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Design students' views on future work at the stage of Industry 5.0 and Society 5.0: Dimensions and levels of resilience

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Abstract

This study investigates design students' perspectives on future work environments shaped by the evolving paradigms of Industry 5.0 and Society 5.0, with a focus on their views of work communities, technological advancements and systemic problem-solving. The concept of resilience is used as an analytical lens. The study explores the relevance of Industry 5.0 and Society 5.0 frameworks in the context of the design profession and examines how design students anticipate and interpret future changes in their professional landscape. The study addresses the following research question: What are the dimensions and levels of resilience according to design students' views of future work? Data were collected in 2023 from 92 design students at various stages of their studies. Using principal component analysis, three dimensions of resilience were identified: resilience in work community, in technological development and in systemic problem solving. The findings suggest that students are aware of major shifts in their field and express varying degrees of readiness and adaptability across the identified dimensions. These results offer insights into how design education might better support students in navigating the uncertainties of future work.

Keywords

design students, resilience, future work, industry 5.0, society 5.0

Contextualising Change: Industry 5.0 and Society 5.0

Designers are increasingly faced with complex and changing challenges shaped by rapid technological developments and global sustainability requirements. In many areas of design, new solutions are shaped by data-driven tools, artificial intelligence and systems that adapt to user behavior based on their digital footprint. At the same time, societal changes and the sustainability crisis require a reassessment of the role of the designer in the future workplace. In this context, designers are expected to reflect on their responsibilities and competences in environments influenced by the visions of Industry 5.0 and Society 5.0 (Mortati, 2022). Understanding resilience among design students is especially important in the current context of rapidly evolving design challenges, shifting technologies, and increasing societal demands. While much attention has been given to future competences, less is known about how students perceive their ability to cope with these changes and shape their role within them.

Two influential frameworks describing transformations are Industry 5.0 and Society 5.0. Industry 5.0, developed primarily in Europe, envisions a human-centric, resilient, and sustainable industrial future where humans and machines collaborate to improve productivity

and well-being (Breque et al., 2021; Adel, 2022). Society 5.0, originating in Japan, proposes a "super-smart" society that balances technological progress with individual well-being and social problem-solving. It emphasises a deeper integration of physical and digital spaces, supported by AI, robotics, and the Internet of Things (Hitachi-Utokyo Laboratory, 2018; Salgues, 2018).

Although these are policy-level visions rather than theoretical models, they offer useful insight into the kinds of futures designers may need to navigate. For design education, they highlight a growing demand for systemic thinking, ethical awareness, and the ability to work interdisciplinarily, often in close collaboration with both humans and intelligent systems (Mortati, 2022; Al-Emran & Al-Sharafi, 2022).

Industry 5.0 and Society 5.0 emphasise the ability to deal with constant change and rapid development. Working environments, and therefore expanding professional opportunities, provide a challenging and unique use of designers' competence. Designers need open-mindedness and the confidence that their professional knowledge is adequate and will develop as the project progresses. Table 1 presents Industry 5.0 and Society 5.0 and their basic differences in a condensed form.

Table 1. Industry 5.0's and Society 5.0's frameworks summarised

	Industry 5.0	Society 5.0
Objectives and scope	A circular economy A focus on sustainability	A supersmart society Society as a whole
Key phrases	Industry supporting long-term service to humanity with planetary boundaries (Breque et al., 2021) From designing to people to designing with people (Schneorson et al., 2019)	The convergence of cyberspace and physical space A super-intelligent social services platform A human-centred society (Hitachi-UTokoy Laboratory, 2018)
Competences	Human centricity, sustainability and resilience (Breque et al., 2021) Communication, collaboration and systemic problem-solving (Schneorson et al., 2019)	An adaptive mindset Applied thinking Critical thinking (Mytra et al., 2021) Systemic problem-solving

