INTERNATIONAL DESIGN CONFERENCE – DESIGN 2022
https://doi.org/10.1017/pds.2022.243

Stories of Design Education: An Analysis of Practices and Competencies

S. Thandlam Sudhindra ✉, Y. He, L. Blessing and S. Ahmad Khan

Singapore University of Technology and Design, Singapore
✉ shravya_thandlam@mymail.sutd.edu.sg

Abstract

Using 61 stories from design educators from different countries, this paper presents (1) the design competencies being fostered at different levels of education, (2) the practices (approaches, techniques, methods and tools) used to facilitate teaching and learning, (3) the 'non-design' competencies being fostered, and (4) the impact of COVID 19. Our findings highlight design education is not only used to teach students how to design, but also to kindle productive attitudes, behaviours and mindsets that give them the ability to address a wide range of challenges.

Keywords: design competences, design education, design methods, design approaches, design pedagogy

1. Introduction

Organizations are increasingly starting to recognize that design brings "special competencies" to the complex nature of work and "numerous studies link commercial success to a design-driven approach" (Benedict *et al.*, 2018; Meyer and Norman, 2020). Design as a discipline has a set of competencies that can be understood in "objective terms" and the core competencies of design facilitate "specific and tangible ways of engaging with problems" (Conley, 2004). It is suggested that the role of design education is to ensure that these competencies "are brought together at the right time, in the right proportion, in the right environment, managed by the right people in order to become an interconnected temporal whole, producing a competent design professional" (Gribbin *et al.*, 2016). While some competencies can be acquired through formal learning, some are embedded in one's personality. It is an educator's role to identify these competencies and direct their curriculum toward nurturing them (Bakarman, 2005). In Singapore, design and design education is a government priority (SkillsFuture, 2019) as shown in the 'Design 2025 Masterplan', which is geared towards "infusing design into the nation's skillset" (DesignSingapore Council, 2016). Schools are continuously looking to equip students with skills that would enable them to cope with twenty-first century demands (Retna, 2016). Design is increasingly being introduced in education, from primary school to university and into professional training. Many different practices (approaches, techniques, tools and methods) can be observed to teach desirable competencies (Gilbert *et al.*, 2018; Retna, 2016).

We are currently working toward creating a framework to teach, learn, assess design competencies (Thandlam Sudhindra and Blessing, 2021) and took the opportunity to analyse design teaching practices and experiences that were mentioned in educators' entries to an open call for stories as part of the Design Education Summit 2021 (https://designeducationsummit.designsingapore.org/), in order to answer the following questions:

1. What are the different practices being adopted to facilitate teaching and learning of design?
2. What are the design competencies being fostered in education?
3. Do instructors use and teach design to foster competencies beyond design?
4. What was the impact of COVID-19 on design teaching and learning?

2. Competencies in Design

Captured in everyday language by terms such as "ability", "capacity", "aptitude", "capability", "effectiveness", and/or "skill" (Crain *et al.*, 1995; Weinert, 2001), the term 'competence' tends to refer to proven abilities, improved capabilities and is often associated with the superior performance of an individual. Competencies can also be seen as tools to enable one's effective performance in a professional, social or learning situation (Nagarajan and Prabhu, 2015). It can be "attributed to an individual, group or institutions, when they possess or acquire the conditions for achieving specific developmental goals and meeting important demands presented by the external environment" (Weinert, 2001). The OECD DeSeCo (Definition and Selection of Competencies) program[1] states that competencies are structured around demands and tasks, and are learned. Rychen and Salganik (2000) emphasise that being competent is broader than one's knowledge and skills but also involves "strategies and routines needed to apply the knowledge and skills, as well as appropriate emotions and attitudes, and effective management of these components".

In design, the understanding of competencies varies from general descriptions of the "inner prerequisites of a person" (Enke *et al.*, 2015) and "the ability to" do something successfully and efficiently (Conley, 2011) to more specific definitions describing the knowledge, skills and behaviours students need to acquire (Fass et al., 2018; Gribbin et al., 2016; Røise et al., 2014; Moes et al.; 2008; Bakarman, 2005) and the relevant attributes, traits and characteristics they need to develop (Gribbin *et al.*, 2016; Lawson and Dorst, 2013; Leclerc and Horan, 2018; Robinson *et al.*, 2005). The terms competencies and skills are often used interchangeably, e.g. (Shah, 2005) and DesignSkills Framework (SkillsFuture, 2019) who use the term "skill" as the encompassing term to describe an individual's ability to perform a task. Irrespective of the discipline, there seems little consensus on what precisely competency is.

