An Instructional Model for Social Design Education: A Design Project for Stray Animals Including Production-Based Learning Approach

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Abstract

Social design education has become a significant part of industrial design education, thus new methodologies are required and being developed. One of these societal problems is animal welfare and human interaction with stray animals that is not a common topic amongst previous studies. This study presents a toolkit for social design teaching, combining social design thinking and product development processes to generate and realise design solutions for stray animals with a production-based learning approach. The toolkit consisting of nine phases under two processes was implemented into the second-year 'Product Design II' 7-week studio project at Gazi University. A total of 35 sophomores taking the course offered during the second semester of the 2017/2018 academic year, participated in housing and feeding stations for a stray animals design project. To analyse the appropriateness of the toolkit, the submissions and process of the project were observed and evaluated by instructors and post-project questionnaires were employed to both instructors and students. The results revealed that this toolkit for social design education combining design thinking and product development processes improved industrial design students' competencies and learning outcomes.

Key words

social design, design education, teaching toolkit, animal welfare, production-based learning

Introduction

The traditional definition of industrial designer as a creative genius or stylist has been changed since Ulm School's scientific approach in design and World Design Organization's (WDO) and Industrial Designers Society of America's (IDSA) new designer definition (IDSA, 2018; Roth, 1999; WDO, 2015). Industrial designers now are perceived as problem solvers and value creators through developing a deep comprehension of user need to design not

only products but also systems, services, and experiences (IDSA, 2018; NASAD, 2017-2018; NCSU, 2018; NJIT, 2018; WDO, 2015).

Comprehending user needs is no longer limited with needs of one user or a group of users, there is an emphasis on needs of society as a whole, the impact of design on society as a component of a system. The values that designers create are economic, social and environmental (ASU, 2018; WDO, 2015).

Since the publication of Papanek (1972), Design for the Real World, drawing attention to the impact of design on the environment and society, "social design" has begun to be a widely discussed term in the field of design research. Papanek (1995) argued that the design profession serves consumer society and capitalism. He supported that designers should use their professional skills for addressing and solving social problems, as well. Similarly, Manzini's (2014; 2015) social design examples such as carpooling and community garden summarize that social design should meet social needs holistically without focusing only on financial profit.

As it was realized that design and designers could significantly influence the development and transformation of society, a variety of methods and models are discussed teaching social design in design education. Margolin & Margolin (2002) argue that social design could not be learned by conventional methodologies like design for the market. Instead, they suggest a "social model" that indicates the ways product design could meet social and environmental needs.

Based on this interest in social design, although there are few, some design schools or institutes included social design issues in their curricula or in their projects. It is seen that animal needs are generally ignored; only a few design schools incorporate animal welfare into social design issues, one of them is Delft Design for Values Institute (TUDelft, 2018). Although there is an increasing sensibility to animal welfare, the research on design for animals is limited and generally emerged last decade. There are some 3D printed prosthesis projects collaborated with veterinary doctors, product design departments, and non-profit organizations to save and improve animals' lives. Some leading international design competitions, A-Design Awards, IF Design Awards, The International Design Awards (IDA) and Red Dot Design Award included product design category for animals (A-Design Awards, 2018; IDA, 2018; IF Design Awards, 2018; Red Dot Design Award, 2018)

Since social design education has become essential in design education, it is necessary to develop new methodologies in design schools. Having examined the content of social design programmes and courses, it is seen that they mainly focus on cross-disciplinarity, co-creation, practice-based learning approaches, combining theory and praxis. It is supported that social design could just be learned by practise-based studios (Heller, 2018). Besides, studies on learning styles of design students indicated that industrial design (ID) students learn better and prefer learning by experiencing, thinking, doing and/or reflecting (Durling, Cross, & Johnson, 1996; Willcoxson & Prosser, 1996). With producing, testing and analysing the full-scale prototyped products for the real world, ID students can learn better whether their project has any problem or not in terms of materials they selected, mechanisms they used, production methods they decided on (Greenberg, 2017; Margolin, 1991; Margolin & Margolin, 2002). Practise-based learning also increases ID students' entrepreneurial skills like creativity, innovativeness, motivation; business skills like

communication and project management and technical skills like tools and materials production, calibration, testing and revision (Ganefri, 2013).

There is limited research about production-based learning in social design education of industrial design students. The existing ones, as mentioned above, emphasize that social design education requires a practices-based, experiential or production-based learning approach. However, these limited research projects lack empirical findings to prove the claim that learning by producing is a necessity in social design education. Therefore, the objective of this study is to present a new toolkit for social design teaching and conducting applied research to observe the effects of the toolkit on education. The presented toolkit combines social design thinking and product development processes to generate and realise design solutions for real-world problems with production-based learning approach and co-designing practices. To achieve this, a toolkit for social design learning, consisting of nine phases under two processes, was implemented into the second-year 'Product Design II' 7-week studio project at Gazi University. The evaluation of the project consisted of an analysis of the submissions and process observations of instructors and post-project questionnaires completed by both students and instructors.

Social Design in Design Education

The terms, social design, socially responsible design, and socially oriented design, are buzzwords and have gained significance in design research in recent years (Melles, de Vere, & Misic, 2011; Tromp, Hekkert, & Verbeek, 2011). Indeed, there is a long history behind social design beginning with the ecological movement in the 1960s and design movements against consumerist society in the 1970s and 80s (Whiteley, 1993).

Undoubtedly, the publication of Papanek (1972), Design for the Real World, introducing the idea of the 'Third World' was the turning point for social design issues. The main characteristic of the book widely accepted is being against consumerism and supporter of the notion that designers should be more responsible in their design professions (Clarke, 2013). Papanek (1985; 1995) criticizes the design profession due to its potential in supporting consumerist society and capitalism. Papanek emphasizes the prominence that designers should focus on design for non-profit and canalise their skills to solving societal problems in the manner of an anti-consumerist approach. Industrial designers should not be limited only to serving companies and increasing their profits, they are expected to take social responsibilities by creating non-profit products for disabled, homeless, older, unemployed people, or for third world countries (Papanek, 1985; Whiteley, 1993; Davey et al., 2003).

Likewise, Manzini (2015), one of the newest theorists in the field of social design research, suggests that social design is not new; it is just a new way of contemporary design (p. 55). Manzini identifies social design as "new products, services, and models that simultaneously meet social needs and create new social relationships or collaborations". Manzini (2014; 2015) states that socially responsible design results in social innovation and it is a behaviour change, a new way of production and consumption bringing social justice.

Margolin & Margolin (2002) suggested a "social model" indicating the ways product design could satisfy people's needs and improve the physical and social environment. The aim is not to put designers against each other, but reveal the opportunities of designers to collaborate with disciplines like education, health, crime prevention for complex social design problems.

As mentioned before, Papanek argues that the design profession only focuses on the market and selling. Although there is an increasing interest in social design, very few designers address social issues and design for social impact due to the current situation of product design education. Therefore, it is vital to develop new strategies in design schools for social design education. Design educators can provide students with opportunities to collaborate with non-profit organizations, institutions, and industries to solve social wicked problems in meaningful ways (Margolin, 1991; Margolin & Margolin, 2002; Manzini, 2015; Yang, 2015).

Having examined the leading design schools; it is observed that there are limited social design programmes and courses. Some of the design schools with social design programmes or courses are School of Visual Arts, Design Academy Eindhoven and Delft University of Technology (Delft University of Technology, 2018; Design Academy Eindhoven, 2018; School of Visual Arts, 2018) The common points of them are cross-disciplinarity, co-creation, practice-based learning approach combining theory and praxis.

Social Design and Animal Welfare

Definitions of social design generally are based on satisfying people needs. However, as human beings, we share our planet with animals as well as the natural surrounding and affect them in several ways. Although animal welfare is one of the concerns of social design, there is limited research addressing the needs of animals. The research about design for animals emerged last decade and mainly focuses on Animal-Computer Interaction (ACI) (Mancini, 2011; Ritvo & Allison, 2014; Väätäjä, 2014; French, Mancini, Sharp, 2015; Westerlaken & Gualeni, 2016; Hirskyj-Douglas & Read, 2016; Wirman & Zamansky, 2016). Animal-Computer Interaction was first introduced as an academic discipline included in Human-Computer in 2011 by Mancini based on three aims:

"(1) studying and theorising the interaction between animals and technology in naturalistic settings (2) developing user-centred technology to improve animal welfare, support animals in their activities and foster interspecies relationships, and (3) informing the development of user-centred approaches to the design of technology intended for animals, enabling them to participate in the design process as legitimate stakeholders and contributors." (Mancini, Lawson, & Juhlin, 2017, p.131)

Production-Based Learning in Social Design Education

Recently, as mentioned in the previous section, social design has become important in design education. Current methodologies developed in design schools generally focus on markets and show less interest in non-profit projects for specific or minority populations.

Social design programmes or courses emphasize a practice-based learning approach combining theory and praxis. Founding Chair of the first MFA program in Design for Social Innovation at SVA, Cheryl Heller (2018) also declares that social design could just be learned by practise-based studios. Since social design issues are related to real-life problems, practice-based phases like prototyping and testing are crucial to solve these problems. Heller's idea is supported by other studies on practice-based or experiential learning methods in design education. Although different results exist about studies on learning styles of design students, a majority of studies support that design students are mainly diverger (concrete experience and reflective observation) and accommodator (concrete experience and abstract conceptualisation) according to Kolb's four-stage Experiential Learning Theory (Bender, 2004; Carmel-Gilfilen, 2012; Kolb & Wolfe, 1981; Nussbaumer & Guerin, 2000). Both prefer doing rather than thinking and practical learning rather than theoretical (Kolb, 1994).

