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MODEL-MAKING COURSES AND APPROACHES IN TERMS OF SUSTAINABILITY: EXAMINATION OF INDUSTRIAL DESIGN SCHOOLS IN TURKEY

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ABSTRACT

Design education has been evolving to meet the needs of the future world which is shaped around the sustainability issue. Specialized courses about sustainability are integrated into curriculum but, the integration of sustainability into whole curriculum is vital to root sustainability in design profession. In this paper, model-making courses and approaches of design schools from Turkey are examined to determine the integration of sustainability into design education in Turkey. Six model-making instructors from chosen universities in Turkey are conducted semi-structured interviews to evaluate the relationship between sustainability and model-making courses. In the light of the findings, the solutions are offered in order to make the model-making courses more sustainable.

Key Words: Design education, sustainable model-making, model-making materials.

1. INTRODUCTION

With the increase of the awareness on ecological and social problems and global development, new opportunities emerge for design, design education and research. Design is challenged by new definitions and new roles to develop sustainable solutions for the future (Cumulus, 2008).

Sustainability perspective, a map to solve and handle the environmental, economic and social problems the world is going through, provides a great potential for industrial designers to decrease the negative effects of production and consumption which makes the design education even more important.

The relation of design curriculum and course approaches with sustainability aspects affects to what extend designers gain the ability of sustainable thinking. As a consequence of the increase in sustainability awareness in higher education, specialized courses focusing on sustainable design are integrated into design education. However, in order to make future designers internalize sustainability and make them interpret it right, the whole curriculum of the program should have the sustainable perspective rather than having only specialized classes about it. The integration of sustainability into whole courses offered in design education is significant to emphasize that sustainability is an integral part of design practice and theory today.

In this paper, the model-making courses in design programs of universities from Turkey are examined to understand the significance of the sustainability approach in the syllabus and also during model-making workshops.

Model-making courses mostly offered in the early semesters of undergraduate education and through the course, students experience different materials and production methods while building three dimensional presentation models to demonstrate their design ideas. Forming the materials manually is in the center of industrial design education since the Bauhaus (Evans et al., 2005; Heskett, 1980; Whitford, 1984). Through the physical interaction of designer with the material, the possibility of effecting the decision making and shaping the design development emerges (Evans et al., 2005). Also, model-making helps students on evaluating the structure, material and production methods (Hallgrimsson, 2012). Due to the nature of model-making process, students have to face environmental, economic and social issues, which force them to develop solutions to these problems. Physical model-making is an instructive tool to gather information about how to produce a specific shape with less energy, material and harm. Vezzoli points out the importance of material selection phase and emphasizes reduction of material consumption, nontoxic and harmless material selection, biodegradable and renewable material selection, and extending material lifetime (2014).

On the other hand, since sustainability is an approach considering the whole life cycle of a product which includes design process of products (Vezzoli & Manzini, 2008), the amount of consumed energy and materials during design process and their results are important, too. Therefore, the materials chosen for model-making, the amount of material consumed, and the end of life process of model are also examined to evaluate sustainability.

Within the light of mentioned views, this paper aims to determine sustainability perspective of design schools in Turkey through examining model-making courses in chosen sample universities offering product design bachelor's degree. Other goals of the study are to examine teaching practice and content of model-making courses in the

context of sustainability, to state approaches and practices of model-making instructors on sustainability, and also to make suggestions to pave a more sustainable way to model-making process.

In the literature review part of the study, effects of sustainability agenda on education field are indicated from two perspectives. Firstly, the integration of sustainability into university curriculum is examined and effective declarations for this process are mentioned. Secondly, the integration of sustainability into operational practices of universities is investigated. For this purpose, sustainable campus networks and initiatives are examined that evaluate and guide universities to have more sustainable processes. After generally investigating the integration of sustainability into university education, the integration of sustainability into industrial design field is sought specifically to understand the effect and development of sustainability approach in industrial design. Approaches related to material usage are explained detailed which are minimizing resource consumption, selecting low impact resources and extending the lifespan of materials through recycling and reusing. The curriculums of industrial design programs from Turkey are examined to understand the place of sustainability in industrial design undergraduate education. And also, graduate courses and research areas are detected to see the tendency to sustainability in design research. The sustainability becomes more of an issue in design practice and education in industrial design programs in Turkey, since there are undergraduate and graduate courses focused on sustainable design.

