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Current Perspectives of Design Thinking and Design Literacy

Rethinking Design Beyond Disciplinary Boundaries

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Abstract

Design thinking has become a cornerstone of 21st-century education and is emphasized across both design and non-design disciplines. Studies have long criticized design thinking as ambiguous because it has diverse definitions and employs a range of methodologies. Recently, the concept of design literacy has entered the literature. It is proposed that design literacy can foster the potential of design thinking to promote the development of the "new literacies" needed to drive change and transformation in an age facing global challenges such as climate change, technological transformations, and social inequality. This article highlights key themes from an international symposium exploring design's foundational role in education, its connection to visual thinking and reasoning, the potential of interdisciplinary problem-solving, the human and social dimensions of design thinking, and the importance of design literacy for effective communication and collaboration among designers. This symposium is part of a broader research project based at Özyeğin University, Turkey, investigating how to cultivate design literacy knowledge and skills in early undergraduate curricula to foster an interdisciplinary and trans-professional learning environment before professional specialization.

1 Introduction

Addressing the complex, multifaceted challenges of the 21st century, such as the COVID-19 pandemic, the climate crisis, earthquakes, and rapid technological advancements, requires multidisciplinary, collaborative research. In this context, it is increasingly important that individuals with critical-thinking, creativity, and problem-solving skills participate actively in design initiatives. While design thinking and design literacy are traditionally core to design disciplines, their importance is also growing in non-design fields and education at all levels. Razzouk and Shute (2012) and Scheer and Plattner (2011) highlight design thinking's role in developing essential 21st-century skills, such as problem-solving, creativity, and teamwork, to prepare students for complex challenges. Design thinking fosters human-centered sensitivity, visualization, and systematic vision. While its relevance across disciplines is already clear, a broader framework is needed to explore its evolving dimensions in today's context. The 21st century's expanding scope of design has led to a multifaceted understanding of design literacy (Bolinas, 2022). Design literacy addresses the limitations and potential of design thinking, providing a broad framework that enables students across disciplines to acquire multidimensional knowledge and diverse literacies. As defined by Bolinas and Torrisi-Steele (2022), design literacy is a human-centered approach that integrates design thinking and participatory culture to foster diverse communication and

knowledge-building. Design literacy enables individuals to generate meaning, utilize diverse knowledge, and collaboratively address 21st-century challenges. It also empowers both designers and non-designers to critically assess design's societal and environmental impact and employ design as a tool for sustainable solutions. Christensen et al. (2016) view design as literacy and suggest that developing design skills enhances individuals' interaction with the world. In higher education, design literacy fosters inquiry, evaluation, and problem-solving through design thinking (Pacione, 2010, 2017). As education adapts to societal shifts, design competencies are recognized as crucial in developing graduates with essential skills (Koskinen & Thomson, 2012; Bolinas, 2022). This strategic role extends beyond practical skills to include social, environmental, and ethical consciousness. Concepts such as "critical" and "responsible" design literacy emphasize the need to integrate design education for sustainability, empowering individuals to become engaged citizens who can address real-world complexities and participate in design processes (Lutnæs, 2021). Accordingly, the 21st-century developments impacting all areas of life are driving a shift in the literature from a focus on design thinking to an emphasis on design literacy.

The writers of this paper are a research team of experts from the disciplines of architecture, design, and education currently conducting a research project entitled "Development of Design Literacy Skills: A Course Design, Implementation and Evaluation for the First Year Students of Higher Education Undergraduate Programs" (123K613). This research is supported by the Scientific and Technological Research Council of Turkey (TÜBİTAK) Social and Humanities Research Group (SOBAG) within the framework of the 1001-Scientific and Technological Research Projects Support Program. We are investigating how design literacy knowledge and skills can be cultivated in the early undergraduate curriculum to promote an interdisciplinary and trans-professional learning environment before professional specialization. The project seeks to develop a design literacy scale to inform the design, implementation, and evaluation of a course aimed at enhancing the design literacy knowledge and skills of first-year undergraduate students.

