ON-SITE LEARNING EXPERIENCE IN DESIGN EDUCATION: INDUSTRY-FOCUSED DESIGN STUDIO AS A COLLABORATIVE MODEL

TASARIM EĞİTİMİNDE YERİNDE ÖĞRENME DENEYİMİ: İŞBİRLİKÇİ BİR ÖRNEK OLARAK ENDÜSTRİ ODAKLI TASARIM STÜDYOSU

Füsun CURAOĞLU

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ABSTRACT

Collaborative project practices between industrial design education and industry provide a multi-layered basis for students to gain realistic experiences. However, there is still a significant gap between design education and industry in Turkey. For this reason, design education needs new opportunities and applications to be extended beyond university boundaries. This study presents a project of being a guest in the manufacturer's house as an alternative practice in design education. In this project, a design studio course is conducted in a factory setting outside the university, combining academic knowledge with real-world production experience for students in design education, with an on-site learning approach. In this context, the aim of the study is to evaluate the impact of an industry-focused design studio course, structured through a collaborative approach, on students' learning motivation and contribution. The importance of the research findings in the study, which was structured as a case study within the scope of the qualitative research method, is based on its ability to bring a new perspective to the "on-site learning" process in the design studio course and to create a new application field within the context of university-industry collaboration.

ÖZ

Endüstriyel tasarım eğitimi ve sanayi arasında ki işbirlikçi proje uygulamaları öğrenciler için gerçekçi deneyimler kazanması için çok katmanlı bir zemin hazırlar. Ancak Türkiye'de tasarım eğitimi ile sanayi arasında hala önemli bir mesafe vardır. Bu nedenle tasarım eğitiminin üniversite sınırları dışına çıkması için yeni fırsatlara ve uygulamalara ihitiyacı vardır. Bu çalışma, tasarım eğitiminde alternatif bir uygulama olarak sanayicinin evine misafir olma projesidir. Üniversite sınırları dışında bir fabrikada açılan tasarım stüdyosu dersinde, yerinde öğrenme yaklaşımı ile, tasarım eğitiminde öğrencilerin gerçek bir üretim deneyimiyle akademik bilgiyi birleştirilmesi hedeflenmiştir. Bu kapsamda çalışmanın amacı; işbirlikçi bir yaklaşım ile yapılandırılan endüstri odaklı tasarım stüdyosu dersinin öğrencilerin öğrenme motivasyonu ve katkısı üzerindeki etkisini değerlendirmektir.
Nitel araştırma yöntemi kapsamında durum çalışması paradigmasına göre yapılandırılan çalışmada araştırma bulgularının önemi, tasarım stüdyosu dersinde “yerinde öğrenme” sürecine yeni bir bakış açısı getirebilmesi ve üniversite-sanayi işbirliğinde yeni bir uygulama alanı oluşturabilmesine dayanmaktadır.

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INTRODUCTION

The new codes of daily life are being redefined in a production-oriented world with premise concepts such as "new generation," "innovation," and "4.0." Our practices, learning settings, learning styles, and competencies are evolving in a variety of domains, from education to the manufacturing industry. This development impactsindustrial design education along with numerous other fields. As designers attempt to bridge the gap between now and tomorrow with a new system, the ongoing transformation reveals what design education will look like both now and in the future. Findeli (2001, p.17) also encourages operating with the knowledge that design education has evolved and that the job profile does not have to remain unchanged.

Design is a complex field. It is both a practical and academic discipline (Meyer & Norman 2020, p.1). Nevertheless, design education continues to conduct the majority of its practices within the confines of the institution, choosing to maintain a distance from industry and production. This divergence between "design education in class" and "production in the industry" undermines the "hands-on learning" model of design education and makes it challenging for students to develop a connection between education and production practices. Many aspects are the sole burden of the student's imagination due to their lack of manufacturing experience.

On the other hand, the qualifications of the 21st century require graduates of the new world to possess a wide range of abilities. However, in the process of adapting to the new reality, design education, like many other institutions, can show strong resistance to change, even though the relationship between industrial design education and industry is a priority among educational issues.

According to Friedman (2012, p.147), the underlying issue is that designers must learn more than they did in the past in order to succeed in a top-tier design program, and students will require higher levels of integrative abilities to be successful after graduation. However, industrial design students can graduate almost without ever entering a factory or interacting with the industry.