Bringing the various definitions together, we consider competency as an umbrella term combining the knowledge, skills, attitudes and behaviours that are necessary for an individual's effective performance in a professional, social or learning situation.

Design Thinking (DT) (Brown, 2009) is a popular approach adopted to introduce essential design competencies to students (Carroll *et al.*, 2009; Henriksen *et al.*, 2020; Retna, 2016; Rusmann and Ejsing-Duun, 2021) and familiarize them with the "designerly way" (Cross, 1982) of knowing, thinking and doing things. A recent, detailed literature review of K-12 (from Kindergarten to 12th grade) design competencies associated with DT (Rusmann and Ejsing-Duun, 2021) highlights six overarching process-oriented competence areas for students to acquire: reasoning, problem setting, empathy, ideation, modelling and process management. Based on a review of design theory reviews and of surveys of design curricula around the world, Røise et al. (2014) suggest 14 design competency categories or "building blocks" that go beyond knowledge and skills and include the earlier mentioned process related competencies suggested by (Rychen and Salganik, 2000).

Focusing on competencies reorients the educational process toward application of knowledge and skills in the real world (Johnstone and Soares, 2014). While competency-based education offers a number of benefits such as focus on the current and future individual, response to changing needs of the profession and effective bridging of curriculum gaps, there are common challenges faced by educators. An often mentioned challenge is competency-based assessment in design: how to identify competencies and assess their development (Silva *et al.*, 2020) in a way that acknowledges the differences in experiences and accomplishments of different students.

In the light of the recent pandemic, educational systems have had to evolve to allow digital and physical layers to coexist (Agasisti and Soncin, 2021). "Before the pandemic an effective online offering was optional, now it is a necessity" (Boggs *et al.*, 2021) requiring both educators and students

[1] https://www.oecd.org/education/skills-beyond-school/definitionandselectionofcompetenciesdeseco.htm

https://doi.org/10.1017/pds.2022.243 Published online by Cambridge University Press

to "cope with new modes of learning, new perspectives and new trends that have emerged" (Jena, 2020). The shift from face-to-face to distance engagement did not come without challenges, the main ones being access to technical infrastructure, competences and pedagogies for distance learning (Marinoni *et al.*, 2020). The often hands-on and team-based nature of design education, and hence the fostering of the related competencies, were particularly effected.

We found that studies into design competencies provide a useful but still fairly high-level overview of required competencies. Research into design competencies at a level of detail that can be used directly in teaching, learning and assessment, is sparse. Such detail is required to be able to, for example, formulate learning outcomes, measurable outcomes or rubrics, and select methods and tools to teach and assess particular competencies. Problem formulation is one such high-level competency: it involves empathy, constructive forethought, contextual knowledge, social skills, etc. each of which requires different ways of teaching, learning and assessment.

3. Method

The Design Education Summit 2021 was organized by the DesignSingapore Council (Dsg) and the authors, to get updated on the best practices in primary to tertiary design education. As a pre-event engagement, educators and students were invited to submit short stories[2] (approx 500 words plus images) on the transformation of education through design, including successes, challenges (including the impact of COVID-measures) or how design has empowered individuals with the mindsets and skills for improving lives. The stories being short, we assume that educators focused on those competencies, methods and tools, and learning and teaching experiences that they considered most worthy of sharing, i.e., the most significant, motivating or impactful. We took the opportunity to analyse those stories.

A total of 85 stories were submitted: 76 by educators and 9 by students. For this paper, we focus on the educator stories. 15 stories were discarded because they did not focus explicitly on design education, or they did not refer to design competencies or methods. This resulted in 61 stories.

Two coders analysed the stories independently. They extracted sentences or parts of sentences that mentioned or indicated competencies students had to have or acquire, and categorized these using the 14 design competency categories of Røise et al. (2014): holistic design approaches and methods, particular design methods and techniques, visualisation, aesthetics, use, user, context, technology, market, ecology, functionality, creativity, teamwork and project management. Table 1 shows example sentences and their categorization. The statements that did not fit the categories of Røise *et al*. were categorized as 'other' and later analysed, resulting in two additional competency categories (Section 4). Regular meetings were held to discuss the coding and resolve ambiguity.