As part of this research project, we convened an international symposium entitled "Design Thinking and Design Literacy Perspectives in the 21st Century" on June 6, 2024, at Özyeğin University Faculty of Architecture and Design, İstanbul, Turkey. Architects and designers working in different geographies at the interface of research, design education, and practice were brought together (see Figure 1). Erik Bohemia, the keynote speaker of the symposium, is also a founding chair of the Design Literacy International Network (DLIN). The invited speakers were Alpay Er, Mine Özkar, Aykut Coşkun, Pınar Kaygan, Sine Çelik, and Onur Yüce Gün. The presentations focused on theoretical discussions of the design thinking approach, research centers focusing on this approach, and the integration of design thinking in

education. The symposium sought to emphasize the growing importance of design thinking skills for individuals in both design and non-design fields, given the multifaceted and complex challenges of the 21st century and the transformative impact of technology. It also highlighted the "design literacy" perspective as a unifying framework for discussing design thinking.

Figure 1

Symposium presentations by invited speakers.

In this article, we address the key discussions at the symposium concerning contemporary approaches to design thinking in both design and non-design fields. Our aim is to explore how design thinking has evolved conceptually and methodologically since its emergence in

the design research literature in the 1980s. We re-contextualize the key points raised in the symposium within the broader framework of the current literature on the potential, challenges, and dilemmas associated with design thinking today. This re-contextualization enables us to discuss how a "design literacy" perspective can be a valuable framework for both designers and non-designers to critically understand and engage with design, ultimately contributing to socially responsible citizenship. The article is framed by three key questions: (1) Why is design thinking still important today? (2) Why is design literacy relevant in education? (3) How can design be the foundation for education? These questions provide the framework we propose in this article to discuss the symposium outcomes. The researchers are exploring potential avenues for the design of a course aimed at cultivating design literacy and equipping first-year undergraduate students with the knowledge and skills to apply design literacy across diverse contexts. By critically analyzing symposium discussions, this study seeks to articulate the evolving definition and scope of design thinking, particularly within the context of the urgent challenges faced in the 21st century. Subsequently, it aims to discuss the dimensions of design literacy, thereby evaluating the potential of this form of literacy to enrich non-design undergraduate curricula.

2. Design thinking in transition

Design thinking, which originated from studies examining the nature of design process in the 1960s, entered the literature as a concept in the 1980s and remains key to the field, was central to the symposium. This section of the article therefore aims to uncover the origins of the growing demand for a shift toward design literacy. To do this, a critical framework is presented regarding the uncertainties related to the definition of design thinking, its transformation since the 1960s, the potential it offers for education and sectoral fields today, and the points it currently fails to address.

2.1. Instrumentalization and popularization of design

In his presentation, "Design Thinking: A Heretical View from the Industrial Design Field," Alpay Er offered a critical historical analysis of the origins and evolution of the concept of design thinking (Figure 1). Er highlighted the instrumentalization of design thinking as a methodology in non-design fields, pointing out that although design thinking was initially limited to academic circles, its scope and application areas soon expanded beyond traditional disciplinary boundaries, and it became a strategic tool in business and management. Er's observations align with Muratovski's (2015) assertion that design thinking has served as a catalyst for developing products, services, and organizational structures in global corporations. IDEO, a design innovation consulting firm, played a crucial role in

popularizing design thinking within business management, as highlighted by Er. Tim Brown, IDEO's CEO, championed the idea that adopting a designer's mindset could revolutionize how companies develop products, services, processes, and strategies. IDEO's business model demonstrated that design thinking could serve as a powerful marketing strategy, selling not only the design product but also the design process itself. Er emphasized that as design terminology gained prominence in management media, appearing in publications such as *BusinessWeek* and *Harvard Business Review*, design thinking was reimagined as a powerful driver of innovation. This shift coincided with a redefinition of innovation, which was increasingly associated with creativity rather than solely technology. In the 1990s, innovation was primarily linked to technological advancements, while in the 21st century, the focus shifted toward design-driven innovation. Er, for example, highlighted the emergence of "non-technological design-driven innovation" within business. This shift has been informed by both a burgeoning interest in research and practice in creativity, innovation, and problem-solving and a recognition of the potential of design thinking to contribute to economic growth and the social good. Notably, the design thinking model developed by David Kelley at Stanford University's Hasso Plattner Design Institute (d.school) serves as a foundational framework. This model positions design thinking as a toolkit applicable to non-design fields, empowering individuals without design expertise to learn and utilize its methods.

