



An Integrative Activity Model Proposal for University-Industry Cooperation Studies in Design Education

Dr. Elmas Merve Özyurt (Corresponding Author)

Mimar Sinan Fine Arts University, Faculty of Architecture, Department of Industrial Design, İstanbul Türkiye,
ORCID: 0000-0002-6187-3038
E-mail: merve.ozyurt@msgsu.edu.tr

Ahmet Çetin Eyüp

Mimar Sinan Fine Arts University, Faculty of Architecture, Department of Industrial Design, İstanbul Türkiye,
ORCID: 0009-0001-7848-8160
E-mail: ahmet.cetin.eyup@msgsu.edu.tr

ABSTRACT

The university-industry collaborations are of considerable significance for the multifaceted and sectoral industrial design discipline. It is one of the most crucial sources for students to obtain ideas and information about which sector they will turn to during their education process. The inclusion of these resources in industrial design education is effective in the student's competence acquisition as well as orientations.

We observe that these collaborations, which are the focus of industrial design education in Türkiye, take place in activities, such as project courses, workshops or competitions. To contribute to the development of these models, this study revealed the contributions of the University-Industry cooperation stakeholders and the learning from a descriptive perspective of design educators. The design and design processes of the workshop, which involved 30 students forming six teams, were made and finalized in line with the relevant literature.

This study aimed to provide two main contributions: supporting teamwork in educational processes and creating professional interfaces in industrial design. With the experiences gained, a sustainable and collaborative model has been proposed for implementation and development in industrial design education processes.

KEYWORDS: Industrial Design Education, University-Industry Collaboration, Design Process, Teamwork.

ÖZET

Çok yönlü ve sektörel bir disiplin olan endüstriyel tasarım için üniversite-sanayi iş birlikleri büyük önem taşır. Öğrencilerin eğitim süreçleri boyunca hangi sektöre yönelecekleri konusunda fikir ve bilgi edinebilecekleri en önemli kaynaklardan biridir. Bu kaynakların endüstriyel tasarım eğitiminde yer alması, öğrencinin yetkinlik kazanmasının yanı sıra yönelimleri üzerinde de etkili olur.

Türkiye'de endüstriyel tasarım eğitiminin odağında olan bu iş birliklerinin proje dersleri, atölye çalışmaları ya da yarışmalar gibi etkinliklerde gerçekleştiğini gözlemliyoruz. Bu modellerin geliştirilmesine katkı sağlamak amacıyla bu çalışma, Üniversite-Sanayi iş birliği paydaşlarının katkılarını ve tasarım eğitimcilerinin betimleyici bakış açısıyla öğrenmelerini ortaya koymuştur. Altı takım oluşturan 30 öğrencinin katıldığı atölye çalışmasının tasarım ve tasarım süreçleri ilgili literatür doğrultusunda yapılmış ve sonuçlandırılmıştır.

Bu çalışma, eğitim süreçlerinde takım çalışmasını desteklemek ve endüstriyel tasarımda profesyonel arayüzler oluşturmak olmak üzere iki temel katkı sağlamayı amaçlamıştır. Elde edilen deneyimler ile endüstriyel tasarım eğitim süreçlerinde uygulanmak ve geliştirilmek üzere sürdürülebilir ve işbirlikçi bir model önerilmiştir.

ANAHTAR KELIMELER: Endüstriyel Tasarım Eğitimi, Üniversite-Sanayi İşbirliği, Tasarım Süreci, Takım Çalışması.

1. INTRODUCTION

Design is a dynamic, ever-changing discipline that is affected by many developments in both technological and social contexts. Design education needs to be constantly updated in line with new needs for future designers to respond to these needs and gain the necessary competencies. Zeegen (2011) argues that the deficiencies in design education and industry communication point to a significant problem area at this point, and states that approaches that will enable the interaction of educators, students and professionals from the industry are necessary instead of the common internship model for designers to get to know the industry. However, Zeegen (2011) emphasizes that universities currently focus on increasing the number of students, which results in less and less time being allocated to students, and adds that this poses a problem for the readiness of new graduates for the needs of the industry. Similarly, Camacho and Alexandre (2019) point out that design education is often carried out in hypothetical situations far from its real context, and that many elements necessary in the interface between academia and industry are ignored in the educational process. However, the execution of university-industry collaborations within the education curriculum can be affected by various factors, such as process management within the course, evaluation of learning outcomes and protocol processes. However, university-industry collaborations within the scope of design education in Türkiye, which has added value potential in many different sectors with its dynamic industry, point to an important area of investigation.

2. LITERATURE

2.1. University-Industry Collaborations in Türkiye and Industrial Design Education

As suggested by Erkarlsan et al. (2011), University-Industry collaborations can contribute to the development of students' competencies in line with the needs of the industry and industrial organizations to follow the developments in the profession and renew a vision for designers to make job descriptions correctly. In addition, collaborations also provide universities with the opportunity to apply theoretical knowledge and transfer knowledge/technology (Erkarlsan & Aykul, 2018).

Many institutions providing industrial design education in Türkiye have been conducting studies on university-industry collaborations, and the scientific studies performed through these studies provide guidance for other institutions in the Turkish context. For example, Börekçi et al. (2016), who focused on the collaborations carried out with companies from three different sectors between 2013 and 2016 at Middle East Technical University (METU), focused especially on the problem identification and concept development processes within the scope of the studio (project) course and revealed their experiences regarding the stages carried out in the process. Similarly, Hasdoğan and Şener (2014), with their publications focusing on university-industry cooperation in graduation projects at METU, stated that this approach is a rehearsal for students before professional life, although the commercialization opportunities of the results are limited. Yenilmez and Bağlı (2020), on the other hand, focused on the changing interests in industrial design studio course education and the findings of their research on studio course educators, stated that collaborations with the industry have increased over the years, especially since the early 2000s, and that they are crucial in terms of learning outcomes from the perspective of educators, but that the continuity of collaborations should be ensured to support their effectiveness. With the motivation of introducing design to SMEs, Istanbul Technical University has realized collaborations within the scope of the graduation project starting from 2003 and carried out the "Design 4 SMEs" (Design for SMEs) project supported by İSTKA in 2011-2012 (Er and Soyulu, 2013). This project introduced a model and mechanism for matching newly graduated designers with SMEs. As a review study, Ovacık et al. (2016) tested the "closed-circuit open-source design" collaboration model in university-industry

collaboration with the study they conducted within the scope of the studio (project) course of Yaşar University Industrial Design Department and emphasized the importance of experience and knowledge sharing between stakeholders. In Mimar Sinan Fine Arts University Department of Industrial Design, many national and international university-industry collaborations have been realized for different industrial fields during the education process (Küçükerman & Şen, 2021). These collaborations cover a wide range of activities ranging from studies within the scope of the project course to competitions and workshop activities. Küçükerman and Şen (2021) stated that the purpose of collaborations in the education process is to enable students to see the real needs of the industry closely and to get to know different sectors.