Moreover, the research by Demirkan (2016) based on Felder-Soloman's Index of Learning Styles revealed that design students prefer a sensing learning style such as facts and concrete material rather than theories. It is also found that design students are active learners; they prefer teamwork and hands-on activities, like drawing and making a mock-up (Carmel-Gilfilen, 2012; Demirkan, 2016; Nussbaumer & Guerin, 2000).

Studies on production-based learning indicate that failure is the most powerful tool for learning and students can only experience the failures with experiments, prototypes, interactions and testing them. Without producing, testing and analysing ID students could not learn whether their projects have any problems or not (Gladysz & Santarek, 2014). In addition, the study of Ganefri (2013) supports that a production-based learning model increases learning outcomes.

ID students in design process deal with not only aesthetic values but also practical and functional values of the products. Thus, in the production-based learning model, full-scale, fully functional real-world prototyping is vital, especially in ID education. While making non-working prototypes, students make their material selection decision randomly. This prevents the students and instructors from evaluating the projects correctly. On the contrary, during full-scale prototyping, contacting with manufacturers, finding sources for real materials, production and assembly processes enable ID students to have full knowledge of materials, mechanisms and current industry trends (Gattis, 2002). Therefore, full-scale prototyping increases the efficacy of production-based learning model (Yamaçlı, Özen & Tokman, 2005).

As the above discussion attests, it can be concluded that a new methodology combining social design thinking process with production-based learning model including real final products to be achieved in social design education and contributing to students' technical and professional skills can be useful in design education.

Methodology – A Toolkit for Production-based Social Design Learning

Concerning the above discussions, a practise-based approach is essential for social design teaching to achieve realistic design solutions. Therefore, a new teaching toolkit for social design focused on production-based learning is created. The fundamental objective of this toolkit is to guide design students through a combination of social design thinking and

product development processes to develop and realise design solutions for social problems with a practise-based learning style.

The toolkit is inspired from different design sources and methodologies, comprising *IDEO's Human-Centred Design (HCD) Toolkit* and *Design for Social Impact Toolkit* (2018), *FROG's Collective Action Toolkit* (2018), *ArtCenter College of Design's Design Strategy for Social Innovation: A Toolkit for Educators* (2018) and from instructors' own professional backgrounds and experiences in the field of design research. IDEO's HCD toolkit (2018) consists of some design phases just for design companies. ArtCenter College of Design's toolkit lacks phases about preparing social design brief and building teams. FROG's toolkit (2018) is missing phases like testing prototypes and optimization. Therefore, none of these toolkits are focused only on social design education. Thus, they are combined in a way that is suitable for the social design project that will be conducted and created a new teaching toolkit. This toolkit combining social design thinking and product development processes consists of nine phases: Preparing guideline, research, building teams, defining problems, idea generation, preliminary presentation, field testing, optimization and final presentation (Figure 1). The toolkit is fundamental for directing the students to new components like field research and co-creating with non-profit, and partner organizations and thus, it differs from traditional design processes used at Gazi University.
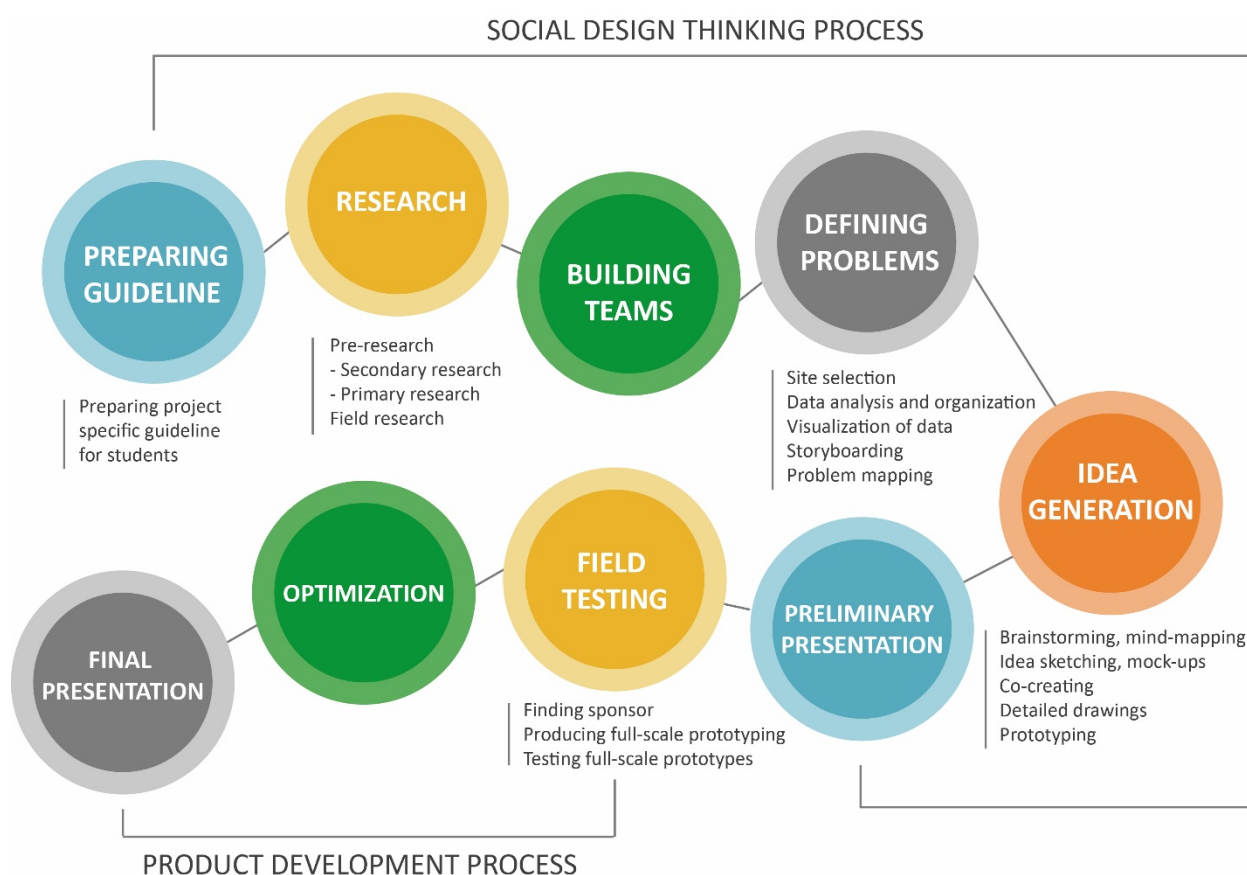
Figure 1. Phases of a new teaching toolkit for production-based social design

The Product Design Project: Housing and Feeding Stations for Stray Animals

Before building the design brief, different alternative design projects for design for animals were evaluated according to their suitability for the proposed social design toolkit, accessibility for students, and approximate duration. Taking account of these specifications, it was decided to assign housing and feeding stations for stray animals in Gazi University campuses as a product design project.

Details of the nine phases of the project combining social design thinking and product development process (as the outline is mentioned in Figure 1) are as follows:

Preparing a guideline for "Design of housing and feeding stations for stray animals"

In this phase, instructors prepared a guideline for "Design of housing and feeding stations for stray animals". This guideline consists of five freedoms of animal welfare developed by The Farm Animal Welfare Council (2009) and principles for design of animal shelters and feeding stations.

Five freedoms of animal welfare: Before designing animal shelters and feeding stations, it is vital to take into consideration the needs of the animals. The Farm Animal Welfare Council (2009) was developed "Five freedoms of animal welfare" describing both the needs of domesticated animals and duties of care owed to them. It is used around the world as a

benchmark for the care of all animals in shelters too. The five principles are freedom from hunger and thirst, freedom from pain, injury, and disease, freedom from fear and distress, freedom from discomfort, and freedom to express normal behaviour.

Design of housing and feeding stations for stray animals

Site Selection: Before selecting sites for the shelters and feeding stations, instructions that should be followed are as follows:

- Identifying the population of stray dogs and cats that needed help in the area over the previous few years, and their behavioural situations whether they live individual or as a group.
- Researching existing situation about stray animals in the area, how they are cared for and by whom. (Local organizations or communities responsible)
- Analysing environmental conditions and geological structure and which materials could be recommended these conditions.
- Obtaining information from local organizations and people about proposed the shelters and feeding stations.

Research

Pre-research: Students were asked to research about stray animals in general. Students made interviews with pet owners, veterinarians, animal organizations and regular pedestrians nearby to understand both animal needs, and how human and animals interact, supported occasionally by online or printed written and visual resources.

Field Research: Students investigated separated campuses of Gazi University in terms of environmental conditions and geological specifications supported by contextual research. They identified the population of stray dogs and cats, observed their behavioural situations, whether they live individual or as a group and how they are cared by whom via interviewing non-profit organizations, community leaders and people caring stray animals in campuses.

At the end of this phase, students submitted and presented all written and visual research outputs and problem definitions revealed accordingly to the instructors.

Building Teams

A total of 35 ID sophomores attending a 'Product Design II' course participated in the project. The demographic makeup included 28 females and 7 males. Seven teams consisting of between three to five members were formed according to their research interests.