Table 1. Example of coding sentences using Røise et al.'s (2014) categories

Approaches	User	Context	Technology	Ecology
"Students had to employ design thinking methodology and the 5Ds approach [...]"	"They presented their consolidated findings, insights [...] to the community partners [...] before embarking on their individual design projects."	"Through online and phone interviews [...] students gathered adequate and relevant information and conducted physical and cultural analysis [...]"	"The transition to an online studio-based learning […] students proved themselves to be flexible in adapting to crisis."	"They further developed their designs in terms of the structure, materials [...] and sustainable design features."

4. Results and Discussion

In this section we discuss the insights we obtained from the analysis of the stories and highlight the various competencies educators mention as well as the approaches, techniques, methods and tools they used to teach design. We also present the impact of the Covid-19 pandemic and the resulting measures educators adopted to maintain student learning experiences.

[2] https://www.designsingapore.org/resources/Stories-on-Transformation-of-Education-by-Design.html

https://doi.org/10.1017/pds.2022.243 Published online by Cambridge University Press

4.1. Participants

The 61 stories we analysed were submitted by educators from 10 countries: 47 from Singapore and 14 from other countries (India (7), Belgium (2) Philippines (2), and 1 each from Australia, Brazil and Pakistan). The Summit being an event organised by Singapore organisations explains the high percentage of entries from Singapore. The stories concerned primary, secondary and post-secondary education. The distribution of levels and countries (Singapore – International) were as follows: 11 primary (Sg-11, Int-0), 11 secondary (Sg-8, Int-3) and post-secondary 39 (Sg-28, Int-11).

4.2. Holistic Design Approaches

39 stories mentioned a specific design approach, some mentioned two. In line with the literature, Design Thinking, as well as the similar 5D process, emerged as the most used approaches adopted by the educators (Table 2). The other approaches that were mentioned focus on particular aspects of design. The stories showed that, depending on their learning objectives, educators use all or some of the stages of these approaches, not only to teach students how to design but also to inculcate competencies that give them the ability to address a wide range of challenges: *"To make better decisions", "For development of meaningful solutions"; or "To experience a creative process".*

Table 2. Frequencies of the design approaches identified in the stories (n=39)

Approaches	Freq.
Design Thinking: Empathize, Define, Ideate, Prototype & Test (and variations)	14
"5D process": Discover, Define, Design, Develop & Deliver	13
Co-creation/Co-design/Participatory Design	5
Interdisciplinary design	4
Human-centred / Inclusive design	4
Experience design	2

4.3. Design Competencies in Education

Table 3 is a compilation of all the competencies as formulated by the educators (column 2), grouped according to the categories of Røise et al. (2014) (column 1). Two additional competency categories were found in the stories: (1) Communication: the ability to communicate with different audiences (peers, users and stakeholders) and (2) Critique & Reflection: the ability to provide critique as well as continually receive and reflect on feedback. The approaches, techniques, methods and tools to which the educators referred were linked to the type of design tasks and the competencies to be taught. We therefore linked Røise *et al.*'s category "particular methods and techniques" (column 3) to their other categories, rather than as a separate category in column 1. The five most mentioned competency categories are - in order of frequency - User, Teamwork, Creativity, Technology, and Context. Creativity was the most frequent category for primary education and User for secondary education. For post-secondary education, User, Context and Teamwork were equally often mentioned.

Table 3. Competencies and particular techniques, methods and tools referred to in the (n=61) stories categorised according to (Røise *et al.*, 2014) and our additional categories (*)

Competency categories	Competencies (skill, knowledge, attitudes & behaviours) identified in the stories		Particular techniques/methods/tools identified in the stories		Freq
Include the **user** in developing solutions.	Identifying user pain points, Empathy, Compassion, Listening, Observation, Co-creation	User need analysis Communication, Self-awareness, Human-centred, Sense of community Intuitive.	Persona Creation, User Journey Maps, User feedback, Conducting Interviews, Experiencing, Site Visits,	Volunteer work, Cultural immersion.	28
Work in or	Digital literacy,	Innovative,	Local community	Brainstorming,	24

https://doi.org/10.1017/pds.2022.243 Published online by Cambridge University Press