According to recent literature, the core competences for future designers are the ability to have a holistic, ethical and interdisciplinary approach to design with a strong understanding of the United Nation's Sustainable Development Goals (SDG) and their implications and the ability to integrate sustainability thinking into all company activities (Adel, 2022; Al-Emran & Al-Sharafi, 2022; Andres et al., 2022; Lutfi, 2023; Mortati, 2022). According to Silver and Ruokamo (2024), industry is expecting the designers entering to field to have systematic problem-solving

competences and the ability to quickly adapt their competence, both technological and theoretical, to versatile business and client needs. Silver and Ruokamo (2024) also outlined new competences that should form the basis for design education. These competences most importantly include meta competences and the ability to solve systemic challenges. In this study, competence is understood through a holistic model that combines cognitive, social, functional and meta domains (Le Deist & Winterton, 2005). The holistic model of competence helps us to understand the combination of knowledge that is necessary for particular professions.

Although some recent studies have examined future competences or pedagogical reforms in design education (e.g. Choi & Song, 2022; Frascara, 2020; Wilde, 2020), only a few have focused on students' own perceptions or on how resilience may play a role in preparing for future work. Most existing research tends to emphasise curricular development from the educators' or institutional perspective, leaving a gap in understanding how students themselves experience and adapt to these systemic changes.

This study does not analyse Industry 5.0 or Society 5.0 in depth but refers to them as a contextual backdrop to explore how design students perceive the future of their work. While several publications have discussed the evolving competences required in design (e.g. Lahdenperä et al., 2022; Wilde, 2020; Noel et al., 2023), less is known about how students themselves anticipate these changes and what forms of resilience they feel are necessary. While this study approaches design education from a future- and industry-oriented perspectives, it is acknowledged that other framings such as critical, cultural, or socially driven perspectives also offer valuable insights into the role of design. The focus on resilience reflects one possible interpretation among many, and further research could explore how different conceptualisations of design education respond to broader societal, ethical, and environmental issues. This study contributes to addressing the gap by answering following research question: What are the dimensions and levels of resilience according to design students' views of future work?

Resilience and societal change in future work

Resilience, as a word, has its origins in the Latin verb resilire, which is defined as the ability to recover from difficult and harmful situations. Resilience also refers to the flexibility or elasticity of a material (Fletcher & Sarkar, 2013). While resilience can be viewed as a physical characteristic, it is also associated with the capacity of both organisations and individuals to respond to change. Resilience can be attached to meanings such as robustness, inner strength, competence, optimism, flexibility and the ability to cope effectively in challenging circumstances (Abiola & Udofia, 2011; Holling, 1973). Hamill (2003) referred to resilience as competence in the face of adversity, and Pooley and Cohen (2010) referred to resilience as resourcefulness, referring to using personal resources in different challenges. The European Commission defines resilience as one of the hallmark features of Industry 5.0 (Breque et al., 2021). Carmeli and Friedman noted that resilience is a two-dimensional construct, it refers to both coping with difficulty but also to the capacity to adapt (Carmeli et al., 2013). Adaptation, when it comes to the ability to work successfully in designers' future working environment, is an essential part of professional competence. As Fernandes and Varajão (2018, p. 816) noted 'Individuals play a very important role in organizations, by creating conditions that enable them to overcome difficulties, as well as to promote the organizational improvement and its overall

performance'. Changes in the design industry are significant and rapid, and new entrants need to be adaptable, motivated and ready to update both their competences and their knowledge in line with current needs.

In this research context, resilience is described as both the ability to adapt to the renewal of systems, environments and ways of working and the ability to see opportunities for personal evolution and dynamic adaptation to change. For the purposes of this study, the most relevant aspects of design education have been highlighted. In this study resilience is further defined through Dweck's framework, which emphasises the tendency to maintain interest in change and open-mindedness towards continuous change.