Defining Problems

Teams selected sites with respect to collected data from previous phases to continue their design process. They organized and analysed these data in order to define problems and to

visualise them. In this phase, team members continued to collaborate and get feedback from stakeholders. They were asked to present their problem statements with storyboards and problem maps twice a week.

Idea Generation

Teams generated ideas considering their design problem statements by utilising creative design thinking techniques; brainstorming, mind-mapping, and design matrices. They presented their ideas with sketching and making mock-ups. In this phase, teams collaborated and co-designed with non-profit and partner organizations. They received feedback from instructors for their design ideas during studio critiques and developed three proposals.

Preliminary Presentation

In the preliminary presentation, teams were responsible to present their research reports, problems they defined and three design ideas by both visually and verbally to jury members with multidisciplinary backgrounds. Presentations included analysis of animals and sites with photographs, storyboards, technical drawings and a mock-up of the proposed product design. They suggested the materials that they will use in final real products. Jury members assessed the preliminary presentation for design thinking process according to four evaluation criteria that are coherency between research and decision-making, analysis-synthesis and problem defining, creativity and originality of the design proposals. At the end of each presentation, the jury eliminated two of the three proposals and teams proceeded to the next phase with the remaining one.

Field Testing

Teams searched for sponsorship. They presented their projects, preferred materials, and approximate costs to various organizations. When agreed, teams began to develop full-scale ready-to-use prototypes. Students benefited from opportunities of both university workshop and sponsor facilities offered. Prototypes were placed on site. Products were tested by dogs, cats, and people caring those stray animals. Students observed kennels and stations in use and they analysed their design in terms of user-product interaction, anthropometrics, and environmental suitability. Teams recorded all phases visually and presented during the course.

Optimization

Prototypes failed in various ways during field-testing. Revisions decided and students changed designs for optimization accordingly. Some of the prototypes were revised in the field, others sent back to the workshops. Teams repeated the optimization phase until designs were satisfactory in all terms.

Final Presentation

Teams presented their full-scale products on the field with a portfolio book including sketches, photographs and other studies made in the process. Products (shelters and feeding stations) were presented with the participation of stray dogs, cats, and caretakers in the final jury. Jury members consisting of instructors from multidisciplinary backgrounds, volunteers from non-profit organizations and employees of sponsor companies assessed designs according to 9 fundamental criteria which are explained below.

Evaluation of the Project

After the project is completed, 7 instructors of the 'Product Design Studio II' evaluated each project group by a set of scores. They individually reviewed the outputs, considering if the prototypes met the design criteria or not. Mean of these scores are announced as the project assessments, which will be shown in the results section of the study. However, as such scores lack providing qualitative findings, observations and questionnaires are preferred primarily.

Analysis of the submissions and process observations

Each instructor followed an assessment guide chart to give a score to the outputs. The guide includes 9 fundamental evaluations: Innovation, holistic design approach, coherency between project and process, engineering design, production quality, technical presentation, visual presentation, technical knowledge, and verbal presentation. Participant observation findings are collected in unconstructed group interviews of the 7 instructors. Visual materials are preferred to complement the observations.

The expected learning outcomes in each of the nine phases under two processes of the methodology that are the base of the process submission and observations were specified as follows:

Social Design Thinking

- Understanding the multiple social dimensions of product design and their relationships with real-world
- Researching, analysing and synthesizing competency about social design issues to develop realistic design solutions
- Collaborate and co-design with third parties (social institutions, non-profit organizations, etc.)
- Applying design thinking method to solve societal problems
- Discovering different creative methods and applying the suitable one for the design problem
- Communicating ideas and concepts via written, visual (drawing and mock-ups) and digital presentations effectively
- Comprehending dynamics of teamwork and being a productive member of a team

Product Development

- Understanding the basics of manufacturing processes and related materials, ergonomics and analysing costs.
- Understanding mechanical principles, devices and tools, and fundamentals of physics.
- Full-scale prototyping and realising design solutions for sustainable and positive social change
- Improving design skills (leadership, business communication, compatibility in teamwork, visual and verbal presentation, project management, design process, analysing environmental conditions, identifying user needs, field researching, cognitive skills, understanding design thinking process).
- Developing technical skills (understanding and applying the material, production techniques, anthropometrics, cost analysis)

Post-project questionnaire

Questionnaire completed by instructors: A questionnaire was asked to 7 instructors of the 'Product Design Studio II' to calculate the mean values of their subjective evaluations (project assessments).

Questionnaire completed by students: To get evaluative feedback about the effectiveness of the new teaching model, a 6-stage questionnaire was developed using a Likert scale. The post-project questionnaire was asked to 35 ID students after the final jury. 33 of them responded with valid answers and the other 2 did not participate.

Results

As mentioned before, 35 (28 female and 7 male) ID students of 'Product Design II' studio courses participated in the social design for the stray animal design project, resulting in 7 student teams. Considering that different design tasks are assigned to each group, various design problems occurred during research and product development stages. Thus, only the notable observations are presented group-by-group first. Later, the results of the questionnaire completed by students are displayed. Finally, the mean values of 9 fundamental assessment scores given by instructors are shown.

Findings of the observations

During the analysis of comments that instructors made during interviews, it is comprehended that evaluations can be divided into 3 phases. Research and design stage (1), prototyping and testing (2), application of final products in field conditions (3). Notable findings are explained below considering the mentioned phases in chronological order.

Team 2- Housing and Feeding Units for Multiple Dogs

The assignment of Team 2 is designing and producing doghouses and a feeding area for multiple stray dogs living as a group in one of the campuses. Students aimed to design seasonally transforming individual houses for each dog, according to their research findings. Students claimed that, in summer, dogs refuse to use houses as the heat rises, thus they begin to search for shadow areas in open spaces. Students also marked that even if the dogs prefer to roam and rest as groups, they also tend to need close yet individual spaces as they sleep. Feeding is also a group activity for these stray dogs, as the carers prefer to feed them in a scheduled order, according to the students. However, dogs are getting disturbed easily from each other during feeding. Thus, food for each dog should be separate and bowls should be placed with distance.

Students proposed designing modular houses with transforming blinds made from chipboard or MDF and glass or PMMA (transparent plastic sheet) first. Later they have decided concerning criticism, that transparency is not a constraint, as it also increases costs and causes shorter product life. Finally, they simplified their designs to be made only out of MDF (Figure 2). Students revised the structure and dimensions of the houses and developed a feeding unit as a part of the product-family, during the design stage of the course.

Figure 2. Team 2-Housing module design (left) assembly of the modules (right)

In the second phase (sponsorship and prototyping), their material decision has changed due to the donation of the wood-like composite material by the sponsor company. However, as the production technic is very similar, students could proceed to manufacture without a design revision. They managed the manufacturing of wall and roof plates for houses and cutting and welding of the profiles for the structure of the feeding station. Students struggled with an overweight of the kennels during shipment from atelier to the field. They also produced some of the missing parts in field conditions by themselves (Figure 3).

Figure 3. Members painting the sheets (left) and carrying the structure (right)

The Third phase (application of the final product) revealed a bunch of design or material related problems as well as some wise decisions. Preferring to use standard fences as tables for feeding bowls is advisable, as it is very cheap to outsource and prevents dirt piling. However, the bowls placed too close and not suitable to prevent dogs from disturbing each other, according to the comment of the carers. Students also missed checking the mass density of composite material comparing with the chipboard. Thus, when they needed to relocate the houses after the assembly, it was impossible to move the houses as the overweight made them need a pallet jack, which was not accessible. They also failed to apply a scissors mechanism for the blind, as they could only outsource improper OEMs. Hence, they had to change plan and fasten the supports permanently in open state. It is fair to discuss that problems that Team-2 experienced were quite educatory, as they had to disclaim some of the functions due to design mistakes and took decisions for solutions in times of crisis. Final products of Team-2 are displayed in Figure 4.

Figure 4. Team 2-Houses (left) and feeding units (right) for group of stray dogs

Team 3- Feeding Units for Multiple Dogs

It was aimed to provide more practical and long-term feeding solutions for stray dogs living on another campus. In the first phase, students observed the area and interviewed with carers. They also took opinions from nearby pedestrians. Students claimed that there is a need for storing large amounts of food to reduce the daily effort of feeding. They also suggested raising awareness by letting other students feed dogs easily by volunteering. Students proposed a combined storage unit design for both food and water with simple mechanisms, which can be activated by volunteering students or instructors (Figure 5).
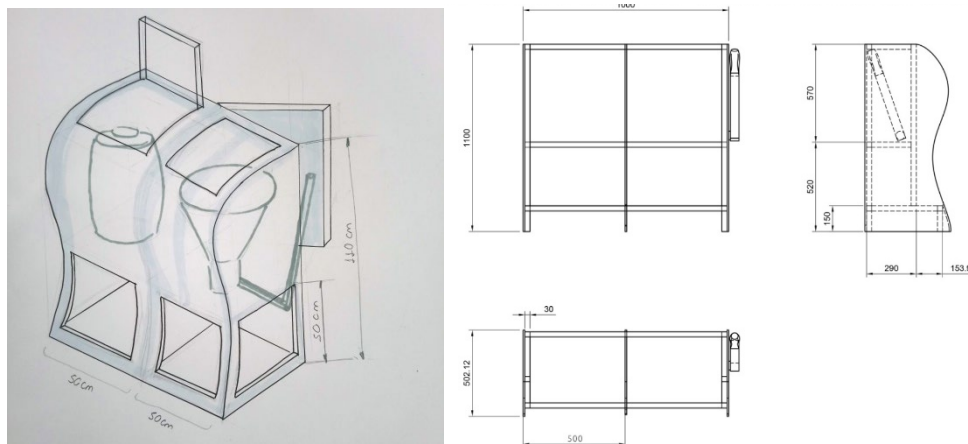
Figure 5. Team 3-Feeding unit sketches (left) and technical drawings (right)

In the second phase, they searched and found sponsorship for cutting, bending and welding steel profiles and sheets. However, after the production is completed they have faced that bowls are inaccessible for the larger dogs due to the low height of the ceiling, food supplying lid is not sealed well, which will cause moisture and rain to harm food and service gates are working hazardously improper. According to the criticism, students revised the prototype by their own (Figure 6), adding a roof, increasing the ceiling height by welding additional profiles and changing the assembling principles of the service gates. During these revisions, Team-3 faced that it is quite hard to revise welded steel products and miscalculating the anthropometrics and human-factor was a crucial mistake causing a lot of additional work. They also struggled hard to find aesthetically satisfying results as the revisions changed the design radically in an unexpected way.