Er drew attention to this second approach to design thinking, which spawned a critical field of discourse. He highlighted the work of Iskander (2018), Kolko (2018), Julier and Kimbell (2019), and Lee (2021) as "heretics of design thinking." These scholars initiated an alternative, critical discourse on the phenomenon, which has shaped the field of research and practice for the past six decades and questioned whether the anticipated outcomes of design thinking have been fully realized. Lee (2021) argued that we must critically re-examine the nature of design thinking and that such a re-evaluation would reveal two significant shortcomings in the field: a lack of "crit," including self-critique and peer review, which are essential for improvement through evaluation; and a tendency for designers to prioritize business needs over the desires and needs of people. Iskander (2018) asserted that while the design thinking approach prioritizes and maintains the designer's role, it may hinder the designer's ability to achieve truly radical innovation. Kolko (2018) criticized the limited understanding of real design capabilities and the lack of comprehensive knowledge, skills, and expertise among professional designers as reflected in current conceptualizations of design thinking. Julier and Kimbell (2019) contend that the limitations and deficiencies identified by Kolko (2018) hinder the applicability of design thinking to broader societal issues, such as social change. Lee (2021) further emphasized that the "conservative" nature

of design thinking is an impediment to fostering innovation and genuine transformations within organizations and society.

2.2. How design thinking originated and transformed in the 20th century

As documented above, the existing literature frequently criticizes design thinking for the ambiguity that arises from the use of diverse definitions and methodologies. This ambiguity hinders our ability to fully grasp and realize the potential of design thinking in both design and non-design disciplines (Tuckwell, 2017). While design thinking's ambiguity can be attributed to variations in the interpretation of the concept across design and non-design fields, the historical evolution of design thinking reveals that broader influences have been at play. Theorists from diverse disciplines have contributed to shaping the concept since the 1960s, demonstrating that design thinking's foundation extends beyond the confines of the design field.

The development of design thinking can be understood within the broader intellectual context, itself shaped by diverse conceptualizations of the term, that emerged in the late 20th and early 21st centuries. Morehen et al. (2013, p. 56) categorized the primary conceptualizations of design thinking as "(1) a process used by individuals, (2) a general theory aimed at solving wicked problems, and (3) a business-orientated approach to focus on innovation." The 1960s witnessed early efforts toward a "design science," characterized by the pioneering work of Herbert A. Simon (1969), a cognitive scientist who emphasized design as a way of thinking and the pivotal role of visual reasoning (Jen, 2017). Robert H. McKim, a mechanical engineer, later advocated a similar approach by highlighting the interplay between seeing, drawing, and imagining. He introduced a method for visualizing the process and outcomes of thought (McKim, 1972). By the 1970s, design thinking had also emerged as a problem-solving approach to addressing complex, multifaceted "wicked problems." This concept became a central focus of design research (Rittel & Weber, 1973). In the 1980s, the "solution-focused problem-solving" perspective emerged as a prominent topic of debate. Nigel Cross (1982), a leading figure in the field, focused on the cognitive processes involved in design activities and emphasized the potential of designers' abilities to solve ill-defined problems in non-design fields. Schön (1983) explored how designers think through his frameworks of "reflection-in-action" and "reflection-on-action," and his work has been a cornerstone for numerous studies on design education. Rowe (1987) popularized the term design thinking in the literature, particularly focusing on architectural designers' problem-solving approaches. Lawson (1990) sought to demystify the cognitive processes of designers, exploring their "solution-oriented problem-solving" methods. Buchanan (1992) prioritized the "ill-defined problems" with which designers deal and argued that the ability

to creatively redefine such problems is a crucial professional skill (Wrigley & Staker, 2017). His contribution to the field also focused on how design can address human concerns and fundamental needs. In the 1990s, David Kelley, co-founder of IDEO and professor at Stanford, played a pivotal role in adapting design thinking for business and management applications. This shift marked a significant turning point in the evolution of the approach. The integration of design thinking into Stanford's curriculum further solidified its growing influence.

While Er is highly critical of the design thinking concept due to its commodification, there is a growing movement to incorporate design thinking as a methodology into undergraduate and graduate programs across various fields, including business, management, engineering, medicine, and the humanities. Incorporating design thinking in this way would involve curriculum development and the redesign of teaching and learning processes. The aim is to harness design thinking as a catalyst for higher education reform, equipping students with the knowledge and skills needed to address the complex challenges of our time through creative and innovative solutions (Morehen et al., 2013; Beligatamulla et al., 2019; Wrigley & Mosely, 2022). Numerous case studies demonstrate the increasing influence of design thinking in non-design disciplines.