Duckworth and Dweck talked about 'grit' and a 'flexible mindset' when they described individuals' tendency to sustain interest, passion and persistence in regard to long-term goals or navigating in a constantly changing working environment (Duckworth et al., 2007; Dweck, 2010). Students with a resilient mindset typically make faster and more determined progress in their studies. Folke (2006) emphasised the necessity to manage by change rather than just reacting. Designers need the ability to tolerate uncertainty and apply their competences in working environments and situations that have not been simulated or taught during education. Resilience towards the continuous application of competences and working in constantly evolving and changing working environments are perhaps the most important competences of future designers. Dweck's (2006) research on growth and a fixed mindset provides a valuable framework for understanding how design students perceive and respond to challenges. A growth mindset, characterised by the belief that abilities can be developed through effort, is closely tied to resilience, which is crucial in navigating the future working environment in the design business (Dweck, 2006).

Each societal change has required resilience from the workforce and the ability to adapt to new situations. Technological, economical and societal improvements have set new challenges during each industrial and societal phase (Rohne Till et al., 2024). Set in the 1960s, Industry 3.0 and Society 3.0 were characterised by the shift from mechanical and analogical processes to digital technology and automation (Schwab, 2016). Industry 4.0 and Society 4.0 were characterised by the dominance of information, digital technologies and automation, marking a shift towards smart factories and cyber-physical systems (Schwab, 2016). Industry 5.0 and Society 5.0 emphasise human creativity, problem-solving and customisation in production process. Society 5.0 addresses human-centred society that, 'through the high degree of merging between cyberspace and physical space, will be able to balance economic advancement with the resolution of social problems' (Hitachi-UTokoy Laboratory, 2018, p. xii). At the same time, Society 5.0 emphasises lifelong learning and people's ability to adapt their competences to the circumstances at hand and modify and develop knowledge (Carter et al., 2019).

Methodology and data

Data was collected by questionnaire in 2023. The questionnaire was developed collaboratively with participants of a doctoral seminar at University of Lapland, ensuring that both academic and practical perspectives were considered. The structure and content of the questionnaire were formed by previous surveys conducted in similar contexts within design education. Prior to distribution, the questionnaire was pilot tested with a small group of design students at the

university of applied sciences. Based on their feedback, minor adjustments were made to improve the clarity and order of the questions.

A total of 92 design students from two Finnish higher education institutions - one university and one university of applied sciences - participated in the study. These institutions were selected because they both offer cross-cutting higher design education. Participation in the study was voluntary. As this is a small-scale study conducted in Finland, the findings do not aim for generalisability but offer insight into how students perceive future challenges in design within a specific national and educational context.

The design students were at various stages of their bachelor or master level studies, with specialisations in digital design, service design, visual communication design, AR/VR/XR design, and industrial design. The data collection was divided into three parts and the questions were related to the work community, technological development and systemic problem-solving. Gender, age and credit accumulation were asked about to gather background information. Credit accumulation was indicated according to the European Credit Transfer and Accumulation System (ECTS), where one academic year corresponds to 60 ECTS credits. In this study, the students were grouped as follows: first year (10–60 ECTS), second year (60–120 ECTS), third year (120–180 ECTS), and fourth year (>180 ECTS). This categorisation reflects the typical European degree structure, where students may take longer than three years to complete a bachelor's degree due to individual study paths or participation in internships, exchange studies, or part-time study. The responses were given using a five-point Likert scale ranging from 1 ('Strongly disagree') to 5 ('Strongly agree'). The statements were designed to assess students' beliefs and attitudes regarding the future of design work and their own role as designers. The prompts included statements such as "In the future, designers will increasingly work in multidisciplinary teams" and "At a personal level, I want to contribute to solving systemic problems (e.g. the climate crisis, natural catastrophes, inequality, ageing population).

Data were analysed using IBM SPSS Statistics 28. First a principal component analysis (PCA) with varimax rotation and KMO and Bartlett's test of sphericity was performed. The Kaiser criterion was used to determine the number of principal components. The aim of the analysis was to identify variables indicating resilience and its sub-areas. Reliability analysis was then conducted on the key variables (loading>.5) of the principal components to assess their reliability and measurement capability. Based on the results of PCA three composite variables were computed representing different dimensions of resilience and they were analysed using descriptive methods.