Figure 6. Team 3-Cutting steel (left) impasting weldments and coating primer (right)

Similar to Team-2, also Team-3 made an advisable choice by outsourcing polypropylene containers that are chemical-resistant, providing hygienically better storing of food and water. Such decisions made students comprehend that outsourcing correct OEMs are also vital in product development. Phase 3 showed out that deciding to revise the design was very crucial, as in few days products faced rainy and stormy weather. During the course, Team-3 experienced that missing to satisfy major constraints could cause a lot of extra hard work. Images of the final product of Team-3 are displayed in Figure 7.

Figure 7. Team 3-Feeding Unit for Group of Stray Dogs

Team 5- Housing and Feeding Units for Multiple Cats

Team-5 made an interesting decision driven by their research findings, right after they are assigned with designing cathouses and feeding area for a group of cats in the campus. Interviews showed that also stray dogs live in the same field that stresses the cats when they are feeding and resting. Thus, students have chosen to focus on a specific tree trunk, which provides a natural structure for locating a cathouse preventing dogs stressing them. Increasing the height is proposed as a solution by students. During phase 1, students measured the tree repeatedly, produced a bunch of mock-ups to test their designs until they finalize the drawings (Figure 8).

Figure 8. Team 5-Measuring the tree trunk (left) testing mock-ups (right)

In phase 2, students obtained sheets of chipboards by contracting sponsorship. They made most of the manufacturing by themselves (Figure 9) without needing and outsourced labour, highlighting that choice of material was considered right, as chipboard is easy to handle, as well as it is relatively cheaper than other woods and composites.
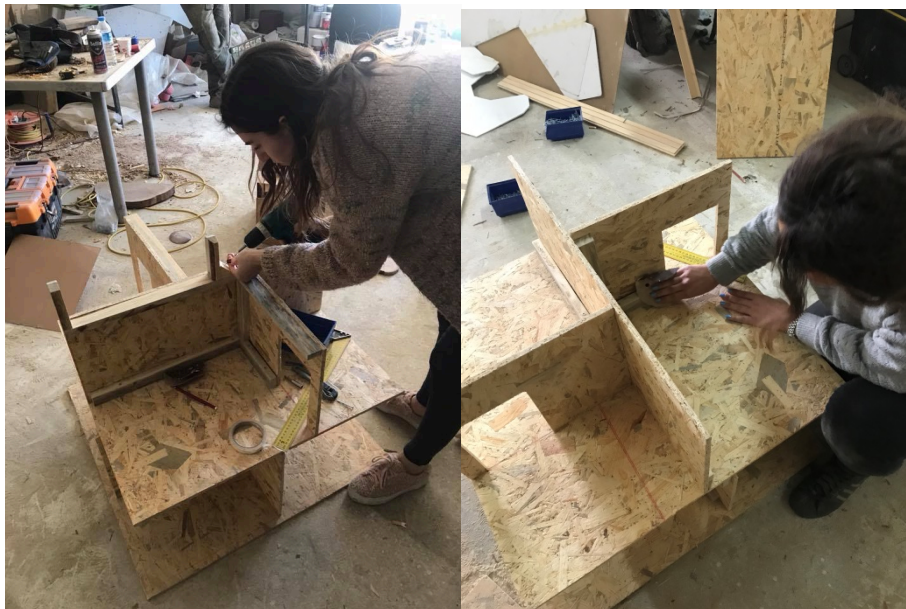

Figure 9. Team 5-Assembling the chipboard parts (left) polishing the surface (right)

Team-5 is exemplary for proving that designing with broader considerations lead to more successful processes. It took a while until cats begin to use the housing due to the smell of varnishing. However, Team-5 faced no other problems than waiting for the smell to dissolve. Final prototypes of Team-5 can be seen in Figure 10.

Figure 10. Team-5 House and feeding unit for group of stray cats

Team 7- Housing and Feeding Units for Multiple Cats

Members of Team-7 focused on increasing awareness by socially influencing campus life. As they are focused on a different campus than Team-5, their constraints are notably different too. These cats were already being cared well by volunteers and there was no factor such as stray dogs stressing them. Thus, students aimed to focus on raising awareness by designing a product with considering aesthetics and user experience, instead of satisfying only the basic needs of cats somehow. Their research showed that using marine plywood would prevent moisture based product life problems, with a minor increase in costs. However, plywood can only be laser cut when the manufacturing costs matter. Thus, in the first phase, students proposed a design which is manufactured by laser cut but no other post-processes and which can also be assembled without any tools, adhesives or else.

Laser cutting plywood is also advisable, as Team-7 could manage prototyping costs only by themselves, saving the time which they would spend for searching sponsorship and making them able to prototype more than once, to optimise better. By this means, students were able to solve the water-leaking problem from the roof joints that occurred when the sealing is tested (Figure 11).

Figure 11. Team-7 Testing mock-up solutions for water leaking problem

The final phase was satisfying as the cats were willing to use the houses (Figure 13). Students demonstrated unpacking a flat package and assembling a cat-house in front of the jury. Going beyond the basic constraints during field research and deeply analysing the materials and production methods, helped students to produce houses with better finishing quality and considering further needs such as packaging or logistics. Even if they have faced a major design problem, students had enough time to figure out a proper roof coating solution, thanks to the decision of manufacturing method that lead them to manage the process more effectively.

Figure 12. Team-7 Houses and feeding units for group of stray cats

Team 8- Houses for Individual Dogs

Students of Team-8 were assigned to produce individual houses for a number of dogs. In phase 1, after they proposed a few different approaches, students focused on combining another social issue with taking care of stray dogs. They focused on recycling wooden euro-pallets to produce houses, which are very cheap to outsource. Even if their material decision had a disadvantage of being unable to use computer-numeric production and disassembling pallets by hand, recycling let them leave less carbon footprint behind. Thereby, Team-8 showed responsibility for both social issues at the same time. Different design approaches of the students are shown in Figure 13.
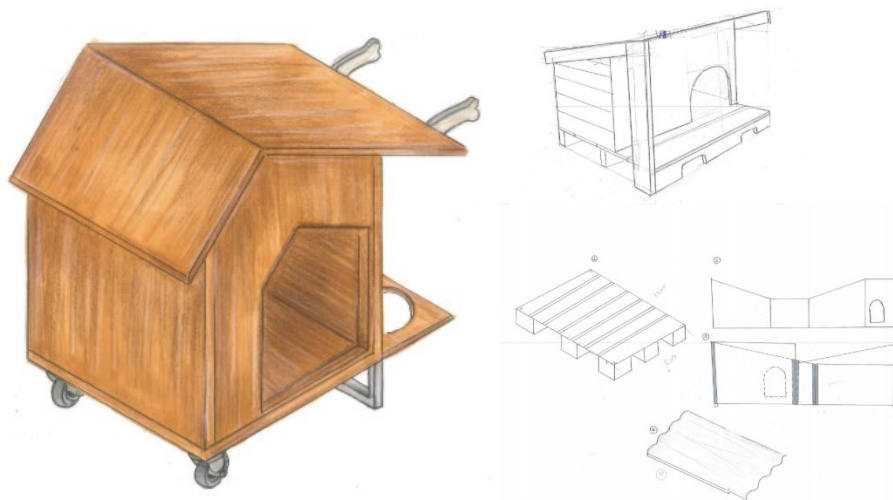

Figure 13. Team-8 Early (left) and matured (right) design approaches for dog houses