3 Unpacking the relationship between literacy and design

Building on the previous section's contextualization of design thinking within the design literacy framework, this section elaborates on design literacy, the symposium's central theme and the foundation for the project's course design. Drawing primarily from Bohemia's presentation, it explores the intertwined dimensions of the concept of literacy, pointing to the significance of communication and the new literacies required in the 21st century, examines design literacy as an emerging research field, and emphasizes the role of design and design education in fostering "future citizens" capable of driving positive societal change. This section addresses Coşkun's presentation, which centers on the human element in design, in alignment with Bohemia's emphasis on the social dimension, and gives examples of integrating design thinking into education, particularly through the Research through Design (RtD) approach. Collaboration, as a concept pointed out in Coşkun's presentation, is further elaborated through reference to Gün, whose presentation underscore the importance of design literacy in fostering collaboration, individual learning, and a shared design language.

3.1. The dimensions of literacy

In his keynote speech, "Charting Design Literacy Dimensions," Erik Bohemia emphasized the "design literacy" perspective as a unifying framework for discussions of design thinking. Directly referencing the symposium theme, he drew a parallel between literacy and design thinking, suggesting that both involve elements of reading and writing. Bohemia argued that literacy encompasses both understanding and communicating knowledge. This aligns with the definition of language as "a system of communication structured by its rules of signification, or meaning-making" (Narey, 2009, p. 2). Languages vary in their structure and representational modalities, affecting how we understand, interpret, and communicate information. Bohemia highlighted the existence of various literacies, including visual and technological literacy. Visual literacy involves understanding information derived from our visual interactions with phenomena and the environment. According to Elkins (2009, p. 11), whatever representational method is used by a language, visual perception is fundamental to recognizing elements of that language and associating them with meaning, which directs our attention to the idea of reading being primarily "a visual skill." Recent debates have centered on the development of a new language reshaped by the transformative effects of technology, necessitating a new literacy. In this context, Dakers (2006) highlighted the importance of technological literacy and defined this form of literacy as extending beyond mere proficiency in using technological artifacts to encompass a deeper understanding of the knowledge and processes that underpin these artifacts, coupled with critical reflection. A technology-literate individual not only recognizes and understands technological tools and techniques but also creatively employs them to develop something new. This definition aligns with Bohemia's initial statement, emphasizing the dual aspects of reading and writing in literacy.

Bohemia emphasized the critical role of literacy in fostering the liberated mind. He posed a key question: how can literacy contribute to the development of better citizens, both designers and non-designers, through education? Bohemia suggested that design literacy can play a significant role in this regard, influencing both public understanding of design and public engagement in reconfiguring design through practice.

3.2. Design literacy as an emerging field of research

Bohemia's remarks on the significance of literacy in design and the importance of design literacy for both designers and non-designers were grounded in the broader context he outlined. Referring to Archer's (1979) classification of human knowledge into science, humanities, and design, Bohemia emphasized that design is intrinsically tied to modeling, underscoring the significance of making and practicing in design. Bohemia's reference to the

Cyclical Cognitive Process Model for Developing Design Literacy Abilities, developed by Jessen and Quadflieg (2023), offered valuable insights into the relationship between literacy and design as well as the potential of design literacy for both designers and non-designers. According to this model, developing design literacy knowledge and skills involves both "reading" and "writing" design. "Reading" a design entails recognizing that something is designed and understanding how it was designed. These cognitive processes lead to "writing" a design, which involves imagining something new and designing it (Jessen & Quadflieg, 2023). Jessen and Quadflieg (2023) regarded design literacy as encompassing more than mere awareness and understanding of design and suggested it also includes the ability to produce something, whether physical or semantic, through critical and creative reflection on design. The literacy emphasized here serves to transform awareness and understanding of design into practical applications that can positively impact the individual. Design offers a fertile ground for such transformative effects, enabling individuals to make a tangible difference in the world.