Results

What are the dimensions and levels of resilience according to design students' views of future work?

PCA resulted three components. KMO value .723. was higher than .50 and hence the analysis met the criteria of sampling adequacy. The Bartlett's test of sphericity was significant (<.001).

The first component was named 'Resilience in the work community', which reflects the ability of designers to adapt and thrive in different collaborative environments. The component title highlights the designer's ability to adapt to teamwork development, engagement with diverse

stakeholders and the ability to navigate complex social dynamics in multidisciplinary and inclusive design contexts.

The second component was named 'Resilience in technological development' in order to describe the evolving role of designers in navigating and shaping technology-driven interactions. This component title highlights the ability to adapt to technology-mediated communication, the enthusiasm to take on human–machine interaction expertise and the open-mindedness to work in new areas, such as augmented reality and virtual reality (AR/VR) design.

The third component was named 'Resilience in systemic problem-solving', reflecting the crucial role of designers in solving complex global challenges. The component title refers to the readiness to move from product and service design towards solving systemic problems (such as the climate crisis, inequality and population ageing) and the personal and professional commitment required to adapt to the changing nature and content of design work in response to these challenges. Table 2 shows the results of the principal component analysis and reliability analysis.

Table 2. The results of the principal component analysis and reliability analysis: Dimensions of resilience

Claim	Resilience in the work community	Resilience in technological development	Resilience in systemic problem-solving
In the future, the designer will increasingly work with a wide range of stakeholders.	**.802**	.064	.309
In the future, designers will increasingly work in multidisciplinary teams.	**.870**	.060	.060
In the future, designers will increasingly work with the public in a non-technological way (e.g. citizen participation in design projects).	**.575**	.097	.097
In the future, a designer's work will be based more on technology-mediated interaction than on face-to-face interaction.	-.234	**.726**	-.036
In the future, designers will increasingly be needed to design human–machine interaction.	.358	**.730**	.094
In the future, designers will increasingly be needed for augmented reality and virtual reality design.	.077	**.724**	.261
In the future, designers will be needed more to solve systemic problems (e.g. the climate crisis, inequality, an ageing population) than to design concrete products or services.	.155	.282	**.668**

At a personal level, I want to contribute to solving systemic problems (e.g. the climate crisis, natural catastrophes, inequality, ageing population).	.018	.089	**.612**
The climate crisis affects the way designers work (e.g. teleworking, the use of equipment and materials).	.467	-.033	**.659**
The climate crisis affects the content of the designer's work (e.g. the designer addresses the challenges posed by the climate crisis).	.107	.016	.797
Cronbach's alpha	.724	.631	.685

Resilience in the work community

'Resilience in the work community' consists of questions that highlight the ability of designers to work in multidisciplinary teams and with multiple stakeholders. Loadings indicate that items related to collaboration with stakeholders and multidisciplinary teams are strongly associated with one another, suggesting that these aspects form a coherent underlying dimension within the data structure. Multidisciplinary and working alongside people with a different professional background have been a tradition in Higher Education Institutions (HEI) for a long time, but now, with Industry 5.0 and Society 5.0, the ability to work in a multidisciplinary team is becoming a standard rather than a curiosity. During their studies, students become accustomed to working in client-based projects involving an increasingly wide range of representatives from different departments on the employer side. On the other hand, multidisciplinary cannot be emphasised enough and even though the students seem to be familiar and comfortable working with versatile team settings, this should be kept as standard practice and not as an exception during the studies. Collaboration with the public was not well identified among students. This may indicate, among other things, that work-life projects in HEIs are largely carried out in cooperation with companies and not with social actors.

