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An analysis of international design education programs training students' competencies and skills for tackling complex social challenges

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This paper presents a study investigating the competencies and skills related to dealing with complex social challenges that are taught in top-ranking international design universities and colleges. It starts with a literature review to identify the required competencies and skills for designers to do so. 6 main clusters of skills: obtaining a comprehensive perspective, overcoming disciplinary barriers in collaboration, communication, and negotiation, integrating management logic and mindset, utilising continuously evolving technology, and traditional design skills, as well as 14 sub-clusters of skills are categorised. Afterward, the study analyses the syllabus, program, and course descriptions of 16 design education programs that focus on educating future designers to tackle social challenges to understand which are the commonly taught skills, and which are the less commonly covered ones. The analysis results enable us to generate an overview of the state of the art of current design education programs that consider training designers to participate in solving society's complex problems. The paper ends with discussions and reflections on the potential directions of future studies on similar topics.

Keywords: design education; design competency; social challenges; complex problem

1 Introduction

For centuries, design is mainly perceived as a creative tool and expertise to build new, different, and competitive artifacts that people like. Thanks to some studies and the success stories of leading design companies in the early 90s, the "human-centred" feature has been more acknowledged by the private, public, and different organisations and associations to solve users' problems and create solutions to satisfy the unmet needs. However, in recent years, more urgent and significant problems need to be solved in which designers could and should actively participate. Solving these complex problems requires capabilities and skills beyond creativity and the human-centred approach. The attention and awareness of design's impact on society and nature have been recalled, and the notion of design for society reminds the whole design discipline to support the whole and human beings to face new challenges.

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In this paper, we first conduct a literature review examining the required design competencies and skills that are becoming much more important for training future designers who will work on complex social problems and should always consider the social impact and values in their design actions. Eventually, the research on the literature identifies 6 main clusters of capacities and skills, which include 14 specific sub-clusters of skills. This result is present at the beginning of the methodology part and is used as the protocol for the analysis. The analysis is conducted on 16 selected design education programs based on the university ranking and education focus. The results are generated through analysing second-hand information and data on each selected design program and summarized at the end of the paper.

2 Theoretical background

In this part, we first present the general reflections on the future of design education for responding to the urgent global development needs, especially the social aspects of these challenges and problems. Then, we explore the literature on discussing all the specific capacities and skills to present a comprehensive understanding.

2.1 An urgent need to rethink design education for the future

Nowadays, designers are increasingly involved in complex and impactful issues: the context in which design activities are conducted has changed radically regarding what to design and how to design. The scope of design has been broadened, from managing businesses and organisations to bringing a human-centred perspective in the policy-making process and creating sustainable living habitats for diverse citizens.

However, the full potential of design, especially to face complex social phenomena and problems, is yet to be fulfilled and recognized. It is very promising to envision and project the role of design and designers in five and ten years and, consequently, to imagine the characteristics and capacities that future designers should have to work and thrive in that scenario. Therefore, as educators and researchers, it is necessary to ask: has design education updated and evolved with the new demands of our society's development?

Literature and previous studies have emphasized how design education should further change (Meyer and Norman, 2020; Noël, 2020; Norman, 2011; Pontis & van der Waarde, 2020). Specifically, Meyer and Norman (2020) express their concerns regarding the fact that design education is not addressing the new demands of the 21st century. Since the scope of design broadened, as stated by Manzini, the contents of university programs should be expanded, considering the complex nature of contemporary design, the diverse fields in which designers could work, and the variety of artifacts they could produce (Frascara, 2020). Indeed, the increased complexity of the current work and global context represents a crucial aspect: each process and event are tightly connected to others, requiring a change in the designers' approach (Peruccio et al., 2019; Voûte et al., 2020). Therefore, the design education system should update to properly train students. As Noël (2020) says "If we claim that designers can solve the complex problems of the world but we cannot improve design education, then our claim cannot be sustained."

Moreover, designers' job has evolved: professionals will not stay in the same workplace for their whole career; instead, they will have a succession of positions. They will be asked to learn continuously to

adapt to their new occupations and the evolving contexts, challenges, and topics (Voûte et al., 2020). This represents a major variation in professional practice that requires a related change in what and how design is taught (Pontis & van der Waarde, 2020). Indeed, design universities should equip students with capacities and mindsets that could be applied to diverse situations rather than with fixed tools and techniques. Buchanan stated that education should prepare for lifelong learning (Frascara, 2020). This ensures that when future designers face new challenges, they will know how to adapt the learned skills and knowledge and address them properly.

