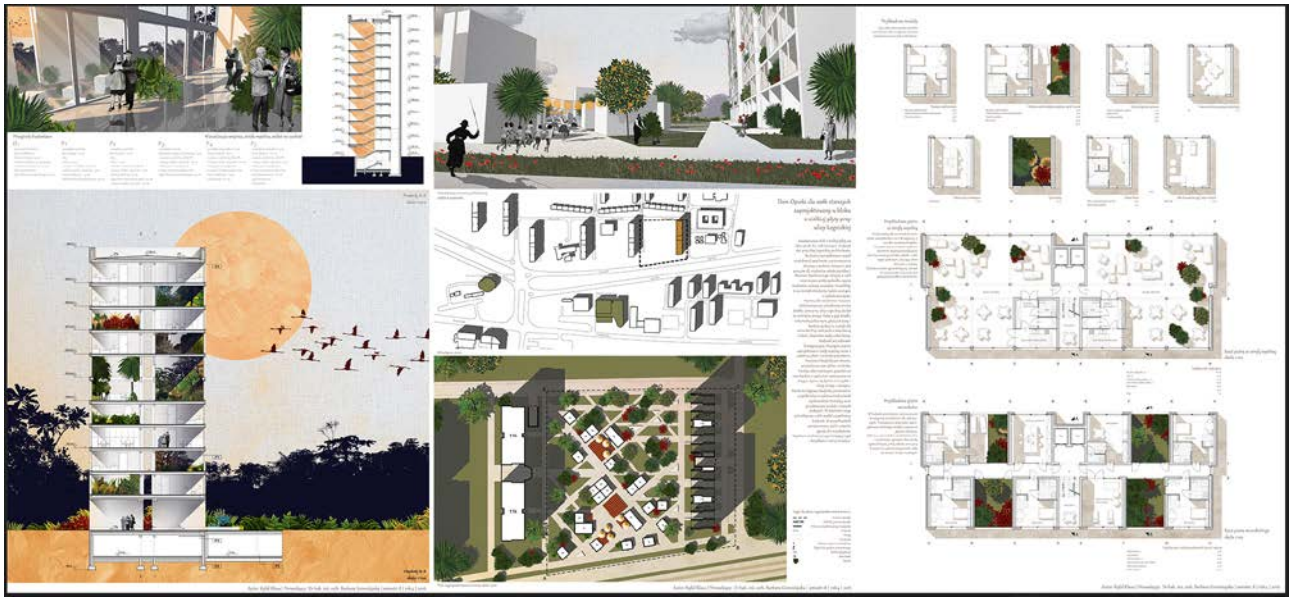

Figure 3: Revitalisation of prefabricated blocks into a residential and service complex for seniors (student: R. Klaus; tutors: B. Gronostajska and A. Miśniakiewicz).

In the presented design, the main structure of the building has been preserved, while a clear communication system and eight module types have been proposed for flexible arrangement within the existing structure by inserting modules with various functions. The concept allows for the development of new modules if necessary, with the author proposing an initial set. The introduction of terrace gardens into the building's design creates additional communal spaces with therapeutic benefits. Additionally, the centrally located floor serves as a common area for all residents, offering essential facilities. The spaces between the buildings are filled with modular pavilions serving various functions, such as retail, dining and cultural activities. These pavilions divide the area into smaller squares with different recreational and leisure purposes (Figure 4). The concept was developed using design thinking tools and universal design principles, both of which focus on meeting users' needs.

Figure 4: Small-scale architecture designed for the elderly during workshops (l) and the implemented version used by seniors (r) (tutors: B. Gronostajska and A. Miśniakiewicz).

STUDY RESULTS

Improvements across the key metrics were observed during the study. There was a notable increase in empathy for users. Initially, students approached the project with a simplified understanding of their target demographic, assuming they were designing solely for frail, elderly individuals. However, through exercises focused on understanding the diverse needs of end-users, they began to recognise the variation within the elderly population. This shift in perspective led to more nuanced and inclusive design solutions. The use of user personas helped students categorise different user types, aligning project functions with various stages of aging, thereby enhancing empathy for the end-users.