Industry 5.0 and Society 5.0 are about human-centric design, and this, in turn, requires authentic collaboration with the public (Lahdenperä et al., 2022). Working with the public in a non-technological way was less prominently identified among the students. This may be because the students do not fully comprehend what this concept means in practice. The current pedagogical paradigm of design education in HEIs does not allow, in most cases, for genuine and wide-ranging collaboration with the public. Society 5.0 and the Internet of Humans (IoH) demand active citizen participation in the form of providing data in different purposes for data gathering and design. User-centred design and its methods are familiar frameworks to designers, but the way in which cooperation and planning itself is carried out with civil society in a Society 5.0 environment seems to still be a bit unstructured. However, the results reveal that the students recognise the change in design protocol. One interpretation of the results is that they show that the students already recognise the importance of collaboration with the public and that it is actualising in workplaces, even if it is not possible in HEIs.

Resilience in technological development

Based on the research, the design of virtual spaces and human–machine interaction are

identified as a part of design students' future work. With technological advances, the work of designers might eventually shift also in designing for virtual spaces and experiences. Individual breakthroughs in working in virtual spaces have already been seen, such as concept of remote surgery and a virtual-training surgical theatre in Stanford (Erickson, 2017).

AR/VR experiences and spaces, which are increasingly adopted in various industries, were not considered more important than other types of design projects by the students in this study. This finding may be related to visibility or integration of AR/VR technologies in students' current educational design environments, which could make it more difficult to anticipate their future relevance. The lack of resources for virtual spaces in higher education institutions and a shortage of skilled labour in HEIs might influence students' ability to recognise and take advantage of new technologies. The high level of investment and the rapid development of technology contribute to making it more difficult for universities to deepen their knowledge in this area.

The design students' views toward technological development correspond well with the European Commission's characterisation of digital resilience (European Commission, 2020). Curiously, 'Resilience in technological development' appears at a slightly lower level than other two components. This may be influenced by the perceived lack of new technologies in learning environments and also by the technological utopianism that is sometimes associated with AR/VR technologies in public debate (Coenen, 2007; Dai & Hao, 2018; Dickel & Schrape, 2017).

Based on the results, the 'supersmart society' that will be brought about by Industry 5.0 and Society 5.0 has not yet penetrated higher education (Hitachi-UTokoy Laboratory, 2018). 'Super-smart society' refers, among other things, to design work that combines physical space with cyberspace. This in turn brings in a new kind of design work that takes place at the interface between the real and virtual worlds and how they are combined, for example, in the development of smart homes and similar environments. Students should be familiar with and prepared to take ownership of the constant development of AR/VR realities and those environments' possibilities and realities in future society; they should also be familiar with virtual working spaces. Face-to-face interaction remains, but there is a significant increase in media-mediated project work.

Resilience in systemic problem-solving

In Industry 5.0 and Society 5.0, designers are increasingly needed to solve systemic problems due to their ability to bring and combine multiple design methods and their collaboration competences (Frascara, 2020; Noel et al., 2023; Redström, 2020; Wilde, 2020). 'Resilience in systemic problem-solving' describes the students' ability and motivation to face and solve large-scale global challenges such as the climate crisis, inequality, aging populations and dwindling natural resources.

The difference between the impact of systemic problems and climate change on future jobs can be partly explained by the visibility of the themes in public debate and in the commissioning of projects by educational institutions (Ávila et al., 2017; Friman et al., 2018; Hess & Collins, 2018). Acknowledgement that Industry 5.0 and Society 5.0 support the development of a sustainable world and underpin the efforts to achieve it is discussed, for example, by Kasinathan et al. (2022). External funding, including for higher education institutions, has at times included climate change issues and mitigation mandates. However, the availability and prioritisations of

such funding has varied significantly across regions and political contexts and is often influenced by changes in government agendas and broader policy shifts. The integration of these projects into teaching has made the work and research projects related to climate change familiar to students in the field and thus revealed the presence of climate change in their everyday work. A similar thematic upsurge has not been seen, at least so far, in the case of the mainstreaming of systemic problems. The responses reveal that design students have not fully grasped the scale of social change. Projects on systemic problems, for example, involve work across local and national boundaries. Designers are increasingly involved in projects where expertise and possible consultancy comes from international actors or collaborative partners.