It emerges how design universities should modify their teaching to address the mentioned topics and challenges. Many design universities and schools currently provide basic and fundamental capacities, skills, and knowledge in the design discipline and practices. However, many of them have already recognized the need for future designers to deal with the increasingly complex and constantly evolving context, focusing on the impact and transformative roles of design on issues related to our society's future.

2.2 Preparing future designers with a new mindset to center human, nature, and society in design actions

High education institutions are responsible for training design students to gain crucial skills for transforming our modern societies. This transformation requires a 360-degree approach considering economic, environmental, societal, and cultural aspects. The most important strategic policies and guidelines – such as 17 SDG (2030 agenda), and the Green Deal - act as a call to action to address current global issues with a comprehensive approach, emphasizing the need for variegated teams and strategies, in which designers may play a relevant role. These global policies also highlight how the boundaries of design interventions are becoming increasingly loose, requiring multifaceted solutions to solve complex interdisciplinary problems (Ni & Cattaneo, 2022). Specifically, in recent years, social factors have influenced diverse fields of practice, including education, urban systems, mobility, medical and elderly care, public health, safety, disaster management, and sustainability. This means that future designers dealing with and working on social challenges will directly impact industries, private and public systems, communities, and society as a whole. Moreover, aware that all the design actions have an impact on the human, nature, and society no matter in which sector they work in, on which product, service, and systems they are designing for, it is essential to equip future designers with the proper mindset and skills.

Therefore, the idea that drives this research on defining the important capacities and skills of future designers is that design can and should help to transform our society and complex societal systems, and all the design artifacts should not be considered isolated but in relationships with people, context, and systems. Designers take a greater responsibility than ever. Weil & Mayfield (2020) stated that they have witnessed a shift from design research roles towards roles focused on social and civic impact through developing services, interventions, and policies that existed in complex systems and served larger and more diverse populations. This opens new reflections for design schools and educators: what are the capacities and skills that enable future designers to fulfil the notions and changes mentioned before? How could we offer updated content and ways to train and educate our future designers?

2.3 The required capacities and skills for curriculum content development in social design education

In this part, we will present the research on the important capacities and skills that future designers need to take part in solving social problems. It focuses on identifying the different categories of capacities and skills that should be included in curriculum content for training future designers. Teaching these capacities and skills to students in the design discipline is very challenging because this requires a process that includes translating knowledge, aggregating skills, and integrating practices. Therefore, this research paper specifically focuses on discussing and studying the "curriculum contents" in Design Education Pedagogy – what educational contents (capacities and skills) the design schools should offer to future designers. For example, the pedagogical models and means are not included in the scope of this study.

1.1.1 Obtaining a comprehensive perspective

The larger (social) problems that we are currently facing and will continuously face in the future are very complex and interrelated with one and another. The level of complexity is much higher than the one of conventional wicked problems (Buchanan, 1992) that designers tackle. Therefore, to deal with the complexity, future designers must gain the competencies to generate comprehensive views and perspectives on social issues. Future designers should equip themselves with new mindsets, perspectives, and practical skills to embrace complexity (Weil & Mayfield, 2020) by facilitating the process of understanding, collaborating, and taking action. Specifically, we identified three types of core capacities that assist future designers to fulfil this mission.

Firstly, it is essential to gain a systemic perspective and approach to understand and articulate and then intervene in the social problems (the social aspects of the problems) and the contexts in which they are situated. The importance of training systemic and holistic thinking skills has been mentioned in several papers that discuss the evolution of design education (Brosens et al., 2022; Norman, 2014; Weil & Mayfield, 2020; and Wiek et al., 2011). This capability enables designers to generate a comprehensive view and understanding of the problems and to break them down into manageable elements with a logical structure. Moreover, designers learn to identify the leverage (intervention) point and the potential frequencies and outcomes on the related actors, relations, and the whole system. The systemic design methodology and tools (Jones, 2014; Jones & van Ael, 2022) have also gained attention by both the academic areas and the practical world.