As can be seen from the examples, university-industry collaborations are a topic regarding the focus of industrial design departments in Türkiye. Research on existing studies has revealed that collaborations are mainly conducted through the studio (project) course, but some challenges may also be encountered in the process. Ovacık et al. (2016) suggested that instead of a 14-week studio course, such studies should be conducted in a block of 14-15 days to increase the effectiveness of such studies. In addition, they observed challenges regarding the educational process in cases where the students realized teamwork.

2.2. A Collaboration Strategy to Complement Training and Focus on Teamwork

Teamwork is becoming an increasingly important issue in design education. This is because the postmodern design approach requires collaborative and teamwork-supported processes instead of creativity where individual genius stands out, and contemporary design education should provide competencies in this direction (Zwirn, 2015). IDEO (2011), in its "Design Thinking for Educators" guidelines, emphasizes the importance of teamwork in the education process and recommends a pluralistic approach, especially in finding solutions to the complex challenges of contemporary design. Moreover, the industry considers teamwork as an important criterion due to the complex problems that today's design struggles with (Zwirn, 2015). However, teamwork dynamics can be a difficult process to manage in the educational process (IDEO, 2011; Tucker, 2016). Design educators evaluate both the process and the end in project-oriented learning processes, but in fact, students should be evaluated in many categories, such as goal setting, progress, co-creation of knowledge, participation and teamwork; however, educators may be biased by a single attribute and ignore contextual factors (Gweon et al., 2017). In addition, students may also have prejudices against teamwork. Tucker (2016) found in his study that teamwork applied to design students was carried out for instructors to control large number of students. She also suggested that prejudices against team performance and grading, gender, and even team members from different cultural backgrounds are factors that make teamwork difficult in the educational process. Developing an understanding of the different roles required in the process to be effective team workers is also an important competency that should be gained in design education (Gudur et al., 2020). However, as Campbell et al. (2018) state, since the nature of design is not well-structured and can potentially contain many solutions, decision-making processes regarding the solution are also an area of investigation that should be evaluated and examined in the education process, and team dynamics in social work environments differ from individual decision-making processes.

It has been observed that the difficulties related to teamwork in the design education process are mainly related to evaluation and grading processes. Thus, this study focuses on developing a strategy that will enable the transfer of knowledge/experience in university-industry studies that design students will be involved in, that will create a teamwork experience in accordance with the real working conditions of the industry, and that will support learning by increasing the interaction of all stakeholders rather than evaluation/grading in the process. In line with the suggestion of Ovacık et al. (2016), instead of a 14-week studio (project) course, we tried to observe how a complementary

and intensive activity affects the interaction between stakeholders: educators, industry participants and students. This study takes a descriptive approach and presents a model for similar studies in the Turkish context, as well as describing the learnings in the process.

3. METHOD

3.1. Study Process

Within the scope of University-Industry cooperation, Mimar Sinan Fine Arts University "Industrial Design Application and Research Center (ETAM)" and "Can Alüminyum A.Ş." collaborated; the event focused on industrial design students experiencing a design process in an intensive study process and in line with the real needs/possibilities of the company.

To advance the collaboration process in line with common goals, communication between stakeholders and joint process development were given importance. Therefore, the first stage of the collaboration was to identify the common goals and the roles required to achieve these goals. As stated by Lundberg and Öberg (2021), universities should focus on educational innovations in their collaborations with industrial organizations and prioritize the acquisition of skills for innovation beyond providing innovative solutions to companies; in this direction, it is important to ensure mutual benefit.

While universities' motivations may include training, access to funding, raising awareness and access to empirical data, firms' motivations may include access to complementary technological knowledge, providing training to current or future employees or access to public funds and incentives (Guimon, 2013). In line with the meetings held with the company, the common main objectives for this collaborative work were identified as follows:

- To ensure the flow of information between the Manufacturing Industry, the University (ETAM) and prospective designers
- To transfer aluminum material and production criteria to students (future designer candidates) in line with the needs and knowledge of the industry
- To research original product ideas by considering the requirements of e-commerce in the field of sales and marketing (e.g., distribution, packaging, and presentation) in line with the company's objectives

As can be seen from the objectives, the first item is important for the university, the second item for the students and the third item for the company. In this direction, this study aims *to develop innovative product ideas that support daily life by using aluminum material around the principles of creativity, functionality and applicability for e-commerce, which is increasing in demand by both consumers and producers today.*

The collaboration program and the roles of the stakeholders, which were prepared in collaboration to provide maximum benefit in line with the objective, are summarized in Table 1. During the preliminary preparation process between the University and Company representatives, it was decided that the design work would be carried out through extrusion and plate production methods. For the students to perform the process as teamwork, it was decided to carry out the design process in the form of a "workshop." The program of this study and the roles of the stakeholders are shown in Figure 1.