The concept of Industry 5.0 and Society 5.0 are regarded as a development trend that is conducive to environmental sustainability, with a focus on sustainability and human-centric concerns. Prior to the implementation of these changes, climate issues assume a substantial role in the realm of sustainable design. However, the research did not reflect the level of recognition and awareness of the impact of environmental change. As Wang et al. (2024) astutely pointed out, designers' role in the sustainability discourse is not just designing for products and services with a lower carbon footprint. Instead, it has to do with making sustainability more accessible and comprehensible to a wider audience (Wang et al., 2024). Calvo and De Rosa (2017) also pointed out that designers are enhancing well-being, addressing issues of justice and acknowledging cultural diversity. These aspects of design are seldom addressed in design education, leaving students with no comprehension of a major part of design responsibilities in working life.

Working with systemic challenges requires the ability to tolerate one's ignorance and the willingness to abandon old ways of working and develop new ones. Resilience in this aspect could refer to processes that limit stress-related negative behaviour. Resilience is particularly important in situations where complicated challenges are encountered so that one is not paralysed by challenges but faces adversity with motivation and perseverance (Bandura et al., 2001; Cassidy, 2015).

Levels of design students' resilience

Table 3 provides an interpretative overview of how different levels of resilience may manifest in various dimensions. The levels are based on Likert scale groupings (1–2 = low, 3 = moderate, 4–5 = high) and are intended to support a deeper understanding of how resilience might present itself in each dimension. The descriptions of each level aim to contextualise how differing levels of agreement may reflect varying degrees of adaptability, motivation, and readiness in relation to future design work.

Table 3. Interpretative overview of different levels of resilience

Levels	Resilience in the work community	Resilience in technological development	Resilience in systemic problem-solving
4–5	Enjoys working in a variety of working environments and adapts easily to different configurations in the work community	Is enthusiastic about new technologies and willing to try them out without reservations	Enjoys new challenges and tolerates feelings of uncertainty well
3	Adapts to different work communities and working	Prefers familiar technologies; has some	Prefers to work on clearly defined challenges; adapts to

	environments but does not seek them out for himself/herself	reservations about adopting new technological environments/devices	feelings of discomfort in work projects
1–2	Avoids changes in the working environment and working teams; works independently as far as possible	Avoids new technologies and sticks to the old ways of thinking for as long as possible	Avoids complicated projects and feelings of discomfort in work projects

A boxplot (see Figure 1) shows the levels of different resilience dimensions among design students. Figure 1 presents the dimensions and levels of resilience according to the design students' views on resilience in regard to the work community, technological development and systemic problem-solving.

