RETHINKING DIGITAL PRODUCT DEVELOPMENT AND USER EXPERIENCE PRACTICES IN INDUSTRIAL DESIGN EDUCATION

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ABSTRACT

RETHINKING DIGITAL PRODUCT DEVELOPMENT AND USER EXPERIENCE PRACTICES IN INDUSTRIAL DESIGN EDUCATION

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Recent developments have expanded the context of industrial design in many areas, and contemporary design fields have emerged incorporating digital approaches. Interaction design, user interface (UI), user experience (UX), and service design are among the prominent fields with increasing market interest and value. Nowadays, many industrial designers are oriented towards these fields. However, since their foundations consist of various disciplines (e.g., computer science, psychology, sociology) working in cooperation in the market rather than academia, they have an interdisciplinary structure with their own design processes, tools, and methods. While there are many similarities between industrial design and digital product development, there also are specific skills and knowledge that industrial designers do not encounter during formal education. This research explores the gap between industrial design education and UX professions. In the data collection phase, the digital product development process, particularly its UX implementations in industrial design education, is explored through the industrial design graduation projects at METU Department of Industrial Design. Two online surveys with industrial design students, visual content analysis of graduation project submissions of 24 students, and 35 semi-structured interviews with students, academics, and UX professionals were carried out. The research findings offer three main conclusions regarding (1) directions for digital product development and UX practices in industrial design education, (2) transformation of digital product development from industrial design education to UX professions, and (3) qualifications for industrial designers on becoming UX professionals.

Keywords: Industrial Design Education, Digital Product Development, User Experience (UX) Methodology, Graduation Projects, University-Industry Collaboration

ÖZ

ENDÜSTRİYEL TASARIM EĞİTİMİNDE DİJİTAL ÜRÜN GELİŞTİRME VE KULLANICI DENEYİMİ UYGULAMALARINI YENİDEN DÜŞÜNMEK

Hatunoğlu, Doğan Can
Doktora, Endüstri Ürünleri Tasarımı
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Son yıllardaki gelişmeler endüstriyel tasarım mesleğinin kapsamını birçok alanda genişletmiş ve dijital yaklaşımları içeren çağdaş endüstriyel tasarım alanlarını ortaya çıkartmıştır. Etkileşim tasarımı, kullanıcı arayüzü (UI), kullanıcı deneyimi (UX) ve hizmet tasarımı, artan pazar ilgisi ve değeri ile öne çıkan alanlar arasındadır. Günümüzde birçok endüstriyel tasarımcı bu alanlara yönelmektedir. Ancak bu alanların temelleri akademiden ziyade piyasada işbirliği içinde çalışan çeşitli disiplinlerden (örn. bilgisayar bilimleri, psikoloji, sosyoloji) oluştuğu için disiplinler arası bir yapıya ve kendilerine özgü tasarım süreçleri, araçları ve yöntemlerine sahiptir. Endüstriyel tasarım ve dijital ürün geliştirme arasında birçok benzerlik olsa da, endüstriyel tasarımcıların örgün eğitimlerinde karşılaşmadıkları belirli beceri ve bilgiler de bulunmaktadır. Bu araştırma, endüstriyel tasarım eğitimi ile UX meslekleri arasındaki boşluğu araştırmaktadır. Veri toplama aşamasında, dijital ürün geliştirme süreci, özellikle de endüstriyel tasarım eğitimindeki UX uygulamaları, ODTÜ Endüstriyel Tasarım bölümündeki endüstriyel tasarım bitirme projeleri aracılığıyla incelenmektedir. Bu kapsamda, endüstriyel tasarım öğrencileri ile iki çevrimiçi anket, 24 öğrencinin bitirme projesi sunumlarının görsel içerik analizi, ve endüstriyel tasarım öğrencileri, akademisyenler ve UX profesyonelleri ile 35 yarı yapılandırılmış görüşme gerçekleştirilmiştir. Araştırma bulguları (1) endüstriyel tasarım eğitiminde dijital ürün geliştirme ve UX uygulamaları için olası yönler, (2) dijital ürün geliştirmenin endüstriyel tasarım eğitiminden UX mesleklerine dönüşümü, ve (3) endüstriyel tasarımcıların UX profesyonelleri olmaları için gereken nitelikleri aydınlatan üç ana sonuç sunmaktadır.

Anahtar Kelimeler: Endüstriyel Tasarım Eğitimi, Dijital Ürün Geliştirme, Kullanıcı Deneyimi (UX) Metodolojisi, Mezuniyet Projeleri, Üniversite-Sanayi İşbirliği

To my family…

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LIST OF ABBREVIATIONS

ABBREVIATIONS

AI – Artificial Intelligence

APP – Application

AR – Augmented Reality

CAD – Computer Aided Design

CJM – Customer Journey Map

CODs – Constraints, Objectives & Directives

CX – Customer Experience

DGSA – Devlet Güzel Sanatlar Akademisi

DIY – Do-It Yourself

DTGSYO – Devlet Tatbiki Güzel Sanatlar Yüksek Okulu

ENTA – Endüstriyel Tasarımcılar Derneği

ETMK – Endüstriyel Tasarımcılar Meslek Kuruluşu

GENZ – Generation Z

GUI – Graphical User Interface

HCI – Human-Computer Interaction

HfG – Hochschule für Gestaltung

HMI – Human-Machine Interface

IA – Information Architecture

IAEK – Human Subjects Ethics Committee

ICA – International Cooperative Association

IT – Information Technology

ITU – Istanbul Technical University

IxDF – Interaction Design Foundation

METU – Middle East Technical University

MIT – Massachusetts Institute of Technology

N/A – Not Applicable

NATO – North Atlantic Treaty Organization

NFT – Non-Fungible Token

NGO – Non-Governmental Organization

NN/g – Nielsen Norman Group

RCA – Royal College of Art

R&D – Research & Development

UESYO – Uygulamalı Endüstri Sanatları Yüksek Okulu

UI – User Interface

UK – United Kingdom

UNTAA – United Nations Technical Assistance Administration

US – United States

UX – User Experience

VR – Virtual Reality

WDO – World Design Organization

YÖK – Yüksek Öğretim Kurumu

CHAPTER 1

INTRODUCTION

This doctoral thesis provides insights into facilitating the professional transition of industrial designers into becoming user experience (UX) professionals by exploring how UX is contextualized within industrial design education by examining digital product development cases as graduation projects. In addition to this examination, this exploratory thesis shows how digital product development and UX practices are included and practiced in industrial design departments in Turkey. The experience of digital product development and UX practices, which are experienced by students in various ways in industrial design education, by UX professionals in the market is another area that the thesis explores. In this way, this doctoral thesis has reached conclusions that answer the research questions of the thesis by examining digital product development and UX practices both within industrial design education and by collecting information about the practical equivalents of these fields in the market.

Introduction chapter of the thesis first describes the problem background by referring to the sources from diverse fields of literature. Based on the problem statement, the chapter states the aim of the thesis and presents its research questions. Later on, the chapter briefly introduces its research methodology and describes its significance. Lastly, the chapter describes the structure of the thesis.

1.1 Problem Background

Like every other discipline of creative industries (e.g., interior design, graphic design, architecture), industrial design strives to provide better human living conditions. According to the World Design Organization (WDO), industrial design is a strategic problem-solving activity that aims to present better living conditions and sustainable futures for people by creating, designing, and enhancing innovative products, systems, services, and experiences (WDO, n.d.). As observed from the definition of WDO, users, their needs, and their experiences from everyday life have pivotal roles in the industrial design profession (Hatunoğlu, 2019). This definition has become what it is due to rapid growth in high technology, innovations, and globalization (Howell, Stark, Christiansen, Hofstrand, Pettit, Van Slooten, & Willett, 2016). From a traditional perspective, industrial designers, as the sole creators (Valtonen, 2005), mainly dealt with the design and production of craft-driven physical products (Jones, 1980; Kolko, 2005; Kiernan & Ledwith, 2014; Carey, 2020). With the help of global developments in economy and technology, contemporary industrial designers include new business developments, social innovations, and experience, system, and service designs within their fields of expertise (WDO, n.d.). Therefore, the contemporary industrial design profession converts the demand into a product with specific functions that refer to specific needs (Qi, Xiongkai, & Hua, 2010). According to Gemser and Leenders (2001), industrial design should influence product appearance, user-friendly interface, easy fabrication, and product function. To sum up, contemporary industrial design should contain all the design activities that involve modern methods to produce and serve (Qi, Xiongkai, & Hua, 2010). According to Soyupak (2021), nowadays, economic activities are shifted from industrial production to knowledge and service creation. Thus, innovations started to shape the practice of design majorly (Brown, 2008). This change led to significant changes in the industrial design profession; high technological developments and innovations introduced the digitalization of industrial design activities and new roles of industrial designers.

According to Cantamessa, Montagna, Altavilla, and Casagrande-Seretti (2020), digitalization implies computerizing previously analog products and practices. Thus contemporary industrial design could be interpreted as digitalized because of its extensive use and dependence on technology and digital industries via design activities and approaches. Computerization, therefore digitalization, of industrial design can be traced back to the 1970s and 1980s when computers progressively were emerged and were utilized to develop innovations. Since then, the emergence of computer-aided design (CAD) (Cantamessa et al., 2020), human-machine interface (HMI) (Kang & Seong, 2001), and human-computer interaction (HCI) (Fallman, 2003) have all strengthened the bond between industrial design profession and technology, and have broken the traditional pattern of industrial design by presenting digital products (Wang, 2022). Developing everyday life objects in the digital environment, even with the most straightforward software, leads to a rethinking meaning and function of the product (Wang, Henfridsson, Nandhakumar, & Yoo, 2022). This development in the industrial design profession reshapes the relationship between people, products, and production. Instead of using traditional practices, industrial designers should follow global trends and the latest technologies while developing digital products (Hajkowicz, 2015). Environmental, societal, and economic issues have driven digital product development since they all shape global trends (Dean & Loy, 2020). Within these global trends and the latest technologies, the digitalization of industrial design involves many digital fabrication and information technology (IT) fields like user interface (UI) design, UX design, CAD, artificial intelligence (AI), virtual reality (VR), and Agile Manufacturing. With the help of these fields, digitalized industrial design makes it possible to deal with all the segments in the product life cycle, improve the quality of the product, and cut the cost while developing digital products (Xiong & Zou, 2004; Qi, Xiongkai, & Hua, 2010). According to Wang (2022), this redesigning and developing activity of traditional products into innovative digital products is a novel form of digital innovation.