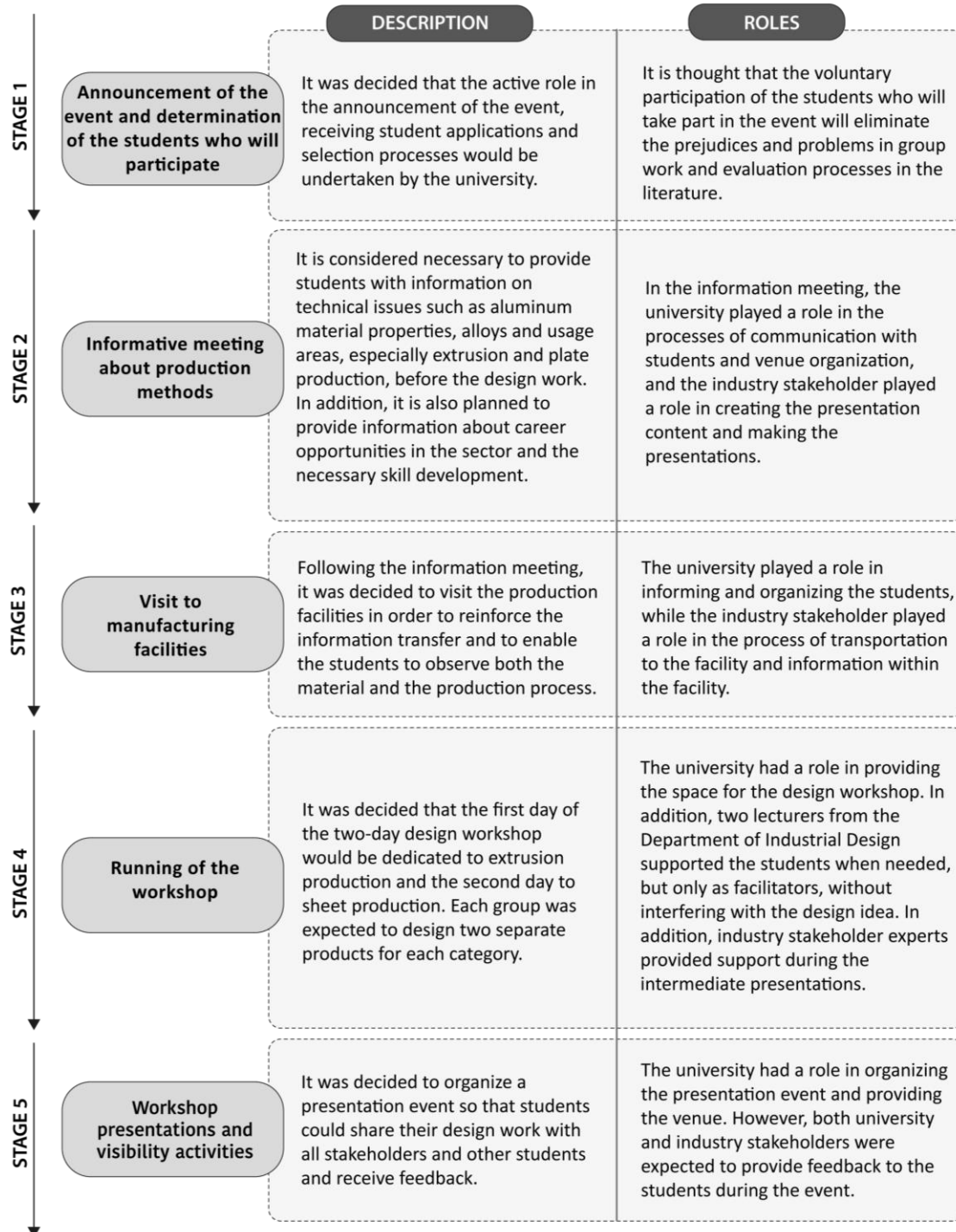


Figure 1: Collaboration Program and Roles of Stakeholders

The event calendar was created in line with the stages of the event determined by the stakeholders with a joint decision; it was planned to be held between May 11-June 8, 2022. Following the completion of the necessary bureaucratic procedures within the scope of the cooperation, information presentations, technical trips and workshop announcements were published. After evaluating the student applications received with the announcement, working teams were formed by the workshop coordinators. This study took place in four stages after the announcement (Figure 2).

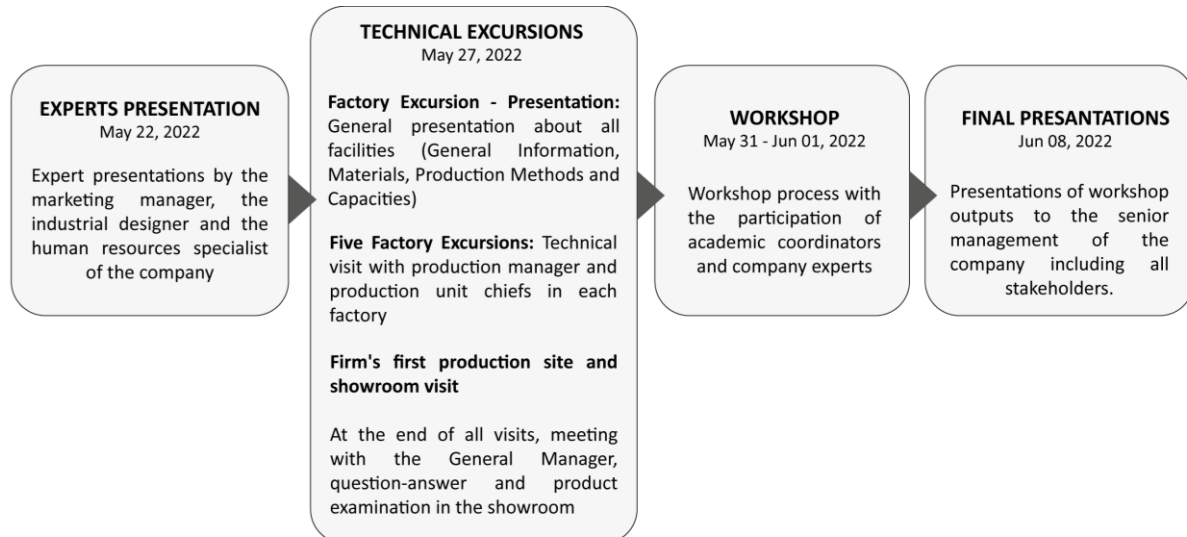


Figure 2: Process stages of the study

In the first step of the event, a seminar on aluminum material and production methods, including company introduction, was held with Can Alüminyum Marketing Manager, Industrial Design Officer and Human Resources Specialist at MSGSU, Fındıklı campus, open to all university students. In addition to industrial design students, students from the architecture and interior architecture departments also attended the seminar.

Following the informative meeting on production methods, factory visits were organized in Bursa within the scope of technical excursions in the second step. During the five factory visits, industrial design students were accompanied by the relevant unit officials. In each factory unit visited, the officials informed the students about the production processes and explained the issues they were curious about with a question and answer session.