Bohemia criticized the narrow societal focus in contemporary design research, both in its definition of design as a discipline and in its conceptualization of design thinking in the 20th-century literature. As Bohemia noted, Cross (1982) emphasized that design is an integral part of general education and has intrinsic educational values that are associated with "designerly" ways of knowing. Cross (1982, p. 226) argued that design education can foster the development of real-world and ill-defined problem-solving skills, "concrete/iconic modes of cognition," and "nonverbal thought and communication." These skills complement traditional reading and writing abilities, enhancing individuals' overall capabilities. Bohemia criticized Cross's focus on the intrinsic educational values of design, which stemmed from Cross's conception of design as "one of the highest forms of human intelligence."

He noted that Cross's work lacks a significant dimension of the social and socio-cultural responsibilities of design. While the cognitive processes involved in design are often celebrated, the broader consequences and impacts of design are frequently overlooked. Considering the nature of the global challenges faced in the 21st century, we must reconsider the definitions of both design and design thinking. Referencing today's complex and multifaceted global challenges and noting that we must reconsider the definitions of both design and design thinking, Bohemia introduced Lutnæs's (2020, 2021) definition of "critical design literacy" or "responsible design literacy," which advocates for integrating design into general education. For Lutnæs, design education can empower individuals to become better citizens by guiding them in developing design literacy skills. A design-literate person is defined by their ability to address real-world complexities, participate in design processes, and foster awareness through making (Lutnæs, 2021).

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Bohemia's talk principally addressed the role of design in creating a better world and the importance of considering the intended beneficiaries of our designs. He emphasized that education, particularly when focused on students as "future citizens," can play a pivotal role in driving change and transformation toward a better society. Design literacy, in this context, can equip us with the knowledge and skills necessary to contribute to such a world.

3.3 Human-centered design research strategies

Aykut Coşkun's presentation focused on the human element in design, drawing parallels with Bohemia's emphasis on the social dimension of design and the potential for design-literate individuals to actively participate in future processes of change. Coşkun presented examples of integrating design thinking into education, particularly focusing on a postgraduate project and PhD research that employs the RtD approach at Koç University-Arçelik Research Center for Creative Industries (KUAR). This approach integrates insights from society, industry, and academia through the active participation of users, professional designers, and scholars from various disciplines in the research process.

The Whisper project and the Storibles project, as completed PhD research, were discussed as examples of human-centered design. These projects aimed to gather insights from users, including their thoughts, reactions, and concerns, regarding the effectiveness of a product in fostering social interaction or enhancing individual learning experiences. In these projects, user insights were gathered not only through traditional data collection techniques, such as observation or focus group interviews, but also through active engagement activities, such as hands-on experiences and reflective discussions with relevant stakeholders. This methodology ensured more active user involvement in the early design and prototyping stages. The 2HANDTouch project was a collaborative project between KUAR and industry in which users' expectations and the benefits they perceived and concerns they felt about gesture-based control in the kitchen were examined. Methodologically, interviews, an online user acceptance survey, and a Wizard-of-Oz user study, gaining haptic feedback from the human body (hands) by monitoring how people use 2HANDTouch, were essential components of the research. The three RtD studies presented by Coşkun were all conducted in multidisciplinary settings and employed iterative design processes that integrated concept development, prototyping, and user experience assessment.

As the RtD projects involve key stakeholders, they have implications for the design, production, and usage stages. However, their true potential lies in empowering users to understand the design process and envision alternative possibilities. By enhancing individuals' design literacy, we can foster more nuanced interactions and partnerships between research, practice, and the social environment.

3.4. Design literacy to facilitate individual and collaborative learning

Onur Yüce Gün's presentation emphasized the significance of the human element in design. He focused on the designer as a subject, highlighting the unique role and capabilities of the designer compared to a machine. Gün connected these roles and capabilities to the notion that designers are incorrigible learners and that design itself is a continuous learning process. In his view, designing is akin to pursuing a dream, and we encounter numerous risks while striving to achieve a goal. Gün's presentation implicitly highlighted the crucial role of design literacy, encompassing both reading and writing, in cultivating a collaborative and individual learning process fueled by design inquiry. Such a learning experience is essential for design to be a transparent action or process and for a shared language to be developed among designers.

According to Gün, the way we define something significantly influences our thought processes and design decisions and, ultimately, the creation of the final product. The challenge for the designers arises when they need to explain design to others or, in other words, open the black box for others so they can become part of the design system. This situation highlights the need for design literacy. Only when designers have such literacy can they creatively process and interpret data. With reference to artist Tim Knowles's series of works entitled *Tree Drawings*, Gün argued that data are not merely something we collect; rather, they are a projection of our perspective onto the world around us. We can place data anywhere we choose to look. This creative data processing encompasses not only problem solutions but also failures and the identification of new challenges. The perceived and actual realities of a design can diverge significantly. Extensive testing and prototyping are essential to bridge this gap, which is more challenging in architecture than in industrial products.