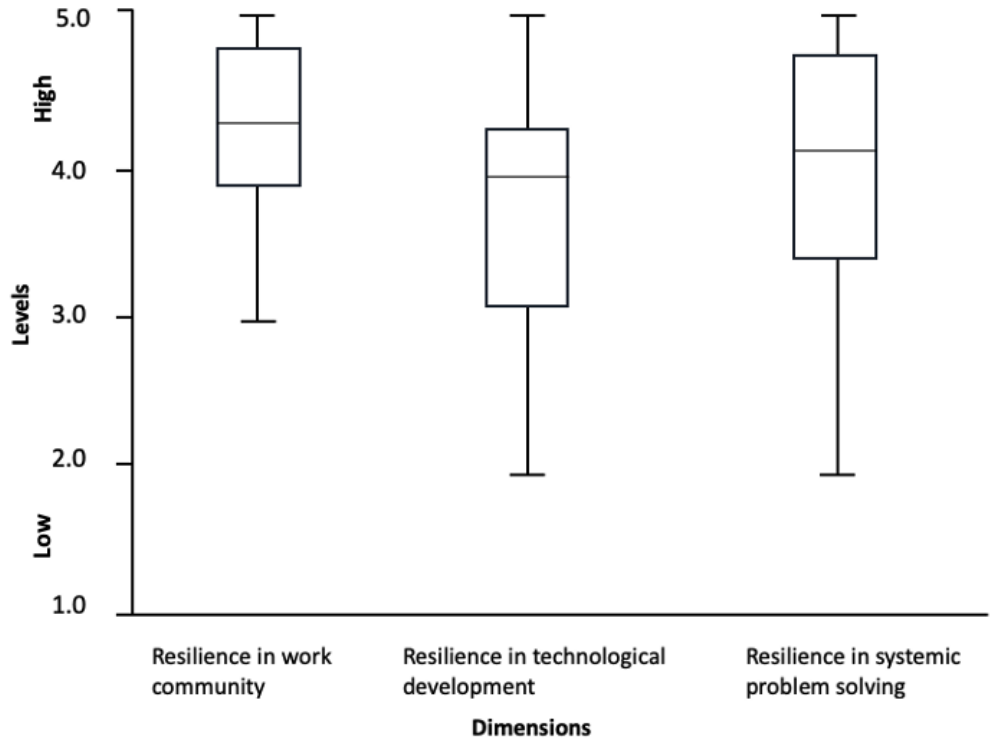

Figure 1. The dimensions and levels of resilience according to the design students' views on resilience

The horizontal axis represents the different dimensions of resilience, while the vertical axis illustrates student responses. The boxplot visualises the spread and central tendency of responses across the three resilience dimensions. The results show that the median score for 'Resilience in the work community' is high, with a relatively narrow interquartile range and values clustered between 4 and 5 for the majority of students. However, a proportion of responses also fall below this range, indicating that not all students share the same level of confidence in this area. Rather than full consensus, the results suggest that many students feel confident in their collaborative abilities, but there is still some diversity in how these experiences are perceived.

The boxplot also reveals broader variation in the dimensions of 'Resilience in technological development' and 'Resilience in systemic problem-solving'. In particular, 'Resilience in technological development' shows the widest range of responses—from 2 to 5—which may reflect significant variation in students' familiarity and comfort with emerging technologies. This indicates that technological confidence is not yet evenly distributed among design students.

In 'Resilience in systemic problem-solving', the median response is also relatively high, but with noticeable variability. This suggests that students recognise the importance of systemic challenges such as the climate crisis or inequality yet differ in their own perceived readiness to engage with these issues.

The component data provides insight into overall trends, but it is important to note that individual items within each component may vary in response patterns. Therefore, while the components help highlight key areas of resilience, variation at the item level should be considered in future studies to explore the nuances of student perspectives more deeply.

Overall, the results suggest that while many design students demonstrate strong readiness in collaborative contexts, their views regarding technological change and complex societal problems are more heterogeneous. These findings offer a useful basis for considering how design education can better support different types of resilience in response to future challenges.

Discussion

The Industry 5.0 and Society 5.0 frameworks provide topical reference points in relation to the future competences of design students. Industry 5.0 and Society 5.0 rely on three core elements: new types of work communities, technological development and systemic problems (Carayannis & Morawska-Jancelewicz, 2022). As stated by European Union publications, the new society attempts to balance economic development with the resolution of societal and environmental problems (Breque et al., 2021). Dguchi and Karasawa (2018) discussed about the new industrial and social era being more than the smart city; it is not just smart but 'supersmart' (Hitachi-UTokoy Laboratory, 2018). The development of cutting-edge technology, big data, AI and the deepening of systematic problems demand for collaboration and communication at all levels and between disciplines (Carayannis & Morawska-Jancelewicz, 2022; Hitachi-UTokoy Laboratory, 2018; Lubis & Lubis, 2024; Mytra et al., 2021; Suganya et al., 2024). Multidisciplinarity and the ability and readiness to work with multiple stakeholders are therefore the core competences for future designers.