Digital products, innovations, and interactions are pivotal in shaping the 21st century (Oygür & Karapars, 2019; Dean & Loy, 2020). As a result of globalization, high technological developments, and social, political, and economic issues within the design discipline, new, digital, and contemporary design branches and fields of expertise have become essential (Oxman, 2006; Wei, 2011; Bravo, 2015). UX (Law, Hassenzahl, Karapanos, Obrist, & Roto, 2014; Hellweger & Wang, 2015; Morris, 2021), UI (Nguyen, Vu, Pham, & Nguyen, 2018), interaction design (Holmlid, 2007), and service design (Stickdorn & Schneider, 2021) are among the most innovative and prominent design fields with tremendous market interest and excellent market value (Canziba, 2018; Morris, 2021).

While there are many studies and discussions among UX practitioners (Law, Roto, Hassenzahl, Vermeeren, & Kort, 2009; Bargas-Avila & Hornbæk, 2011), there is still no harmonized definition of UX (Mkpojiogu, Okeke-Uzodike, & Omopariola, 2022). UX has emerged as an umbrella term that focuses on understanding the quality-in-use of interactive products. However, according to Law et al. (2009), broad and fuzzy nature of UX, which contains emotional, experiential, and aesthetic variables, makes it difficult to define it universally. UX, nonetheless, is associated with the experience notion, and in scope, it is interactions of humans with digital products, application (app), and artifacts (Mkpojiogu, Okeke-Uzodike, & Omopariola, 2022). It analyzes perceptions, responses, and reactions of humans while interacting with a particular digital product. Given this information, UX practice can be defined as a multi-disciplinary profession that includes design, research, business, and engineering fields (Morris, 2021).

UI is how users interact with a digital product or software application (Bødker, 2021). Its goal is to present a user-friendly and intuitive way for users to perform tasks and reach their goals within the digital domain. While UI initially emerged in the early days of computer systems (Jørgensen & Myers, 2008), the creation of the graphical user interface (GUI), which replaced text-based commands with visual ones, presented the contemporary UI concept (Galitz, 2007). Nowadays, UI is closely related to digital products since all software applications that people use on their phones or computers have user interfaces and active roles in the current design solutions (Bødker, 2021; Morris, 2021). Within digital product development, UI has an interconnected relationship with UX (Bargas-Avila & Hornbæk, 2011) because the interface design of a digital product should meet the user needs, capabilities, and limitations (Ruiz, Serral, & Snoeck, 2021). According to the Interaction Design Foundation (IxDF), UI design is the process designers use to develop interfaces in digital products, focusing on visual style (IxDFa, n.d.). In that process, designers aim to create user-friendly and pleasurable interfaces by putting humans in the center. UI visually illustrates the UX elements that enable meaningful interactions and the overall design feel (Javier, 2022).

Within digital product development, another vital contemporary design field is interaction design, by Bill Moggridge and Bill Verplank during the 1980s (Cooper, Reimann, Cronin, & Noessel, 2014). During the 1970s, HCI research studies explored how people interacted with computers. In light of this exploration, researchers developed design principles and guidelines to help designers create more usable and efficient interfaces (Kolko, 2010). As a result of the growth in the software industry and the global developments in the field of innovation and technology, a wide range of digital products and services have emerged (Wang, 2022). As computers and digital products became a fundamental part of everyday lives of people, a growing need for designers who create user-friendly and engaging digital interfaces and experiences became inevitable (Smith, 2007; Kolko, 2010). As a result, interaction design emerged as a design field that focused on creating digital products and services, such as websites, mobile applications, software, and other digital interfaces (Siang, 2021). Since interaction design focuses on shaping digital products (Fallman, 2008), interaction designers are involved not only in the usability and functionality of digital products but also in the emotional and aesthetic experience of using them (Kolko, 2010). Thus, designers who work within interaction design must know how to deal with UX (Löwgren, 2002). After all, interaction design aims to improve the interactive experience by focusing on the moment of interaction of user with a digital product (Babich, 2019).

Another essential contemporary design field is service design. Even though service design is closely related to interaction design, both have distinct features, focuses, and approaches (Holmlid, 2007). While interaction design deals with how people interact with digital products and services (Löwgren, 2002; Fallman, 2008; Kolko, 2010), service design is concerned with the whole service experience, beginning with first contact with the customer to the end of service delivery (Stickdorn & Schneider, 2021). The emergence of service design is traced back to the 1990s due to the growing importance and interest of services in the global market and growing awareness of the importance of customer experience (Kimbell, 2011). In its early years, service design mainly focused on designing physical service settings such as banks or stores (Saco & Goncalves, 2008). By creating convenient, emotional, and valuable physical service settings, designers aimed to create positive customer experiences. With the rise of digital technology and the emergence of digital products, service design started to comprise digital interfaces, mobile applications, and online platforms. Thus, the context of contemporary service design is constructed. Researchers who define it all agree that service design is about innovating or improving existing services to make them more efficient, practical, desirable, and effective for people and organizations (Moritz, 2005; Kimbell, 2011; Stickdorn & Schneider, 2021). In service design, designers systematically apply design methods, principles, strategies, and tools to design services (Holmlid & Evenson, 2008). In that sense, the similarity between the role and appliance of customer experience and design methodology in service design and industrial design makes an interlocked connection between these two design professions.

As could be observed from the definitions above, multiple contemporary digital design fields point out the significance of UX within their contexts (Kolko, 2010; Stickdorn & Schneider, 2021). Since the design practice aims to offer better living conditions to all living beings, concentrating on UX that is centered on the needs and goals of the users (Law et al., 2009), has great importance in achieving the goals of contemporary design. In traditional product design, the needs and goals of the user are all handled by the designers, who are considered the sole creators (Valtonen, 2005), based on their experiences, professional knowledge, and know-how that comes from their design education (Hatunoğlu, 2019). On the other hand, usability and UX are addressed differently in digital product development because of the involvement of different disciplines during its design process (Dean & Loy, 2020). The interdisciplinary aspect of UX could be traced back to HCI which has always been considered an interdisciplinary field due to its deep connections to different disciplines, such as computer science, cognitive psychology, design, and engineering

(Wright, Blythe, & McCarthy, 2006). Different perspectives, knowledge, and tools from these fields in HCI have an essential impact on shaping UX as a subheading of HCI that focuses on creating positive and meaningful experiences for users in interacting with digital products (Luther, Tiberius, & Brem, 2020). Thus, UX contains various disciplines (e.g., design, psychology, engineering, marketing) working together to create effective and engaging products and services (Kort, Vermeeren, & Fokker, 2007). While each discipline brings its own sets of rules, perspectives, skills, and tools to the mixture, rules of the UX are formed in the field, depending on the interactions of its stakeholders. It is constantly extending its scope due to global developments in technology and innovation (Luther, Tiberius, & Brem, 2020). In this case, the constantly updated context of UX reveals the urgent need for it in the market, which leads to an increasing demand for professionals working in this field. This situation shapes the professional life preferences of many new university graduates (Oygür Ilhan & Karapars, 2019; Süner-Pla-Cerdà, Günay, Töre Yargın, & Ural, 2021).

1.2 Problem Statement

Today, physical product-focused traditional design disciplines are being replaced with digital product design and UX fields focusing on digital product usability (Sanders & Stappers, 2013; Howell et al., 2016). More recently, the sudden emergence of the Covid-19 pandemic has also accelerated this process and made it mandatory for designers to not only include but also focus on high technology and digital tools in their design perceptions and practices (Demirci & Hatunoğlu, 2021). All around the world, traditional design culture, education, and processes changed radically. Over the last few years, technology literacy of designers has increased (Blanco, Casas, Manchado-Pérez, Asensio, & Lópéz-Pérez, 2017), changes have occurred in design education (Liu & Han, 2020), and remote working options have influenced the professional preferences of designers (Wang, Liu, Qian, & Parker, 2021).

UX, as a field, has an increasing demand for professionals from various disciplines, including industrial design (Süner-Pla-Cerdà et al., 2021). The fields of industrial design and UX are interrelated. Many industrial design professionals have transitioned their careers from industrial designers into UX professionals, and many recent graduates prefer to work as UX, UI, interaction design, or service design professionals (Kiernan & Ledwith, 2014). Multiple research studies present a detailed analysis of how the professional preferences of industrial designers tilt to digital realms by exploring their motivations, expectations, and preferences and also by examining open positions posted by certain companies and industries (Inal & Rızvanoğlu, 2016; Oygür Ilhan & Karapars, 2019; Süner-Pla-Cerdà et al., 2021). While there are many similarities between industrial design and UX regarding design approaches, processes, methods, strategies, and tools, there are also differences that industrial designers do not encounter in their formal education (Süner-Pla-Cerdà et al., 2021).

The emergence of UX in industrial design and the implementation of its strategies and tools has broadened the scope of industrial designers by presenting new perspectives with new needs for skills and knowledge (Kolko, 2005; Inns, 2007; Carey, 2020). Industrial designers, as UX professionals, learn the practical aspects of the UX profession by collaborating with other disciplines in the field. Professional preferences of industrial designers towards the field of UX has led to an extension of industrial design education and the inclusion of contemporary praxes into the curriculum (Kolko, 2011; Getto, Potts, Salvo, & Gossett, 2013; Yargın, Günay, & Süner, 2019). Industrial design departments include more and more propensity to digital product development and UX into their curriculum every day (Yargın, Süner, & Günay, 2018); however, contemporary industrial design education is still primarily based on physical product design with traditional design models and lacks proper UX methodology (Morris, 2021). Therefore, in this sense, there is a gap between industrial design education and the UX profession. While UX-related courses were recently added to the curricula of specific industrial design departments, most of these courses are undergraduate elective, graduate-level, or certification based. There is no clear path to becoming a UX professional within the scope of industrial design.