The student's production-based practices beyond the school are mainly confined to a few internships and factory visits due to design education's indifference toward industry. Moreover, students cannot become what they have not seen or done. As Watters (2016) emphasizes, the partnership between academia and industry offers unique learning opportunities. Real-time applications will enhance learning intensity.

The primary concern is that design education is failing to match the changing demands of the twenty-first century (Meyer & Norman 2020, p.41). These changes in the twenty-first century necessitate a reevaluation of industrial design education's joint projects with industry using diverse techniques. As Friedman (2019) notes, design education must confront these challenges as well as the potential they bring.

Increased collaboration between academia and industry offers limitless potential for students. The primary application areas for revealing the contributions of these collaborative approaches are studio courses. These studies, however, become regulars "inside" the classroom within the school after a few production visits. Students engage in the process in the classroom by envisioning and attempting to comprehend the actual manufacturing and industry chooses to stay on the sidelines of its collaboration with design education.

The purpose of this study is to evaluate the effects of an industrial design studio course called Industry Oriented Design Studio (IoDeS), which was created as a joint venture between design education and industry and held in a foundry factory on the learning motivations and contributions of project instructors and students. This study aims to promote the combination of classroom-based design education with real-world production experience in a studio course held in a factory as an alternative application in design education and to reveal the on-site learning opportunities offered by IoDES. To sum up, IoDES is a project in which you are a guest in the home of an industrialist who does not wish to or is unable to attend university. The significance of the research findings lies in their ability to introduce a new perspective to the "on-site learning" process in the design studio course and to create a new application area for university-industry collaboration.

IoDES was held in a factory that produced cast kitchenware with 17 industrial design students, 5 studio instructors, and one industry consultant enrolled in the ENT 301 studio course offered by the Industrial Design Department of Eskişehir Technical University. A particularly intriguing aspect of the project is the transformation of a production space into a design learning environment through the relocation of a design studio course outside the institution into a factory over the course of eight weeks. The fundamental goal of this approach is to propose a hybrid studio model that combines on-site learning with academic education and mutually reinforces each other. The findings could lead to the development of a variety of applications to enhance the relationships between classroom-based design instruction and production outside the classroom within the context of university-industry collaboration. This study attempts to comprehend this. In this perspective, the study's research questions are as follows:

1. How does an IoDES opened within production contribute to students?
2. What effect does an IoDES opened in production have on student motivation?
3. How do students and teachers describe IoDES?

Industrial design education benefits greatly from the incorporation of design studios based on real -world applications to better prepare students for the workplace.

LITERATURE REVIEW

Design Education and Studio Tradition

The learning process is the act or process of acquiring new skills or information. (Arsham, 2002, p.10). Schön (1987) believes that working with genuine challenges is essential for acquiring professional design knowledge and techniques. Teaching students how to design is a top focus in process of learning. Understanding the design process is equivalent to designing.

Studio culture is probably the most striking aspect of design education. The design studio is beyond a simple lesson and a location to practice creative work; it is actually the main source of design education and culture in the classroom. The workshop tradition, which is rooted in the history of design education, promotes the experience - based learning method in design studios (Buchanan, 2004).

According to Lackney (1999), the fundamental features of studio-based learning are hands-on learning, collaboration with the environment and the process of redoing until stakeholders reach a consensus. Schon (1992) asserts that the design studio as a reflexive practice is a real-time laboratory as a reflection and creative process. The most thrilling feature of studio culture include an infinite amount of outstanding experimental studies, such as experimenting, making mistakes, discovering, and solving. After graduation, student finds himself in real production and in a setting that he has never encountered or experienced before. Papanek (1984) underlines that the majority of the skills we teach are tied to the processes and working techniques of a bygone era, and that design education must address the difficulties and opportunities it offers.

The studio is a living area where students develop meaningful relationships with their peers and instructors. Dutton (1987) characterizes design studios as "active venues in which students participate intellectually and socially by shifting between analytical, synthetic, and evaluative thinking modes in different activities. Yocom et al.(2012) also define the studio as a hands-on learning environment. The aim of IoDES is to define a new living and learning space outside the classical studio.

On-Site Learning

Learning is the act or process of acquiring new abilities or information (Arsham 2002, p.17). Different perspectives exist on design learning. Schon (1987, p.39) emphasizes the importance of working with real problems to gain professional knowledge and skills in design development.