After gathering information on sustainability and education, the methods, tools and materials used in model-making courses are 3odellinin terms of sustainability. In the context of the study, the courses offered for teaching model-making in industrial design education in Turkey were determined. After that, the literature indicating the relationship of model-making and sustainability is reviewed. Sample practices of design programs on model-making materials selection, reuse and recycle are mentioned to address the sustainability approach in model-making process. This part of the study indicates that there is a strong relationship between model-making and sustainability but there is not any common practice regulating which and how materials should be used during design education.

2. METHODOLOGY

As the main research method, semi-structured interviews with six model-making course instructors were conducted

to analyze model-making courses and approaches in terms of sustainability. In the sampling phase of this study, in addition to the universities from Turkey which are World Design Organization (WDO)members, the universities specialized in model-making and Mimar Sinan Fine Arts University, having the earliest industrial design department in Turkey, were chosen. Ozyegin University, Middle East Technical University and Istanbul Technical University were chosen among WDO member universities in Turkey. Kadir Has University and Anadolu University were added to the sample due to the FabLabs they have for model-making. The list of chosen universities is given in Table 2.1sorted by interview date.

[Table 2.1] The chosen universities and instructors for the interview

University, City	WDO member	Instructor	Date of interview
Kadir Has University, Istanbul	No	Dr. Cinar Narter	17-4-2018
Mimar Sinan Fine Arts University, Istanbul	No	Asst. Prof. Oguz Eratac	18-4-2018
Ozyegin University, Istanbul	Yes	Inst. Fuat Ari	24-4-18
Middle East Technical University, Ankara	Yes	Dr. Mehtap Ozturk Sengul	27-4-18
Istanbul Technical University, Istanbul	Yes*	Inst. Mehmet Erkok	7-5-18
Anadolu University, Eskisehir	No	Inst. Zeynep Baskici Kapkin	16-5-18

* Istanbul Technical University's WDO membership has ended after the date of interview.

The instructors of the model-making courses were interviewed with the aim of understanding how the content of the course is related to the sustainability and finding out the approaches of both the instructors and the universities. Each instructor answered 12 questions which examine topics like the materials used during the course, model-making material research, approach on minimizing the effects of consumed materials, recycling and reusing abilities and thoughts of instructors for a more sustainable model-making class. During the semi-structured interviews, below questions were asked to the instructors:

- Which model-making courses do you teach? How long have you been teaching the course?
- Could you explain the course content briefly?
- Have you revised the course syllabus and added different topics to the course in time?
- Which materials are preferred mostly in model-making?
- Which characteristics of materials are more effective when choosing the model-making materials? Do you give advice to the students during material selection?
- Are there any forbidden materials in model-making course?
- Is there any forbidden surface treatment due to environmental or health effects?
- Are the students encouraged to discover different materials and methods for model-making?
- Does the course include topics about reducing environmental effects of materials?
- How is the process for remaining materials and physical models which are not needed anymore? Are the students directed to recycle and reuse? Is there any regulation and process of the university for recycling or reusing?
- How does the course affect students' habits of model-making material using, when the course is completed?
- What kind of topics and events can be integrated to the course for students to gain sustainable material using habits?

After the interviews, voice record of the interviewees were transcribed into text for the analysis.

3. RESULTS AND ANALYSIS

Firstly, the courses on model-making offered in design programs are listed according to the information gathered from instructors. Since the study is based on the sustainability in model-making classes, it is also given in Table 3.1 whether there are specialized sustainability courses and course content in the design program.

[Table 3.1]Model-making and sustainability courses in sample universities

Offered model-making courses	Offered sustainability	Courses	Sustainability integration into whole curriculum
Kadir Has University (KHU)	Mock-up and Prototype	Sustainability in Industrial Design	Unknown
Mimar Sinan Fine Arts University (MSFAU)	Model making-1, Model making-2	None	No
Ozyegin University (OZU)	Model making	Sustainable Design Research	Unknown
Middle East Technical University (METU)	Atelier and computer internship	None	Yes

Istanbul Technical University (ITU)	Model making-1, Model making-2, Advanced model making techniques	Sustainable Product Design	Unknown
Anadolu University (AU)	Model making techniques	Sustainable Design Atelier	Unknown

According to the expressions of course instructors, there are differences between model-making course syllabuses. After the comparison of model-making course contents, this study shows that courses generally focus on three alternatives: model and prototype, only presentation model or all model types that student needs during design projects including mock-ups. Based on the interview results, when model-making process is more focused on temperance quality of the model, this leaves the sustainability dimension of model-making out of concern.

