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Situating societal challenges in an industrial design classroom

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Designing for societal challenges requires not only traditional design competencies but also knowledge from other disciplines such as social science and engineering. In particular, designers should have the ability to take entrepreneurial action, demonstrate design leadership and create responsible designs. Design education has adopted the design studio approach to creating opportunities for design students to learn and practice design skills. However, scholars often criticize it due to its lack of scientifically rigorous. This paper discusses a teaching case in an industrial design class where design students learned to design for a societal challenge through a combination of different educational activities such as following lecture, participating workshops, conducting field research with end users and stakeholders, and giving presentations and receiving feedback from industry experts and academic staff. By combining a mixed-perspective, they got a better understanding of different stakeholders involved, created propositions with all parties in mind and were able to communicate their ideas clearly. In this way, stakeholders were informed, inspired and empowered to collaborate and create the intended innovations. By balancing the rationality and creativity in the design class through offering the theoretical foundations as well as the societal embodiment, this course aimed at equipping future responsible industrial designers with the desired competencies related to entrepreneurial action and design leadership.

\textbf{Keywords:} responsible designer; design education; societal challenge; design studio
Introduction

From the mechanization in production process, to the intensive use of electrical energy, to the widespread of digitalization, and to the combination of internet of things (internet technologies and connected smart objects), industry is experiencing a fundamental new paradigm shift (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014). These modern trends provide new insights and potentials to tackle the priority challenges recognized by the European Union (EU) such as the increasing aging population and the associated healthcare challenges, limited natural resources, irreversible climate change, environmental pollutions, and etc. Dedicated investment in research and innovation has, therefore, been planned to create real impacts benefitting the citizens (EuropeanCommissie, 2018). As a result, the field of industrial design practices has been changed and will change continuously.

Traditional design education programs focusing on educating design specialists are unable to equip the future designers with necessary competencies to deal with these contemporary, networked and ill-understood phenomena (Teixeira, 2010). On the one hand, these challenges, often known as wicked problems (Rittel & Webber, 1973) (Conklin, 2006), call for a human-centered design thinking approach (Buchanan, 1992) (Melles, Howard, & Thompson-Whiteside, 2012) in which designers and stakeholders need to take collective actions in co-creating related innovations. On the other hand, designers can take an active role in initiating such changes (Tomico, Lu, Baha, Lehto, & Hirvikoski, 2011). Gardien et al. (2014) suggest that designers should be able to inspire, inform and facilitate different stakeholder to be personally dedicated to realizing the desired societal transformation. They call for strong communication competencies from designers to make ideas more concrete by making use of their designer’s toolkits (Sanders, 2008) so that the stakeholders can join the discussion and reflection sessions and contribute to the desired societal transformation. Therefore, industrial design education programs should more focus on stimulating design students to take entrepreneur actions and develop design leadership competencies (Teixeira, 2010). Besides, the increasing digitalization in daily life and the recent privacy law enforcement in EU suggest that industrial design education should also look into how to educate responsible designers. As we know, industrial designs have brought many joys to the daily lives, but the resulted design does not necessarily always contribute to the wellbeing of the environment, the people and the planet (Greer & and Bruno, 1997). The industrial design education should also focus on educating future responsible designers in this context. In fact, the call for responsible designers started already in the 1960s when design became a discipline, and there was an increasing awareness that designers should design with fulfilling human needs and overcome environmental problems in mind (Papanek & Fuller, 1972) (Cross, 2001).

This paper is interested in exploring how to train future designers to be able to perform the entrepreneur actions, take the design leadership and create the responsible designs in classrooms so that they will be capable of taking up the priority challenges (EuropeanCommissie, 2018). The question is two folded: what to learn and how to learn.

To train future designers to deal with wicked problems in knowledge economies, Teixeira (2010) envisioned a new design curriculum in which other disciplines such as business, management, finance and liberal arts provide their relevant input to help to teach design students with competencies related to entrepreneur actions and leadership skills.