Another element that future designers could not ignore when dealing with complex social problems is the ethics issue: the ethics of product, service, system, and the values that they bring to users, communities, and the society. Also, designers face new and different territories, with specific cultures, and values systems. They should be equipped with the principles to guide their design choices and decisions (Meyer & Norman, 2020). Future designers will take more responsibility to act as gatekeepers for appropriate practices and procedures in companies and organizations that produce or provide the designed products and services (Justice, 2019).

Thirdly, the emphasis on teaching critical thinking to designers is widely accepted as a fundamental professional ability to solve complex problems situated in interconnected contexts and systems (Lopez-Leon, 2017; Evans, Menold, & McComb, 2019). The capacity to critically reasoning a desirable solution, vision, and future direction should be taught in every domain of design regardless of the

subject and the theoretical or practical orientation. This element has played a crucial role in developing the theories and methods in critical and speculative design (Dunne & Raby, 2013).

2.3.1 Overcoming disciplinary barriers in collaboration

The second cluster focuses on the capacities related to "disciplinarity" - the necessity and importance of collaboration and cooperation through inter-discipline, multi-discipline, trans-discipline, or even anti-discipline approaches (Ito & Howe, 2017). The complex social problems are inter-sectoral and inter-disciplinary. To solve them, on the one hand, requires involving stakeholders from public, private, and the third sectors in different industries; on the other hand, it needs knowledge, know-how, and practices from a variety of disciplines that were not traditionally connected (such as healthcare, insurance, circularity and so on) (Voûte et al., 2020). If future designers will contribute to this scenario, what are the capacities to obtain?

Sanders & Stappers, (2008) have presented an evolutional role of designers in the process of design and development of solutions, especially in terms of the relationship with the users. The notion of co-design and co-creation has shaped the designers' capabilities of being coaches, guides, and mentors to facilitate users and the whole communities to actively participate in researching, generating, and implementing creative solutions to reply to the social challenges (Meyer & Norman, 2020). Future designers will be able to build on the existing initiatives in the community and trigger more promising ones to level up the results and realization of the participatory process (Manzini & Rizzo, 2011).

It is well acknowledged that design is "human-centred" thanks to the diffusion and success of Design Thinking (Brown & Waytt, 2010; Liedtka, 2015; Lockwood, 2009; Martin, 2009). However, many of today's complex problems require collective action, in which "human" has an extended meaning: all the relevant actors/stakeholders in the system. Therefore, the design actions address not only the "end-users" needs and aspirations, but also create storytelling and generate tangible ideas that help engage and motivate diverse actors/stakeholders towards more significant impacts (Weil & Mayfield, 2020). To fulfil the notion of co-design and co-creation, designers' capacity to involve actors/stakeholders is multifaceted, from being aware of the importance of building accessibility to the participatory processes to developing situated tools for facilitating the contexts and occasions to meet, discuss and collaborate among them.

With all said above, future design students should learn not only the skills of design itself but how a team functions and how different roles act in a team. Working on tackling complex social problems requires breaking the old habit of individuality by prompting students to work productively with others (Noël, 2020). This enables design students to get used to working in environments and contexts that are intercultural, interdisciplinary, and hybrid with both physical and digital/online interactions with team members. To be able to work with others and actively engage others in a co-design and co-creation process, design students should possess the capabilities to motivate, negotiate, and facilitate through effective communication, empathy, and more importantly leadership (Wiek et al., 2011). Future designers will not only facilitate content generation but also be responsible for team function and teamwork. Designers should learn and balance their positions of leadership and fellowship in the team and the co-creation process. Compared to other professionals, designers also play the role of a mediator to help others better understand the situations by visualizing the complexity, mapping the hidden information, and presenting diverse perspectives (Pontis & van der Waarde, 2020), which helps to build the significant common basis to start conversations.

2.3.2 Communication and negotiation

The third cluster looks at the designers' future capacities and skills related to communication and negotiation (Brosens et al., 2022; Kunrath et al., 2020). On the one hand, it is necessary to communicate projects and activities clearly and effectively to diverse actors, recognizing how different audiences require different ways of presenting due to their levels of expertise and involvement. This enables designers to show the project's values and to nurture the implementation of design ideas and solutions. On the other hand, setting collaborations and establishing networks and rapport is also significant in motivating stakeholders' involvement and participation in the design and research actions. Wiek et al. (2011) stated that design students should possess communication skills to motivate, negotiate and facilitate inter-disciplinary collaborations.