1.3 Aim of the Research

This research aims to explore the gap between industrial design education and UX professions in order to facilitate the transition of industrial design graduates into UX professionals. To achieve its aim, the research is constructed as an exploratory study. Lately digital products have become more visible in the graduation projects of industrial design undergraduate programs in Turkey. Therefore, in the data collection phase, the digital product development process, particularly its UX implementations in industrial design education, is explored through the industrial design graduation projects. Ultimately, as the goal, this research presents insights into the possible further implementations of digital product development and UX practices in industrial design education. Therefore, it is expected that these insights would help industrial design students, academics, and professionals to understand and illustrate how to move towards UX professionals from an industrial design background by describing the core aspects, requirements, and approaches needed.

1.4 Research Questions

To explore the problem area and fulfill the research aim, this thesis addresses the following research questions:

- How does digital product development, and the UX practices it embodies, currently take part in industrial design education, and in which directions can it be further developed?
- How does digital product development process evolve from industrial design education into the UX professions, and what are its key drivers?
- How do industrial design students transform into UX professionals, and what knowledge, skills, and competences do they need during this process?

1.5 Research Position

As mentioned in Section 1.3, the research aims to bridge the gap between industrial design education and UX practices. The lack of a clear path to becoming a UX professional with a background in industrial design shapes the research design. In that context, this research focuses on digital product-driven industrial design graduation projects within the course of ID402 Graduation Project (Section B) conducted at Middle East Technical University (METU) Department of Industrial Design during the 2021-2022 Spring Semester. One of the reasons to choose graduation projects from METU Department of Industrial Design is based on the strong industry collaboration ties of the department (Hasdoğan & Şener-Pedgley, 2012; Börekçi, Hasdoğan, & Korkut, 2021). In the METU Department of Industrial Design, industry cooperated graduation projects have been carried out regularly since 2002 and have been exhibited at METU Culture and Convention Center annually (METUa, n.d.). Many METU Department of Industrial Design graduates keep their contacts and continue collaborating with the department through courses and design projects. They join these courses as part-time instructors, give seminars/lectures, and occasionally facilitate workshops. METU Department of Industrial Design offers multiple undergraduate and graduate-level elective courses focusing on digital product development and UX in industrial design, such as ID415 User Experience for Special User Groups, ID420 User Research in Design, or ID730 Modeling User Experiences (METUb, n.d.). Course instructors have acquired professional and academic experiences with diverse backgrounds and perspectives. Therefore, undergraduate industrial design students can have first-hand knowledge and experience in digital product development and the implementation of UX by the time they start their graduation projects. For instance, students collaborate with advisor firms in their graduation projects. Apart from that, in 2019-2020 Spring Semester, third year students collaborated on a fully digital project. Also, since 2020-2021 Spring Semester, UX/UI firms have been working as advisor firms in graduation projects and some graduation projects offer hybrid projects, while others offer fully digital products (METUc, n.d.). Apart from the undergraduate program, graduate students who want to develop academically in these fields can take advanced courses within the department.

Given this information, a qualitative approach was selected for this exploratory research. Firstly, two online surveys were distributed and filled out by the students, the first at the beginning and the second at the end of the graduation project semester. These surveys gathered information on perceptions, motivations, expectations, and self-evaluations of the students on their graduation projects. Then, a systematic visual content analysis of 24 industrial design graduation project submissions was carried out. These submissions were examined according to submission requirements of the projects in terms of project content and design features. Additionally, project process portfolios of the selected students were analyzed to see more detailed information on the assignments that were conducted through the semester. Finally, the semi-structured interviews were conducted for an in-depth assessment of the research focus of this thesis. Thirty-five semi-structured interviews were conducted in total with industrial design students, industrial design academics, and UX professionals involved. Since the first two steps of the research were carried out focusing on the industrial design students, the semi-structured interviews were mainly carried out with industrial design academics and UX professionals. To gather the most diverse data possible, in addition to METU Department of Industrial Design academics, semi-structured interviews with academics from various educational establishments in Turkey were conducted according to the relevance of their academic and professional experiences to the context of the thesis. Similarly, semi-structured interviews with UX professionals with different backgrounds and disciplines were conducted to enrich the gathered data. Interviews with the UX professionals strengthened the interdisciplinary nature of the context of this thesis by showing the impact of having different backgrounds on work experiences. Semi-structured interviews with academics pointed out their perceptions, attributions, and evaluation criteria of the significance of UX within industrial design education. In contrast, the others conducted with UX professionals showed the expectations and real-life experiences in the field of UX concerning industrial design graduates.

1.6 Significance of the Research

Globalization and the ever-increasing use of technology in everyday life are shaping the contexts of many professions, including industrial design, and the market needs and interests to a great extent. As a result, in terms of the design discipline, focusing on digital products within tech-savvy design fields such as UX, UI, AI, or AR became a prominent professional preference among industrial designers. However, the interdisciplinary roots of these fields have their own sets of approaches, rules, and regulations primarily established in the professional field, which industrial designers are not familiar with due to their more traditional, tangible product and production-driven formal education. Aiming to bridge the gap between industrial design education and UX practice, this research explores how industrial designers first encounter digital products and implement UX design and research in their formal education with an industrial designer perspective before working as a UX professional. This doctoral thesis emphasizes its difference from other studies presented in the literature by focusing on how industrial design students encounter, perceive, and implement UX through digital product development and by comparing this information with the perceptions and expectations of UX professionals from different disciplines. The research examines and compares data from both perspectives and discusses the implications of these on digital product development process. The research also examines how the knowledge and skills gained in industrial design education prepare industrial designers to work professionally in the field of UX. A digital product development process that considers the knowledge, skills, and methodology of UX practices will contribute to the visibility of industrial designers as professionals in these fields.

1.7 Structure of the Thesis

This doctoral thesis consists of five chapters, and an overview of the chapters can be seen in Figure 1.1.

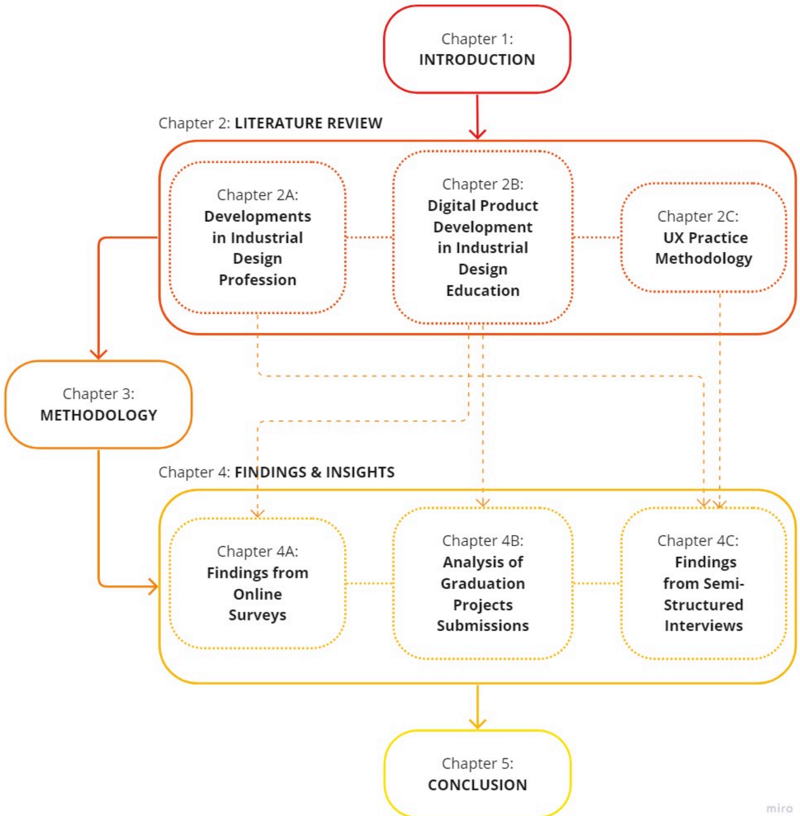

Figure 1.1: Structure of the Thesis

Chapter 1 illustrates the problem background of the research, its problem statement, research aim, research questions, theoretical framework and research position including its methodology, and concludes with its significance and structure.

Chapter 2 provides a literature review on the related themes on the context of the thesis focusing three main fields; (1) developments in industrial design profession, (2) digital product development in industrial design education, and (3) UX practice methodology. In the developments in industrial design profession, chapter presents the evolution of the profession from its traditional approach to its current state emphasizing digitalization and emergence of the contemporary design fields. Second section of the chapter provides information on the inclusion and implementation of digital product development in industrial design education over the years. Last section of the chapter illustrates UX practice methodology, including its background, frameworks, methods, and process.

Chapter 3 introduces the research design of the thesis starting with its research approach. It continues with the data collection process of the research with its three methods, (1) online surveys, (2) visual content analysis of graduation project submissions, and (3) semi-structured interviews. Later, the chapter presents the data analysis process of its field research focusing on the coding process of survey data, the analysis process of student submissions, and the coding process of interview data.

Chapter 4 introduces the findings of the field research and presents the insights. Findings from the online surveys, the analysis of graduation project submissions, and the semi-structured interviews are analyzed deeply, and selected codes, figures, and quotations illustrate the context of the results. Findings of the online surveys are presented through an outline formed according to the digital product development process. Findings of the graduation project submissions are presented through the assignments given during the semester, and through the project process portfolios of the selected students. Findings of the semi-structured interviews are presented through a framework formed as a flow from industrial design education to UX professions, concentrating on (1) the implementation of digital product development and UX practices in the current industrial design education, (2) the graduation projects as a bridge between industrial design education and UX professions, and (3) the reflections of industrial design education on UX professions.

Chapter 5 summarizes the findings into a conclusion and discusses the outputs of the thesis based on its research questions. First, the chapter revisits the research questions of the thesis to answer with both insights from the literature review and the findings from its field research. Later, the chapter mentions the contributions of the thesis. Lastly, the chapter concludes the thesis by stating its limitations and presenting potential research directions for further studies.