The introduction of design thinking workshops had a significant impact on the students' creativity in developing design solutions. At the outset, their approaches were heavily focused on architectural form, with limited consideration for the broader urban context. By encouraging divergent thinking, fostering experimentation and promoting exploration, students began to consider a wider range of ideas, integrating varied functions and living arrangements, such as co-housing models. This expansion in their thinking led to more inventive solutions in both form and function, with several students exploring form through the lens of function.

In terms of adaptability to complex challenges, students initially found themselves overwhelmed by the scope of the project, struggling to manage the intricacies of designing care centres and residential environments for the elderly. The multi-layered nature of the task, which included designing services and facilities, posed a significant challenge. However, the structured approach of the course helped students organise their workflow and break down tasks into manageable steps. By framing the design challenge systematically, students addressed each element of the project with greater confidence, using insights from the educational process to guide their decisions.

Critical thinking also improved throughout the course. At first, students tended to rely on existing typologies and borrowed forms from other projects, often focusing on creating novel forms without questioning their functionality. By challenging students to question assumptions, analyse problems from multiple perspectives, and iteratively test and refine solutions, the course encouraged them to challenge the *status quo*. This process prompted them to rethink established design conventions and develop new, innovative solutions.

Lastly, collaboration among students saw an enhancement. Initially, teamwork was fragmented, with students dividing tasks and consulting each other only during formal tutor meetings. Peer-to-peer idea exchanges were limited, and joint problem solving was rare. However, group brainstorming sessions, interactive tasks and hands-on work around shared tables helped foster a more cohesive team dynamic. These collaborative activities encouraged students to work together more closely, improving both the quality of their ideas and the effectiveness of their teamwork

To illustrate the observation protocol, a radar chart was developed to represent the pre- and post-intervention assessments. The evaluated metrics included empathy, creativity, adaptability, critical thinking and collaboration. Each metric was assigned pre- and post-intervention scores based on observational methods. The results indicated that

the scores for empathy, creativity, critical thinking and collaboration improved from 2 to 4, while the score for adaptability increased from 1 to 4 (Figure 5).

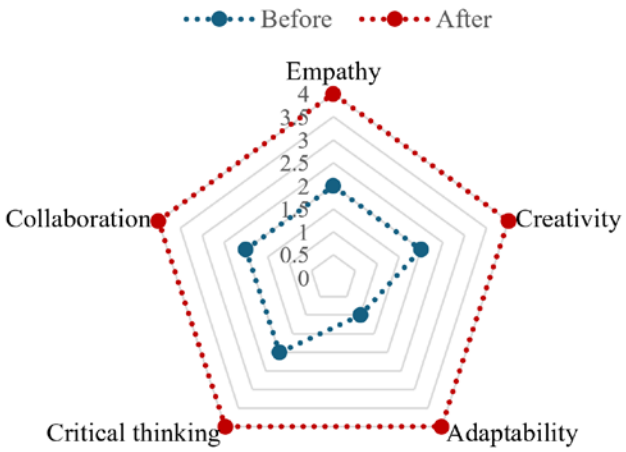

Figure 5: Improvements across the key metrics observed during the study for the *Design Study: Housing Architecture for the Elderly* course in the radar chart.

CONCLUSIONS

Architecture is both an art and a science, but unlike other arts, such as literature, music, film or painting, it does not offer the possibility of active participation or conscious resignation. Architecture studies are responsible for instilling in students the responsibility and social sensitivity associated with this profession, awareness of tradition and contemporary, dynamically changing design contexts, research competencies and the quality of the built environment around. Introducing DT tools and methods can be helpful and organise the process in contemporary teaching of architecture. The study revealed progress in several key areas, particularly in empathy, as students shifted from simplified assumptions to a deeper understanding of the diverse needs of elderly users. Creativity improved as students explored new living arrangements and broadened their approach to design, moving beyond form-based solutions. The structured DT process enhanced their adaptability to complex challenges, helping them manage the multifaceted demands of the project.