2.3.3 Integrating management logic and mindset

Scholars and educators have pointed out that designers also need management mindsets and skills to shape solutions in a rapidly changing and challenging world (Hawari-Latter et al., 2021; Voûte et al., 2020;). Brosens et al. (2022) revealed that research on design education has presented entrepreneurial and business thinking skills as a needed part of the designer skillset. Wilson & Zamberlan (2017) has also highlighted the notion of training designers' entrepreneurship capacities beyond the fiscal growth to include the social impact and changes. It aims to develop the sense of identity and new venture creation and support start-ups and agencies for social contributions. Designers need to understand business logic and speak the business language to make the best contribution of design and creativity to purpose-driven and impact-driven solutions. Future designers should also be aware that very few well-defined positions in existing companies and associations provide the opportunities and contexts to work on social challenges and problems. Therefore, interdisciplinary entrepreneurship education (Winkler et al., 2021) should be given more acknowledgment and attention in design education.

2.3.4 Utilising continuously evolving technology

The increasingly growing roles of technology that play in our society call educators' reflections on how to train students' capacity to deal with it. The arising research areas, like design and artificial intelligence (AI), design and data, design and advanced manufacturing, have attracted many design scholars and practitioners. However, there is still a lack of research outcomes on how to equip future designers with the capacity and skills to use technologies that continue to evolve and prepare students to be able to find the best ways to integrate and utilize technology (Coorey, 2016; Meyer & Norman, 2020).

2.3.5 Traditional design skills

Considering designers as professionals requires defining unique and irreplaceable capacities and skills that distinguish them from other professionals and disciplines – here referred to as traditional design skills. Norman (2011) emphasized that the classically trained designers for styling, for forms, for the intelligent use of materials will never go away. One of the most important skills a designer obtains is the ability to visualize and think through drawing (Cross, 2001; Schön, 1983). In complex systems, visual thinking and the use of diagrams and maps make it possible to visualize knowledge, making explicit the directions and intentions of the project team and creating a shared vision (Ricci, 2009). This nature of designers facilitates to form many previously discussed capacities and skills, such as stakeholder engagement and communication with diverse actors.

Mulgan and colleagues (2007) have pinpointed that in social innovation practices, there is a strong need for widespread support from practical skills in design: prototyping, pilots, experiments, evaluation, and iteration. These skills enable to transform the ideas and concepts into tangible and scalable artifacts, which provide the possibility to test and improve possible solutions, as well as foster visible and impactful social changes.

Designers need to continuously develop and acquire knowledge on materials for making design decisions and updated results aligned with global development strategies and paths. The urgent considerations on circularity, ecological sustainability, and cultural and social inclusiveness will make the selection and potential utility of materials more much complex and sensitive, both on the functional performance and representative meanings behind them (Haug, 2019; Santulli & Rognoli, 2020).

It is known that the aesthetics of a design solution influences user perception and adoption of products and interiors. When design deals with more complex social issues and form new types of solutions – such as service systems and interaction experiences – the beauty can also be understood as a "combination of practical use and intrinsic value" and a "social and ethical dimension", which influences the behaviour of individuals and societies. (Pacenti, 2019; Ross & Wensveen, 2010; Shusterman, 2000). Nielsen et al., (2019) stated that aesthetic qualities can be used to support cultural preferences and foster inclusion, which are crucial elements of the development of our society.

3 Research methodology

The first step of literature review on the capacities and skills that future designers need to deal with social changes provides the opportunity to explore and present a comprehensive view and understanding of these required capacities and skills. The literature review result is then transformed into a research tool for analysing existing design education programs that focus on the social aspect of design and commit to teaching design students methods and skills for studying emerging social challenges and developing potential solutions to solve these social problems. Specifically, the second research activity aims to investigate: 1) whether the required skills are taught, 2) which of them are considered as priorities, 3) where the space is to make improvements and further reflections.

3.1 Design the research tool: protocol development

Firstly, we have developed a protocol based on the literature review results on the relevant skills that future designers will need to deal with social challenges (Table 1). This protocol consists of a grid with the list of identified and clustered skills explained in Chapter 2.3. Each cluster of skills describes an area of knowledge and capacity that includes several specific sub-skills (except the cluster related to capacities to use technology, which has not received numerous discussions in the design education literature). The protocol development itself is the first research result of this investigation. It presents a collective result on the required capacities and skills for future designers who will play a more significant role in supporting social changes and in solving social-related problems. Secondly, the protocol is then used to answer the previously stated research objectives, and it allows to map and evaluate the skills already taught in selected design education programs that focus on the social values and roles of design.