During phase 2 (prototyping), some of the wooden parts of pallets broke as the students were polishing the surface. However, as it is very easy to find scrap pallets for almost free and as they are lightweight, it took no time for students to obtain another pallet to continue production. Thus, using recycled material helped them to overcome the crisis. Students only outsourced the scrap pallets, which made them do a lot of hard work by themselves (Figure 14), yet improving their learning outcomes as observed.
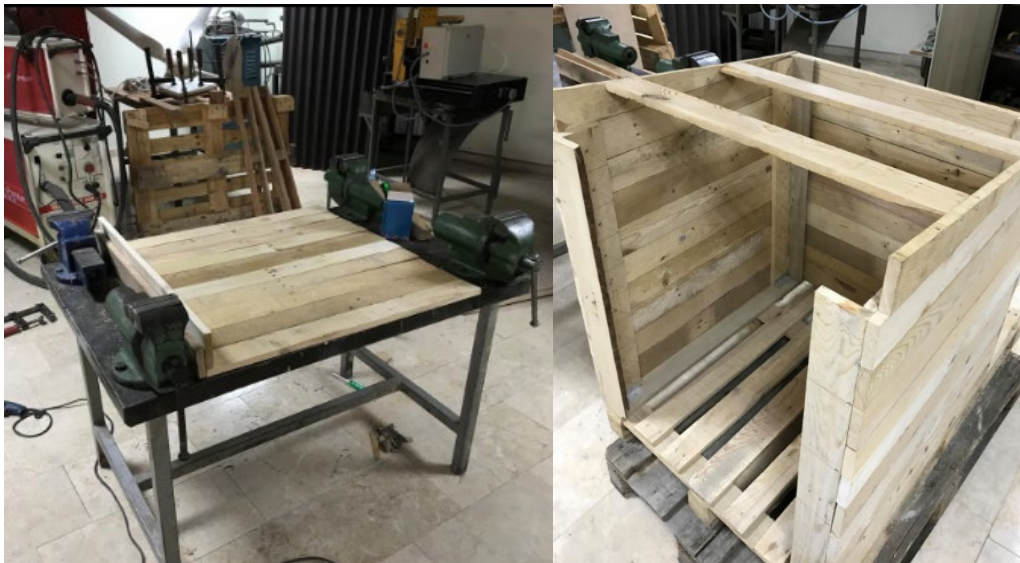
Figure 14. Team-8 Assembling recycled pallet parts to form a doghouse

Even if the students were limited to obtain aesthetically satisfying results due to the pallet recycling decision, they afforded the costs without needing a sponsorship, took social design into a further level of sensitivity than expected and managed production with preventing a possible manufacturing crisis. Dogs were curious to meet the house produced as seen in Figure 15, which fulfils the most important constraint: Developing a serviceable social design for the stray animals.

Figure 15. Team 8 Housing Unit Design for Individual Dogs

Results of post-project student questionnaire

Criticism of the students is preferred to discuss the efficacy of the new teaching method, as such an evaluation provides more reliable findings than self-criticism. Students scored their learning outcomes affected by experiential learning by the production method in social design for stray animals. 33 of the 35 students who participated in the project completed the questionnaire. Results are shown below in 6 parts.

Part 1- Learning professional skills: In these first 11 questions, students rated the impact of new methodology on their professional skills (leadership, business communication, compatibility in teamwork, visual and verbal presentation, project management, analysing design process, analysing environmental conditions, identifying user needs, field researching, cognitive skills, understanding design thinking process). As shown in Figure 16, at least more than two-thirds of the students agreed all 11 statements. Increase in leadership skills is the least agreed outcome, yet only one-third of the 33 students rated the question by 3 out of 5, as the others were satisfied. Notably, all of the students agreed or strongly agreed that field research is critical in design, and more than 90% of them think they comprehended the importance of analysing these researches. In addition, more than 95% believe that they take environmental conditions critical in design processes as an outcome of the project. Results of "compatibility in teamwork", "visual and verbal presentation", "cognitive skills" and "understanding design thinking process" mark that the new method does not lack in other learning outcomes as at least three-fourths of the 33 students rated the statements 4 or 5 out of 5. Even if 85% of the participants agreed or strongly agreed that they can identify the user needs hereupon, remaining 15% were neutral, probably because of dogs and cats are harder to analyse such observations than humans are.
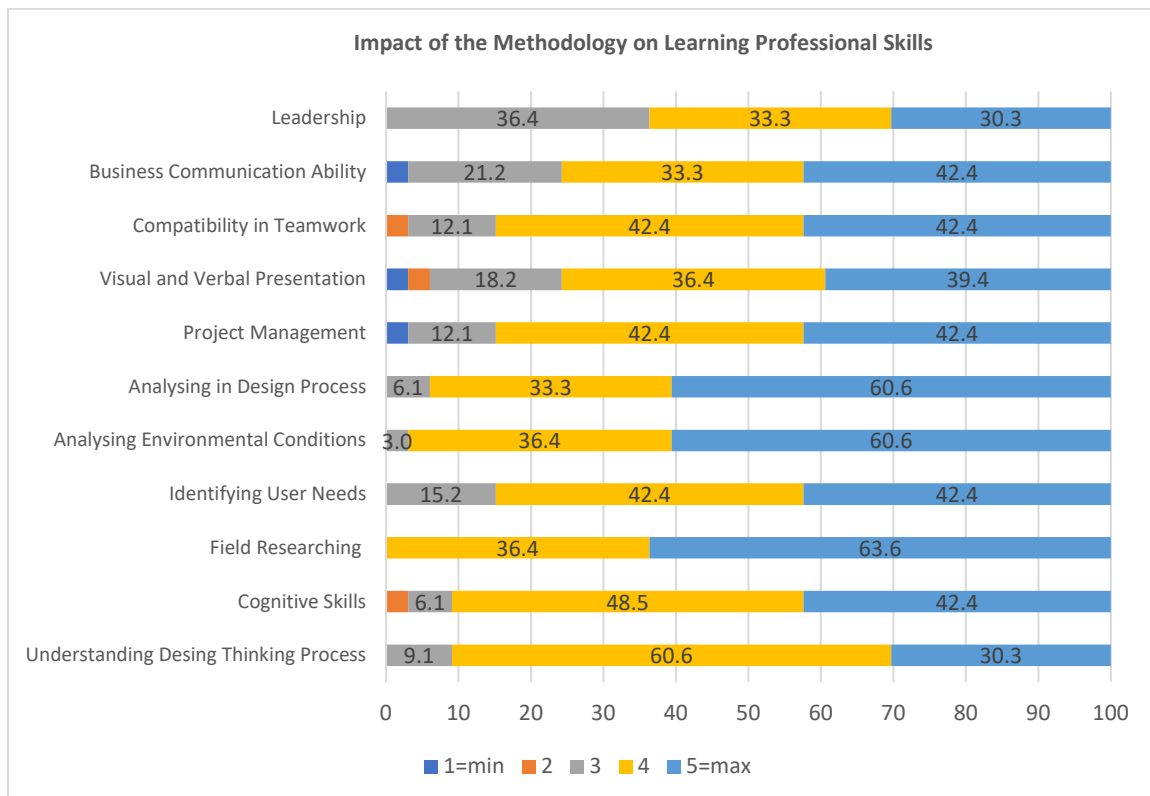

Figure 16. Analysis of post-project questionnaire part 1

Part 2- Learning technical skills: In the next 4 questions, students rated the impact of new methodology on their technical skills (understanding and applying the material, production techniques, anthropometrics, cost analysis). More than 90% of the participants agreed that they gained practical knowledge in materials and production technics expectedly, as they have faced and solved many material and manufacturing based problems. Even if a few students were neutral or unsatisfied about their improvement in anthropometrics knowledge, the majority of them agreed that they are now better in comprehending the ergonomics. Instead of other design projects, focused on consumer electronics, for example, social design for stray animals contains both human and animal factor. Thus, high satisfaction levels can be explained accordingly. Less than 10% were neutral or unsatisfied when evaluating the outcomes of the project on improving their financial skills. As it was probably their first time making cost analysis, most of the students agreed that they are better in financial management hereupon. Distributions of answers to these 4 questions in part 2 are shown in Figure 17.
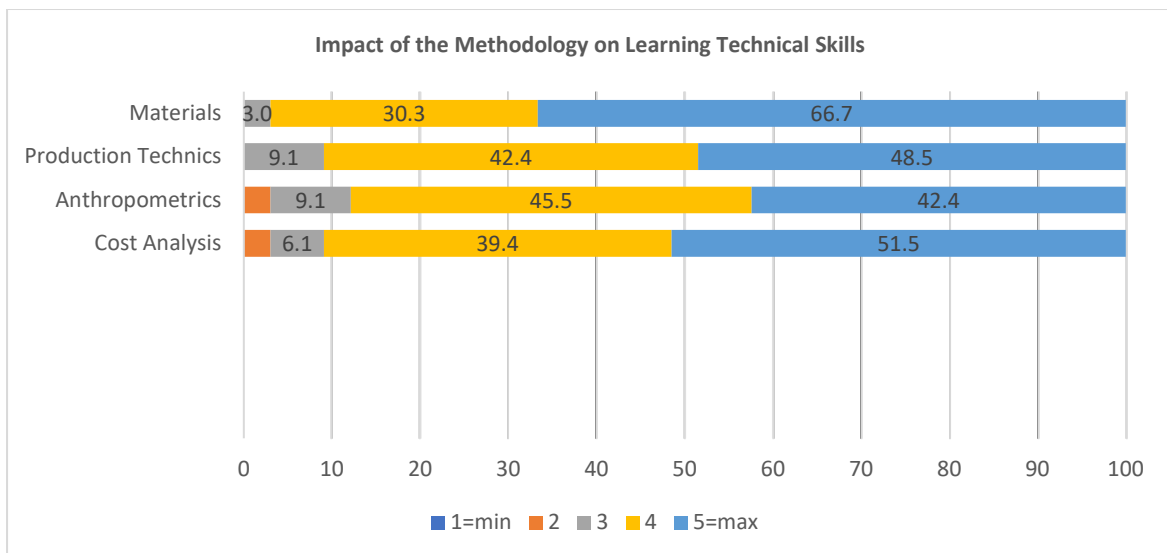