After the excursion and seminar stages, on the first day of the workshop, the students were informed by ETAM coordinators about the place and process of this study. The students were assigned to work teams by the coordinators, met with the team members and started to work on ideas and sketches on the subject. On both days of the workshop, students were asked to make a short presentation about the product in the afternoon and a feedback meeting was held. These meetings contributed to the finalization of the presentations. The teams were expected to visualize scenarios in which user processes were defined in different concepts suitable for the e-sales channel. In these scenarios, all stages, from the product user to the production processes, were asked to be examined. The teams, who worked for two full days to produce design products, gave presentations on June 08 and provided information about the user groups, production and assembly of their designs.

For the development of presentation skills, which is an important competency for professional work life, university environments are academic environments where students can practice. Thus, during and at the end of the workshop, it was requested to cover the speech of the whole team to contribute to the development of students' presentation skills. As Camacho and Alexandre (2019) point out, it can be said that the elements that remain in the background in the educational processes affected by the number of students come to the forefront in the workshop processes, and by practicing these practices, students can contribute to the development of their expressive skills in their future professional lives.

4. FINDINGS

In this section, evaluations of the university-industry cooperation work carried out as a complementary activity in design education and the learning in the process are given.



4.1. Student Participation

Participation in the workshop was limited to MSGSU Department of Industrial Design undergraduate program students. The workshop was announced through the university's corporate digital communication platform on May 11, 2022, and 37 student applications were received in 12 days. Because the number of requests for participation in the workshop was higher than the number of groups to be formed, the method of eliminating first-year students who had not taken the project course was used in the selection criteria. The aim of the selection criteria was to eliminate the possibility of students who have not been trained in the project discipline having difficulties in stages, such as projecting, visualization, modeling, presentation preparation during the workshop design process. It was foreseen that the motivation and excitement of these students might decrease in the stages where they would have difficulties due to their lack of experience. At the same time, it was thought that a situation of unequal working balance with other team members might arise.

While forming the student teams, based on IDEO's (2011) recommendation of 2-5 students, five students were assigned to each working group, and 30 students took part in the six working groups. In the distribution of students in each team, the level of project design experience in the educational process was evaluated and the distribution was tried to be balanced. It was observed that students from different grade levels working together in the workshop teams (vertical diversity) provided an opportunity to transfer their experiences among themselves, while providing a balanced formation opportunity for the project outputs to emerge at stages, such as drawing, modeling and presentation. This situation also allows students to work with new peer groups in teams. It can be said that students who are included in new peer groups in design workshops are more comfortable in the processes of communication and adaptation with the team.

4.2. Informative Activities and Impact on Stakeholders

In the seminar session, which was the first stage of the design activity, students were informed about Can Alüminyum A.Ş. and the other companies of Yeşilova Holding. Within the scope of the presentation, the properties of the aluminum material, its usage areas and details about the products made with this material were given, while the industrial designer of the company explained the final product perspective. The fact that the designer who conveyed the information about product design graduated from the same school was effective for the students to receive information about the processes and design outputs through a common professional language.

In the second stage of the production facilities visit, the students were given detailed explanations of different production and processes in five factories. In each factory, the authorized person explained the technical details and processes of the production lines and exemplified them through the products.

Through these explanations, students had the opportunity to ask questions about the production techniques and methods specific to their product ideas. It was observed that the students' knowledge and awareness increased with their factory experiences. In this context, the importance of transferring sector-specific and production-targeted experiences onsite and direct interaction with industry in the design education process has been observed. As Camacho and Alexandre (2019) emphasize, the lack of the university-industry interface can be improved by including these experiences in education models. The fact that the students stated that the interaction they experienced during the process supported their design education and contributed to their production processes supports Zeegen's (2011) assertion that "approaches that ensure the interaction of stakeholders are necessary." The students also had the opportunity to observe the possible technical problems related to the production processes on site.

The presentation, excursion and workshop provided an important transfer of knowledge on how to use theoretical knowledge in application areas and technology transfers, as emphasized by Erkarslan and Aykul (2018). In this context, the students who took part in the workshop received information about how the product designs they will make will go through production processes and which technologies will be used with the information given during the factory visits and received professional comments from the relevant department officials on their final products. Especially the presence of a designer graduate from the same university in the collaboration process increased the efficiency of the process; as a result of the communication with the students and the supportive and guiding approach of the company in the collaboration process as a result of the precise roles established in the first stage. In addition, the effect of ensuring the continuity of interactions between stakeholders on the efficiency of the product design process was observed.

4.3. Observations on the Design Process and Teamwork

The design process phases followed in the design activity were (i) the research phase (literature research, expert opinions, technical visits), (ii) idea generation phase (concept development, sketches and model studies), (iii) the interim presentation, (iv) main presentation. The design expectation summary created upon the company's request for collaboration was developed with the academic stakeholder. The collaboration process was thus supported to meet the expectations of all stakeholders. As shown in Figure 3, the roles of the company in the processes are stages 2,3,5, while the roles of the university are all stages as it requires a managerial approach in the process. Students were the main stakeholders who benefited from both stakeholders and created the main outputs in the process.