Table 1. summary of required capacities and skills for future designers to deal with complex social challenges (elaborated by authors based on the literature review in the second part)

Clusters	Skill 1	Skill 2	Skill 3	Skill 4
Obtaining a comprehensive perspective	Systemic thinking	Ethics	Critical thinking	
Overcoming disciplinary barriers in collaboration	Co-design & co-creation methods and tools	Stakeholder engagement	Mediation, Leadership, Followership	
Communication and negotiation	Project and values communication	Collaborations & network creation, public relationship		
Integrating management logic and mindset	Entrepreneurship	Business thinking		
Utilising continuously evolving technology	N.A.			
Traditional design skills	Prototyping & experimentation	Visualization	Materials knowledge	Aesthetic

3.2 Sample selection and data collection

The data collection and selection aimed to identify the existing university programs focusing on designing to face social challenges.

The search was restricted to the Top15 universities in 2022 according to the *QS World University Ranking by subject: Art and Design*, listed in detail in Table 2 (QS Quacquarelli Symonds Limited, 2022). Both undergraduate and postgraduate programs were considered, for a total of 116 and 184 programs respectively.

QS Ranking Position	University	Country
1	Royal College of Art	United Kingdom
2	University of the Arts London	United Kingdom
3	The New School	United States
4	Rhode Island School of Design (RISD)	United States
5	Politecnico di Milano	Italy
6	Aalto University	Finland
7	Pratt Institute	United States
8	Massachusetts Institute of Technology (MIT)	United States
9	Design Academy Eindhoven	Netherlands
9	School of the Art Institute of Chicago	United States
11	The Glasgow School of Art	United Kingdom
12	Tongji University	China (Mainland)
13	Delft University of Technology	Netherlands

14	Art Center College of Design	United States
15	RMIT University	Australia

Table 2. Top 15 universities in the QS World University Rankings by Subject 2022: Art & Design

The research team collected second-hand data, analysing the programs syllabus and main description to select only those focusing on design to face social challenges. The selected programs explicitly state their total or partial focus on the social aspects of design and detailly explain how and why they address the current social challenges. Specifically, all the included programs precisely describe their approach and attention on one or more of these themes: 'social innovation', 'social change', 'social challenges', 'design for social equality', 'social justice', 'social design', 'socially conscious design', 'social value of design'. Programs only vaguely mentioning the social dimension - without explaining how they address it and/or prepare students to face it - were instead excluded.

17 selected programs are analysed, including 3 undergraduate programs and 14 postgraduate ones. The details are shown in Table 3.

University	**Program**	**Level**
Royal College of Art	City Design*	Postgraduate
Royal College of Art	Global Innovation Design*	Postgraduate
Royal College of Art	Healthcare & Design*	Postgraduate
University of the Arts London	Service Design*	Undergraduate
University of the Arts London	Design for Climate Justice*	Undergraduate
University of the Arts London	Global Collaborative Design Practice*	Postgraduate
University of the Arts London	Design for Industry 5.0*	Postgraduate
University of the Arts London	Design for Social Innovation and Sustainable Futures *	Postgraduate
The New School	Design & Urban Ecologies*	Postgraduate
Politecnico di Milano	Product Service System Design*	Postgraduate
Aalto University	Creative Sustainability*	Postgraduate
Design Academy Eindhoven	Social Design*	Postgraduate
The Glasgow School of Art	Design for Health and Wellbeing*	Undergraduate
The Glasgow School of Art	Design for Health and Wellbeing*	Postgraduate
The Glasgow School of Art	Design Innovation (& Circular Economy, & Citizenship, & Service Design) *	Postgraduate
Tongji University	Advanced Environmental Design*	Postgraduate
RMIT University	Disaster, Design and Development *	Postgraduate

Table 3. Programs focusing on design to face social challenges selected among the programs offered by the Top15 Art and Design universities

* On each program name there is a link to the program website, from which all the information about the program's syllabus, description, structure, courses were selected.

3.3 Data analysis

The data analysis phase aimed at investigating whether the selected university programs focusing on design to face social challenges already teach the skills and capacities identified as relevant for future social designers.