The new operating environment emphasises the importance of citizens as the end users of technological solutions and as the data providers of new product and service innovations. As Hitachi-UTokoy Laboratory (2018, 165) put it 'Society 5.0 is a society that facilitates innovation by citizens and for citizens and that is itself the product of the aggregate of such innovation'. Therefore, designers' ability to work alongside with citizens, carefully reviewing the needs and translating them into products and services that are feasible, is a vital role for future designers. Industry 5.0 and Society 5.0 force societal actors to increasingly consider global climate change challenges in all their activities. The SDGs framework and stakeholders' willingness to take

sustainability into account at all levels will also influence designers' job descriptions and project briefs.

In addition to the quantitative results of the survey, the open-ended responses provided valuable information about how students see their future work. Responses reveal that students' resilience involves reflection, uncertainty and ethical considerations. Many students described how their understanding of the work of a designer had evolved during their studies. Some reported increased clarity and confidence in their future tasks, while others became more aware of the complexity and ethical dimensions of the field. Technological developments, the impact of artificial intelligence and sustainability challenges were seen as new challenges. Several respondents saw the potential of new tools, while others expressed concerns about their ability to keep up with technological developments or the impact of automation on creative work. A recurring theme in the responses was the desire to work in a way that reflects personal values and to be involved in solving broader societal challenges. Several students emphasized the importance of designing with social challenges and environmental impacts in mind. Many also emphasized the emotional and cognitive work required to cope in a rapidly changing and uncertain world.

The students' reflections suggest that resilience is not only about coping with change, but also about forming a professional identity, reassessing personal values, and finding meaning in their future careers. In addition to technical skills, students crave opportunities for critical thinking, discussion, and the ambiguous role of a designer in the future of work.

Based on the results of this study, the challenge in reforming design education is therefore not related to the students' ability and willingness to undergo change in design education development but relates to the HEIs' ability and willingness to undergo this change. The change in working life is so significant that it requires a change and update in teaching content and pedagogical solutions; this, in turn, may be seen as resistance from the teaching staff.

Limitations and future research

The design students who participated in this study have a versatile design background, which may affect their interpretation of how changes in the design field relate to their future working environment. To gain more detailed and generalisable insights into design students' understanding and views toward change, a larger and more diverse sample would be necessary. This study was conducted in Finland and provides an overview of the situation in Finnish design education. The results are a starting point for building a broader understanding of students' capabilities in adapting to change.

The research did not examine how current curricula or educational content in higher education reflect changes in working life and society within the content and framework of design projects. As a result, the participants did not need to reflect directly on how their current education and training support the competences needed for their future careers.

In addition, there are some limitations related to the validity of the questionnaire itself, even within the Finnish context. The instrument was developed specifically for this study and, although it was pilot tested and informed by previous reserach, it has not been validated through broader empirical or cross-institutional testing. The interpretation of the identified dimensions is based on the researcher's conceptual framing of resilience, which may influence

how student responses are grouped and understood. Future research could benefit from further development and validation of the instrument across different educational and national contexts.

Conclusion

The research answered the following research question: What are the dimensions and levels of resilience according to design students' views of future work? The research findings were based on 92 answers gathered with a questionnaire from design students in 2023. Industrial and societal change reshape what is expected of the future workforce, including designers. The overarching theme for the change is the concept of a supersmart society which combines technology, data and human-centric design. Among technological know-how, the emphasis lies in soft skills and understanding of how to combine, for example, worldwide systemic change, climate change and worldwide ageing with multiple stakeholders' needs and cross-cutting teamwork. Resilience plays significant role in coping with change. According to the study, the design students' levels of resilience are good in relation to the three dimensions of future work: 'Resilience in the work community', 'Resilience in technological development' and 'Resilience in systemic problem-solving'.

The responsibility of equipping the future designers with the modern know-how lies with higher education institutions. The results of the research propose that HEIs should seize the moment and critically examine their design curricula to better meet the needs of new industrial and societal demands. As Carayannis and Morawska-Jancelewicz (2022, 3445) put it: 'Universities are created to tackle the unknown. While their future cannot be planned, the tools they have at their disposal to meet the future can be improved.'

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