Impact of the Methodology on Learning Technical Skills

Category	3	4	5
Materials	3.0	30.3	66.7
Production Technics	9.1	42.4	48.5
Anthropometrics	9.1	45.5	42.4
Cost Analysis	6.1	39.4	51.5

Legend: 1=min 2 3 4 5=max

*Figure **17**. Analysis of post-project questionnaire part 2*

Part 3- Impact of Field Research throughout Design Process: In the next 3 questions, students rated the impact of field research throughout the design process. All these 3 questions are left unanswered by 1 student. However, the reason for the non-response is unknown. Even if all of the students considered that field research is critical in design (see Figure 17), almost half of them were neutral or unsatisfied when answering the statement that the field research improved their motivation (Figure 18). Surprisingly, one-fifth of them rated that "field research made our design more successful" statement with less than or equal to 3 out of 5, yet 85% of them agreed that it prevented meeting unpredictable problems. As field research is quite challenging compared with *googling*, lack of students' resources (convenient time or observation equipment), and physical fatigue can be discussed as the reason of decreasing motivation in near half of the students. Findings mark that field research promotes the learning outcomes, yet it may be better in motivating students if physical fatigue is less.
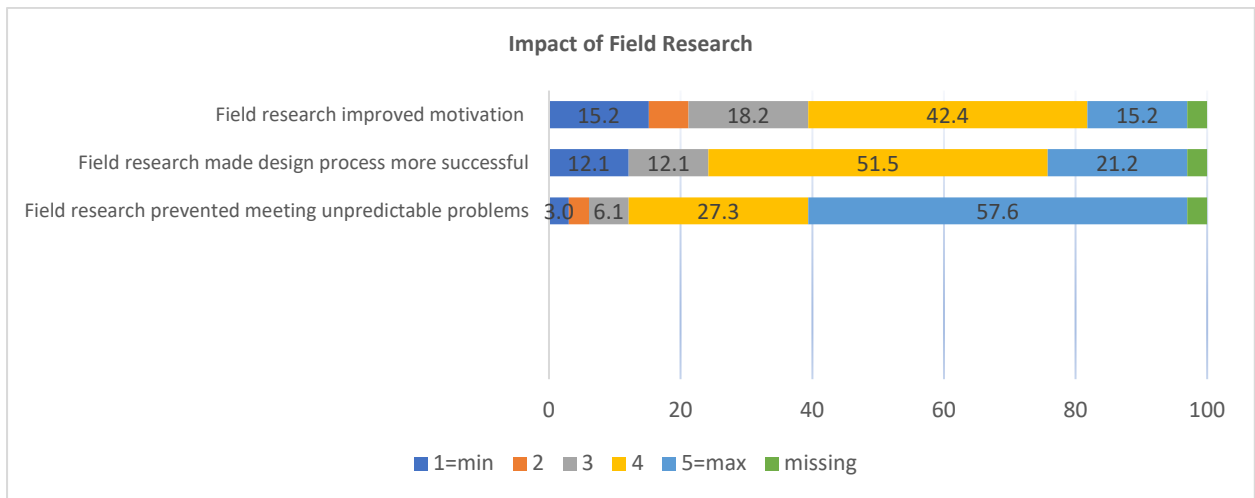
Impact of Field Research

Field research improved motivation: 15.2 | 18.2 | 42.4 | 15.2

Field research made design process more successful: 12.1 | 12.1 | 51.5 | 21.2

Field research prevented meeting unpredictable problems: 3.0 | 6.1 | 27.3 | 57.6

Legend: 1=min | 2 | 3 | 4 | 5=max | missing

Figure 18. Analysis of post-project questionnaire part 3

Part 4- Comparison with traditional studio courses: In the next 3 questions, students compared social design for stray animals project with traditional studio courses. 2 questions are left unanswered by 1 and 1 question by 2 students by unknown reasons. It is obvious that full-scale production motivated students (94%) even it was notably challenging for them. All of the valid answers marked that participants agree or strongly agree that the new method improved their practical knowledge in production techniques and materials, more than traditional courses would. Also, almost 80% of the students considered that social design for stray animals project developed their vocational abilities. Distributions of answers to these 3 questions are displayed in Figure 19.
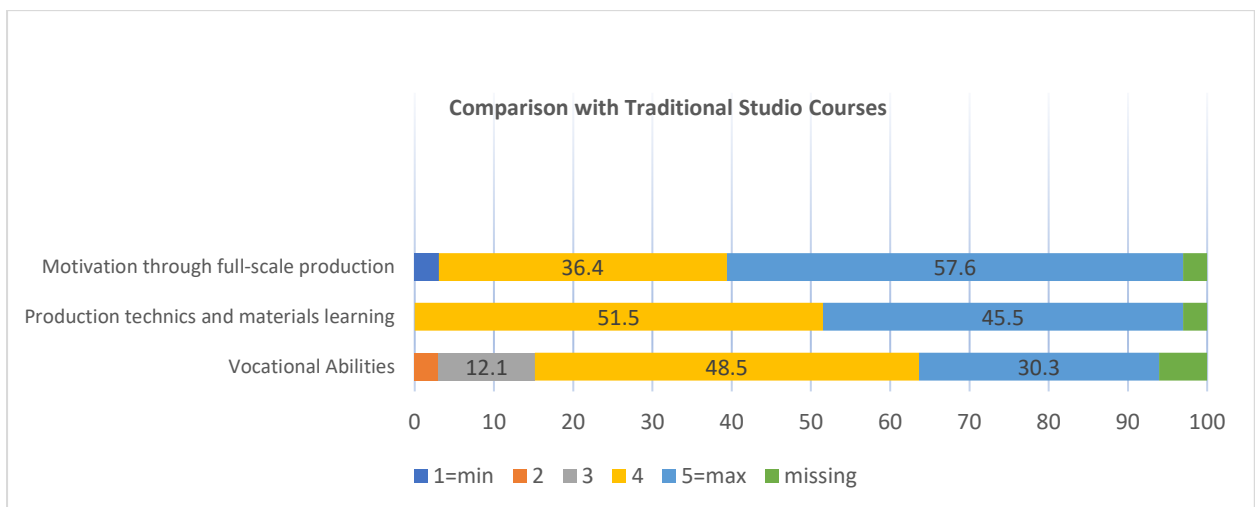
Comparison with Traditional Studio Courses

Motivation through full-scale production: 36.4 | 57.6

Production technics and materials learning: 51.5 | 45.5

Vocational Abilities: 12.1 | 48.5 | 30.3

Legend: 1=min | 2 | 3 | 4 | 5=max | missing

Figure 19. Analysis of post-project questionnaire part 4

Part 5- Impact of Social Design on Educational and Personal Development: In the next 8 questions, students rated the impact of social design on their development in both educational and personal level competencies. Participants scored the acceptability of the given sentences on a Likert scale of 1 to 5, similar to the previous sections of the questionnaire.

Q1-This project raised my awareness of animal rights.

Q2-This project made me comprehend that design is crucial for animals to live better.

Q3-This project showed me that industrial design has a social effect.

Q4-By producing our designs, we have made a sustainably positive social change.

Q5-Collaborating with third parties (communities, sponsors, university employees, students, people who care the stray animals, etc.) affected the project positively.

Q6-I believe I am more interested in social responsibility projects.

Q7-I think both my vocational and personal skills are developed.

Q8-I was more satisfied compared with traditional courses.

As seen in Figure 20, at least 70% of the students agreed or strongly agreed on all of the statements. Even the reasons for neutral and unsatisfied answers are unknown, it is discussed that some of the students could be considering that they are already socially responsible, desiring a broader influence on this specific social issue or contrarily not interested in the social design topics.
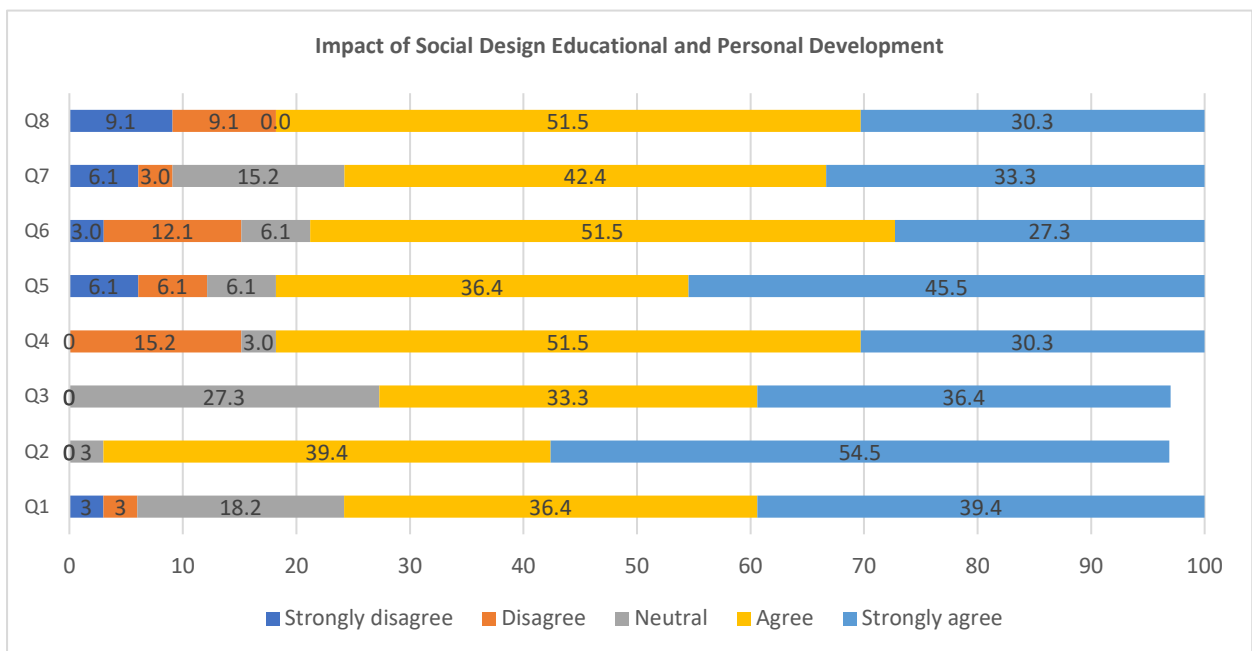