According to Friedman (2012, p.146), the point is that designers need to learn more than before to succeed in a world-class design program. He emphasizes that graduates will need higher levels of integrative skills to be successful. There is no doubt that school education is much more than preparing students for work. However, where industrial design education and industry interaction are primarily limited field trips, it takes time for students to acquire the expected and necessary competencies of the 21st century.

In IoDES, with novel learning environments are intended to provide students with an "on-site learning" experience. The Dewey, Dale, and Kolb educational paradigms served as the foundation for the IoDES' planning.

Dewey, an American philosopher, and educational thinker argued that education develops naturally through experience. Dewey's theory of "Experimental Education" served as the philosophical foundation for out-of-class education in the 19th century, with the goal of promoting experiential training.

The "Experiential Learning Theory" developed by David A. Kolb states that people learn from their own experiences and that the evaluations of their learning are reliable. John Dewey (1938) and more recently David Kolb (1984) have established mutually supportive learning theories on the opportunities and contributions of learning environments within and beyond the classroom, as well as hands-on learning.

As an example for structuring the IoDES's background, the learning model of Edgar Dale's life cone was used. Edgar Dale (1969) indicates that there is a direct correlation between the living areas of learners and the method distribution in terms of learning. In this model, Dale

Figure 1. Dale's Cone of Experience Dale E. Audio-Visual Methods in Teaching. 3rd Ed. New York: Holt, Rinehart & Winston. 1969: 108.

emphasizes that the best learning is achieved through hands-on experience (Figure 1).

IoDES as an On-Site Learning Experience

In fact, design education is somewhat opaque in its link to manufacturing and industry. Design education sees; she does not deny; but she lacks the requisite concern. Without a doubt, design education is also responsible for connecting students with the opportunities offered by the business world and structuring the environments where they can practice.

Cooperation between universities and industry includes collaborative research, research contracts, or scientific consultancy by more researchers (Perkmann et al., 2013). While the universities as knowledge producers demonstrate the significance of this contribution, they also establish a network of collaborative relationships. However, industrialists' collaboration with design education is progressing slowly.

In this approach, the idea of taking design training to the home of an industrialist who is unable to attend university constitutes the infrastructure for IoDES. IoDeS was designed as a catalyst between industry and academia in the process of transforming existing theoretical knowledge into design practice. Many students are not able to pull together the disparate lectures on mechanics, materials science, manufacturing and marketing and relate these to the design process. There is little time for reflection in most undergraduate programs and it has It is to be said that this is also a major issue in industrial design (Green, L. N., & Bonollo, E., 2003,p.272). The focus of IoDeS is to give students the opportunity to experiment with production realities in the background of a design brief.

METHOD

The purpose of this study is to discover the effects of IoDES, which was established in a casting factory producing kitchenware items in the Organized Industrial Zone in Eskişehir, on the learning motives of industrial design students. This study employs the qualitative research method of case study to investigate the experiences and views of students and instructors regarding the on-site learning strategy. According to Stake (1995), one of the foremost experts on case studies, a case study is expected to catch the complexity of a single case. According to Creswell (2009), a case study is a qualitative research method in which the author examines in-depth one or more limited cases over time using data collection tools (observations, interviews, audio-visuals, documents, and reports) that include multiple sources and define situations and situation-related themes. Since IoDES is a unique, representative, and typical case that has never been employed before, the research was structured as a holistic single-case study design.

The study group of this research consists of 17 IoDES students selected by a preliminary project jury among 42 students who took the Product Design III course. Participants came from various social backgrounds and random levels of academic achievement. This is a capstone project carried out in the final 8 weeks of the 14-week academic curriculum. Students attended the project course at the IoDES at the enterprise for four hours on Tuesdays and eight hours on Fridays at the university.

In this study, semi-structured interviews were used as the data collection method. In IoDES, semi-structured interviews with 17 students, three instructors, a research assistant, the authors' and students' project diaries, video and images of the setting were all analyzed. This method is neither as rigid as structured interviews nor as flexible as unstructured interviews; it falls somewhere in the middle (Karasar, 2015). A descriptive systematic analysis was conducted to analyze the raw data gathered from observation, interviews, and document analysis. The purpose of descriptive analysis, in which data are summarized and interpreted according to predetermined themes, is to provide the reader with results that are arranged and analyzed according to the findings. (Yıldırım & Şimşek, 2018).