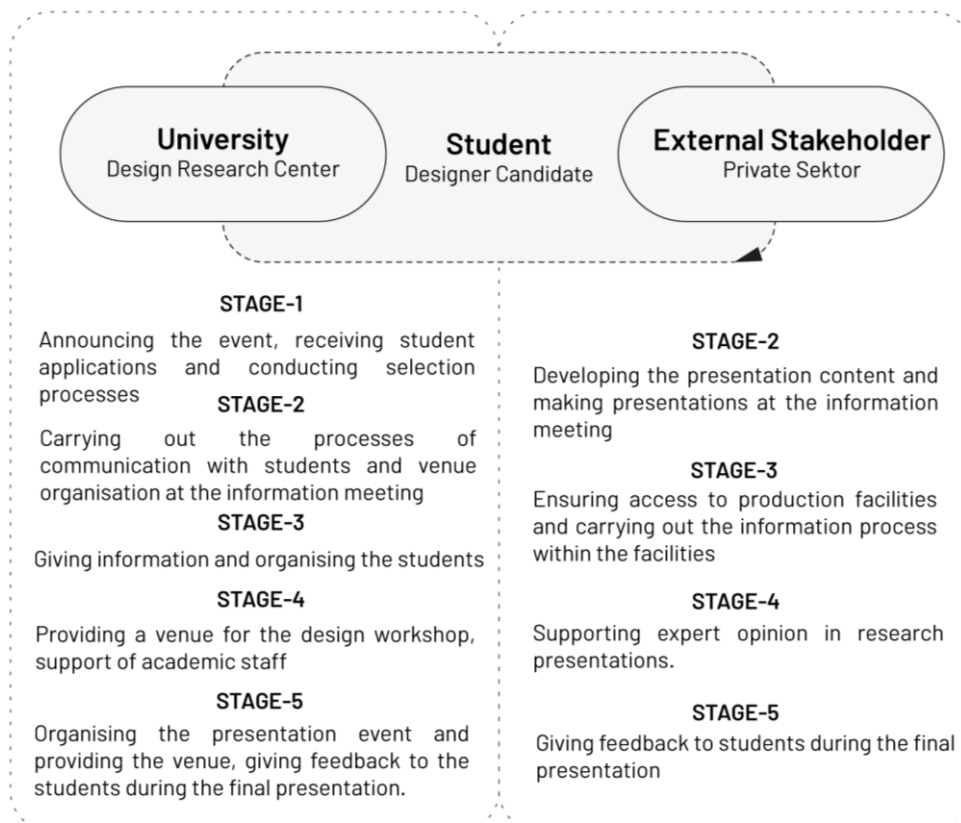


Figure 3: Roles of Stakeholders in the Design Process Stages

For the design process to proceed efficiently and to create a common ground for the expectations of all stakeholders, the "specification" was prepared together with university and industry partners before the event calendar. This specification and design brief were



presented to the students at the beginning of the process to initiate the project. This specification and design brief included the targeted user, project requirements, sales, marketing, purpose, objectives and expectations for the design outputs. In addition to the specification and design brief, students were informed about the purpose, objectives, criteria, schedule and expectations of the project verbally and in writing through the publication of the specification and design brief.

Through the information meetings and factory visits organized by the company, students gained deeper knowledge about the structure of the material, how it is processed, production methods and product types. In addition, thanks to these activities, students had the opportunity to share ideas and comments with each other before the workshop. The workshop topics were announced as two separate topics on two separate days and these topics were announced in the morning of the day of the workshop and the teams started working on their product ideas that day. The reasons why the workshop facilitators chose this method were to ensure that the students focused on the topic they would be working on, to prevent the fragmentation of their ideas and to enable efficient time management over a single topic.

The research process started with expert presentations and technical visits and continued with the teams' background research on the design. At first, the students participated in independent information activities, and then conducted background research with their teammates.

Having received preliminary information about the company and the material, the teams conducted deeper research as the process progressed and simultaneously consulted expert opinions. Expert opinions were obtained from both the company and the university.

Following the research phase, the teams developed product ideas through brainstorming processes in which opinions and suggestions were shared with the participation of all team members, and determined product scenarios by clarifying the subject areas for design. The ideas that emerged as a result of brainstorming were asked to be visualized with concept and mind maps, and it was observed that this approach contributed to the development of scenarios. The teams identified the expected scenarios and subject areas under the following headings:

- User groups,
- Sales channels,
- Trend headlines,
- Use of sustainable materials,
- Fast production,
- Ready-made profiles and easy-to-produce profile sections.

While developing their designs suitable for the e-sales channel, the teams thought through sketching and drawing at the idea stage and supported the idea generation processes by making models. The team members clarified the design alternatives by interpreting the findings obtained during the literature review, sketching and modeling processes. It was observed that group discussions played an important role in problem-solving and supporting project concepts.

Teams that created more than one design idea were asked to present their alternatives for expectations in the interim presentation. The comments made by university and sector stakeholders during the interim presentations in Phase 4 helped the teams clarify the concept and design decisions. The concepts that emerged after this stage were presented by the teams in the final jury without much change in design proposals. The titles of the products made by each team for two different product groups are given in Table 1.



Table 1: Product Group Topics Covered in the Workshop

PRODUCT GROUPS DESIGNED			
TEAM NUMBER	PRODUCT NUMBER	1. PRODUCT GROUP: USE OF ALUMINUM AS PLATE	2. PRODUCT GROUP: USE OF ALUMINUM WITH PROFILE CHARACTER
1	PRODUCT 1	Office Coaster	Needle Bulb Crusher
	PRODUCT 2	Bookmark	Door Stopper
2	PRODUCT 1	Instrument Hanger	Envelope Bag and Bottle Opener
	PRODUCT 2	Cellphone Stand	Candle Holder
3	PRODUCT 1	Napkin holder	Organizer e.g., for Jewelry
	PRODUCT 2	Bathroom Shelf	Cellphone Amplifier
	PRODUCT 3	Tray	
4	PRODUCT 1	Bookmark	Toothbrush Holder
	PRODUCT 2	Lighting	Paint Tube Scraper
5	PRODUCT 1	Book Holder	Modular display e.g., for Scarf and Belt
	PRODUCT 2	Headphone Stand	Modular Coaster
6	PRODUCT 1	Modular Wall Board	Latch
	PRODUCT 2	Crumb Collector for Table Surface	Window Holder

It was observed that the teams developed ideas and made decisions together after performing their research individually at the beginning of the process. The findings showed that most team members were in constant communication and interaction and carried out the stages together. In case of team-related problems, it was observed that the students went to solve them internally.

In connection with Tucker's (2016) observation that the courses in which students develop the habit of working together are not included much in the education process due to assessment, it was observed that the teams had difficulties in some stages in this study and this situation occurred, especially in the product concept development phase. During the development of the product idea, it was observed that the process progressed negatively because the team members were too critical of their ideas.

Making 1/1 scale mock-ups of the design proposals and turning them into three-dimensional models in the light of the information obtained during the technical visits supported the technical and production drawings to be close to the real production. In the decision-making processes of the resulting designs, especially the manufacturability and the properties of the material were at the forefront.