Figure 20. Analysis of post-project questionnaire part 5

Part 6- Criticism for a Hypothetical Participation in a Similar Studio Course: In the final 2 questions, students rated their willingness to participate in a similar course and hypothetically answered if they would succeed better or not. Each question has a non-response by 1 participant due to an unknown reason. Nearly one-third were neutral when evaluating their willingness, none of them were unsatisfied, and two-thirds did agree or strongly agree to participate again. Almost all of the students agreed that they would be more successful, marking that learning outcomes were notably effective (Figure 21).
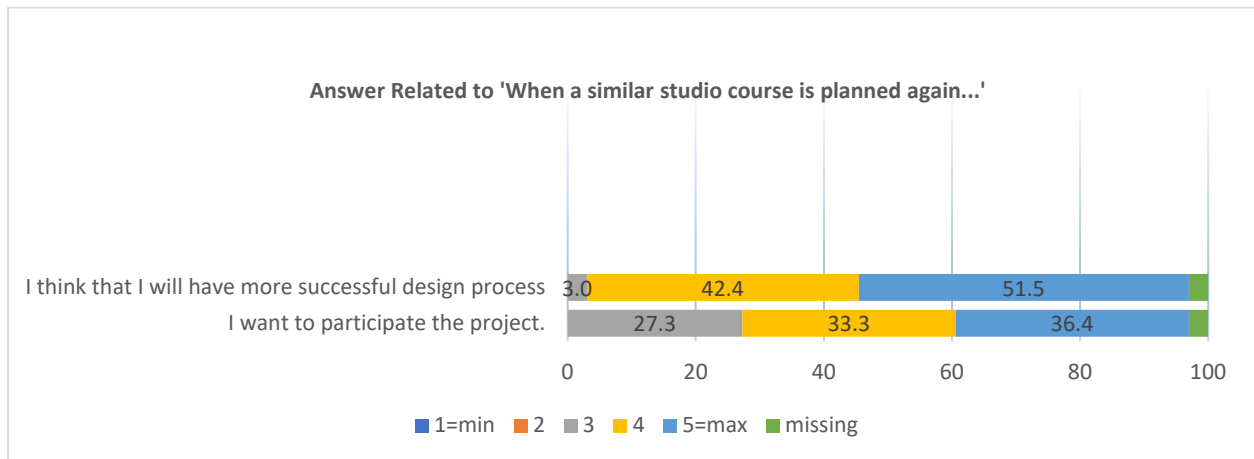

Figure 21. Analysis of post-project questionnaire part 6

Instructor assessments of the projects

Unlike the 5-point Likert scaled students' questionnaire, evaluations of instructors are based on scoring previously determined 9 fundamental outputs from unsatisfactory, marginal, good and outstanding. The meaning of each score for each question is briefly given in written form to the instructors. An essential part of these meanings can also be found below tendencies are explained in detail. As seen in Figure 22, mean scores given by instructors to all of the 7 projects show that improvement in these all 9 skills is gathered mostly in "Good". Instructors considered that production quality of prototypes improved at most and visual presentation skill at least. As even the highest unsatisfactory levels are less than one-third of the instructors, it can be discussed that they are generally satisfied quantitatively.
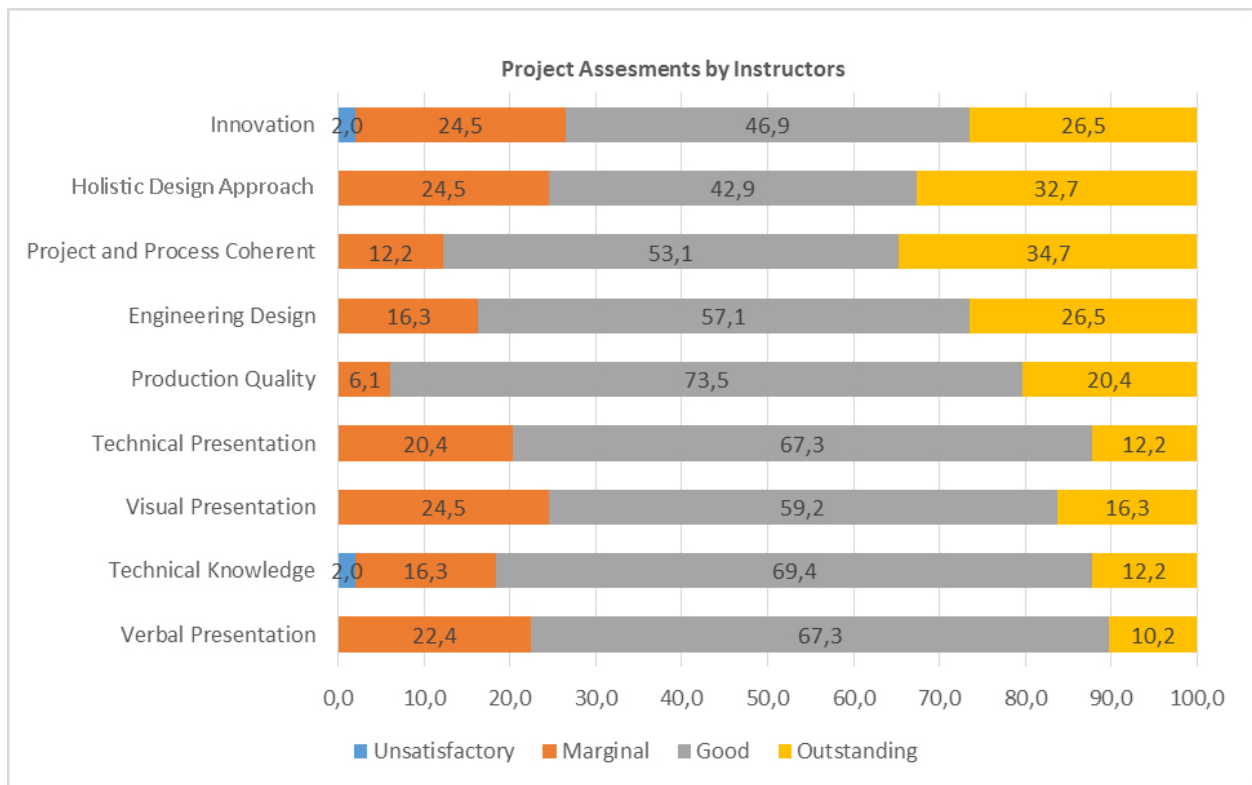
Figure 22. Analysis of project assessments by instructors

Additionally, 'Good' grading can be considered as a positive score since it is very difficult for the instructors in design schools to assess a project fully successfully.

According to Figure 22;

Production quality that is scored 73,5% 'Good' grade means that the prototype is acceptable. There are minor failures, such as surface finish, colour, prototype is in line with the project. Technical knowledge that is scored 69,4% 'Good' grade means that students have enough knowledge to answer questions asked by audiences as expected. The technical presentation that is scored 67,3% 'Good' grade means that the technical details of the presentation are sufficient for the understanding of the project. There are no major defects.

The verbal presentation that is scored 67,3% 'Good' grade means that students use verbal communication skills to express the project to audiences. The visual presentation that is scored 59,2% 'Good' grade means that the presentation is sufficient to describe the project, but there are 1 or 2 of basic design defects.

Engineering design that is scored 57,1% 'Good' grade means that students understand technical knowledge like ergonomics, production, mechanics, mechanism, form, material, and system. There is a meaningful and logical synthesis between design and production, but it is not so impressive. Coherency between project and process that is scored 53,1%

'Good' grade means that final design is generally coherent with findings and targets. There are inconsistencies that are not considered important; the final project can be improved.

Innovation that is scored 46,9% 'Good' grade means that it is an improved version of the existing product/system/services partly original, new and innovative. Holistic design approach that is scored 42,9% 'Good' grade means that the project focuses on product and other criteria as expected, but there is no impressive output.

According to observations of the instructors, for sophomores taking the 'Product Design II' course, all of the projects are generally acceptable and satisfactory. However, the scores of students in technical knowledge and presentation in particular are less than other scores. It can be discussed that succeeding *in a sort of way* is not what instructors expect. Instead, they are focused on educating the right way. Also, innovation scores are discussed as lower than expected.

Discussions and Conclusion

Since it was widely accepted that industrial designers could significantly influence the development and transformation of society, design schools and institutes have begun to deal with social design issues. However, generated social design models mainly focus human needs, the issues about animal welfare and interactions between stray animals and humans are generally disregarded.