In the analysis, explanations were provided by assigning a code to the students whose opinions were sought, such as (S1-S2-S3…), and academics, such as (A1-A2 ...) It is critical to underline that the students in the industry class have never taken a design-oriented industry class before. The planning and implementation process of IoDES is detailed below;

Phase 1 – Preparation Process

The IoDES course was conducted in four sections by four instructors and a research assistant, including the author. As an instructor left the institution at the end of the semester, he was excluded from the interviews. It was anticipated at the beginning of the semester that 47 students would enroll in the course. The author briefed every instructor about IoDES during the planning phase. He discussed the project's content, procedure, and contributions.

- It was determined that a preliminary jury concept jury would be held during the third week to identify which students will participate in IoDES.
- The author attended all IoDES classes and activities, while the other instructors took turns attending once a week. They participated only as project instructors in the process and did not take part in the research.
- The two organizations have a formal agreement regarding intellectual and property rights.
- It was decided that the student who performed well in the IoDES final jury examination would be supported by the collaborating company to participate in the Milan Design Fair.

Phase 2 – Implementation Process

- A factory tour was organized in the first week of the project. The objectives of the business, production capacity, market targets and sector analysis were explained to the students.
- Factory cafeteria was organized for IoDES (Photograph 1 and 2).

Photograph 1. Factory Cafeteria was Organized for Iodes (F. Curaoğlu's Archive).

- As the project progressed, based on the content of the student projects, field-competent personnel such as mechanical engineers, casting masters, and enamel masters engaged in IoDES and provided feedback on the student projects (Photograph 2).

Photograph 2. Critical Processes in the Factory (F. Curaoğlu's Archive).

- Students made trial productions in the factory within the scope of their sketches.
- Students submitted a one-page process report each week.
- After the final jury, students and instructors were individually interviewed for 35 minutes with four semi-structured questions.

The interview questions directed to the students are as follows:

1. What contributions has the IoDES process made to you?
2. What is your description of the IoDES application?
3. What kind of motivation has it provided?
4. What are the best ways to incorporate IoDES into the curriculum? Which semester would you recommend it to be offered?

The interview questions directed to project instructors are as follows:

1. What are the contributions of the IoDES process?
2. What is your description of the IoDES application?
3. What kind of motivation has it provided to students?
4. What are the best ways to incorporate IoDES into the curriculum? Which semester would you recommend offering?

FINDINGS

The academia-industry cooperation is the entire course of education, research development, and other service activities that are carried out by combining resources of universities within a framework of a system that will yield to both parties within the designated target. According to Dura (1994), this process is based on the notion of reciprocal benefit. Tis study was conducted to determine the effects of IoDES on student motivation, the following themes were identified. Three primary sources were considered while interpreting the findings. These are the themes that emerged from the analysis, the researcher's and students' diaries that demonstrate the researcher's insight, and the literature citations that connect the data to the field. Observation in qualitative research requires keeping a field diary. The data emerged from the interviews are explained in the context of five themes below.

Question 1. What contributions has the IoDES process made to you?

Theme 1: Learning in Production

When asked about the contributions of IoDES to students, more than half (N = 15) emphasized the importance of production-based learning. They discussed the contribution of learning in industry to learning production techniques and mastering materials. The sub-themes of this title were determined as Knowing the Material, Production Process, Observing the Production, Knowing the Material, Learning the Material. For example;

"We know the material, for example, I have a pencil in my hand, it's plastic, and I know how it's made. But I've never seen plastic melt before. I wasn't able to see how the worker poured the plastic into the mold. In industrial design, we not only sell this pen to the manufacturer, but we also reach out to the person who will produce it." (S1).

"I believe it was a significant step. What we did here) and what we did there were fundamentally opposed. As a result, it was a benefit to me. " (S-4).

"When you take a tour of a factory, you get to see the whole production process. Seeing how things are made helps us learn a lot. There is a distinction between seeing a chair at an exhibition and exclaiming, "what a gorgeous chair!" and sitting in that chair. In the IoDES, we even lived next to the manufacturer for 4 hours a week (We worked alongside the manufacturers. We watched the workers handling the material and sanding it). We were involved in everything"(S-11) .

"Being in production made it clear to me that none of the designs I had originally created were feasible. For instance, I didn't give a second thought to the draft angle, slopes, or reverse angles when I was designing the product. When I look back at some of my older projects, I realize that they were never meant to be produced. It's been fruitful. Being inside the factory has benefited us because we can observe the production every time we visit." (S-9).