In the resulting designs, it was observed that it was easier to develop the model-making and process of design ideas for office and desktop products. For example, it was observed that the groups working on coasters or cell phone accessories tested the product model with different users in their groups and other groups. They continued to test the research conducted in the first stage of the process with the users through mock-ups during the concept and design development stages. These experience outputs were effective in providing feedback on design ideas. It also reveals that there was interaction not only within the team but also between the teams for the students. In line with the given topics, it was observed that the teams mostly included products for their (young adult user profile) daily needs (Figure 4) and/or hobbies (Figure 4).

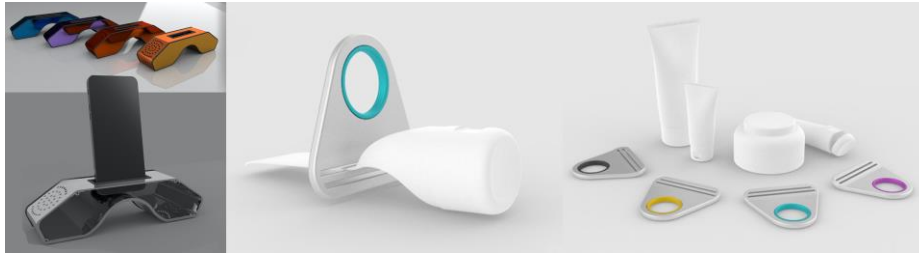


Figure 4: Design studies for the daily and hobby needs of young adults (Url-1).

In addition, as seen in Figure 5, the work teams also developed product ideas for office needs in professional business life.



Figure 5: The design to be produced by cutting aluminum profiles meets daily needs, such as bottle opening and letter opening (Url-1).

Campell et al. (2018), who stated that the design decision is an output of the whole team dynamics, found that the motivation of the teams that make decisions together at the stages of the design process is higher than that of the other teams. It can be said that teamwork dynamics are more active in these groups. In this context, the fact that each member of the team was involved in the process stages had a positive effect on teamwork. On the other hand, it has been observed that in teams with members who stand out individually, grouping among members causes low motivation. It was found that individuals working separately in teamwork caused separation in the idea development phase and had a negative impact on the process. This confirms the importance of team decision-making, not individual decisions, in decision-making processes, as stated in Campell et al. (2018). Another noteworthy situation was that in the processes of the teams that had difficulties in the background research phase of the design process, the individual work of the members was more and their information sharing with each other was more closed. One of the reasons for this situation may be that students do not have much teamwork practice in their education processes.

At the end of this study, all teams produced four products, two separate products belonging to the plate and profile product group, as expected. However, as can be seen in Table 1, team No. 3 developed three products for the first product group on its own will. With this result, it can be said that all teams successfully and motivatedly completed their design processes, although there were teams that experienced various setbacks in the design process.

4. 3. Contribution of the Evaluation Activity to Stakeholders

In the presentations made by the teams at the end of the design activity, it was seen that the product designs that were created with the aim of making products suitable for e-sales, in accordance with current trends and manufacturability principles, were included. In this direction, it is seen that the workshop outputs are in line with the design expectation summary.

The fact that the university includes collaborations in its education processes contributes considerably to its ability to see the current sector problems closely. Students who realized these problems and took the opportunity to research and develop in cooperation with the

sector had the opportunity to discuss them in their evaluation presentations. In design processes, all stakeholders had the opportunity to see their needs more clearly and to communicate with different disciplines. It is especially important for prospective designers to gain this awareness before graduation for their professional lives.

It was observed that the fact that the company supplies aluminum to different sectors, such as train, automotive, furniture, etc. and provides services to different areas of use caused the students to diversify their knowledge and terminology, and that they used their knowledge about the special properties and production processes of aluminum material in their product ideas and presentations during the workshop. An example of this is the needle bulb crusher (Figure 6), designed by a working group as a promotional product for the material's anti-microbial properties.

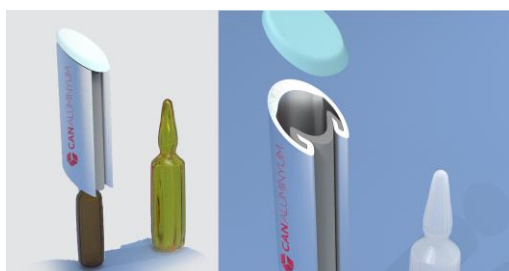


Figure 6: The design with aluminum shell and rubber inner surface ensures safe and hygienic breaking of needle bulbs (Url-1).

This collaboration and the technical information required in production methods, materials and processes have been effective in developing students' competencies, as emphasized by Zeegen 2011. During the evaluation presentations, it was observed that the students developed their solution proposals in line with the feedback they received from the experts in the company throughout the process and the technical information activities they experienced. It can be emphasized that university-industry cooperation workshops, as a complementary activity to design education, are effective in increasing students' knowledge of sectoral issues as well as in developing their problem-solving thinking skills in production processes. It can be said that the students gained ideas and experience on how the theoretical and applied knowledge they acquired in their university education can be put into practice in production processes.

It was observed that the students' shyness gradually decreased throughout the workshop process and that they were more comfortable in the evaluation presentation compared to the intermediate presentations. Each team member contributed to the evaluation presentation and presented it together. It was observed that motivation was higher in the presentations of all teams, especially in the presentations of all teams, where team dynamics were seen to be positively active.

Regarding the workshop that took place after the pandemic, students stated that they had reservations at the beginning of the process but were excited about what they would do. Students who expressed various uncertainties at the beginning of the process gave feedback that their motivation increased and they enjoyed themselves throughout and at the end of the process.

In the evaluation presentations, the company stated that they had not already addressed many of the product groups designed and were pleased to receive different design alternatives. With this approach, it is planned to implement some of the new design ideas for production. Product development processes for the production of some of the workshop outputs were evaluated and a plan for the future was developed. However, as stated in the specification, the company needs to make a separate agreement with the design students regarding the intellectual rights in the process of realizing the design.

4.4. Visibility Activities

Both university and industry stakeholders took part in the visibility activities of the design workshop. Announcements of all process stages and information about the stages were made regularly. The informative presentations organized within the scope of the university attracted the professional interest of not only the participating industrial design students, but also other industrial design students and students from different disciplines, such as architecture. Especially among the feedback given by the students who participated in the event, it was stated that the visibility activities increased their motivation positively.