Because of the craftsman nature of the design discipline, design education programs do not adopt traditional university lecture-based learning as the primary teaching approach. They often combine the forms of lecture- and studio-based learning (SBL) to overcome the shortcoming of the lecture-based learning alone (Schön, 1987). However, this studio approach was often criticized because of its focus on subjective creativity based on interpretivist epistemology and therefore lack of scientific rigorous (Niederhelman, 2001). Wang (Wang, 2010) called for a balance between rationality and creativity in design education to deal with the increasingly complex contexts that design education is facing.

This paper reports a short design innovation course with a real-life case provided by Alibaba User Design Committee (Ali UED). Through discussing and reflecting on the design of this course program, this paper outlines how to situate the real societal problems into a design class to teach future designers to learn entrepreneurial and leadership related competencies scientifically and responsibly.
Related work

Need for scientific knowledge from other disciplines
Entrepreneur actions refer to activities that entrepreneurs take to discover and exploit entrepreneurial opportunities (Alvarez & Barney, 2007). If recognizing opportunities is an individual action of entrepreneurs and often connects to the creativity of the designers, exploiting these opportunities is a collective action with all stakeholders involved. Design leadership here refers to "leadership by design" (Teixeira, 2010) and assumes that certain designers can take up the lead in initiating and managing design and innovation projects because of their capabilities in combining design, business, user, and engineering related competencies. To create responsible designs, designers need to know to make the right design decisions on, e.g., selecting materials, defining communication protocols, etc. To develop these three competencies, it is crucial that the design education includes knowledge from management, business, engineering, etc. According to Beucker (2004), scientific thinking is needed to support design students to apply scientific knowledge to their design learning processes. Scientific design education should, therefore, offer students a set of possible approaches, e.g., humanities and research approach, marketing experience and design management so that they learn to make the appropriate selection strategically (Beucker, 2004).

Studio-based learning
SBL started in the Bauhaus School of Design during the early 1900s in Germany (Bayer, 1975). It has become a critical component of a variety of college and university design programs (Schön, 1987). Schön (Schon, 1984) proposed to apply the design studio approach to teach design and architecture students to become reflective practitioners and learn to work in multi-disciplinary design teams. Studio-based learning takes place typically multiple times a week in a physical space where students can work individually or in groups. The teaching and learning interactions usually do not take place via traditional lecture formats, but instead through organizing multi-directional experience sharing (teacher-student, student-student) that provides students with new insights in their work (Cennamo, et al., 2011). Schon (Schon, 1984) stated that the core quality of a design studio-based learning approach lies in its reflective practice nature. He stressed the intuitive and undescriptive nature of the reflective practice of individual designers is critical to the studio-based learning approach. Although it’s reflective, creative, communicative and collaborative features have been widely recognized (Valkenburg, 2001) and considered very important for managing complex design problems (Cennamo, et al., 2011), increasing critics were raised upon its scientific rigor in higher education (Niederhelman, 2001) because of its subjectivity in both instruction and learning. Gross and Do (Gross & Do, 1997) warned that there is a danger of exaggerating creativity at the expense of practicality and social and ethical responsibility.

This paper is interested in exploring how to combine both scientific rigor and studio approaches in an 8-day pressure-cooker industrial design course to deal with societal challenges.

Research setup
The course setup
The design course discussed in the paper is an 8-day design innovation course offered at Zhejiang University (ZJU) in China in the first week of July 2017. Four scientific staff members from Eindhoven University of Technology (TU/e) were the leading lecturers of this course. The 30 participating students were second-year bachelor students following the second-degree program on Design at ZJU. This course was part of the curriculum focusing on the design competencies related to business and entrepreneurship. 6 Staff from Alibaba UED acted as experts throughout the course to provide input and feedback to the students.

The purpose of this course was to create awareness of entrepreneurship and to provide design students with the managerial, economic and strategic thinking knowledge, as well as design skills and motivation to encourage entrepreneurial success. Students took different learning activities to learn related knowledge and practices about entrepreneurial action and design leadership, including following lectures, participating workshops, conducting field research with end users and stakeholders, presenting to industry experts and writing reflection reports on their learning experiences.

The Situated societal challenge
Among others, one real-life design challenge provided by Alibaba UED aims at promoting healthy seafood online consumption experience. One student group with five students worked on this challenge for a period of 8-day in this course. The other students worked on other design challenges proposed by Alibaba. This paper will discuss this course using this design case as an example. The following paragraphs describe the design case in detail.