with **teams**	Engagement, Troubleshooting, Idea generation, Accommodative, Compromising, Listening, Creativity, Critical thinking,	Understanding, Helpful, Collaborative, Management, Driven, Observation, Task management.	engagement, Involve industry partners, Multi/Cross-disciplinary teams, Online collaborative tools, Psychosocial support,	Games, Professional learning Teams, Learning fests, C-sketching, Padlet, Teleconferenc e,Industry project	
Be **creative** in ways of developing concepts.	Imagining, Excitement, Interest, Building, Innovation, Collaboration, Novelty, Curiosity, Storytelling, Co-creation,	Sketching, Divergent mindset, Fun, Empathy, Critical thinking, Vulnerability, Simulation, Exploration, Originality, Designing.	Brainstorming, Prototyping, Rapid ideation, Games, Play, Ideation Platforms, Ideation techniques, Treasure hunt, Toy making, Predefined metrics (desirable, feasible, viable)	Artwork, Tinker Shop, Simulations, Science lessons, Exposure to diverse topics, Inspirational material, Product design, Open-ended projects.	23
Identify & use new **technology**	Coding, Programming, Animating, Imagination, Troubleshooting Collaborating Problem-Solving, Flexibility, Adaptability, Simulation, Focus, Interpretation,	Computing, Scientific-thinking Idea translation Crisis management, Resilience, Awareness, Creativity, Motivation, Initiative.	Use of Autonomous Mobile Robots, RFID technology, Scratch, Microbit, MS Teams/Zoom, Mentimeter, Google Docs, FTGP/ASPIRE, Miro, Figma, Otter.ai, Padlet, Fiverr,	AMR Docking and Smart IoT Technologies, AR/VR MakeyMakey, 3D Softwares, Patreon, Trello, ArtStation, Social media platforms.	19
Reflect upon surrounding **context** of an idea or object.	Synthesising issues, Empathy, Open-mindedness, Opportunistic,	Analytical thinking, Challenge oriented, Authenticity, Values.	On-site observations, Situating workshops within the socio-cultural-ecological context,	Physical & Virtual tours, Experiencing, Volunteer work, Interviews.	18
Communicate with different audiences.*	Confidence, Clarity, Listening, Interaction,	Presenting, Critiquing, Giving Feedback, Writing.	Teamwork, Industry Engagement, Project Showcase, Social Interactions,	Interviews, Games, Presentations.	16
Visualize ideas & concepts through different media.	Basic drawing, 3D modelling, Hands-on making, Self- expression, Prototyping, Storytelling, Exploration,	Video making, Coding, Creativity.	Use of Templates, User Journey Maps, Webinars, 3D Models Making Prototypes, Augmented Reality, Story Boarding,	Videos, FabLab session, resources such as: Strawbees, Cubetto Quirkbots, Daskbots.	15

https://doi.org/10.1017/pds.2022.243 Published online by Cambridge University Press

Consider aspects of **use** & usability.	Observation, Idea generation, Testing, Improvising Iterating	Empathy, Gathering feedback Making Prototyping.	Project Briefs, Project/User Requirements, User feedback, Mock-ups,	Data Collection (Market, Stakeholders), Prototyping.	10
Take part in structuring & **managing a project**.	Self-directed, Innovative, Adaptable, Engaging, Clarification seeking, Planning, Workload analysis,	Strategizing, Purposeful Resourceful, Empowered, Taking charge, Rigorous, Administration, Interested, Collaboration.	Group Activities, Digital tools, Deadlines, Learning resources, Protocols, Entrepreneurship/ Business Opportunities, Consultations.		9
Critique & reflect on one's work & others.*	Analytical Thinking, Critical Thinking, Empathy,	Reflection, Motivation, Perseverance, Purpose.	Teamwork, Presentations, Project Showcase, Project work.		9
Consider **functionality**.	Synthesis, Careful, Implementation, Mechanical, Practicality,	Workability, 3D thinking, Sketching, Eye for detail, Prototyping.	Makey Makey, Mix to fix, Getting fresh perspectives, Mechanics, Core dynamics,	Making Prototypes, Equal grades for practicality and workability of a product.	4
Appreciate **aesthetics** of a product.	Appreciation, Exploration, Artistic,	Emotional & visual connection.	Arts and Crafts, Exposure.		3
Consider **market** aspects.	Research, Communication, Opportunistic,	Analytical thinking, Networking, Socializing.	Networking events, Incubator experience, Residency Programs,	Business class, Mentorships, Startups.	3
Be concerned about **ecology**, sustainability.	Sustainable mindset, Readiness,	Sensitive, Conscious, Awareness.	Use recycled materials, Videos.		3

As mentioned before, design education is often used for much more than teaching how to design something. The following quotes from each category show educators' intent towards nurturing design competencies to equip and empower students to take-on challenges and find meaningful solutions.