After the analysis of the interviews, findings are gathered in main categories like materials used in courses, disposal of materials, safety and health issues in courses, the content of courses and the model-making instructors' approaches. In the following, the answers concentrating on model-making material preferences and relationship of model-making and sustainability will be mentioned.

3.1. Selection of Model-making Materials

According to the findings on material preferences of instructors, as seen in Table 3.2, paperboard and wood are the materials which used in all design schools. Aluminum, PS foam and plaster are widely used materials in four schools out of six.

Materials which are harmful for humans and environment are sometimes chosen for training model-making by instructors. Especially polyurethane (PU)foam is a debatable material containing carcinogenic ingredients but, due to easy and speedy forming ability of PU foam, the material may be preferred for physical models. Another easy shaped and widely used material is polystyrene (PS) foam, whose recycling is problematic due to high costs and materials' lightweight which result in environmental pollution.

[Table 3.2] Materials used in model-making courses

	Paperboard	Foamcore	Acrylic	Acetate	Forex	Aluminium	Poliester	PS foam	PU foam	Silicon	Ceramics	Clay	Wood	Plaster	Concrete
KHU	+		+			+	+			+			+		
MSFAU	+		+			+	+			+			+		
OZU	+	+		+	+			+	+			+	+	+	
METU	+					+		+	+				+	+	+
ITU	+		+		+	+	+	+		+		+	+	+	
AU	+	+						+			+		+	+	+

Although one instructor mentioned that it is forbidden to use hazardous materials both during the course and in their university (METU), it is seen in Table 3.3thatthe most effective criteria when selecting material is the easy and speedy forming ability of the material. In two schools, PU and PS foam are not advised to use in model-making, not because of harmful effects of the materials, instead, due to the easy shaped nature of the foam which is acknowledged as difficult to control the geometry of physical model. Some instructors claimed that they adapted the model-making syllabus for avoiding hazardous processes like polyester molding and spray painting. In METU and AU, polyester molding is removed from the course syllabus because of emitted hazardous gases during molding. Only in METU, solvent based paints and adhesives are banned throughout the university, although there is a sufficient ventilation system in the model-making atelier. In other sample schools, a comprehensive regulation is not applied.

[Table 3.3] Factors for material selection and forbidden/undesired materials

	Most important properties affecting material selection	Forbidden materials	Undesired materials
KHU	Easy forming, possibility of fixing	-	PU and PS foam
MSFAU	Strengthening geometry perception, Suitability to form in various places	PU and PS foam	-
OZU	Easy access, Tools for shaping	-	Wood
METU	Easy forming, easy access, sustainability	Solvent based paints and adhesives	All environmentally hazardous materials
ITU	Similarity to final products material	-	-
AU	Easy forming, possibility of fixing, cost	-	Polyester

3.2. Sustainability and Model-making

The issue of recycling and reusing of materials is also problematic for some universities. In most of the sample universities, the recycling process is unclear. The waste is not separated in model-making atelier and it is believed that the waste is separated later in recycling area. It is seen that some waste emerged from model-making process is not recyclable, but it is not regarded mostly. In five universities, it is claimed that there are boxes or a special

room in ateliers for students to leave left-over materials, but it is also mentioned that the efficiency of reusing is not enough. Especially materials such as wood, acrylic, paperboard, PS foam are aimed to collect for reuse. In Figure 1, different material storing solutions in model ateliers for left-over materials after model-making process are seen. It is important to store these materials in separate boxes systematically, otherwise, reusing is not achieved properly.

[Figure 1] Containers for left over materials in ateliers

Four out of six instructors mentioned that they teach how to consume lesser material and reduce scraps in model-making, which is an important issue since students learn the methods of reducing material consumption.

Since the obligation of work safety regulations, the workspaces have been controlled to avoid injuries and unhealthy circumstances during working. In model-making courses the instructors care about these rules and take precaution to prevent students from having injuries during machine use in atelier. There are forbidden machines that students cannot use without the help of a technician or instructor due to safety reasons.

Another problematic area in the ateliers the efficiency of air conditioning, which is substantial to remove not only dust occurred during forming materials like wood and foam, and also gases emerged from casting polyester in atelier. For painting process, which is one of the dirtiest sectors in industry, specialized booth or paint oven is needed with an aspirator system. In most universities, there are not comprehensive solutions for painting process, which is argued by instructors. It is also mentioned by the instructor having the most sustainability-sensitive 6odellingcourse that the existence of a good quality air conditioning does not mean that it is okay to use paints containing hazardous chemicals. In fact, this approach on air conditioning is unique, since in other universities a complete sustainability approach, regarding the environment as a whole, is not detected. Generally, hazardous materials and processes in model-making are not regarded in most universities, if there is an air conditioning system in atelier.