Despite the well-recognized benefits of e-grocery shopping in saving time and convenience (Morganovsky & Cude, 2000), there is still a long way to develop this concept. Compared to grocery shopping in physical supermarkets, implementing e-grocery shopping is much more difficult due to some reasons (Anckar, Walden, & Jelassi, 2002). First, the process to bring the consumable food products to consumers is beyond the world wide web, i.e., it is not entirely online. Second, consumers prefer to physically examine the quality of the grocery products before the purchase because groceries are perishable products (Canedy, 1999) (Baker, 2000). Third, the e-grocery products have to stored locally because of their tangibility and perishable nature. Fourth, due to the high operational costs involved in e-grocery shopping (Kämäräinen, Småros, Jaakkola, & Holmström, 2001), the grocery prices online are not always economic compared to those in the physical stores. Lastly not least, online grocery shopping makes some consumers’ favorite shopping habits (Ahola, 1999) (Canedy, 1999) no longer possible.

Alibaba became the largest e-commerce company since 2017. Online grocery shopping is one of their e-commerce platforms. Promoting healthy food intake is very important to improve population health and contribute to economic growth of a country (National Research Council (US) Committee on Diet and Health, 1989). Legal systems and standards are already in place in China to secure the food quality and safety (Xinhua, China National, 2007). Especially for seafood, there was a national-wide quality standard mandated by China’s Ministry of Agriculture (MOA) to award a green label to qualified safer seafood and earlier research has shown that the Chinese consumer is willing to pay more for green-labeled seafood for the protection of individual benefits (Xu, et al., 2012). Alibaba started a new retail concept, HEMA Fresh Seafood, based on a combination of the online and offline shopping experiences (NAJBERG, 2017), which indirectly also responded to these e-grocery challenges and legal requirements of selling seafood above. Online order service is available via an app, and the goods ordered will be delivered within 30 minutes. In offline stores, the seafood can be sent to consumers’ residence as soon as it is purchased in the store, either using in-store payment system or the app so that consumers can enjoy fresh and high-quality seafood within a short time. Consumers can receive advice on how to cook the seafood and can also buy the appropriate amount of fresh vegetables that go with it in the offline stores. Most importantly, the sources of the seafood and accompanying vegetables are carefully evaluated, selected, transported and stored according to the legal requirements in China to ensure safety. At that moment when the course was given in July 2017, there was only one grocery store to sell seafood in this new retail model opened in Shanghai. Today there are more than 15 offline stores in more than six different cities in China, and the number is still growing. The challenge that the student team received related to modern families. Families come in many shapes and sizes; sometimes both parents work, sometimes multiple generations live together in the same home. But what many families have in common is that they want to cook and enjoy a family meal together. Responsible families focus on healthy, high-quality products. It is more convenient for these modern busy families to order groceries online than to shop for them. However, many families are hesitant to do so because they are concerned about the quality of the grocery products that they order online. The challenges were how to design a new experience for these families from the HEMA Fresh Seafood perspective so that the quality of the seafood is guaranteed and well communicated to the families. The societal relevance lies in how to motivate these families to sustain their healthy eating behavior intentions through HEMA Fresh Seafood.

Figure 1  Impression of HEMA Seafood Grocery Store, courtesy of Alibaba UED
This paper is interested in how the students learned to design for this real societal challenge in both scientific and creative manner. The course program, the student group design process, their concept, the feedback from consumers and Alibaba, and their reflection data were analyzed to answer the research question above.

**Results and analysis**

*Detailed education program*

The entire course program was carefully designed to offer knowledge related to entrepreneurial actions and design leadership. Firstly, students were instructed to follow a design process with mixed perspectives (Smeenk, Tomico, & van Turnhout, 2016) in their independent learning activity for the design case. In this way, the students could be encouraged to continuously reflect from the 1st person, 2nd person, and 3rd person perspective through the design iterations. According to Tomico (et al., 2012), designing from 1st person perspective means that designers design for themselves within the context involving their own experiences as the user; designing from 2nd person perspective means designers design together with a small group of people involving in the use situation; designing from 3rd person perspective means designing for people and society in general without involving users or having direct contact with experts based on what they know, think, hypothesize, assume, and speculate. In this way, the students were stimulated to follow their creativity and instinct and continuously move between their perspectives and their users and other stakeholders’ perspectives. Mastering this process is an essential skill when taking up design leadership and designing for complex societal challenges. It is important to mention that field research with end users, and stakeholders was a must independent learning activity especially when designing from the 2nd perspective. At the end of the course, the students were asked to integrate the results from the three iterations together and make a final presentation.