User: Irrespective of the design approach used or the final outcome expected, most educators expressed their desire to kindle empathy in their students by *"putting themselves in the shoes of different personas and empathising with their pain points"*, *"empathising and gaining insights"*, *"listening and understanding their problem"*, *"building rapports"*, *"a human-centred perspective"*.

Teamwork: As one of the most exercised competency, teamwork is considered fundamental and helps weaker students: *"Not all pupils are good at everything; […]. Even for those that do not specialise in a specific task, they are still capable of being a good helper to everyone or anyone in the team."*

Creativity: *"The intangible value of creative thinkers who are trained to think multi-faceted is the next big thing"* Some educators expressed this by embracing student creativity *"the outcomes may be far from what we had in mind before, but the final works were fresh, original, and inventive"*.

Technology: In a technology-driven world, educators and students are learning to keep pace with the rapid advancement in technology. *"Technology helps design students to go beyond their limits"*. Need

https://doi.org/10.1017/pds.2022.243 Published online by Cambridge University Press

for technology was accelerated during COVID-19 - "*The transition to an online studio-based learning environment was made out of necessity and the students proved themselves to be flexible in adapting to crisis"; "Collaborate online became quick norms"; "Students remained resilient and resolved glitches independently through trial and error and learning from online forums".*

Context: Educators encourage students to *"see the real world"; "learn experientially"; "move outside the safe confines of the academic design studio into the messiness of the real world"* and take into consideration much larger issues in hand so that they can *"respond in a coherent and viable way"*.

Communication: Many stories include the need for interacting, engaging, understanding, identifying and presenting. Some express the lack of proper communication. E.g.: **"***The humble art of making conversations was fast becoming an uncomfortable affair, risking disappearance. Consequently, the art of listening and engaging attentively was dying too. The loss of this most natural mode of communication disengaged students from their immediate environment, affecting their practice as young designers."*

Visualize: In addition to technical skills like drawing, modelling or coding, educators foster visualization *"as a way to think"* to help students *"express themselves", "communicate ideas", "make decisions to arrive at solutions."*

Use: To ensure optimal use and usability of a solution, educators believe that students must continually *"gather user feedback"* on their solution, and *"test within and outside the project team"*.

Critique and Reflection: Students need *"to take ownership, seek guidance when needed, critique, provide constructive feedback, improve though self-reflections, take in different perspectives from peers"* and not only rely on feedback of the instructor.

Project Management: To prepare for practice *"Pupils have to learn how to adapt quickly to new situations that are constantly evolving during the project"*. However, *"Design students […] are constantly pressured by the rigours of the projects, deadlines and submissions"*.

Functionality: Students are directed toward understanding and considering functionality of their solutions e.g.–*"To prevent solutions that can be novel but impractical or not working, the prototype was also graded with an equal weightage on practicality and workability"*.

Aesthetics: When students put thought into the aesthetics of the products they create, it helps "*emotionally and visually connect to the respective audiences"*.

Market: In some cases, educators took students on site-visits or invited experts to provide fresh perspectives to help *"translating the student's ideas and designs into marketable product/service."*

Ecology: Educators provide opportunities to explore the concept of sustainability*: "Let the students use recycled materials to prototype the ideas", "students developed their designs in terms of the structure, materials, indoor and outdoor elements and sustainable design features".*

4.4. Competencies beyond design

The stories highlight that educators frequently use design in their teaching to kindle productive attitudes, behaviours and mindsets. Table 4 shows the personal attributes educators strive to instil in their students through design education. e.g.: *"As we now try to negotiate new realities, the […] group provided an opportunity to experience resilience and adaptability as fundamental to design education"; "We believe learning by doing is motivational. It lays the foundation for a collaborative and learning to learn mindset and to navigate ambiguity in an unstructured scenario, at the same time ready individuals for exciting real-world scenarios in a powerful and personal way".*

Table 4. General competencies (personal attributes) extracted from the stories

Resilience	Sense of mission	Responsibility	Critical thinking
Adaptability	Passion	Accountability	Lifelong Learner
Character building	Purpose	Determination	Focus
Perseverance	Self-confidence	Clarity	Self-awareness
Embracing uncertainty	Sincerity	Optimism	Future-ready
Change maker	Grit	Curiosity	Enthusiasm

https://doi.org/10.1017/pds.2022.243 Published online by Cambridge University Press

4.5. Design teaching and learning, and the impact of COVID-19

Compared with traditional education, design education requires different ways of teaching. The educators' stories demonstrate different pedagogical approaches to facilitate design education (Table 5).