All the processes of the event and design outputs were exhibited on the university's social media and virtual exhibition platform (<https://sanal-sergi.msgsu.edu.tr/aluminyuma-hayat-ver-2022/>) and especially the videos were among the successful examples. In addition, Bursa local news (<https://enbursa.com/can-aluminyum-ve-msgsu-den-1-aluminyuma-hayat-ver-tasarim-etkinligi-312058.html>) and company communication channels, to which the company is affiliated, gave wide coverage to the event with the contribution of senior management. The positive feedback from the company to the university supports the continuity of future cooperation.

Another effect of these visibility activities is that other companies want to cooperate with the reference of this project. Thanks to this cooperation, new cooperation negotiations were held with about five companies. This situation points to the sustainability of the work and education-oriented university-industry cooperation activities.

5. RESULT

This study discusses the contributions of the workshop, which was realized with an integrative approach to design education within the scope of university-industry cooperation, to the stakeholders and our learning in the process from a descriptive perspective as design educators. The fact that the process progressed in partnership with its stakeholders enabled it to be well-planned from the beginning to the end. Clarification of stakeholder roles and job descriptions was the most important factor in the positive outcome of the collaboration processes. In line with the experiences obtained, the collaborative and sustainable model in Figure 7 is proposed for the implementation and development of university-industry collaborations with different sectors to include industrial design education processes. Repeating such activities during the education process will be beneficial for students to improve their product development practices. In this way, it can be said that the speed of adaptation of students to the product development processes expected by the industry will be better.

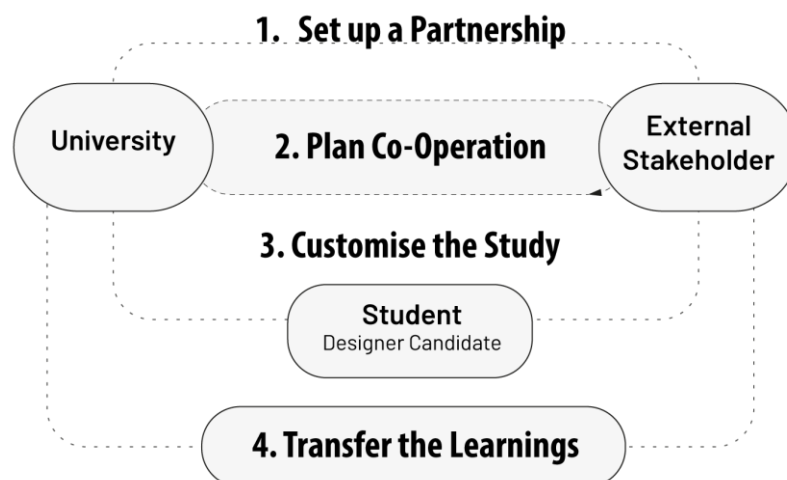


Figure 7: A Proposal for a University-Industry Collaboration Model Supporting Design Education



With the model proposed in Figure 7, it is recommended that stakeholders start by establishing their partnerships and plan their cooperation in the second step. In these processes, the roles of each stakeholder, the stages they will be involved in and the program are determined. Adapting the work to the relevant sector and transferring the learning that emerges after its implementation will guide future work. The learning outcomes that will ensure the sustainability of the model are as follows.

The necessity of teamwork in education processes: In the industrial design profession, it is expected to make design analyses by working and collaborating with many different sectors. It is important for students to develop teamwork and interdisciplinary working skills for these professional solutions required in professional business life. This situation underlines the need for students to develop teamwork skills in their educational life. With this workshop, it was concluded that courses on different disciplines and teamwork should be increased in the education system; thus, the importance of teamwork emphasized by IDEO (2011) and Zwirn (2015) should be emphasized and included in educational models. Based on the suggestion of Ovacik et al. (2016) that students experience difficulties regarding the educational process when they work in teams, it was concluded that unlike the difficulties of teamwork and grade anxiety in collaborations within the scope of the semester project, the motivation and focus of the student remained directly on the effort to produce a project because this workshop did not have a grade equivalent.

One of the most important reasons for students' participation in the workshop was this structure that supports teamwork. The fact that there are not many courses on teamwork in the education program points to this need. In this context, it is important to offer students the opportunity to experience teamwork and interdisciplinary work, which they will frequently encounter in their future professional lives. Teams consisting of students with a high level of workshop experience are more motivated to complete the design process and the work. One of the contributions of the teams utilizing the vertical education model is that it also supported peer learning, where competencies are shared.

Practice of professional interactions and industry experience: At the end of this study, another result that is in line with the literature matching the student feedback is that professional life is a rehearsal of work experience, as stated by Hasdoğan and Şener (2014). It was observed that the involvement of industry professionals in the process positively affects the processes and improves the final product positively. Carrying out these processes with professionals also gave students the opportunity to get to know business life. With the increase in these interactions, designer candidates' knowledge about professional practices increases, and the opportunity to get to know the sectors increases. As the intersection between the professional world and educational life begins to be filled, there is a rapprochement that is especially important in the industrial design profession. Complementary university-industry cooperation projects organized for students who continue their education life allow students to meet the sector and give them an idea about the sectors, working conditions and real needs they can take part in after graduation. It was observed that the informative activities contributed to the need to see the needs of the sector, which is also emphasized by Küçükerman and Şen (2022).

Vocational motivation: As a result of the findings of this study, it was observed that the motivation of the students to take part in extracurricular activities during their education process was high, and the involvement of all stakeholders and the graduate as a role model was effective in the development of industrial design skills. Collaboration with industry helped students to focus on real product needs and process problems, which increased their motivation to design. Ensuring university-industry relations through applied studies is effective in understanding each other in product development processes.

Qualified human resource development and job/internship opportunities: While it is emphasized that design is an activity that makes a difference in terms of the value and

benefits it adds to the product, there are also important findings that design is one of the crucial factors that increase the competitiveness of countries in international platforms and that design can contribute to business success (Moultrie et al., 2007). Design plays a role in the differentiation of products (Veryzer and Mozota, 2005). Therefore, industry relations during the education period are important in the development of qualified human resources. The development of students' competencies through interactions with external stakeholders during the education process is effective not only for the success of the university but also for the industry to access qualified human resources. Ensuring the visibility of the company's cooperation with the university has positively affected its support for future designers. In addition to the development of students' learning outcomes, it has made a significant contribution to their professional competencies. With these contributions, students can create a professional network and support future job and internship opportunities. University-industry collaborations also provide students with the opportunity to meet experts from different sectors. The flow of information and experience in cooperation processes, which are thought to contribute to improving the quality of university education with an integrative approach, also enables the development of the quality of academic human resources. Establishing the intersection of the industrial design profession with the sector while constituting the preparation stage of students for professional life also provides the opportunity for the sectors to recognize and understand the profession. With the results of this study, it is thought that the workshop will provide long-term contributions to education by increasing the interaction between students, universities and industry.