Secondly, the academic lecturers delivered some scientific lectures and hands-on workshops to provide related competencies from market research, stakeholder analysis, competitive analysis, business modeling, service design, etc., so that the students could learn the appropriate attitude and knowledge to work and communicate with stakeholders during the design process. For example, a lecture was organized to teach students how to collect user insights through a hands-on workshop session using cultural probes (Gaver, Dunne, & Pacenti, 1999). A lecture on persuasive strategies was provided together with a hands-on workshop using Perswedo cards (Ren, Lu, Oinas-Kukkonen, & Brombacher, 2017) to teach students to create designs that could trigger behavior change. A lecture and workshop were held to introduce the personalized motivational strategies and apply them to the concepts created earlier (Valk et al., 2017). A lecture and workshop were held to help students to conduct competitor analysis using different methods and tools such as the centrality-distinctiveness map (Dawar & Bagga, 2015). A workshop was held to introduce the use of different stakeholder analysis techniques including stakeholder map (Freeman, 1984), service blueprint (Shostack, 1984), etc. to help students understanding the complex stakeholder relations in the given challenge and to design for and with the different stakeholders.

Thirdly, at the end of each iteration, pitch session was organized. The student teams were expected to present their results based on the progress so far and explain: who they designed for, why, how they designed and what the designed results were in terms of value propositions and business models. Academic staff and Alibaba UED staff acted as panel members to provide both educational feedback on the application of the different methods, tools and related theories and practical input on how the presentation was structured and delivered, how different media was used in the presentation to support the argument, whether there was a central message in the presentation and how well the business thinking was developed along the design process, and etc. Attention was given on whether the proposed design was a responsible one as well.

An overview of these learning activities is given below in Table 1.
### Table 1: Learning activities in the class

<table>
<thead>
<tr>
<th>Topics</th>
<th>Learning activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design for complex societal challenges with focus on responsible designers and multi-stakeholder collaboration</td>
<td>Lecture + workshop</td>
</tr>
<tr>
<td>Design for the users making use of culture probes, user experience flow, and etc.</td>
<td>Lecture + workshop</td>
</tr>
<tr>
<td>Ideation from 1st person perspective, prototyping and prepare for 1st pitch presentation</td>
<td>Independent learning</td>
</tr>
<tr>
<td>1st pitch presentation</td>
<td>Presentation</td>
</tr>
<tr>
<td>Concept evaluation on personalised motivational strategies</td>
<td>Lecture + workshop</td>
</tr>
<tr>
<td>Field research with end users and stakeholders and evaluate 1st concept with them</td>
<td>Independent learning</td>
</tr>
<tr>
<td>Design for the market based on market research and analysis including trend analysis, competitors analysis and etc.</td>
<td>Lecture + workshop</td>
</tr>
<tr>
<td>Re-ideation from the 2nd person perspective, prototyping and prepare for 2nd presentation</td>
<td>Independent learning</td>
</tr>
<tr>
<td>2nd presentation</td>
<td>Presentation</td>
</tr>
<tr>
<td>Design for the business and system based on business model, service blueprint, and etc.</td>
<td>Lecture + workshop</td>
</tr>
<tr>
<td>Field research and 2nd concept confrontation with end users and involved stakeholders</td>
<td>Independent learning</td>
</tr>
<tr>
<td>Ideation from the 3rd person perspective, prototyping and preparing for the 3rd presentation</td>
<td>Independent learning</td>
</tr>
<tr>
<td>3rd presentation</td>
<td>Presentation</td>
</tr>
<tr>
<td>Fine-tune concept, prototyping, field research and 3rd concept confrontation with end users and involved stakeholders, prepare for the final presentation</td>
<td>Independent learning</td>
</tr>
<tr>
<td>Final presentation and writing reflection reports</td>
<td>Presentation and reflection</td>
</tr>
</tbody>
</table>

The course was organized to balance the scientific rigor and design intuition and creativity.