At this point in his presentation, Gün emphasized the facilitating role of digital tools while underlining that the human element (the designer) remained indispensable. This perspective informed Gün's position regarding computational design methods and processes that rely on precision and accountability. In Gün's view, the critical challenges are to quantify visible qualities without isolating them from their experiential context and to establish a dialogue with digital tools using mathematical terms while leveraging the repetitive capabilities of these tools. The designer is expected to guide the attempts to understand a design problem by grasping the part and reaching the whole through constructing and/or reconstructing the relationship between the parts. In doing so, vision and perception (of the embodied human being) are important, and this is something that the machine (artificial intelligence [AI]) cannot fully grasp.

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Concluding his presentation, Gün proposed several resolutions about the nature of design and of the designer. Designers need to find a way to use and utilize ambiguity, even in working with tools that seek precision and accountability. The state of confusion is generative and empowering for the designer. The designer reinvents the self by not knowing something and trying to explore it. Human thought cannot be fully replicated by a machine. Critical inquiry is greater than knowing; thus, any digital tool should be used to create meaning and improve things for other humans. Design is inherently human, being influenced by the mind, heart, and past experiences of the designer. Lastly, a designer can only develop a momentary solution for life, as design is an ongoing process with endless opportunities for refinement.

4. DESIGN AS A FOUNDATION FOR EDUCATION

This section focuses on the presentations of Özkar, Kaygan, and Çelik, which addressed the symposium theme by zooming in and zooming out within the framework of the concepts of design, systemic design, and design thinking. Özkar highlighted how design thinking was once conveyed through art study and visual literacy and how equipping students with the necessary skills of reasoning and accountability can form a foundation for education. Kaygan discussed the challenges of interdisciplinary teamwork—stemming from differences in disciplinary approaches—in teaching design thinking to non-designers through the case study of the "ID403 Collaborative Design Course" taught at Middle East Technical University. Like Kaygan, Çelik discussed how design tutors can integrate design thinking aspects into interdisciplinary and collaborative environments, with a special focus on systemic design as a crucial approach to addressing complex issues in the 21st century.

4.1.   Core competencies of design and their relevance for education

Mine Özkar's presentation, entitled *Design, Education, and Foundations,* posed a dual question: what are the foundations of design education, and can design be a foundation for education? The first question addressed the basics of design education. For Özkar, this referred to design reasoning, that is, making the design process explicit for both us and the external gaze, such as instructors and peers. Therefore, Özkar argued that the foundations of design education should equip the students with "how to reason" skills by focusing on the accountability of their design decisions (Özkar, 2017, p. 4). The second question touched upon a wider framework since it inquired whether design can be a core competence in education. The term education here may refer to higher education or the perspective of lifelong learning. This essential question triggers another: what do we need to learn to design?

As addressed by Özkar, in his book *The Design of Business: Why Design Thinking is the Next Competitive Advantage*, Roger Martin (2009) highlighted that design thinking lies at the intersection of analytical and intuitive thinking. While engineers search for analytical thinking that is reliable, safe, and proven, designers emphasize intuitive thinking. Design thinking is the mixture of these two that addresses both reliability and validity. What, then, are the core competencies of design and design thinking? Here, Özkar referred to Conley, a professor at the Institute of Design in Illinois, Chicago, who provided definitions for seven core competencies of design. For Conley (2004), design covers the ability to identify multiple potential solutions for a given problem. Designers must be able to think both broadly and specifically, visualizing solutions even when they have incomplete information. Core aspects of design are creating and assessing numerous alternative solutions as well as increasing or preserving value through integration. Additionally, designers must consider how the solution fits into the larger context and how its components work together. Finally, they must effectively convey their ideas through visual and physical representations. Second, Özkar pointed to Buchanan's definition of the core competencies of design. Buchanan (cited in Hegemen, 2008) argued that design, rooted in a human-centered approach, involves a holistic perspective, interdisciplinary collaboration, and the use of multiple senses to understand a situation. Designers embrace rapid experimentation and prototyping, and they value learning from failure. By focusing on individuals and their goals within organizational contexts, designers aim to create innovative and human-centered solutions (cited in Hegemen, 2008).