However, a limitation of this study is that it presents a single example of the emerging model. However, the model has been created with an inclusive approach and can be applied to different collaborations. Cooperation negotiations are currently ongoing with different industrial organizations for the continuity of the model. In addition, the fact that the workshop is organized as a separate event and a full day of activities during the education period has an impact on the course programs of the students in the academic calendar. In future studies, it is planned to examine the validity of the model in different institutional structures such as public institutions, other educational institutions and non-governmental organizations in education-oriented and complementary cooperation studies and interdisciplinary studies.

ACKNOWLEDGEMENT

This work is derived from a design activity conducted at MSFAU ETAM-Industrial Design Research and Application Center. We would like to thank MSFAU Etam, Can Aluminium A.Ş., all employees who supported the process and all students who participated in the design event.

REFERENCES

- Börekçi N. A. G. Z, Kaygan P., Hasdoğan G. (2016). Concept Development for Vehicle Design Education Projects Carried Out in Collaboration with Industry. *Procedia CIRP* 50T, 751-758.
- Campbel C., Roth W-M, Jornet A. (2018). Collaborative Design Decision-Making as Social Process. *European Journal of Engineering Education*. DOI: 10.1080/03043797.2018.1465028.
- Camacho B., Alexandre R. (2019). Design Education. University-Industry Collaboration, A Case Study. *The Design Journal*, 22/Sup1, 1317-1332. <https://doi.org/10.1080/14606925.2019.1594958>
- Er Ö., Soylu Y. (2013). A New Model to Introduce SMEs with Design. *10th European Academy of Design Conference – Crafting the Future*, Göreburg-İsveç.
- Erkarslan Ö., Kaya A., Dilek Ö. (2011). Türkiye'de Endüstriyel Tasarımcıda Aranan Niteliklerin Lisans Eğitim Programları ve Kariyer Siteleri Üzerinden Karşılaştırmalı Analizi. *Anadolu Üniversitesi Sosyal Bilimler Dergisi*, 11/2, 121-130.

- Erkarslan Ö., Aykul Z. (2018). Review of Curriculum Development for University-Industry Collaborations with a Comparative Analysis on Master of Industrial Product Design Education. *Design and Technology: An International Journal*, 23/2, 1-22.
- Gudur R., McDonagh D., Harris M., Rogers W. (2020). Design as a Catalyst: A Pedagogical Framework. *International Conference on Engineering and Product Design Education*. 10-11 Ekim 2020, Via University College, Danimarka: Herning
- Guimon J. (2013). *Promoting University-Industry Collaboration in Developing Countries*. The Innovation Policy Platform.
- Gweon G., Jun S., Finger S., Rose C. P. (2017). *International Journal of Technology and Design Education*. 27, 165-180.
- Hasdoğan G., Şener B. (2014). Endüstri Destekli Eğitim Projelerinin Arkasındaki Motivasyonlar: ODTÜ Endüstri Ürünleri Tasarımı Bölümü Mezuniyet Projeleri. *UTAK 2014 Bildiri Kitabı*, 10-12 Eylül, ODTÜ Mimarlık Fakültesi, Ankara, 219-234.
- IDEO (2011). *Design Thinking for Educators*. <https://www.ideo.com/post/design-thinking-for-educators>
- Küçükerman Ö., Şen S. M. Ö. (2021). Türkiye’de İlk Endüstri Ürünleri Tasarımı Bölümünün; İstanbul Devlet Güzel Sanatlar Akademisi’nden, Mimar Sinan Güzel Sanatlar Üniversitesi’ne 50 Yıllık Serüveni. *Tasarım Kuram*, 17 (Özel Sayı 4), 1-28.
- Lundberg H., Öberg C. (2021). Teachers, Researchers, but not Innovators? Rethinking University-Industry Collaboration. *Journal of Business & Industrial Marketing*, 36/13, 161-173.
- Ovacık M., Merter S., Gençtürk S. (2016). Endüstriyel Tasarım Eğitiminde Açık-Kaynak Tasarım Yönteminin Stüdyo Derslerine Uyarlanma Örneği. *UTAK 2014 Bildiri Kitabı*, 10-12 Eylül, ODTÜ Mimarlık Fakültesi, Ankara, 107-117.
- Storvang, P., Jensen, S., & Christensen, P. R. (2014). Innovation through Design: A Framework for Design Capacity in a Danish Context. *Design Management Journal*, 9(1), 9-22. <https://doi.org/10.1111/dmj.12006>
- Tucker R. (2016). Prejudicial Evaluation: Bias in Self-and-Peer-Assessment of Teamwork Contributions to Design. Ed. Richard Tucker, *Collaboration and Student Engagement in Design Education*. IGI Global: PA, 76-104.
- URL-1 <https://sanal-sergi.msgsu.edu.tr/aluminyuma-hayat-ver-2022/>(Erişim Tarihi 25 Ekim 2023)
- URL-2 <https://enbursa.com/can-aluminyum-ve-msgsu-den-1-aluminyuma-hayat-ver-tasarim-etkinligi-312058.html> (Erişim Tarihi 25 Ekim 2023)
- Yenilmez F., Bağlı H. H. (2020). Changing Paradigms, Subjects, and Approaches in Industrial Design Studio Education in Turkey. *Journal of Qualitative Research in Education*. 8/2, 754-775.
- Zwirn R. V. (2015). Differences between Art and Design Education-or Differences in Conceptions of Creativity?. *The Journal of Creative Behaviour*, 1-15, DOI: 10.1002/jocb.98
- Zeegen L. (2016). *What use is Design Education?* Iridescent, 1/1, 48-51 <https://doi.org/10.1080/19235003.2011.11782242>