CHAPTER 2

LITERATURE REVIEW

This chapter introduces the review of related literature on the topic of this doctoral thesis. The literature review consists of three main sections; (1) developments in industrial design profession, (2) digital product development in industrial design education, and (3) UX practice methodology (see Figure 2.1).

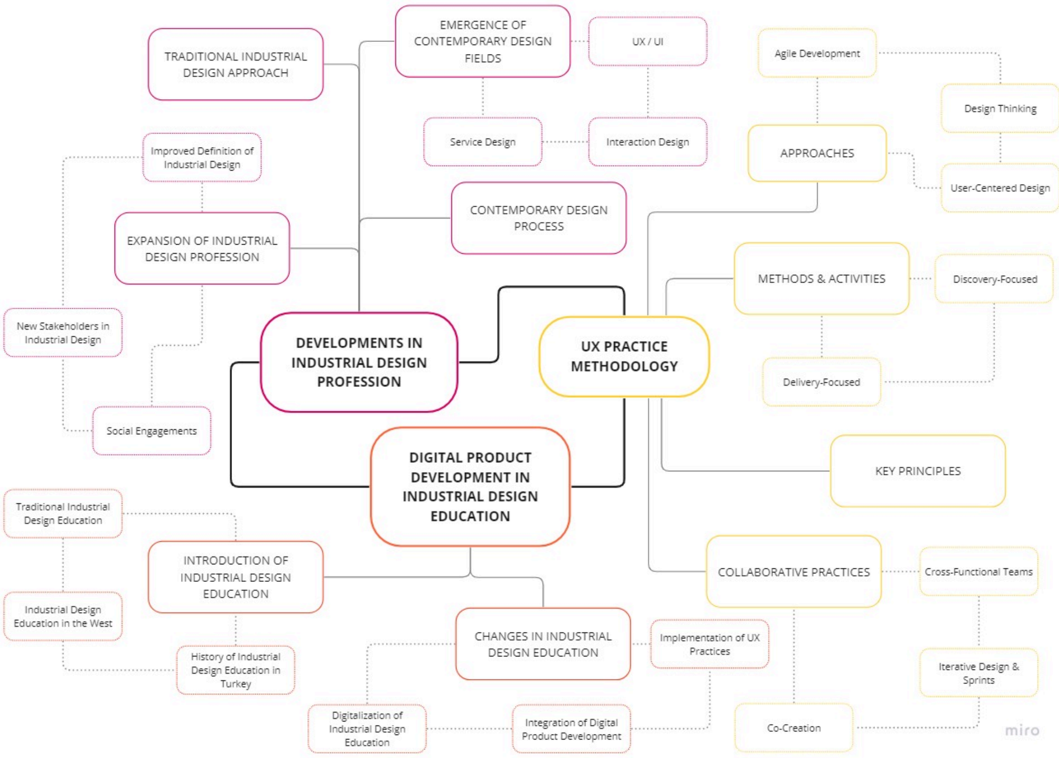

Figure 2.1: Mind Map of the Literature Review

The chapter begins by presenting traditional industrial design profession and how it is expanded over the years. While doing so, stakeholders, their qualifications, their contributions to the design field, and their social engagements in the design process are explored deeply. Within the developments in industrial design context, the section also presents contemporary approaches and fields within industrial design profession, and presents an in-depth review of contemporary design process and its phases. Later on, the chapter presents a section focusing on the contemporary industrial design education and digitalization and UX practices in it. In that sense, section presents traditional industrial design education, its evolution over time, and its actors and their roles within the process. Last section of the chapter examines the UX methodology in detail. Section explores various key drivers, prominent approaches, methods, and collaborative practices within the UX professions by refering the overal digital product development process.

2.1 Developments in Industrial Design Profession

First main heading of the literature review is about exploring industrial design profession from its core. To do this, first, traditional industrial design approach is discussed regarding its emergence and origins, its traditional definitions, and its sole actor industrial designer. Later, expansion of industrial design profession over the years is examined deeply. In that context, improved definitions of the profession are stated. Various stakeholders in industrial design (i.e., contemporary industrial designer, experts from other disciplines, different communities, companies, organizations, and establishments) are introduced. Social engagements of the stakeholders in the overall design activity are explored to discuss the work dynamics in the process. Following heading presents an in-depth review of contemporary design fields (i.e., interaction design, UI design, UX design, and service design). Their formations and definitive features are examined in relation to industrial design practice. Last section of the heading inquires into the contemporary product design and development processes and their stages focusing on digital products.

2.1.1 Traditional Industrial Design Approach

While the long-established design discipline is known as designing and creating products and artifacts activity of craftspeople, industrial design refers to a modernized design activity that emerged at the beginning of the 20th century in Europe with the Industrial Revolution (Overbeeke & Hummels, 2014; Koch, 2022). Earlier in that period, products and artifacts were produced by craftspeople or artisans with a long history of apprenticeship and guild tradition (Friedman, 2000; Ahmed, 2015). With the advent of industrialization and the mass production of consumer goods, new techniques, materials, and technologies emerged (Campbell, Hague, Şener, & Wormald, 2003; Overbeeke & Hummels, 2014). These new professional developments set up mechanization, mass production, standardization, modularity, and diversification of designs (Stevenson, 2013). Technological developments and specializations within the field separated processes of making and designing (Heskett, 1980; Walker, 1989). With this separation, design led to the emergence of a specialist profession, industrial design, concerned with industrial mass-manufactured products (Heskett, 1980). In that sense, in 1972, Tomás Maldonado defined industrial design as "*…the planning of objects fabricated industrially, that is, by machine, and in series*" (Margolin, 2005; p. 237).

While there are many debates on the early definitions of the industrial design profession regarding its human-environment relation (Lucie-Smith, 1983), its abstract nature (Moody, 1980), and its commercial issues (Fry, 1988), studies agree on the human-centered nature and its broad content. In that sense, definition by Heskett (1980) summarized the traditional aspects of the industrial design profession by stating, *"…industrial design is a process of creation, invention, and definition separated from the means of production, involving and eventual synthesis of contributory and often conflicting factors into a concept of three-dimensional form, and its material reality, capable of multiple reproductions by mechanical means"* (p.10). Inter-disciplinarity and multi-disciplinarity are also discussed as vital aspects of industrial design (Stevenson, 2013; Ahmed, 2015). The involvement of multiple perspectives and broad knowledge from various disciplines in industrial design practice (Hatunoğlu, 2019) has a connection with industrial design education (Campbell et al., 2003). At the beginning of industrialization and the emergence of mass production, a lack of industrial design education led to industrial designers from diverse disciplines such as architecture, engineering, and social sciences (Heskett, 1980; Lucie-Smith, 1983; Järvinen & Koskinen, 2001). These diverse backgrounds brought their perspectives, knowledge, know-how, methods, tools, and strategies into the profession.

According to Valtonen (2005), in traditional pre-industrialized craft-based design practice, designers were seen as the sole creators of custom-made products. However, the impact of industrialization, mass production, and the emergence of new production techniques and technologies broadened the roles of industrial designers (Campbell et al., 2003). Additionally, the interdisciplinary nature of the profession (Buchanan, 1992; Friedman, 2002) brought an extensive amount of new knowledge that led to a frequent overlap among different disciplines of knowledge that extended the roles of industrial designers (Conway, 1995). Therefore, with these new developments in traditional industrial design, the profession started to extend its context and continuously develop the roles of its actors.

2.1.2 Expansion of Industrial Design Profession over the Years

Previous section presented the origins, traditional definitions, and early roles of industrial designers in the design profession. This section presents; (1) improved definitions of industrial design, (2) involvement of various stakeholders in industrial design, and (3) social engagements in the overall design activity, respectively.

2.1.2.1 Improved Definitions of Industrial Design Profession

The shift from traditional to contemporary industrial design led to some significant changes in the context of the profession (Kolko, 2005; Kolko, 2011; Kiernan & Ledwith, 2014). While traditional industrial designers mainly dealt with craft-driven form and production of physical products (Kolko, 2005; Carey, 2020), with the help of global developments in the field of economy and technology, contemporary industrial designers include new business developments, social innovations, and experience, system, and service designs within their fields of expertise (WDO, n.d.). Today, industrial designers are active in the areas such as UX, UI, interaction, new product development (NPD), research and development (R&D), marketing, manufacturing (Hertenstein, Platt, & Veryzer, 2005), service, experience, system, and innovation design (WDO, n.d.).

According to the Design Council (2010), industrial design requires designers with a particular design culture that contains creativity, flexibility, adaptability, communication, management, and leadership skills. Research of Hatunoğlu (2019) presents six critical aspects of the industrial design profession as being (1) human-centered, (2) production-based, (3) creative and abstract, (4) having critical thinking, (5) having a broad scope, and (6) built with experiences (see Figure 2.2).

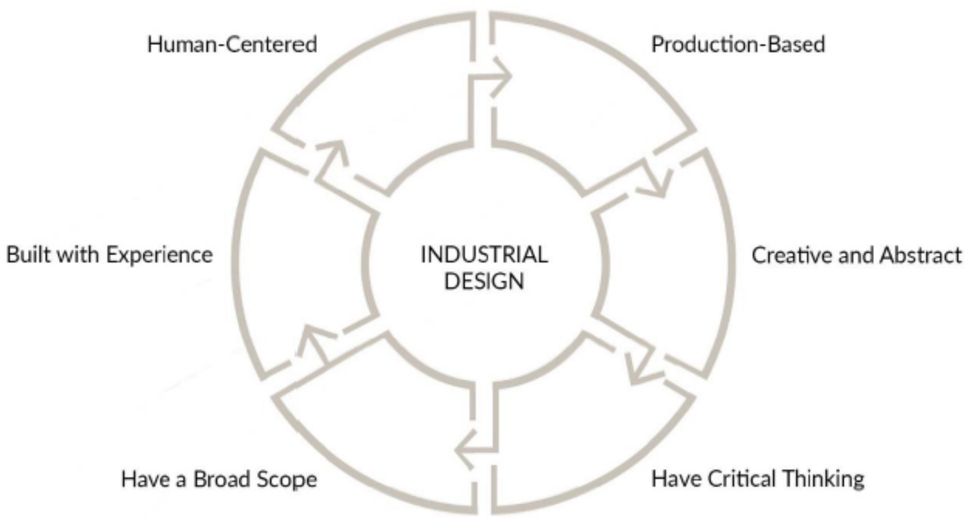

Figure 2.2: Aspects of Industrial Design Profession (Hatunoğlu, 2019, p. 53)

Social, political, environmental, and technological developments with emerging new practices while extending industrial design also provide new roles for its practitioners (Muratovski, 2016). The following section presents the actors of an industrial design process and states their roles within.