Table 5. Pedagogical approaches extracted from the stories

Pedagogy	Observations in stories	
Holistic strategies for teaching and learning	Competency-based evaluation, Student-driven/directed learning, Students co-create subject contents, Project-based learning, Problem/ Challenge-based learning, Whole brain thinking,	Open-ended opportunities, Use of digital/engagement tools, * Experimental approaches, Changemakers through Play, Passion, Purpose, Multi-dimensional thinking
Emphasis on learning experience	Continual Engagement, * Gamification, play, joy and emotions	Learning material curated online * Social connection *
Effective curricular arrangement	Fundamental theories, basic skills Scaffolding lessons, Blended face-to-face/online learning, *	Blended synchronous & asynchronous methods, * From multi-disciplinary to cross-disciplinary
Exposure outside classrooms	Service Learning, Sharing from experts in academia and, industries, *	Authentic & Real-world problems, Collaboration with industries
Tools for design education	Physical toolkits, Designer growth chart,	Digital Interactive Tools, Software, websites resources *
Extra-curricular opportunities	New design centres, Free maker space,	Open design challenges, Business incubation
* Observations related to the digital transformation accelerated by the COVID-19 crisis.		

The stories reveal the goals and details of chosen pedagogic approaches, the accelerated digital transformation, and the impact of COVID-19 measures.

Holistic strategies for teaching and learning. Design education always promotes a student-centred approach, but the stories also reveal a student-driven approach in which students come up with their own design problems, co-create subject content, or determine what they want/need to learn: *"Students select their skill strands and achievement levels from the learning menus based on their learning interests and needs"*. Students also joined the exploration of the potential of digital tools, e.g. *"[…] the idea of using AR emerged unsurprisingly from their rich experiences with new age digital games"*

Emphasis on learning experience. Educators emphasised the strong need to engage students by *"instilling joy into learning" and "Infusing play and self-directedness in the learning approach"* and aim to provide an enriched online learning experience: *"Learners appreciate a familiar yet intuitive learning environment".* Unfortunately, due to COVID measures "*students are feeling isolated and disengaged*" and "*become less driven and productive."*

Effective curricular arrangement. *"With the push for graduates to be more multi-disciplinary, design education must be more encompassing"*. To do so, educators change curricula to foster collaboration and empower students: *"We've explored project collaboration between 2 courses and since merged these into 1 course."; "Scaffolding lessons to guide the students in different aspects of creating a customer journey map leveraging [different] customer analytics tools"*. COVID-19 has triggered reflections on teaching: *"While blended online (Blend of synchronous and asynchronous) offers some relief, students seem to actually prefer a blend of face-to-face and online learning"*.

Exposure outside classrooms. To expose students to the real-world authentic problems and collaborations external organisation are introduced, e.g.: *"[…] self-directed learning for students to integrate their design skills with overseas exposure, industry expertise and social responsibility to produce innovative design solutions"*. The use of virtual classrooms accelerated by the COVID-19 crisis enabled a much wider exposure than before: *"Students learn experientially from guest speakers from academia and industry who share their unique design approaches […]"*.

https://doi.org/10.1017/pds.2022.243 Published online by Cambridge University Press

Tools in use for design education. Educators actively develop tools to cultivate holistic and particular design competencies, e.g.: *"[…] a growth chart for designers to be guided by […] to grow into a full-fledged designpreneur"; "The Conversation Toolkit facilitates conversations that help decode the complex concept of culture and then helps them brainstorm on creating a new culture by the end of the game"*. COVID-19 has extensively influenced the use of digital tools, e.g.: *"Use up to 3 platforms to minimise confusion for the learners yet varied enough for engagement"*.

Extra-curricular opportunities. The increasing attention to design led to more facilities and extra-curricular opportunities for students, e.g.: *"[…] a rigorous 6-month incubation program […] filled with mentoring, training, networking events, capacity-building activities, business classes and the likes"; "[...] opens its Tinkershop's doors after school hours daily, welcoming students to enter into an environment conducive for tinkering"*.