"We actually learned about the production conditions at the factory, but I realized how much it restricts the design. My usual way of doing things had to change. However, it felt good to be real" (S-12).

Understanding the material and mastering the materials and the production method, in particular, were regarded as key contributions by the students. For instance;

"It was amazing to be a part of the production. When we go inside, there is an intense smell of iron; to be honest, I liked being around the smell of coal because I had the feeling of "yes, I'm dealing with this, which excited me ." (S-7).

"The information we were given was more realistic, accurate, and first-hand. For instance, we sacrificed design aesthetics while taking the production method into account. It's a terrible thing for me."(S-3).

Theme 2: A realistic contribution

When students were asked to evaluate the contributions of the IoDES process, more than half of the students (N= 13) used the expression "A realistic contribution" to describe the process. They found the process realistic and evaluated the sub-themes of Meeting with the Producer, Being in Production, Being the Driving Force, Observing Real Production, and Being in the Real Process as realistic contributions to the process. They frequently emphasized the importance of meeting with the producer within the production and going beyond its borders. To illustrate;

"I was so thrilled the first time I heard it because I thought I was going through something like this for the first time. I would also work with a company. I believed that the IoDES would be extremely beneficial to my future, whether in business or during my internship. Working with the firm was both real and challenging" (S-4). "It was considerably easier to obtain information from a manufacturer, and we received accurate information.

Even when we were heading to the jury, we couldn't always trust the information we found. It was fantastic to obtain the knowledge when it was in production" (S -8).

"The IoDES was quite beneficial to me, at least in terms of working on a project in a unique environment. I felt more "professional" as a result. There was a full "foreign" group waiting for us, so we ended up with three times as much work as we would have in a typical project class" (S-6).

Theme 3: Contribution to establish a link between Industrial Design Education and production

When asked about the contributions of IoDES to students, more than half (N =14) stated that being in production contributed to the experience of "combining Industrial Design Education and production". They evaluated this experience under the sub-themes of Being in Production, Knowing the Profession, Defining the Profession. They stated that being involved in the production process contributes to the recognition and definition of the profession, thus establishing a connection between industrial design education and production.

''When my grandma asks what an industrial designer does, I tell her that they design everything except living things. This is my definition of industrial design.At school, we draw and build models. There is just one project product, and we are the only ones generating in the classroom. Thousands of items are produced there, nevertheless. Being able to see it was something different. Industrial design

already places manufacturing at its core. Anything that is not produced has no reality" (S-1).

"In my opinion, industrial design is meaningless without production; it only exists on paper." Nothing lives, including the product. I noticed this here. This is the way it should be" (S-4):.

''I see it as a great opportunity to incorporate industrial design education into production. Because our entire focus is on production. We are developing items for mass production, thus we must understand mass production and observe the material as it is produced" (S-9).

''Industrial design cannot be defined without mass production. It is inconsistent with its own existence. Here, I experienced this and concluded that a creative idea only on paper is not real" (S- 11).

2- What is your description of the IoDES application? What kind of motivation has it provided?

Theme 4: Feeling like a Designer

Students (N=13) defined the motivation given by IoDES as an experience with the theme of "Feeling Like a Designer". They defined their motivation to feel like a designer in the whole process with the sub-themes of this experience as a pleasant feeling, production-oriented thinking, self-confidence and feeling special. Sub-themes:

''It is a very pleasant feeling. It makes people feel special. We came very close to being a manufacturer and designer together with the IoDES" (S-1).

'It assisted my designer vision as a student who grows abstractly in his tasks. I can think more like a professional in terms of production" (S-2).

''Like a skilled designer, I created a product that can be produced and molded" (S-5).

''I'm a junior who had no prior knowledge of the corporate sector. I never imagined myself as a designer. I was always concerned about what I would do after graduation. I felt secure when a product that was nearly ready for production was released" (S-3).

"I was intrigued. I was so excited while working there that I assumed my product was in the catalog " (S-4).

''I realized how to do business with the manufacturer even before I graduated. I discovered that things are viewed from quite diverse perspectives" (S-7).

"It was a unique experience for me. Each week when I entered the factory, it felt as if I had graduated and started working. It was like being a designer" (S-16).

Theme 5 : Feeling Experienced

The students (N=10) provided the motivation given by the Industry Oriented Design Studio with the theme of "Feeling Experienced". They identified their motivation to feel experienced during the entire process as a pleasant feeling, self-confidence, feeling special, and production-oriented thinking. Sub-Themes: They evaluated this experience under the sub-themes of getting closer to reality, being exciting, being realistic. For example;

''Experience, "Getting closer to realism, meeting reality" (S-1).