2.1.2.2 Stakeholders in Industrial Design Profession

This section of the literature review presents the literature related to the stakeholders in the design process starting from industrial design profession, its process, and the roles of its actors. The section first reveals the qualifications of the contemporary industrial designer. Later on, the section explores the internal actors of design process with their roles, industrial designers, experts from other disciplines, and different communities. Lastly, section presents external actors and their roles and contributions, organizations, NGOs, municipalities, institutions, and companies.

2.1.2.2.1 Qualifications of Contemporary Industrial Designer

The roles of industrial designer have grown and changed over time through different approaches (Valtonen, 2005; Yee, Jefferies, & Tan, 2013). The broadening scope of industrial design presents new layers and approaches with new needs for skills and knowledge (Inns, 2007). Consequently, the role of the industrial designer as the sole creator has extended into being a thinker, planner, and coordinator (Cooper, Junginger, & Lockwood, 2011).

Valtonen (2005) explains that there are six emerging roles of the industrial designer between the 1950s to the 2000s (see Figure 2.3). Industrial designers started with developing forms of products and increasing their values means for promoting nations. During the 1960s, due to emerging social issues and increasing importance of human-rights movements, industrial designers started to collaborate with teams of engineers and marketing experts within the product development process. In the 1970s, human factors and ergonomics shaped the roles of industrial designers with user needs and usability as the essential focuses. Discussions on social inclusion and empowerment through industrial design became more prominent. The importance of management in the design process influenced the roles and professional preferences of industrial designers in the 1980s. Roles of the designers as facilitator and coordinator became visible under design management. With the dominant commercial and market culture in the 1990s, brand building and strategy entered among the roles of industrial designers. With the global technological developments, in the 2000s, industrial designers remarked the high potential of UX/UI as a new direction.

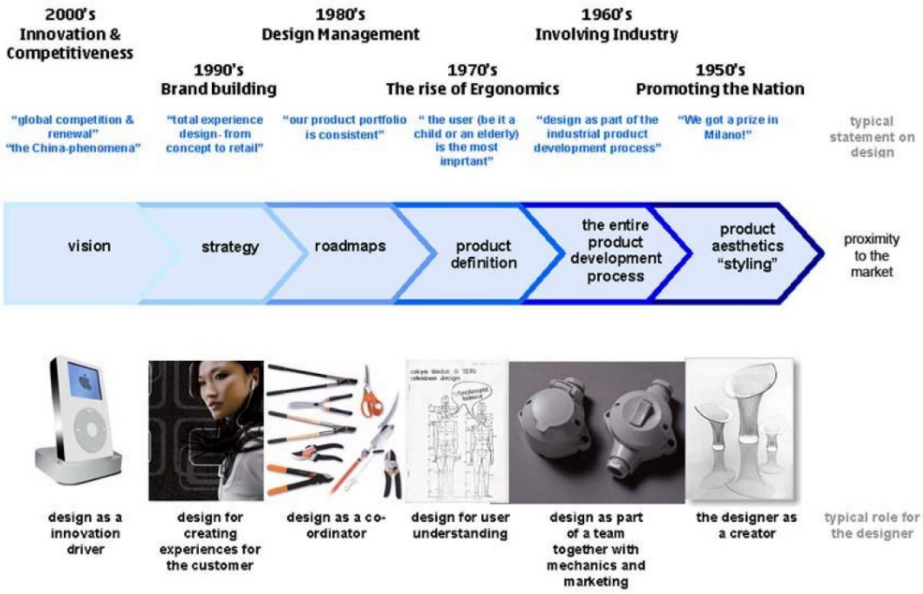

Figure 2.3: Six Emerging Roles of Industrial Designers (Valtonen, 2005, p.7)

The product development process is the field of expertise of industrial designers (Wölfel, Krzywinski, & Drechsel, 2013). By creating new experiences, they push innovation. Press and Cooper (2003) state four main aspects of their concept of the new industrial designer as an intelligent maker, knowledge worker, sustainable entrepreneur, and active citizen. In terms of being an intelligent maker, designers should contribute to the design process with their creative, reflective, and critical thinking. Their craft-related qualities are essential in the process of making. Secondly, qualities of designers such as being an active learner, communicator, and networker form the basis of their aspect of knowledge worker. Thirdly, with the help of the global developments and social issues, roles such as business strategist, manager, and marketer, and being ecologist joined professional preferences of the new designers. They form the aspect of sustainable entrepreneur. Lastly, emergence of the social issues led designers to work on the social context prominently. Roles of the designers as social initiators, empathizers, and internationalist make them active citizens.

2.1.2.2.2 Internal Actors and their Roles

With the emergence of social, political, and environmental issues, the urgent need for including diverse perspectives in design has been acknowledged. Because of the abstract and creative nature of industrial design profession, its stakeholders deal with wicked problems that require an inevitable collaboration with multiple perspectives (Haemmerle, Shekar, & Walker, 2012). Today, the open-source culture (Bucks et al., 2007) provides individuals new research and learning environment where different people learn from the fields of expertise of each other. This new way of learning makes people realize the primitive nature of the monodisciplinary perspective (Harris, 2010). In that sense, Kim and Lee (2016) state that product or industrial design might not be fully explored through a monodisciplinary approach. According to Escobar (2018; 2020) transcultural and transdisciplinary discussions is the absolute way to break out colonized minds. Thus, collaborative industrial design process includes different stakeholders such as designers, experts from other disciplines, and different communities, with interchanging roles (van Dam, Simeone, Keskin, Baldassarre, Niero, & Morelli, 2020).

Experts from Other Disciplines

According to Wölfel, Krzywinski, and Drechsel (2013), industrial design has, instead of a linear process, iterative circular developments of knowledge, concept, and design. Because of the essential aspects of industrial designers (see Section 2.1.2.2.1), its product development always involves different disciplines such as engineering, architecture, interior design, graphic design, and business management (Bucks et al., 2007). While industrial designers have an essential role in the design development process, their roles can differ according to the type of outcomes or the dominant discipline and its culture in the company or organization (Eckert & Clarkson, 2005; Hatunoğlu, 2019).

Since no single individual can possess all the skills and knowledge (Harris, 2010), interdisciplinarity, multidisciplinarity, and transdisciplinarity become well-known and widely used concepts in many fields such as design, business, education, and engineering (Bucks et al., 2007; Kruck & Teer, 2009). Complex problem-solving activity of industrial design profession enables social interactivity within the process of design and development (Eckert, Maier, & McMahon, 2005). Therefore, interdisciplinary, multidisciplinary, and transdisciplinary collaboration and teamwork contribute to the process with diverse perspectives (Bucks et al., 2007) and broad knowledge from different fields of expertise (Harris, 2010; Kim & Lee, 2016). In that sense, the research of Eckert and Clarkson (2005) presents an example of how experts from different disciplines are involved in and contributed to an automobile design process (Figure 2.4).

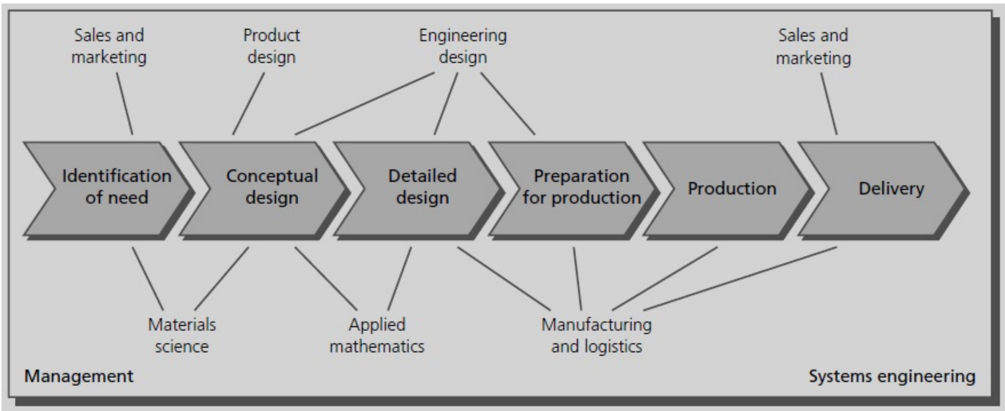

Figure 2.4: Activities of Different Disciplines in a Design Process (Eckert & Clarkson, 2005, p.5)

The process starts with market research conducted by sales and marketing teams to identify product type, user needs, and preferences. To have a better understanding of the project, teams contact and collaborate with end-users. At the same time, teams contact clients to discuss development, limitations, and market potentials of the product. Later, teams of designers and engineers (explicitly selected according to the product) work on the initial ideas concerning the concept, detail, and production of the design. Then, production teams prepare the proposed design for manufacturing. Lastly, manufacturing and logistic teams deal with how product reach to the end-user, while sales and marketing teams concentrate on the best possible way to present the product to the global masses. In this highly collaborative and complex process, effective management and communication skills are considered vital elements (Eckert & Clarkson, 2005; Eckert, Maier, & McMahon, 2005). To avoid challenges such as time, budget, and conflicts that can be caused by diverse perspectives, ways of doing, and culture, the process needs a facilitator or coordinator from the dominant actor or discipline (Eckert, Maier, & McMahon, 2005). Since new technologies and innovations are extended to the context of industrial design (Wölfel, Krzywinski, & Drechsel, 2013), today, industrial designers have additional roles as facilitators and coordinators.