Despite all enthusiasm for design education, some educators were concerned that the desired impact on student learning did not always materialize: *"It fails to produce the shifts in student's core design skills and mindsets"; "When students execute design tasks, teachers offer the same level of knowledge and coaching over and over again and expect different results"; "Students are unable to link the learning from subjects […] due to a focus purely on content or process knowledge."*

5. Conclusions

Our study involved the analysis of 61 stories that were not collected as part of a research study, but obtained from a pre-engagement activity for the Design Education Summit we co-organised. As a consequence the countries and levels of education were not equally represented, the instructions unspecific, and the length of the stories capped, limiting the content to analyse. Despite these limitations, we considered the stories worthy of analysing as – we assumed – the stories capture what design educators consider most important for sharing.

The stories provided insight into (1) the design competencies being fostered at different levels of education, (2) the practices used to facilitate teaching and learning, (3) the "non-design" competencies being fostered, and (4) the impact of COVID 19. Using Røise et al.'s (2014) competency categories, we found the most often mentioned design competencies to be those associated with the user, teamwork, creativity, technology, and context, and to be dependent on school level. We identified two additional competency categories – Communication and Critique & Reflection – that were not mentioned by Røise *et al*.. Furthermore, by linking Røise *et al*.'s competency categories "holistic design approaches" and "particular methods and techniques" to each of the other categories, we were able to obtain insights into the specific use of the mentioned approaches and methods, rather than just a list.

The stories clearly show that design education is used not only to impart design competencies, but also for a more holistic development by equipping students with competencies to face a wide variety of real-world challenges, such as resilience, flexibility, etc. The COVID-crisis did have a strong impact on design education, but also provided an opportunity (albeit enforced) to reflect on educational tools and formats. Educators mentioned richer learning experiences through effective curricular arrangement, adoption of interactive tools for learning and increased out-of-class exposure. The latter was found to be easier and more efficient when using online tools due to the absence of time or travel constraints. This study gave us valuable insights for our research on design competencies and the development of our design competency framework. Yet, at the same time the study confirmed the need for much more research into teaching, learning and assessment of competencies in the context of design education.

References

Agasisti, T. and Soncin, M. (2021), "Higher education in troubled times: on the impact of Covid-19 in Italy", Studies in Higher Education, Taylor & Francis, Vol. 46 No. 1, pp. 86–95.

Bakarman, A.A. (2005), "Attitude, Skill, and Knowledge: (Ask) a New Model for Design Education", Proceedings of the Canadian Engineering Education Association (CEEA), Kaninaskis, Alberta, July 18-20.

Benedict, S., Kouyoumjian, G., Sarrazin, H. and Dore, F. (2018), The Business Value of Design, McKinsey.

Boggs, H., Forero-Hernandez, P., Laboissiere, M. and Neher, K. (2021), Scaling Online Education: Five Lessons for Colleges, McKinsey Insights.

https://doi.org/10.1017/pds.2022.243 Published online by Cambridge University Press