''Exciting, enthralling, nothing out of the norm, yet I'd call it an experience. We defi nitely got valuable experience" (S-2).

''It was challenging, realistic, a simulation, and educational all at the same time"(S-3).

"It was an experience that would benefit me in business, and it was a significant gain" (S-4).

''I'm not sure" (S-5).

"It was an experience. If I had to explain this event... It felt like I was breathing" (S-12).

''It was a tough experience. It was a demanding, realistic, and dirty environment" (S-13).

In addition, students who participated in the interviews were asked which semester they would recommend taking IoDES if it were a course and more than half of the students (N=11) indicated that it should be offered in the sixth semester.

What are the best ways to incorporate IoDES into the curriculum? Which semester would you recommend it to be offered?

More than half of the IoDES students (N=9) proposed that the course be a vocational elective studio course or that the spring semester project course be designed as IoDES. According to them, campus-factory mobility is problematics during the winter; therefore, opening the course in the spring will facilitate this procedure. The sixth semester was suitable for them.

How do studio instructors evaluate IoDES?

The themes that emerged from the face-to-face interviews conducted with three instructors and a research assistant in charge of the IoDES course are detailed below.

What contributions has the IoDES process made to your students?

Theme 1: Experience

The experience was identified as the most fundamental contribution of IoDES to the students by all four studio instructors (N=4). The concepts of production learning and opportunity were identified as sub-themes. Sub-themes are learning in production and opportunity.

‘’They cast molds of their own designs with the help of the foreman. They were right in the middle of the fire, right in the middle of the manufacturing, and in such a hot and dirty production technique. DoIC, I believe, was the student's production learning test” (A-1).

‘’They have firsthand knowledge of everything in the field and in manufacturing. It was a fantastic opportunity for them to see a drawing become a product while they were still students. Furthermore, they discovered this by trial and error. I'd call it industrial-class learning in production‘’ (A-2).

‘’It's what I'd call a real experience process. DOIC evolved into a process at the heart of production in the industrialist's house” (A-3).

‘’I believe that was a valuable manufacturing experience. They had the opportunity to have a warm fire experience.

They witnessed how nothing is easy and how an idea emerges in a hot and sooty environment”(A-4).

Theme 2: On-Site Learning Experience

When asked what benefits IoDES offered to the students, the studio teachers overwhelmingly (N=3) responded that it enhanced the on-site learning experience. The sub-themes were identified as being involved in the production and understanding the material-production relationship. Sub-themes are being included in the production and understanding the material-production relationship.

‘’We wanted them to obtain on-site learning experience with this project. The opportunity to design, experiment, and produce in a factory is a once-in-a-lifetime opportunity for a student” (A-1).

‘’No matter how many models they create in the classroom, the projects remain two-dimensional. Now they worked and produced in a factory like a real designer. I believe an industrial designer should not only be involved in sketching, but also in all processes, from material to production, and they strive to be a designer” (A-2).

‘’By viewing and implementing on-site, the students gained experience as designers. They discovered immediate answers to their questions in production. It was significant to me that they were in production since it demonstrated where an industrial designer's obligations begin and end" (A-3).

‘’They explored the realities of being a designer. When they left their ivory tower studio, they explored every process an industrial designer would meet” (A-4)

What is your description of the IoDES process? What motivation has it provided to students?

Theme 3: Real Experience

When questioned about the motivation the IoDES process provided for the students, more than half (N=3) of the studio teachers characterized the process as a "real experience" for the students. Therefore, IoDES application can be defined primarily with the concept of real experience for project instructors. The following were identified as sub-themes: Sub-themes are designing in the factory and being at the heart of production. For instance;

‘’The students were ecstatic. It was a unique experience for them because it was their first time designing in a factory. They were at the hearth of the production‘’ (A-1).

‘’I did not anticipate such intense student participation. If you perform the same action with 3D printers at school,

you will not achieve the same result. From the behavior of the material to the production methods, the entire experience was real" (A-2).

''It was a wonderful opportunity for them to be in charge of the process they will be in approximately a year and a half. I believe the students had a real experience that they would remember for the rest of their lives" (A-3).

''During their training, they had never been in such a long-term production situation. Although they were perplexed at first, they were as excited as if they were going to work every week. It's also a little shocking to me.