3.3. General Findings

In the following, the findings of the interviews are summarized.

a). Materials used in model-making courses:
The ease and fastness of shaping is important for material selection.
There are hazardous model-making materials for health and environment.
Universities may ban a material due to hazardous content.

b). Elimination of used materials:
How to dispose model-making materials is mostly unknown.
Scraps are thrown into containers without separating according to material type.
Some of the waste cannot recycle.

c). Syllabus of model-making courses:
In courses, instructors aim to show different kind of materials as possible.
The model-making course content and the focus is not same in all design schools. There are three alternative types: Model and prototyping, only presentation model or whole type of models.
In some courses, safety and work health topics are integrated.

d). Approaches of course instructors:
The syllabus of model-making course depends on the approach of the instructor. This causes different model-making course types having focuses such as safety, sustainability or appearance of models.

4. DISCUSSION

The model-making courses and approaches can be examined from two point of views. Firstly, the course can be regarded as a tool to raise awareness on sustainability issue through material and process selection. Design instructors usually direct students to prefer materials which are easily and fast taking form and due to the focus on rapidness, it is not regarded mostly how the materials produced, disassembled, disposed and reused (Gerber et al., 2010). Amount of consumed materials for physical models are ignored when compared to production processes. In fact, the main problem is the habit of consuming gained by students through courses (Gerber et al., 2010).

Since the students and also in some cases instructors do not have comprehensive information about the materials and techniques they prefer, there should be a material guide showing the hazardous materials with alternative materials and suggesting more sustainable methods for model-making from environmental, health and economic point of views. Subjects like resource minimization, recycling, reusing can be added to course content to raise awareness of students not only during model-making but also during deciding on materials and production methods, with which the students' first meet is in the modeling course mostly. One of the main objectives of model-making which provides an experience with real materials can be gaining the ability of choosing sustainability-oriented solutions.

Furthermore, the model must be regarded as a product consumed to demonstrate the design idea. The model-making course is naturally required to consume materials to build three-dimensional physical models but these models, in fact, have their own life cycle as products which means the materials of models would be better reused or recycled when the need for the product is over. From this perspective, the model-making can be reconsidered and redesigned caring the whole life cycle of the model. The processes preventing sustainable end of life options should be questioned. It is also necessary to find out new model-making materials having easy and fast forming ability, being recyclable and not containing harmful ingredients. Through new material research, new alternative materials should be added to model-making materials, which are superior from sustainable point of view (Hallgrimsson, 2012).

Since the approach of the instructor and the university is effective on the model-making course syllabus, some of the courses seem to care more safety regulations or sustainability than others. If there is a general guidance across the university for recycling and permitted chemicals to use, the model-making course reflects it in its syllabus also. One of the main results of the study is that there is an urgent need for complete sustainability approach covering whole curriculum and operations of the university. Only in that case, it is feasible to design a model-making course regarding safety, health, environmental and economic side effects. Otherwise, sustainability being a complete approach having environmental, economic and social points is not achieved truly.

BIBLIOGRAPHY

1. Cumulus. (2008). Kyoto Design Declaration, Cumulus International Association of Universities and Colleges of Art, *Design and Media, Kyoto*. Retrieved December 2014 fromhttp://www.cumulusassociation.org/component/content/1-current-affairs/217-kyoto-design-declaration-signed-on-march-28-2008/225
2. Evans, M., Wallace, D., Cheshire, D., and Sener, B. (2005). An Evaluation of Haptic Feedback Modelling During Industrial Design Practice. *Design Studies,* Vol 26 N0 5 pp 487-508
3. Gerber, A., McKenna, A., Hirsch, P., and Yarnoff, C. (2010). Learning to Waste and Wasting to Learn? How to Use Cradle to Cradle Principles to Improve the Teaching of Design.
4. Hallgrimsson, B. (2012). *Prototyping and Modelmaking for Product Design*. London: Laurence King.
5. Vezzoli, C. (2014). The "Material" Side of Design for Sustainability. In E. Karana, O. Pedgley, V. Rognoli (Eds), *Materials Experience Fundamentals of Materials and Design.* (pp 105-121).
6. Vezzoli, C. and Manzini, E. (2008). *Design for Environmental Sustainability.* London: Springer.