**Course results**

From the program, we learned that the students were continuously switching perspectives: from 1st person, to 2nd person, and to 3rd person perspective. They started with exploring the challenge from their perspectives and based on the scientific knowledge they have learned then. After that they confronted their views with the views of the users and stakeholders, using the culture probes and prototypes. When only low-fidelity prototypes were made, they interviewed the users and stakeholders by demonstrating these prototypes. When high-fidelity prototypes were available, they were able to test these prototypes for a short while. In this case, the students first made a storyboard and a video which they could show to the users and stakeholders; later they also made a mock-up for the app so that the users and stakeholders could test and have the first experience with it. Whenever more insights were collected, they continued the process from the 3rd person perspectives and tried to interpret these insights in their ways to create potential solutions.
The students were very much emerged themselves into this design challenge because of the active participation of the Alibaba UED designers and continuous interactions with the end users and stakeholders. The dynamic moving in and out of the classroom made it feasible for students to design for the reality. In fact, university-industry collaboration is not a new phenomenon. Brainport, where TU/e locates, is well known for its triple-helix model (Etzkowitz & Ranga, 2015) in which industries, universities, and government organizations collaborate closely with each other in education, research, and innovation. What was so unique in this course was that the participation of Alibaba UED made it feasible for the students to design in the context where the challenge came from. They could have access to the knowledge source within the Alibaba UED related to the end users. This active collaboration made it feasible for this pressure cooker course to be held just in 8 days. Students were designers in-situ.

Their presentations were also gradually improved. From being barely able to convey their initial ideas to fluently and confidently presenting their well-argued thoughts using their sketches and prototypes, they demonstrated the design and communication competencies desired when dealing with societal challenges (Gardien, Djajadiningrat, Hummels, & Brombacher, 2014).

The final concept HEMA-Go was about supporting the busy families to grasp their necessary seafood and accompanied vegetables as fast as possible so that they could go home to cook accordingly or let it prepared in the store and eat there or take away. It has a new feature within the existing HEMA shopping app. Through an in-store interaction with the food via a QR code, it could help the consumers to view how the HEMA Fresh Seafood followed the legal requirements and protocols and make sure that the seafood and vegetables are acquired, stored and transported to the store and the consumers in a proper manner. By envisioning that the close collaboration between HEMA Fresh Seafood and the seafood suppliers, this information aimed at providing the end users confidence about the safety and quality of the food products. Next to this, by shaking the smartphone when consumers pass by the vegetable section in the store, the consumers could be provided with different suggestions on how to combine the seafood with mixed vegetables available in the store to make their grocery shopping quick and meaningful. In addition, this concept connected to the already existing experience in the store. Once a choice of seafood collection was made and recorded in the app, the purchasing order could be processed as an ordinary online order. An already existing and carefully designed logistic service would be activated to ensure the seafood and other groceries to be delivered safely and freshly to the homes of the consumers within 30 minutes. Or it would be cooked by the chef in the store so that the consumers could either enjoy the food in the store or take it away and eat at home. They also envisioned once there were more shopping and consumed menu data available per consumer, better personalized online and offline services could be developed further. They used different persuasive design principles (Oinas-Kukkonen, 2009) listed below, based on what they have learned from the scientific lecture.

- Tailoring & personalization of recipes. Based on the users’ movements through the store while using the application, it would be possible to track what categories of food products they would tend to buy.
- Suggestion. In the meantime, purchasing recommendations could be made based on their purchasing and cooking history.
- Reduction. Instead of carrying their food products to the cashier to check out, the users were able to make the purchase immediately with the shake of their phone screen. The purchasing order would be quickly dropped into their virtual shopping cart. This interaction made things more comfortable than going through the multi-step process of everyday online purchases, of course avoiding the offline waiting experience at the cashers, no matter whether it is a self-cashier service or assisted one.

The feedback from the consumers was positive. They created personas, and customer empathy map (learned from the scientific lecture) firstly based on their desk research, then verified it with the culture probe study, acquired from the scientific lecture, with users in the field. They tested the first concept scenario and the last concept prototype with the users as well. One working mother aged between 30-40 mentioned

“This application would be handy. I have to bring my child to the supermarket after work, and with this app, I am more hands-free.”