It is evident from Özkar's first two initial questions that she associated design thinking with design reasoning. Özkar explained that one good example that refers to the question "how does one design?" is John Habraken's silent game (Schön, 1993). In this game, one of the players silently builds a composition or organization; the other player then adds parts to the composition and must intrude on the patterns created by the first player. The players are not allowed to talk. The first player is observing the arrangement (this is the "reading" part), and whatever is read is interpreted to enable the second player to continue adding parts to the organization (this is the "writing" part).

In this silent game example, a silent conversation occurs between the players about the procedures and processes of design. This conversation draws on the skills of visual thinking and visual reasoning; in this context, we might call it visual literacy or, in broader terms, design literacy. Özkar highlighted that visual thinking and visual literacy were essential parts of U.S. education even before the 20th-century design discussions triggered by the Bauhaus school. The Massachusetts Drawing Act, which became law in 1870, aimed at teaching drawing (literacy) to everyone in the US (Bolin, 2004). All kinds of drawings, including

industrial and mechanical, were to be taught to people in public schools. Özkar also referred to Denman Waldo Ross (1907), who in his book *The Theory of Pure Design* explained how design is made by using basic guidelines to visually analyze portraits. Around this time, educational philosopher John Dewey (1934) supported the inclusion of art education in public schools, where the study of pictures became an essential course. In short, Mine Özkar's thoughtful presentation showed how design thinking was once conveyed through the study of art and visual literacy and how the fundamentals of design education—briefly defined here as equipping the students with the necessary reasoning and accountability skills—can be a foundation for education.

4.2. Searching for a common understanding of design and of the design process

Design thinking is principally integrated into today's higher education curricula through interdisciplinary courses, as shown by another presenter, Pınar Kaygan from Latvia. Kaygan's presentation drew attention to the reasons we need interdisciplinary collaboration in higher education and presented a comprehensive pedagogical approach to teaching design thinking. The major component of interdisciplinary work, Kaygan argued, was the existence of people from different disciplines aiming to achieve a synthesis by bringing together their own disciplinary sets of knowledge and methods to solve a common and multidimensional problem. Such multidisciplinary groups develop a unique approach to problem-solving. However, interdisciplinary collaboration is not without challenges, especially regarding how the collaborators can develop a shared understanding of the problem and goal, how disciplinary sets of knowledge and methods can be integrated without one being prioritized over the other, and how multiple disciplinary contributions to the solution of complex problems can be recognized and appreciated.

Having sketched this conceptual background, Kaygan described the strategies she and her colleague developed in designing and executing an interdisciplinary course at the Middle East Technical University (METU) in 2019. Kaygan was from the Department of Industrial Design (ID) and her colleague was from the Department of Food Engineering (FDE) at METU. The resulting course, *ID403 Collaborative Design*, was open to students from the ID and FDE departments. She and her colleague used design thinking in this course, Kaygan explained, to provide students with "a systematic and holistic understanding of problem-solving" by facilitating several steps of Tuckman's model for small group development and to promote the potential for design thinking among people without a related academic background. By giving FDE students a lecture about design thinking both as "a mindset" (dealing with ambiguity, risk-taking, testing, and learning from failures) and "a methodology" (working on

wicked problems, facilitating divergent–convergent thinking, and following a user-centered approach), the course creators aimed to present to the students the entire iterative design process that they would experience during the course. Whereas a design process starts with a technical problem in engineering education, the students taking this course were expected to go through an iterative and multi-staged process based on feedback mechanisms. The outcome of this lecture for FDE students, Kaygan explained, was that they reconsidered design as a more systematic and holistic process. The lecture helped the industrial design students to develop an interdisciplinary framework to make the design process and its underlying logic understandable to non-designers.

The course then addressed problem definition. The FDE and ID students were asked to reframe the problem within their disciplinary frameworks and then collaboratively develop a mind map visualizing their understanding of the project topic. The FDE students preferred to prepare tables as a format in which information can be observed more concretely and understandably than in mind maps, which have a more complex structure. Thus, differences in the methods and vocabulary used by the FDE and ID students became visible during this stage. Kaygan concluded that while the systematic structure and set of tools and methods for problem-solving helped the students from both departments adapt to this interdisciplinary course, the existence of a positive mindset, including humor and social interaction, enabled and enhanced the team to develop both technically and psychologically. However, Kaygan mentioned that the use of design thinking does not guarantee successful interdisciplinary collaboration. Rather, it must be supported by enabling students to acquire new knowledge and new ways of thinking and doing, addressing adequate representation of all disciplines, and maintaining a balance between fun and productivity in a course. Collaboration between educators is also essential.