Different Communities

Today, in addition to designing products, industrial design also contributes to social, technological, and business innovations that aim to create socially inclusive and sustainable futures (Manzini, 2009; WDO, n.d.). Thus, designing for a social change creates an open and collaborative environment that includes different individuals, communities, companies, institutions, organizations, and NGOs (Manzini, 2009). In these environments, all stakeholders come together and share their knowledge, values, perspectives, and tools. According to Micklethwaite (2002), this interactive activity brings an inclusive and empowering discourse to industrial design activity.

In addition to social issues, economic concerns of industrial design profession have also shaped its process and actors. Modernization and new technological developments that the Industrial Revolution brought changed the roles of craftspeople (Canova, 2009; Tung, 2012). According to Shiner (2012), flexible production techniques and new consumption patterns blurred the line between craftspeople and designers. By collaborating with local craftspeople communities, designers learn their tacit know-how and re-interpret the craftworks according to contemporary aesthetics and user needs (Pannozzo, 2007). In terms of product and local craft development, Sanders and Stappers (2008) emphasize the importance of the co-creation activity of these communities.

Maker communities also have a close relationship with contemporary industrial design. The Maker Movement is considered a socio-cultural phenomenon that makes, creates, or develops innovations by using new fabrication tools such as 3D printers. Designers, craftspeople, engineers, thinkers, do-it-yourself'ers (DIY), and other individuals and communities collaboratively work for open-source outputs (Hatunoğlu, Gürkanlı, & Demirci, 2021). Founder of the Maker Movement, Dougherty (2012; 2013), defines every individual as a maker. Maker communities and their activity of making offer open learning environment without any age, gender, or culture related limitations. With high technology, availability of rapid prototyping, and mass customization (Kohtala, 2009), these individuals can freely conduct, facilitate, or participate in any design or product development process. Open, sustainable, and diverse nature of maker communities emphasizes ever-changing roles of stakeholders during the design process (Green & Kirk, 2018). In that context, the research of Hatunoğlu, Gürkanlı, and Demirci (2021) explores several makerspaces in Istanbul, Turkey focusing on the collaboration and facilitation process. With the help of global developments in technology and open-access information, makers collaborate and facilitate different activities in makerspaces, which become active learning environments for diverse groups.

2.1.2.2.3 External Actors and their Contributions

While internal actors and their contributions are primarily personal, informal, and small in scale (see Section 2.1.2.2.2), external actors and their contributions to the design process are more formal and larger in scale. In the design literature, many researchers, in addition to their collaboration with different communities, collaborate with and are supported by larger actors such as agencies, companies, consultancies, municipalities, institutions, NGOs, and professional organizations mainly in the social design or design for social innovation projects. Most of the research projects within social design choose to work with different communities from various developing or underdeveloped geographies (Hussain, 2010; Escobar, 2018; 2020; Reynolds-Cuéllar & Chong Lu Ming, 2020). However, since these projects aim to develop, enhance, or present sustainable futures, most researchers collaborate with large-scaled actors such as companies, consultancies, municipalities, institutions, NGOs, and professional organizations to have more impacts.

Today, as large-scaled external actors of the design many organizations, councils, and institutions such as Design Council UK, WDO, Cradle-to-Cradle either work for sustainability and local development or support the works in social design projects of the industrial design. Since the social design and design for social innovation are part of the contemporary industrial design profession, many design researchers collaborate with these large-scaled actors in their studies to reach out global masses. For instance, Hussain (2010) collaborates with the International Red Cross Committee to produce prosthetic legs for children in Cambodia, while Reynolds-Cuéllar and Chong Lu Ming (2020) collaborate with two coffee farming collectives in Colombia to locally produce and enhance artisanal, organic, and sustainable coffee. Additionally, design global and national organizations and consultancies such as IDEO, Participle, and Think Public has conducted in-depth researches and presented valuable and exciting information focusing on social change, empowerment, and democratization tracks of the contemporary industrial design.

2.1.2.3 Social Engagements in the Overall Design Activity

This section of the literature review presents the literature related to social engagements in the design process. The section first explores collaboration in design. While doing so, it discusses the meaning of collaborative design, and then, it explores design communication and teamwork within the design process.

2.1.2.3.1 Collaboration in Design

According to WDO (2022), industrial design is a transdisciplinary creative profession that designs, enhances, or develops products, systems, services, or experiences for enhancing human lives and creating sustainable futures. Diverse fields of expertise of design disciplines require diverse perspectives to reach the broadest possible user group (see Sections 2.1.2.1). In that sense, contemporary design is supported by various disciplines such as management and engineering (Dykes, Rodgers, & Smyth, 2009), at different stages of its process (Bucks et al., 2007; Kruck & Teer, 2009). Therefore, as mentioned in the previous sections, the design process not only requires designers but also diverse perspectives from different fields of expertise (Dumas, 1996; Harris, 2010; Haemmerle, Shekar, & Walker, 2012; Kim & Lee, 2016). In this way, abstract problem-solving activity of the design discipline enables social engagements and fulfills the requirement of working collaboratively at different stages of contemporary design practices (Eckert, Maier, & McMahon, 2005).

According to Kleinsmann (2006), in collaborative design, actors from different disciplines share their knowledge about both design activity and process. They share knowledge to create a shared understanding and integrate and explore their knowledge while designing a new product. Design collaboration and communication (Chiu, 2002) are vital to maintaining a successful design process that influences the quality of the project designed (Valkenburg, 2000).

While in the traditional design practice, designers could act as the sole creators or actors in the process (Valtonen, 2005); Emmitt and Ruikar (2013) state that building design is the result of collective knowledge of different disciplines. In the design process, professionals exchange information and ideas, and they discuss, negotiate, and finally agree upon a collective building design. Focal points of these collaborative processes are equal participation, equitable power, and shared decision-making responsibilities (Emmitt & Ruikar, 2013).

2.1.2.3.2 Communication and Teamwork in Industrial Design

Since a collective design project could not be achieved with the works of a single individual (Harris, 2010), team activities and division of work are essential (Kvan, 2000). Team activities and division of work enable experts from different disciplines to contribute to design within their fields of expertise (Eckert, Maier, & McMahon, 2005). Teamwork creates diverse groups in the work environment, and these groups are more efficient at creative thinking and problem-solving activities than regular homogenous groups (Hoover, 2017). Instead of contributing from a single set of expertise, using knowledge from multiple perspectives and multidisciplinary teams presents diverse solutions to the wicked problems of design (Tessier, 2020). Multiple perspectives and multidisciplinarity takes information from different disciplines but stay within their limits (Choi & Pak, 2006). Teams with active members bring knowledge from their different fields of expertise and develop solutions that are more creative. Team members get together, collaborate, co-create, and co-design until the conclusion of the project (Sanders & Stappers, 2008). These creative activities are vital in developing more open, democratized and sustainable design processes (Strouse, 2013).

To develop a successful collaborative design process, sustaining open and transparent communication among team members is essential (Emmitt & Ruikar, 2013). While dealing with wicked problems, explicit communication and solidarity greatly influence the productivity of team members (Tarricone & Luca, 2002). Their work also states some of the essential aspects of the skillset of a team member, such as socializing, adapting to environments, using time effectively, and, most importantly, working with others. Since collaborative design is based on knowledge interactions of certain team members, aligning individual knowledge to a shared direction enables a collaborative negotiation process (Kleinsmann, Buijs, & Valkenburg, 2010; Kleinsmann, Deken, Dong, & Lauche, 2012). In that sense, Rosen (2007) states that diversified perspectives and common understanding sustain communication and collaboration in design. However, lack of common communication and understanding might block creativity, blurs tasks, and creates a hierarchical domination that might lead to collapsed teams (Johnson, Heimann, & O'Neill, 2000).

In addition to sustaining teamwork, collaboration, and communication, facilitating and organizing tasks are required in the design process. The design expertise, culture, social function, and management skills of actors influence the success of collaboration (Chiu, 2002). With effective communication and management, teams of different disciplines could collaboratively enable successful design processes and contribute to social inclusion, empowerment, and democracy in design at the same time (Sanders & Stappers, 2008; Strouse, 2013).

2.1.3 Emergence of Contemporary Design Fields

This section of the literature review chapter presents a review of the four most prominent contemporary design fields; (1) interaction design, (2) UI design, (3) UX design, and (4) service design that have strong connections with global developments in the fields of technology and innovation. The current market value of these contemporary topics and the high academic interest in these fields formed the context of the review. The scope of the review presents a brief introduction to their origins and their relations with the industrial design profession.

2.1.3.1 Interaction Design

As the first of the contemporary design fields, interaction design mainly targets to present interactive digital products, services, and systems that aim to enhance the wellbeings of users with meaningful and engaging experiences (Brown & Cooper, 1999; Fallman, 2008). Moreover, the application area of the interaction design covers the design of user interfaces, user interactions, and user experiences with technology.

The origins of the interaction design field have its roots in the 1970s when GUIs were developed to replace text-based interfaces for more user-friendly computer systems (Smith, 2005; Fallman, 2008; Cooper et al., 2014). In the early days of computer systems, system interfaces were mainly text-based and required users to have a certain knowledge of the language of programming. As computers became more accessible to a broader range of users over time, it was seen that there was an urgent need for more accessible, understandable, and user-friendly computer interfaces. The emergence of GUIs introduced visual elements such as icons, windows, and menus to facilitate user interactions with computers (Badre, 2002).

After the emergence of GUIs in the 1970s, with the widespread use of personal computers in the 1980s and the emergence of the Internet in the 1990s, the field of interaction design became widespread and drew attention to itself in different market areas (Brown & Cooper, 1999). Designers began recognizing the importance of considering user needs, behaviors, and expectations when creating digital products. The perception of usability of designers, who had previously focused on more technical implications with a focus on HCI (Luther, Tiberius, & Brem, 2020), began to be reshaped with digital products (Löwgren, 2007). Their focus shifted from mainly technical considerations to a user-centered approach prioritizing usability and user satisfaction.