This study proposes and presents a teaching toolkit for social design education combining design thinking and product development process and consisting of nine fundamental phases. The toolkit is designed based on the claim that social design could be learned just by the practised-based approach (Heller, 2018) and combined the design thinking approaches or pedagogy of three other toolkits (ArtCenter College of Design, 2018; FROG, 2018; IDEO, 2018). The teaching method is implemented into the 'Product Design II' course at Gazi University. The methodology of the project is designed to fulfil the determined learning outcomes. Students developed kennel and feeding station designs for stray animals and produced them. The applied toolkit is observed and questionnaires for students and instructors are preferred for evaluating the toolkit.

Findings indicated that in most phases of the project the outcomes are as expected. Designing for the real world instead of a hypothetical project, obliged students to research in the field voluntarily, comprehend the environmental conditions and determine the needs of participants in depth. However, even if nearly two-thirds of the students believed that the field research prevented design-based problems, a notable number of them evaluated in-depth research as motivation-breaking, probably resulting from the physical effort needed. Producing full-scale prototypes is inherently effective in teaching materials and manufacturing, anthropometrics and cost analysing compared to conventional studio courses. Findings validate the previous study (Yamaçlı, Özen & Tokman, 2005) which claims prototyping increases production-based learning. Most of the students also agreed or strongly agreed that producing their designs motivated them as well as improving production-based skills even it required a lot of hard work.

Being in collaboration with non-profit organizations, sponsor, manufacturers and suppliers was an opportunity for students to improve their business communication and project management skills. It is comprehended that nearly three-quarters of the students evaluated the project as better in improving verbal skills compared to previous design projects.

As mentioned previously, design students are active learners; they prefer teamwork and hands-on activities (Nussbaumer and Guerin, 2000; Carmel-Gilfilen, 2012; Demirkan, 2016). Thus, students tending to be satisfied overall can be described by their increased motivation when designing for a social issue and producing for the real world, according to their answers.

Students continued to investigate how often targeted dogs and cats use their final products and whether there is a problem related to animal-product interaction or environmental conditions. As mentioned in detail above in the findings, teams made iterative revisions after producing. It helped students to comprehend the importance of the iterative design process.

The results of post-questionnaire completed by instructors indicated that the projects of teams were satisfactory in terms of production quality, technical, and verbal and visual presentation. Instructors discussed that students should have scored higher in innovation criteria. Yet, it has to be discussed in further studies, how innovation or holistic design approach should be evaluated in social design projects, as usually budget restrictions oblige students (or designers) to avoid solutions requiring high costs.

In summary, students evaluated the toolkit as improving their material and manufacturing knowledge higher than conventional courses and strengthening their motivation except being obliged to do field research. According to their answers project also increased their interests in social responsibility projects. However, comparing the results of a conventional social-design project is necessary to claim that production-based education is better in increasing these responsibilities.

The study was limited to the participation of 35 students at one university. Therefore, further studies with larger samples or similar studies conducted at other universities can be useful for criticising the toolkit from a wider perspective. Overall results of the project proved that this toolkit for social design education combining design thinking and product development process could improve competencies and learning outcomes of ID students.

References

A-Design Awards (2018). https://competition.adesignaward.com/

ArtCenter College of Design, ArtCenter College of Design's Design Strategy for Social Innovation: A Toolkit for Educators, retrieved May 12th, 2018, from www.designmattersatartcenter.org/library-entries/social-innovation-toolkit/

ASU (2018). Arizona State University, Design School, retrieved May 12th, 2018, from https://design.asu.edu/degree-programs/industrial-design?dept=144305&id=1

Carmel-Gilfilen, C. (2012). Uncovering pathways of design thinking and learning: Inquiry on intellectual development and learning style preferences. *Journal of interior design, 37*(3), 47-66.

Davey, C.L., Wootton, A.B. Cooper, R., Heeley, J., Press, M., and Kim.S. (2003) "Socially Responsible Design: Targeting Crime with Fashion Design". International Journal of New Product Development & Innovation Management, March/April, Vol.5 (no.1), pp45–56.

Delft University of Technology (2018). https://www.tudelft.nl/en/

Demirkan, H. (2016). An inquiry into the learning-style and knowledge-building preferences of interior architecture students. *Design Studies, 44*, 28-51.

Design Academy Eindhoven (2018). https://www.designacademy.nl/

Durling, D., Cross, N., & Johnson, J. (1996). Personality and learning preferences of students in design and design-related disciplines.French, F., Mancini, C., & Sharp, H. (2015, October). Designing interactive toys for elephants. *In Proceedings of the 2015 Annual Symposium on Computer-Human Interaction in Play* (pp. 523-528). ACM.

FROG, Collective Action Toolkit, retrieved May 12th, 2018, from https://www.frogdesign.com/wp-content/uploads/2016/03/CAT_2.0_English.pdf

Ganefri, G. (2013). The development of production-based learning approach to entrepreneurial spirit for engineering students. *Asian Social Science, 9*(12), 162.

Gattis, T. (2002). The Large Design Project: Beyond Traditional Education. *National Education Conference 2002, USA.*

Gladysz, B., & Santarek, K. (2014). Experiential learning for production and engineering management studies–a case study. Conf. In *Proc. IV international scientific-technical conference MANUFACTURING* (pp. 87-95).

Greenberg, E. (2017). The value of the full-scale prototype in architectural education. *Charrette, 4*(1), 27-39.

Heller, C. (2018). Design for Social Innovation, retrieved May 12th, 2018, from https://dsi.sva.edu/program/chairs-letter/

Hirskyj-Douglas, I., Read, J. C., & Cassidy, B. (2017). A dog centred approach to the analysis of dogs' interactions with media on TV screens. *International Journal of Human-Computer Studies, 98*, 208-220.

IDA (2018). https://idesignawards.com/

IDEO, Design for Social Impact, retrieved May 12th, 2018, from IDEO's Human-Centred Design (HCD) Toolkit, The Field Guide to Human-Centered Design, retrieved May 12th, 2018, from http://www.designkit.org/resources/1

IDSA (2018). Industrial Designers Society of America, retrieved May 12th, 2018, from http://www.idsa.org/events/what-id

IF Design Awards (2018). https://ifworlddesignguide.com/

IMMIB (2018). http://tasarim.immib.org.tr/tr/

Mancini, C. (2011). Animal-computer interaction: a manifesto. *interactions, 18*(4), 69-73.

Mancini, C., Lawson, S., & Juhlin, O. (2017). Animal-Computer Interaction: The emergence of a discipline.

Manzini, E. (2014). Making things happen: Social innovation and design. *Design Issues, 30*(1), 57-66.

Manzini, E. (2015). *Design, when everybody designs: An introduction to design for social innovation.* MIT press.

Margolin, V. (1991). Design studies and the education of designers. *Temes de disseny,* (6), 49-54.

Margolin, V., & Margolin, S. (2002). A "social model" of design: Issues of practice and research. *Design issues, 18*(4), 24-30.

NASAD (2017-2018). National Association of Schools of Art and Design Handbook 2017-2018, retrieved May 12th 2018, from https://nasad.arts-accredit.org/wp-content/uploads/sites/3/2017/12/AD-Handbook-2017-2018.pdf

NCSU (2018). NC State Industrial Design Program, retrieved May 12th 2018, from https://design.ncsu.edu/academics/industrial-design/what-is-industrial-design/

NJIT (2018). New Jersey Institute of Technology, School of Art & Design, retrieved May 12th 2018, from http://design.njit.edu/bachelor-science-industrial-design/

Nussbaumer, L. L., & Guerin, D. A. (2000). The relationship between learning styles and visualization skills among interior design students. *Journal of Interior Design, 26*(2), 1-15.

Papanek, V. J. (1995). *The green imperative: Natural design for the real world* (p. 234). New York: Thames and Hudson.

Papanek, V.J. (1972). *Design for the real world* (p. 22). London: Thames and Hudson.

Red Dot Design Award (2018). https://www.red-dot.org/

Ritvo, S. E., & Allison, R. S. (2014, November). Challenges Related to Nonhuman Animal-Computer Interaction: Usability and 'Liking'. In *Proceedings of the 2014 Workshops on Advances in Computer Entertainment Conference* (p. 4). ACM.

Roth, S. (1999). The State of Design Research. *Design Issues, 15*(2), 18–26.

School of Visual Arts (2018). https://www.sva.edu/

The Farm Animal Welfare Council, (2009). *Farm animal welfare in Great Britain: Past, present and future.* Farm Animal Welfare Council.

TUDelft, 2018. http://designforvalues.tudelft.nl/

Väätäjä, H. (2014, November). Animal Welfare as a Design Goal in Technology Mediated Human-Animal Interaction. In *Proceedings of the 2014 Workshops on Advances in Computer Entertainment Conference* (p. 6). ACM.

WDO (2015). World Design Organisation, retrieved May 12th, 2018, from http://wdo.org/about/definition/

Westerlaken, M., & Gualeni, S. (2016, November). Becoming with: towards the inclusion of animals as participants in design processes. In *Proceedings of the Third International Conference on Animal-Computer Interaction* (p. 1). ACM.

Willcoxson, L., & Prosser, M. (1996). Kolb's Learning Style Inventory (1985): review and further study of validity and reliability. *British Journal of Educational Psychology, 66*(2), 247-257.

Wirman, H., & Zamansky, A. (2016). Toward characterization of playful ACI. *Interactions*, 23(4), 47-51.

Yamacli, R., Ozen, A., & Tokman, L. Y. (2005). An Experimental Study in an Architectural Design Studio: the Search for Three-Dimensional Form and Aesthetics through Clay. *International Journal of Art & Design Education, 24*(3), 308-314.