Brown, T. (2009), Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperBusiness.
Carroll, M., Goldman, S. and Royalty, A. (2009), "Destination, imagination & the fires within: Design thinking in a middle school classroom", C&C 2009 - Proceedings of the 2009 ACM SIGCHI Conference on Creativity and Cognition, Vol. 1 No. 2010, pp. 371–372.
Conley, C. (2004), "Leveraging Design's Core Competencies", Design Management Review, 15 (3), pp. 45–51.
Conley, C. (2011), The Core Competencies of Design: The Basis of a Broadly Applicable Discipline, available at: https://www.idsa.org/sites/default/files/Chris Conley.pdf.
Crain, R.W., Davis, D.C., Calkins, D.E. and Gentili, K. (1995), "Establishing engineering design competencies for freshman/sophomore students", Proceedings - Frontiers in Education Conference, Vol. 2, pp. 937–939.
Cross, N. (1982), "Designerly ways of knowing", Design Studies, Vol. 3 No. 4, pp. 221–227.
DesignSingapore Council. (2016), Design 2025, Singapore.
Enke, J., Kraft, K. and Metternich, J. (2015), "Competency-oriented design of learning modules", Procedia CIRP, Vol. 32, Elsevier B.V., pp. 7–12.
Fass, J., Rutgers, J. and Chui, M.-L. (2018), "Using Design Competencies to Define Curricula and Support Learners", Proceedings of DRS2018, Vol. 7, Design Research Society.
Gilbert, C.G., Crow, M.M. and Anderson, D. (2018), "Design Thinking for Higher Education", Stanford Social Innovation Review, Vol. 16 No. 1, pp. 36–41.
Gribbin, J., Young, R. and Aftab, M. (2016), "Towards a holistic framework of design competence.", 20th DMI: Academic Design Management Conference Inflection Point: Design Research Meets Design Practice Boston, USA, pp. 25–35.
Henriksen, D., Gretter, S. and Richardson, C. (2020), "Design thinking and the practicing teacher: addressing problems of practice in teacher education", Teaching Education, Routledge, Vol. 31 No. 2, pp. 209–229.
Jena, P.K. (2020), "Impact of Covid-19 on higher education in India", International Journal of Advanced Education and Research, Vol. 5 No. 3, pp. 77–81.
Johnstone, S.M. and Soares, L. (2014), "Principles for Developing Competency-Based Education Programs", Change: The Magazine of Higher Learning, Vol. 46 No. 2, pp. 12–19.
Lawson, B. and Dorst, K. (2013), Design Expertise, Taylor and Francis.
Leclerc, R. and Horan, R. (2018), "'Fit' for change: measuring designer competence", International Journal of Design Creativity and Innovation, Taylor & Francis, Vol. 6 No. 3–4, pp. 185–210.
Marinoni, G., Van't Land, H. and Jensen, T. (2020), The Impact of Covid-19 on Higher Education around the World.IAU Global Survey Report, IAU Global Survey Report.
Meyer, M.W. and Norman, D. (2020), "Changing Design Education for the 21st Century", She Ji, Elsevier, Vol. 6 No. 1, pp. 13–49.
Moes, C.C.M., van Doorn, E. and Fain, N. (2008), "Attitude development in designers' education", Proceedings of the TMCE 2008, pp. 755–768.
R.Nagarajan and R.Prabhu. (2015), "Competence and Capability - A new look", International Journal of Management (IJM), Vol. 6 No. 6, pp. 07–11.
Retna, K.S. (2016), "Thinking about 'design thinking': a study of teacher experiences", Asia Pacific Journal of Education, Routledge, Vol. 36, pp. 5–19.
Robinson, M.A., Sparrow, P.R., Clegg, C. and Birdi, K. (2005), "Design engineering competencies: Future requirements and predicted changes in the forthcoming decade", Design Studies, Vol. 26 No. 2, pp. 123–153.
Røise, Ø., Edeholt, H., Morrison, A., Bjørkli, C.A. and Hoff, T. (2014), "What We Talk About When We Talk About Design. Toward a Taxonomy of Design Competencies", FormAkademisk - Forskningstidsskrift for Design Og Designdidaktikk, Vol. 7 No. 2, pp. 1–17.
Rusmann, A. and Ejsing-Duun, S. (2021), "When design thinking goes to school: A literature review of design competences for the K-12 level", International Journal of Technology and Design Education, Springer.
Rychen, D.S. and Salganik, L.H. (2000), Definition and Selection of Key Competencies, Fourth General Assembly of the OECD Education Indicators Programme The INES Compendium Contributions from the INES Networks and Working Groups GA(2000)12.
Shah, J.J. (2005), "Identification, measurement & development of design skills in engineering education", Proceedings ICED 05, the 15th International Conference on Engineering Design, Vol. DS 35, pp. 1–15.
Silva, P., Khan, S. and Blessing, L. (2020), "State of Design Education in Singapore - Insights from Design Education Summit 2018", International Design Conference - DESIGN 2020, pp. 1805–1814.
SkillsFuture. (2019), Skills Framework for Design - A Guide to Occupations and Skills, Singapore.
Thandlam Sudhindra, S. and Blessing, L.T.M. (2021), "A Framework for Design Competency Assessment", Proceedings of the International Conference on Engineering Design (ICED21), Vol. 1, pp. 91–100.
Weinert, F.E. (2001), "Concept of Competence: A Conceptual Clarification. Defining and Selecting Key Competencies.", American Psychological Association, pp. 45-65.

https://doi.org/10.1017/pds.2022.243 Published online by Cambridge University Press