It was sweltering, their heads were caked in soot, and they smelled like soot''(A-4).

In addition, project instructors who participated in the interviews were asked which semester they would recommend offering IoDES if it were a course, and more than half of them (N=5) indicated that it should be offered in the sixth semester as a vocational elective course.

What are the best ways to incorporate IoDES into the curriculum? Which semester would you recommend offering?

All project instructors (N=5) running IoDES suggested that the course be opened in the sixth semester as a vocational elective studio course. Justifying their suggestions, they stated that a studio course that is structured as an elective course will be more efficient if it is conducted within a 14-week program, that the subject of the project can be discussed in greater depth, and that it will be easier to maintain if it is a separate course from the main project.

CONCLUSION AND DISCUSSION

The projects carried out by design education in collaboration with industry are key models of cooperation in the process of transforming a creative idea into a commercial product with high added value. Each experience gained in this process is a stepping stone toward a career in business. It may not be sufficient to evaluate the accomplishments by evaluating and analyzing this procedure solely as an educational contribution. Finding out the students' emotional states and their motivational strategies are also significant outcomes of the cooperation gained in this procedure. The following conclusions were drawn based on the research questions developed for the purpose of this study and the participants involved:

The students identified the primary contribution of IoDES as learning in production, stating that this enabled them to become familiar with the material of the product they developed and to see the production process through observing its production. Meyer and Norman (2020, p.20), in an examination of what and how the system teaches young designers, point out the flaws in the system by stating that the designer rarely learns the most valuable aspects of the process and that some designers surpass their education with their industry experience, learning accidentally along the way. The research reveals how students evaluate the learning contributions of IoDeS in production and how this experience influences their potential in the design process from the perspective of collaboration and learning. At this time, we can anticipate that collaborative design studio courses structured in the field with the industry will aid students in getting industry experience while they are still in school. This reduces the likelihood that students may acquire their productive gains by mistake. As the students underlined, the benefits of real-time and real-life experiences enabled them to meet both the potential and restrictions of the product design process.

Students also described IoDES as a real experience. It can be considered as a valuable finding that IoDeS provided a real experience for students, with the interaction in production and the contributions of real manufacturing being significant to their learning process. Meeting with the manufacturer and being in production have been identified as driving factors, and as the process is real, they define seeing production as a contribution to the IoDES project. Yeşil and Bonollo (2003) explain the difference between project-based learning and problem-based learning as not only waiting for a solution to a given problem with the help of established foundations but also giving students a chance to explore the problem. At this point, Leutenecker, Ferchow, Klahn, and Meboldt (2018) emphasize that combining the production, material, finance, and result-oriented approach of design practice with the research, analysis, development, and process-oriented approach of academic education will allow students to learn more professionally without needing new experiences. Another contribution of IoDES, according to students, is developing a relationship between industrial design education and production. As Taylor (2009) stated, the spatial characteristics of a design studio can have a direct impact on learning.

The fact that IoDeS makes students feel like designers, contributing to their self-esteem and sense of self,is also one of the main findings of the study. Students have reported that the inspiration they gained from IoDES enabled them to feel like designers, which in turn boosted their self-esteem and sense of uniqueness. One of the goals of IoDeS was to provide industrial design students with real-world experience. Buchanan (1998) and Friedman (2003) point out that the mechanisms in the studio encourage formal and informal interactions as well as being a transitional ground for professional practice by emphasizing that design researchers have overlooked the fact for some time that studio is defined only as a place where students imitate the real-life design profession. A significant finding of this study is that IoDeS provides strong motivation to students. While the students described motivation as a pleasant emotion, they also mentioned feeling special and safe. One of the greatest concerns for a student or recent graduate is the production conditions and the inability to feel powerful and experienced against industrialists. Hence, it has been deemed essential that IoDeS provides students with this confidence-building motivator.

Students claimed that being in IoDeS made them feel experienced, which they regarded as encountering reality. They view IoDeS as a motivator that is fun, demanding, and challenging. Academics have stated that IoDeS provides students with a real-world experience, and that being at the factoryputs them at the heart of production. The design studio is "at the heart of most industrial design curricula and is a place where students learn to visualize and represent aspects of a problem graphically and to think as a designer (Green & Bonollo, 2003,p.269). Bringing design education beyond the boundaries of the institution, establishing models that will make this possible, and constructing new structures will provide students with possibilities to discover and develop their own innovative design techniques.