REFERENCES

1. Kamrowska-Załuska, D. and Parteka, T., Design thinking (DT) for the design and planning education of engineer-architects. *World Trans. on Engng. and Technol. Educ.*, 18, **2**, 97-101 (2020).
2. Lüley, M., Non-linear design thinking in architectural education. *World Trans. on Engng. and Technol. Educ.*, 18, **3**, 302-306 (2020).
3. Turlíková, Z., Paliatka P. and Orfánusová V., Design thinking and interdisciplinarity: *Living 2050* - a case study. *World Trans. on Engng. and Technol. Educ.*, 19, **1**, 108-112 (2021).
4. Pusca, D. and Northwood, D.O., Design thinking and its application to problem solving. *Global J. of Engng. Educ.*, 20, **1**, 48-53 (2018).
5. Léger, M.T., Laroche, A-M. and Pruneau, D., Using design thinking to solve a local environmental problem in the context of a university civil engineering course-an intrinsic case study. *Global J. of Engng. Educ.*, 22, **1**, 6-12 (2020).
6. Phunaploy, N., Chatwattana, P. and Piriyasurawong, P., On-line instruction with design thinking for creative skills development. *Global J. of Engng. Educ.*, 23, **2**, 121-127 (2021).
7. Rosinsky, K., Murray, D.W., Nagle, K., Boyd, S., Shaw, S., Supplee, L. and Putnam, M., *A Review of Human-centered Design in Human Services*. Human Centered Design for Human Services, OPRE Report 2022-78, July (2022).
8. Richardson, A., *Innovation X: Why a Company's Toughest Problems are its Greatest Advantage*. John Wiley & Sons, 184 (2010).
9. Visser, W., *The Cognitive Artifacts of Designing*. Lawrence Erlbaum Associates (2006).
10. Rowe, P.G., *Design Thinking*. MIT Press (1987).
11. Rowe, P.G., *Design Thinking in the Digital Age*. Sternberg Press (2017).
12. Bootcamp Bootleg. Institute of Design at Stanford (2024), 31 October 2024, www.dschool.stanford.edu/resources/the-bootcamp-bootleg
13. Norman D., *The Design of Everyday Things*, Basic Books (2013).
14. Gronostajska B.E. and Berbesz A.M., Universal design in the education of architecture students. *World Trans. on Engng. and Technol. Educ.*, 18, **3**, 345-349 (2020).
15. Buchanan, P., The Big Rethink Part 4: The Purposes of Architecture, https://www.architectural-review.com/archive/campaigns/the-big-rethink/the-big-rethink-part-4-the-purposes-of-architecture

16. Gronostajska, B.E., *Kształtowanie Środowiska Mieszkaniowego dla Seniorów*. Oficyna Wydawnicza Politechniki Wrocławskiej (2016) (in Polish).

BIOGRAPHIES

Magdalena Wąsowicz is an architect and assistant professor at the Chamber of Architectural Design and Construction, Faculty of Architecture, Wrocław University of Science and Technology (Wrocław Tech), Poland. She earned a Master's degree in architecture from Wrocław Tech in 2011 and completed her doctoral studies there in 2018, with a dissertation focused on visual perception in architecture. Dr Wąsowicz actively contributes to professional development in the field as a BIM software trainer, having graduated from the postgraduate BIM Management Studies at WSB Merito University in Poznań, Poland. Her academic portfolio includes numerous scientific publications and contributions to research. In addition to her academic career, Dr Wąsowicz has acquired practical experience in architectural firms in Poland and is an active member of the Wrocław branch of the Polish Association of Construction Engineers and Technicians.

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Anna Maria Berbesz is a PhD architect and research and teaching assistant in the Chamber of Architectural Design and Construction at Wrocław University of Science and Technology (Wrocław Tech), Poland. Her research interests include sustainable development, responsive architecture and user-centered design, with a focus on biomimetic, nature-inspired solutions. Her recent publications underscore a commitment to sustainable practices, emphasising universal design principles and the functional adaptation of urban spaces to social and environmental needs. Dr Berbesz is also an active educator, teaching design courses at Wrocław Tech. She is a member of the Polish Green Building Association, the Polish Association of Construction Engineers and Technicians (Wrocław branch), and the International Association for Shell and Spatial Structures.