They could not say much about the complete new seafood shopping experience yet since it was not feasible to try out, though they were eager to try once it would be available since they liked the app prototype.

Based on the stakeholder tools they learned from the scientific lecture, the students recognized that the close collaboration between the HEMA Fresh Seafood and Alibaba logistics would be of great importance because of the...
required real-time reliable delivery services. The cooperation with the trustful and dependable seafood and grocery providers would be also very critical since only this could secure the food safety and quality required by the governmental legal requirements. They worked out the value proposition canvas, business model canvas, and service blueprint, based on what they learned in the scientific lecture, to demonstrate the values in their concept and the different actions that each stakeholder need to take so that it was ready for commenting by stakeholders and end users.

The ALIBABA UED designers and the project owner appreciated that the students recognized that the use of the physical stores to promote online sales is a valuable tool to build HEMA into a trustful brand. However, the high costs of real-estate imply that HEMA would have to create a more efficient in-store environment to respond to the increasing number of visitors. Overcrowding could negatively affect customers’ experience of the store. The use of an online payments system could help to reduce waiting times and improve the revenue at the store. This payment method would be desirable for the existing HEMA consumers who were already familiar with the online payment environment of Alibaba, i.e. Alipay. It would be also attractive for the new HEMA consumers since this could make them more willing to buy more groceries from HEMA even when they were not at the physical store. They applauded that tracking of customers’ activities in the store via the application was also important in helping understand the preferences of HEMA’s consumers. They confirmed that HEMA could create tailored recipe recommendations for its customers and find out more ways to satisfy its customers.

The students also jointly reflected on their learning experiences. They welcomed very much the scientific lectures on the different methods and tools needed.

“We are taught to look through the eyes of our customers, followed by the market and finally the business and systems level. We learn to think about these different viewpoints to judge the viability of our business concept. On a more detailed level, we are taught to interview our customers and find out what their pain points are. We used tools such as the Empathy Map (to understand our users) or the Business Model Canvas (to figure out the intricacies of how our business should work, and the stakeholders involved)”.

They appreciated the importance of learning the methods and tools scientifically but acknowledged that successful innovation does not come from theories but a lot of experimentations, as they further discussed that

“One can certainly start his own business without any of such knowledge. ... But we feel that exposure to such tools is still useful. It mitigates the risks of failure. Of course, this course is just the beginning of truly being able to understand these tools. This course is only meant to make us aware of the tools that exist. ...... Through this course, we also realized the inadequacies of the material covered. ...... Our group understands that a lot of what will eventually work will rely on continual experimentation, and not on theory. ...... A great learning experience for all team members.”
Conclusion

The reported education case here clearly suggests the following

• The active participation of the industrial partners in the industrial design class made it possible to empower students to design for and in the context of interest. They acted in-situ and had direct access to the knowledge at stakeholders and the contact with end users.

• The education program which integrated scientific lectures and practical project development work in an organized way gave the students opportunity to learn to apply different methods and tools appropriately in their project. It just triggered their curiosity and encouraged them to learn continuously.

• The iterative design process based on the mixed-perspective embedding in the teaching structure enabled the students to learn step by step and design from different perspectives. In this way, they developed their empathy skills towards end users and stakeholders.

• This reported education format demonstrated the possibility to run a design education program in a living lab context. Firstly, it enabled the design students to design in real life context with the necessary scientific knowledge; second, it supported the scientific teaching staff to teach based on their research development; last, not least, it enabled the industrial partner to get inspiration for future growth and of course scout for talents.

The approach may sound similar to Design Factory concept (Björklund, Clavert, Kirjavainen, Laakso, & Luukkonen, 2011). However, it is still different. Firstly, it does not require a physical location and workplaces for students explicitly. It is mainly classroom based with an open connection to the design case including end users, stakeholders, and clients. Secondly, it makes use of scientific lectures to ensure the scientific rigorous next to workshops, presentations and prototyping and field research. Lastly not least, it has a strong focus on societal challenges, business creation, and design entrepreneurship. Future research is needed to evaluate the impact of this platform and see whether it can lead to something even more substantial.

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