4.3. Systemic design to grasp and deal with complex societal challenges

Kaygan's emphasis on defining design thinking as a systematic and holistic understanding of problem-solving can also be seen in Sine Çelik's presentation. Çelik argued that dealing with complex societal challenges does not only require perfect individual performances that can help fix the problem. Rather, we should enlarge the system to bring about interaction with different systems, such as society, politics, and healthcare. The goal should not be merely to fix the parts but also to look at the relationship and interaction between them. Understanding the scale and impact of the issues with which a designer should deal is a prerequisite both in practice, research, and education, and systemic design has a key role in facilitating such an approach. Systemic design adapts the iterative, creative, emphatic, and exploratory aspects of design thinking and the holism of systems thinking. Hence, for Çelik,

systemic design lies at the intersection of design thinking and system thinking and has emerged as a new research field.

Both Kaygan and Çelik discussed how design tutors can integrate design thinking aspects into interdisciplinary and collaborative environments. However, we should note here that the role of design thinking in education should not be limited to its potential to engender systemic problem-solving and facilitate teamwork among people from different disciplinary backgrounds. As discussed earlier, design thinking can be a foundation for education when it is combined with art, visual studies, and design literacy.

5. Reflections

This article provides an overview of the Design Thinking and Design Literacy Perspectives in the 21st Century symposium held in Istanbul, recontextualizing its points within broader disciplinary discussions. The selection of speakers (Turkey, Latvia, the Netherlands, and Norway) from different fields of design and human sciences (architectural design, design computation, industrial design, sociology, and urban planning and design) and whose work is interdisciplinary in nature, addressing the fields of sociology, social network analysis, politics, computation, and human–computer interaction, provided a panorama of the dynamic landscape of current design teaching and learning practices and perspectives from across the globe. The symposium prompted speakers to examine the relationship between design thinking and design literacy within theoretical and methodological frameworks and to reflect on their own practices through this lens. As a result of the inclusiveness offered by the design literacy perspective, they contributed to mapping out the field by touching upon issues of design as a foundation for general education, the relation of design thinking to visual thinking/reasoning/literacy, the potential of interdisciplinary collaboration and systems thinking for solving complex problems, the human and social dimensions of design thinking, and design literacy as a means for design to be an explainable process and to develop a common understanding among designers and the general public.

This article, informed by symposium discussions, extends the scope of design thinking beyond conventional uses, examining its role in fostering education and interdisciplinary learning within the broader framework of design literacy. It underlines the way design literacy stands out among multiple 21st-century literacies by highlighting design's crucial role as a core competency for learning and societal transformation. The symposium, which was held as part of the ongoing research project for the development of a design literacy course for first-year higher education students, provided us with a critical framework for why and how we can approach design literacy in the 21st century through discussions in which

experts from different countries and design fields reflected on their teaching and research practices. This framework informed the "needs analysis" and "scale development" stages of the research, which involved empirical data collection from students, academics, and industry professionals across design and non-design fields. The symposium and the preliminary analysis of empirical data significantly impacted our research project, revealing several implications. The historical emphasis on design's role in education, particularly in fostering reasoning and accountability, has evolved. As the definition and scope of design expand, so too do core design principles and the problem-solving focus of design thinking, which now encompasses dimensions such as social and ethical responsibility and environmental awareness, reflecting a broadened domain. The 21st century's complex challenges are forcing us to reconsider established concepts, such as creativity, innovation, and human-centeredness, and underscore the significance of alternative concepts, such as empathy, care, and reuse (Fitz et al., 2019; Cephas et al., 2022). This conceptual evolution is reshaping education through content and methodological changes, particularly the rise of interdisciplinary approaches. Design literacy strengthens existing educational content and approaches. It fosters collaborative, interdisciplinary learning communities, empowering students to be responsible citizens through understanding, communication, and knowledge application, particularly in non-design programs before professional specialization.

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