The field of interaction design, whose activities, and tools are constantly updated as a result of digitalization, touches many different disciplines (e.g., cognitive psychology, HCI, and industrial design) due to this extension in its context (Kolko, 2010; Cooper et al., 2014). Within the context of industrial design, user experience, the form and function of products, and their manufacturing processes play an important role in shaping the extending context of interaction design. Interaction designers started to use features from industrial design practices, such as affordance and feedback mechanisms in their digital design projects (Kolko, 2010), and over time, the boundaries between interaction design and industrial design have become more blurred.

With the emergence of digital products, industrial designers have increasingly added interactive and digital features into their fields of expertise and works, while interaction designers have started including more and more physical interactions in their works (Löwgren, 2007). This merger is visible in the design of contemporary everyday life products such as smartphones and wearable technology, where both digital and physical interactions are integral to the user experience (Moggridge, 2007).

2.1.3.2 User Interface (UI) Design

As the second contemporary design field, with the development of GUIs, UI design emerged in the 1970s as a result of the urgent need for creating visual and interactive elements for computer systems (Badre, 2002). As computers became more accessible and user-friendly, the number of personal use of computers increased. The lack of knowledge regarding computer systems created obstacles for users while using this new technology. Therefore, an urgent need to create visual and interactive elements that facilitated user interactions with computer systems emerged (Galitz, 2007). The emergence of GUIs revealed early digital design features such as windows, icons, menus, and buttons, forming the basis of UI design (Ruiz, Serral, & Snoeck, 2021).

In that context, one of the most fundamental people in the origins of UI design was Donald Norman, with his coined term *user-centered design* (Ruiz, Serral, & Snoeck, 2021). Norman (1988) discussed that the focal point of UI design should be on the user, and its goal should be to provide interfaces that are easy to use and understand. UI design, which puts the user-centered design approach at its center, has expanded its context with technological innovations with the increasing number and frequency of use of digital products over the years and has become an important part of the digital product development process (Malik & Frimadani, 2022).

In addition to Donald Norman, another fundamental person in the origins of UI design was the co-founder of the IDEO design firm Bill Moggridge due to his strong ideas that emphasize the need for using industrial design principles in UI design (Moggridge, 2007). The industrial design profession provides valuable information, skillsets, and approaches to UI designers in terms of user-centered design, functionality, ergonomics, and aesthetics (Ruiz, Serral, & Snoeck, 2021). Therefore several principles of industrial design, considering user needs, human factors, and UX, have shaped the development of UI design.

Since industrial design has long been concerned with designing physical products that are aesthetic, functional, and user-centered (WDO, n.d.), and UI design focuses on developing intuitive and aesthetic digital interfaces to enhance user interactions with digital products (Malik & Frimadani, 2022), their relationship can be observed in their common principles and practices (Bødker, 2021; Morris, 2021).

Just as the industrial design profession feeds UI design with its principles and practices, UI design has extended the scope of the industrial design profession by introducing digital interactions into the design process (Ruiz, Serral, & Snoeck, 2021). The relationship between UI design and industrial design is prominently visible in the design and development of several products that combine physical and digital interactions, such as smartphones, tablets, and other smart devices (Neil, 2014).

Nowadays, UI design is one of the contemporary design fields in which industrial design graduates prefer to work (Süner-Pla-Cerdà et al., 2021). Since industrial designers acquire knowledge and skills in many design principles, attributions, and implementations (Kimball, 2013) for UI design in their undergraduate education, this helps them to become suitable UI designers in the market.

2.1.3.3 User Experience (UX) Design

As an umbrella term, UX is defined as the experiences of any user while interacting with a product, system, or service (Forlizzi & Battarbee, 2004). It contains the perceptions of users focusing on the usability, efficiency, emotional appeal, aesthetics, and effectiveness of products (Danış, 2023). Therefore, its core includes perspectives, knowledge, skills, and approaches from different fields, such as cognitive psychology and HCI. While UX draws inspiration from a variety of fields, the design discipline falls short of offering a cohesive theory and experience in this subject (Forlizzi & Battarbee, 2004; Law et al., 2009). UX design offers practical approaches to UX in the product development process in light of knowledge and competencies from other disciplines (Hartson & Pyla, 2018).

Similar to UI design, UX design also has its roots back to HCI and the need to develop user-friendly interfaces and products to create satisfying experiences (Hassenzahl & Tractinsky, 2006; Kou & Gray, 2019; Branch, Parker, & Evans, 2021). UX design focuses on the needs, behaviors, and preferences of various user groups toward products (Hartson & Pyla, 2018). The fields of cognitive psychology and HCI research also construct research on the user-product relationship at the center of UX design practices and form the basis of the knowledge, skills, and approaches that underpin the field of UX design (Morris, 2021).

Drawing from the fields of cognitive psychology and digital product usability, Donald Norman plays an essential role in the context of UX design, just as he does in the context of UI design. Donald Norman increased the visibility of UX in design research considering his work in cognitive science and emphasized the need to design products that are intuitive, functional, and aesthetically pleasing, leading to positive user experiences (Norman, 1988). As a result of the interdisciplinary nature of the UX design process, many professionals from different disciplines, such as design, psychology, communication, or engineering, who practice different aspects of user and usability in their professional lives become UX designers (Bačíková, 2015).

Among many other design disciplines, the relationship between industrial design and UX design is similar to its relationship with UI design. According to social, economic, environmental, and technological developments, both UX design and industrial design constantly interact and shape each other (Ruiz, Serral, & Snoeck, 2021). While industrial design provides valuable information regarding user-centered design, aesthetics, functionality, and the overall physicality of products to UX design and designers, at the same time, UX design and designers expand the scope of the industrial design profession by incorporating digital interactions and user-centered methodologies into the design process (King & Chang, 2016).

Especially in recent years, as digital products, systems, and services have become widespread, the boundaries between UX design and industrial design have become interconnected. Many industrial designers have extended their expertise to incorporate digital interfaces and interactions into their work (Süner-Pla-Cerdà et al., 2021), while UX designers increasingly consider the physical and digital aspects of products in their designs. Professional knowledge of industrial designers regarding principles and practices related to user-centered design shows their fundamental place in UX design. In light all the information about the various aspects of UX, its definition could be stated as the practice field that focuses and includes all user interactions with the given digital product, service, or system.

2.1.3.4 Service Design

As the last of the contemporary design fields, service design concerns the whole service experience, focusing on the design and improvements of the services in terms of quality, efficiency, and experience (Moritz, 2005; Holmlid, 2007; Stickdorn & Schneider, 2021). The origin of service design is constructed as a multidisciplinary approach to create solutions for developing and improving the existing services according to the ever-changing customer and user needs, expectations, and demands (Saco & Goncalves, 2008). Thus, service design began to attract interest and recognition from the industry in the 1990s with the influence of design thinking, user-centered design, and customer experience (CX) management (Kimbell, 2011). During that period, the emphasis on developing digital products shifted into developing holistic service experiences that consider all touchpoints and interactions throughout the customer journey (Moritz, 2005).

As a result, in the current digitalized world, by using many principles from the industrial design profession, service design acts as the digital product-related contemporary design field that focuses mainly on the process with an emphasis on the experience of the user or customer (Sangiorgi & Prendiville, 2017; Stickdorn & Schneider, 2021).

Just like interaction, UI, and UX design, service design has an interconnected relationship with industrial design. The emphasis on designing and enhancing products, systems, and services within the scope of the industrial design profession (WDO, n.d.) emphasizes the strong bond between industrial design and service design. By introducing user-centered design principles and methods to the field of service design, industrial design contributes to the context of this field in terms of ergonomics, usability, functionality, and aesthetics (Holmlid, 2007; Kimbell, 2011). While the industrial design profession provides these contributions to the service design field, service design provides the industrial design profession with knowledge and competencies about service ecosystems, including interactions, touchpoints, processes, and user journeys (Miettinen, 2016; Stickdorn & Schneider, 2021).

Nowadays, the multidisciplinary nature of service design, just like UX/UI design, attracts professionals from diverse backgrounds, including design, social sciences, technology, and engineering, who work on user and usability in different capacities (Sangiorgi, Lima, Patrício, Joly, & Favini, 2019). Among these professionals, industrial designers become suitable service designers through their user-centered design expertise. By combining the related design principles and practices from their undergraduate industrial design education with service-focused thinking, service designers work on creating user-centered service experiences. They use UX and digital product-related methods and models, such as user research, prototyping, and co-creation, to understand user needs, develop and visualize service processes, and iterate on service improvements (Miettinen, 2016; Sangiorgi et al., 2019).

As a result, service design has become a well-structured contemporary design field with an increasingly global market interest. It is acknowledged as a key tool for creating functional, meaningful, and engaging services, with its principles and methods used in a diverse range of industries, such as education, healthcare, and transportation (Saco & Goncalves, 2008).

2.1.4 Contemporary Product Design and Development Processes

The contemporary design fields heading of the literature review show how the definition and scope of the industrial design profession have been digitalized over the years. The extension and digitalization of the definition and scope of the profession have led to the digitalization of the product development process and its shaping through market practices. The contemporary design process and its stages mentioned in this heading basically focus on the digital product development process and its stages. In order to explain the evolution of the contemporary design process and its stages into contemporary by digitalization, the heading first briefly gives information about the product development process.

Just as there are various researcher definitions of the UX field in the literature, it is seen that there are many definitions of the product development process shaped by the approaches of different disciplines (Guérineau, Rivest, Bricogne, Durupt, & Eynard, 2018; Gerschütz, Spießl, Benjamin, & Wartzack, 2021) and especially by the differences in corporate culture in the market (Alves, Marques, Saur, & Marques, 2007).

According to Karadoğaner (2020), the product development process, entitled the design process, is the process of iteratively designing solutions to various problems identified based on specific design briefs through specific stages. Although the involvement of inter- or multidisciplinary teams shapes the process and stages by interpreting them with their approaches, this thesis evaluates the stages of the product development process through the approach of Wright (2002, p.113), as in the research of Karadoğaner (2020), consisting of seven stages; (1) problem identification, (2) information gathering, (3) creative solution searching, (4) ideation to preliminary design, including modeling, (5) evaluation and selection of solutions, (6) reports, plans, specifications planning, and (7) design implementation. While these seven stages are constructed with their methods and activities, to reach the desired solutions, stages could be shifted or implemented more than once (Wright, 2002).