Academics at IoDeS noted that as an on-site learning experience, students experienced being a designer and gained the ability to comprehend the material-production link with IoDeS. It was crucial for IoDES to remove design education from its ivory tower and bring it closer to industry and manufacturing. Similarly to how we attempt to learn physics in the physics laboratory and biology in the biology laboratory, the fundamental objective of the project is to teach and learn design through real manufacturing. Studio instructors defined this as an experience, opportunity, and test. Students no longer desire to graduate from institutions with solely theoretical knowledge.

The motivation to gain experience focused on practical applications is a common theme among both students and academics. The themes for these comparisons and partnerships are shared in Table 1. The similarities in themes between the two groups are important for identifying findings. In this context, student and scholarly feedback were generally positive and encouraging. Participants discussed their views on the significance and success of the process. The ability of students and instructors to grasp the collaborative approach of IoDeS was identified as one of the study's most important findings. Extending design education beyond institutional boundaries, establishing educational models that make this possible, and constructing new structures will provide students with opportunities to discover and develop their own unique design techniques. According to Green and Bonollo (2003), many students struggle to integrate and apply separate lectures on mechanics, materials science, production, and marketing to the design process.

Table 1. Theme Titles of Students and Academics

	Theme Titles (Students)
Theme No	Learning in Production
	A Realistic Contribution
	Contribution to Establish a Link Between Industrial Design Education and Production
	Feeling Like A Designer
	Feeling Experienced
Theme No	**Theme Titles (Academics)**
1	Experience
2	On-Site Learning Experience
3	Real Experience

Furthermore, the fact that universities produce information and solutions in collaboration with industry will accelerate the commercialization of knowledge and increase its widespread effect. As Kolko (2005) points out, the professional world of product design has evolved drastically and Industrial Design graduates must now possess new skills.

To sum up, as Norman (2010) points out, we need new kinds of designers, people who can work across disciplines, and who understand human beings, business, and technology and the appropriate means of validating claims.

A design studio primarily employs a project-based learning methodology. This method's inquisitive character strives to speed up the learning process by employing a number of analytical and exploratory applications (Blumenfeld et al., 1991). Some challenges in the implementation of the project will continue to be difficult, as the process of structuring the new implementation of the course and aligning it with external stakeholders will continue to address all the content discussed throughout this article. Setting up and maintaining a design studio off-campus and within a factory takes extensive collaboration and careful planning. But as long as the increases in outcomes are favorable, the process can be enhanced. The main method for industrial design education is the studio, where students learn design knowledge through the design process by working on real design problems (Green and Bonollo 2003,p.270) in which the design process is set into many small tasks for implementation and assessment.

Taking design education beyond the confines of the institution and developing models that make this feasible can be an effective strategy to help industrial design students discover the real world they will live in afterward. In IoDeS, it was crucial to bring the studio class, which is essentially an area of application, closer to the industry. Students should be encouraged to explore and create their own design methods during this process.

Universities are not just places where practical design is carried out. They are also places where innovations, knowledge, and adaptive information related to real professional life are produced. IoDeS is also important for providing different gains in our perspective on design and studio education. Its contributions and opportunities to university-industry collaboration can be evaluated across various fields. The benefits it offers as a new collaboration model in design education can be enhanced through different applications.

This study will also contribute to overcoming the existing boundaries of design education and opening up new areas for practical application. As design education's industry-collaboration initiatives expand and on-site learning practices increase, students' investigations will move down much more intriguing pathways.

Contribution of the Research to the Field and Practice

Today's design education occurs in the context of post-industrial society and the industrial society from which it sprang (Friedman, 2012). The priority at IoDeS was bringing design education closer to production.

The application demonstrated several application possibilities for design studio education and was based on a methodology that focused on on-site learning by expanding design education beyond the university's boundaries.

Creating models and new frameworks that make this possible can allow students to find new design methodologies for themselves while also allowing industrialists to recognize their responsibilities. Students designed through doing, observing, and sensing as opposed to envisioning.

The goal of this application is not to replace the design studio course, but rather to propose a hybrid studio model based on on-site learning with industry that feeds off of each other. Within the context of university-industry cooperation, the results may lead to the development of various application examples to improve the relationships between design education inside and production outside. In future research, it can be verified if similar results are found while studying diverse populations of the same type. In this context, new collaboration models will provide

them with new experiences for their new professional discoveries

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