For each program, the research team analysed second-hand data presented on its and/or on the university's website: its description, structure, and syllabus and – if available – additional documents (i.e., the program manifesto and aims) and mandatory course descriptions. The study is based on the available information: not all universities describe the programs in detail so that some skills could be taught but not explicitly stated and therefore not represented in the analysis. Moreover, if the program contents were not detailly described, that program was excluded, since the available information was insufficient to understand whether the mapped skills are taught there properly. This was the case for the Healthcare & Design program of the Royal College of Art. A different case is the one of Design for Climate Justice and Design for Industry 5.0 taught at the University of the Arts London. Both programs will have their first edition in September 2023, and their syllabus and structure are not fully detailed yet on the university website. Despite this, the available information allowed to identify several transmitted skills, and – for this reason – both programs were included in the analysis. However, it should be considered that – once the program structure will be finalized and the related documents are diffused – the number of skills taught could be higher. One final consideration regards the Design Innovation program of the Glasgow School of Art. The program has eight specialist pathway routes and three of them – Design Innovation & Circular Economy, Design Innovation & Citizenship, Design Innovation & Service Design – focus on social design. Since only the general Design Innovation structure and courses are detailly explained, the program was analysed once. To summarize, the analysis included 16 of the 17 listed education programs.

The analysis of each program led to identifying the currently taught skills among the ones mapped in the protocol. A skill is considered taught if (1) it is the topic of a specific course, (2) it is underlined as one of the exit skills for students in a specific course and/or the whole program, (3) the course topics, contents and/or activities enable and train it.

4 Analysis results

The analysis shows an overview of design education programs that have focused on training future designers' capacities and skills related to dealing with social challenges, and the analysis results provide us with different levels of information to answer the three questions we have listed in the methodology part. In this part, each of the questions will be discussed in detail.

Firstly, all the identified clusters of competencies and skills have been taught. This result shows that the required capacities to train future designers to solve social-related problems have already been offered by at least one of the selected design programs from the top 15 universities. However, when looking at the single cluster of skills, it emerges a significant variation in the number of programs addressing it. Among all the clusters, the cluster "overcoming disciplinary barriers in collaboration" is most commonly present in the taught skills. All the 16 analysed programs offer courses that train students on specific skills related to facilitating collaboration. Among all, universities have paid high attention and effort to teaching design students about "co-design and co-creation methods and tools", provided by 12 programs. Many universities address the importance of training students' ability in

mediation, leadership, and followership, which enable future designers to obtain the proper approach, attitude, and strategy to work in different situations and to speak different “languages” with different actors. This skill is taught by 11 programs from 7 universities. 8 programs out of 16 teach courses about skills for engaging stakeholders in design activities and processes.

Following that, the clusters “obtaining a comprehensive perspective” and “communication and negotiation” are also well represented in the education offerings for transferring and training future designers to participate in solving social problems. In the former cluster, “ethics” is one of the most taught skills in the analyzed design education offerings related to social issues. 12 programs among 16 have courses on teaching this skill. 8 programs have included “critical thinking” in their education curriculum, and 7 programs have planned courses on training design students on the systemic thinking approach and methods to be embedded and applied to their design actions and practices. In the latter cluster, 10 design programs have emphasized training design students’ capacities of presentation and storytelling to show the projects’ values on different occasions and to different actors who might be interested. among all 16 programs, 7 also consider the importance of supporting students to learn how to establish networks and create relationships, which are significant elements to guarantee the success and implementation of design initiatives.

However, the other three clusters of competence and skills are relatively less included in the education programs from the selected universities and programs. Most design programs don’t put “business logic” as the education priority. Competencies and skills related to “entrepreneurship” are taught only by 1 program: a design for Industry 5.0 from the University of the Arts London, and it is the least common teaching content and course among all the identified skills. An obvious decrease can be observed in programs that teach students “business thinking”. 3 programs out of 16 include this component in their curriculums. This result shows a lack of embedding the business logic and mindset in training design students to deal with social challenges.

Similarly, competencies and skills on “continuously utilise evolving technology” are among the least taught. 5 programs offer courses and lessons to train design students’ capabilities to use and collaborate with technology. There is certainly a huge space to improve due to the increasingly growing role of technology in our lives.

The “traditional design skills” cluster has gained attention in educational content. For example, skills related to “prototyping and experimentation” (offered by 8 programs) and “visualization” (offered by 7 programs) are commonly included in the teaching and training plans. Knowledge of materials is considered by only 2 education programs and training skills related to “aesthetics” is included in 3 programs among all the 16 selected ones. There is still a huge space to improve how to teach and train design students' competencies and skills related to traditional design objects and discourses.

The summary of how the competencies and skills are covered in the selected design education programs is presented in Figure 1.

Program	Level	Obtaining a comprehensive perspective			Overcoming disciplinary barriers in collaboration			Communication and negotiation		Integrating management logic and mindset		Utilising continuously evolving technology	Traditional design skills			
		Systemic thinking	Ethics	Critical thinking	Co-design & co-creation methods and tools	Stakeholder engagement	Mediation, leadership, followership	Project and values communication	Collaborations & network creation, public relationship	Entrepreneurship	Business thinking	N/A	Prototyping and experi-mentation	Visualization	Materials knowledge	Aesthetic
City Design	P			X	X	X	X	X	X			X		X		
Global Innovation Design	P		X	X			X	X	X			X	X			
Service Design	U	X	X		X	X	X	X					X	X		
Design for Climate Justice	U		X	X	X		X	X	X					X		
Design for Industry 5.0	P		X		X					X		X				
Global Collaborative Design Practice	P		X			X	X					X	X			
Design for Social Innovation and Sustainable Futures	P	X	X		X				X				X			
Design & Urban Ecologies	P			X	X	X			X		X			X		
Product Service System Design	P				X	X	X	X			X		X	X		
Creative Sustainability	P	X	X		X	X	X		X		X				X	
Social Design	P		X	X	X			X					X		X	X
Design for Health and Wellbeing	U	X	X	X	X	X	X	X					X	X		X
Design for Health and Wellbeing	P	X	X	X	X	X	X	X	X				X	X		X
Design Innovation & Circular Economy	P															
Design Innovation & Citizenship	P		X				X	X								
Design Innovation & Service Design	P															
Advanced Environmental Design	P	X			X							X				
Disaster, Design and Development	P	X	X	X			X	X								
Total		7	12	8	12	8	11	10	7	1	3	5	8	7	2	3

Figure 1. Analysis results to show how the identified capabilities and skills are taught in different university programs. In 'Level', 'P' stands for Postgraduate, 'U' for Undergraduate. Source: The Authors.

5 Discussion

This analysis is an interpretative analysis mainly through second-hand research data, and it suffers from diverse limits associated with this qualitative research activity. As explained in the methodology part, due to the availability of information and the difficulty of exploring in-depth in each design education program, this study is the first step to observing and examining this specific education area. It aims at starting to bring reflections on how to teach future designers to take active, positive, and impactful participation in understanding, initiating, and implementing solutions for solving complex social problems and challenges. Here we are going to pinpoint several issues for future studies.

Firstly, from the analysis result, we have witnessed the analysed programs focus on teaching skills strongly connected with peculiarities of the social aspects, such as "ethics", "co-design and co-creation", and engaging stakeholders. Skills in management, business logic, and competencies to cope with technologies have gained relatively less attention in planning and designing education programs. In the real context to solve social problems properly and successfully, designers might need these skills and knowledge to better balance their design actions among society development (combining human

desire and development with nature), viability (business and management logic), and feasibility (technology). And the "traditional design skills" might need to be taught with a new lens and in a new context. Since future designers will not only deal with physical products and spaces, but intangible systems, networks, and organisations, how design universities could train students to transfer their traditional design skills, such as aesthetic, material, and form, to design (give a "shape" to) new elements that are part of the social challenges, such as social relationships, sustainable behaviours, and human-machine collaboration.

A potential link between the program level (undergraduate or postgraduate) and the curriculum content. For example, a possible explanation for why there is a lack of teaching traditional design skills in the programs could be that most of the analysed programs are at the postgraduate level (13 out of 16). Therefore, the target design students might have already acquired a certain level of knowledge and practical experience in the above-mentioned traditional design skills. However, it should be noted that several of these programs are open to students with diverse backgrounds that may not have developed design-related capacities during their previous studies. In the future, an in-depth analysis could be planned to understand the potential links and strategies on how the identified capacities and skills should be taught at different educational levels.

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