Within the design discipline, the product development, or design process has experienced various updates with the increasing importance of digitalization and the contemporary design fields. This *contemporary* product development process, focusing on digital products, is a flexible and iterative approach that emphasizes collaboration, user-centricity, and continuous improvement (Canziba, 2018). It includes the latest design tools, methodologies, and technologies to create innovative and user-friendly digital products and services. The fact that technology is the focal point in the context of contemporary design fields brings specializations for digital products to the contemporary design process (Gerschütz et al., 2021). Since the collaboration of different disciplines makes digital products, many different fields bring different features and process approaches. Mainly, the stages of digital product development process of contemporary design fields comprise the entire process, from ideation to launch, with continuous improvements.

Nowadays, many design and consultancy firms (e.g., *northell, net solutions, EL Passion, uizard, uxstudio*) and their professionals have made their digital product development processes and stages available (Kerim, 2020; Illés & Funtek, 2021; Matviyuk, 2022; Singh, 2022; uizard, 2022). When the approaches of different firms to the digital product development process are examined, it is seen that they all have various common points. These process approaches are based on market-oriented practice, built on the design thinking methodology, and customized according to the scale and product-specific preferences of the firms. Matviyuk (2022) presents the findings of his study on the steps of the digital product development process on more than 150 cases within the scope of the *northell* firm (see Figure 2.5).

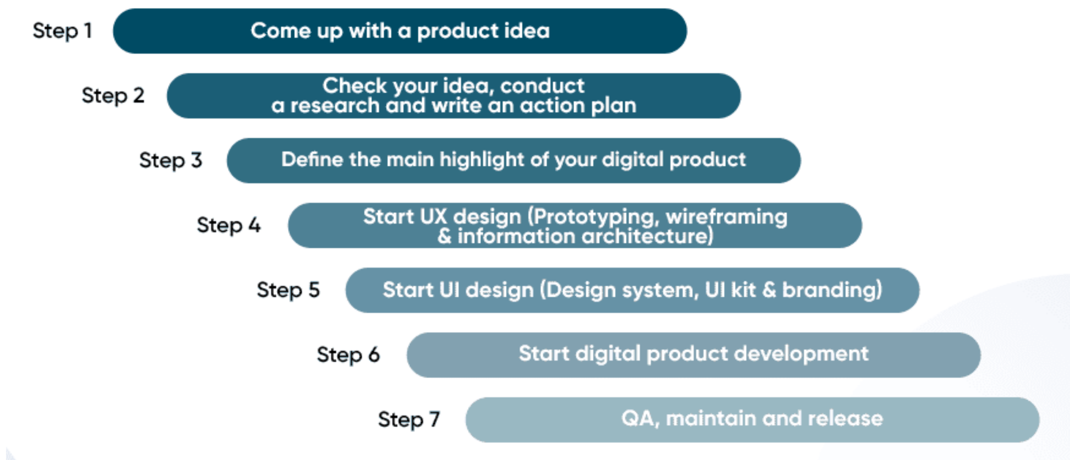

Figure 2.5: Seven Steps of Digital Product Development (Matviyuk, 2022)

Based on the study of Matviyuk (2022), within the scope of digital product development, the starting point for the product to be developed is first determined. Based on problem identification, creative idea is generated with teamworks at this stage. Then, the possible product decisions that are jointly decided are checked with various research. This research process provides detailed information about the position of the product in the market, market demands of the product, similar products in the market, and the expectations and needs of the user from the product (Canziba, 2018; Savarit, 2020). After reaching various conclusions about the product from the research, an action plan is designed, and the design and development process and the goal of the product are revealed. Then, the UX design phase of the digital product design and development process begins. This stage starts with creating basic sketches and wireframes, then creating an outline for the customer journey (Savarit, 2020). After the wireframe and information architecture (IA) stages, the clarified ideas start to be realized with low-fidelity prototypes. This process can evolve as a result of tests and validations and develops toward the final product. Based on the prototypes that reach a certain saturation, work on UI design begins (Malik & Frimadani, 2022). At this point, various design systems or UI kits are developed, and studies are carried out on digital product branding and visual components (Canziba, 2018). Following this stage, the designs of the digital products move on to the development stage. Conceptual designs and prototypes start to function with the work of software developers. The digital product design and development process in the market is launched after the functioning products are subjected to tests and the problems found as a result of these tests are solved. After the digital products are launched, they are followed up, tests continue, and product development and maintenance processes continue (Canziba, 2018; Savarit, 2020).

Based on many different definitions of the digital product development process and stages (Canziba, 2018; Kerim, 2020; Savarit, 2020; Illés & Funtek, 2021; Singh, 2022; uizard, 2022; Matviyuk, 2022), this thesis presents a general digital product development process with as follows:

Research

The research stage is considered as the discovery process for the digital product, system, or service that is planned to emerge as a result of the design process. This stage focuses on understanding market needs and wants, identifying user problems, needs, and wants, and deciding on business objectives. In this stage, market research is used to obtain information about similar products and market requirements (Canziba, 2018). With user research, qualitative, quantitative, or mixed-method approaches are used to obtain information about the product-user relationship through data collection methods such as interviews, surveys, observations, and data analysis (Mkpojiogu, Okeke-Uzodike, & Omopariola, 2022). In addition, this information helps identify pain points and opportunities (Savarit, 2020).

Ideation

During the ideation stage, insights regarding conceptual design, market requirements, and product-user interaction that are discovered in the research stage are used for generating possible design ideas (Canziba, 2018). Ideation could include focus groups or brainstorming activities formed by cross-functional teams consisting of certain stakeholders of the digital product development process. Since cross-functional teams are composed of professional stakeholders from different disciplines, they offer diverse ideas and perspectives on the product (Gothelf & Seiden, 2021). In the ideation stage, the conceptual ideas agreed upon through this teamwork and collaboration are prioritized based on the product strategy, potential impact on user experience, and business goals, and features, functionalities, and overall value are proposed for the product to be developed (De Roeck, Stappers, & Standaert, 2014).

Design

The design stage of digital product development can be divided into two parts; UX and UI design. With the conceptual ideas on the products, UX designers start creating basic sketches and wireframes on how users navigate the product. Later, in line with wireframes, IA and user flows are created to illustrate user scenarios, the layout of the product, and interaction points. With wireframe and IA, UX designers start to develop digital prototypes of the digital product (Illés & Funtek, 2021). The UX design stage focuses on ensuring an intuitive user experience. Building upon the UX design, UI designers work on creating design systems and UI kits to create visually appealing interfaces that align with the identity of the client and further develop the UX with technical attributions. UI designers define design systems focusing on color schemes, typography, and visual elements that enhance the aesthetics and usability of the product. The design stage shows the overall look and feel of the digital product (Malik & Frimadani, 2022).

Development

After the design stage, the digital product is taken into the development stage with software developers to be prototyped, coded, tested, and got feedback, and fix the problems. The development stage involves prototyping, coding, and/or programming to build the product. Collaboration between designers and developers is vital to ensure that the aesthetic design systems can precisely connect with the functionality of the product. Before its launch, the developed version of the product undergoes various tests to identify and fix any issues or bugs regarding its usability, functionality, compatibility, and performance (Kleinsmann & Ten Bhömer, 2020). Testing the product could be repeated until the product meets the defined criteria (Singh, 2022).

Launch and Beyond

When the product is ready to meet with users, it is deployed or published on various platforms. After the product is launched, its development continues with ongoing monitoring and improvement. This stage includes conducting tests, collecting user feedback, fixing problems, and adding new features to the product accordingly (Savarit, 2020).

2.2 Digital Product Development in Industrial Design Education

The second main heading of the literature review is based on industrial design education, just as the first heading of the literature review focuses on the industrial design profession. The heading explores how contemporary industrial design education has evolved and how digital product development has been incorporated into physical product design education. To do this, it first discusses the history of industrial design education and how it emerged from within the design discipline. Then, it is presented how different countries approached to industrial design education, and how were they formed and differentiated from each other as a result of various social, cultural, political, and economic issues. A brief history of relatively new industrial design education in Turkey, which is built on educational approaches abroad, adds a perspective from Turkey to the literature review. After providing information on how industrial design education was created in different geographies based on social, cultural, political, and economic issues, emergence of the traditional industrial design education is examined in depth.

Then, it is examined how traditional industrial design education has changed over the years with an emphasis on the emergence of information age and high technological developments. Lastly, in-depth information is provided about contemporary industrial design education, which is often defined on the basis of technological developments. This in-depth knowledge focuses on the digitalization of contemporary industrial design education and how it implements contemporary practices such as UX in its current context.

2.2.1 Industrial Design Education from Past to Present

This section of the literature review discusses industrial design education on a global scale. The section first presents the origins of industrial design education through Western examples from UK, Germany, France, Scandinavian countries, and US. How global social, political, and economic issues shaped industrial design education is examined at this stage. Later, the formation and development of Turkish industrial design education, which has a relatively younger history, is examined considering Western examples. Later, the section continues with the evolution of industrial design education over time with an emphasis on the digitalization starting from the traditional industrial design education. The section concludes with the integration of contemporary design fields and UX practices into industrial design education.

2.2.2 Introduction of Industrial Design Profession and Education

Early design education started in the apprentice tradition within the art and craft guilds. Later, schools of arts and/or crafts were founded, and finally, some of these schools were developed into schools of art and design (Friedman, 2002). With the impact of industrialism, economic transitions, and global developments in innovation and technology, new needs and demands came into view. Thus, the context of industrial design expanded, and industrial design education spread to universities.

The previous section explained with many examples that the design practice and creative industries have emerged from developed countries with a Western way of thinking. Industrial design initially emerged in developed countries according to their social, economic, and political agendas (Başar & Ülkebaş, 2011; Erkarslan, 2013). Since these issues affected industrial design itself, they played a pivotal role in how industrial design education differed among countries (Novoa, 2018). In the following section, the formation of Western industrial design education is presented.

2.2.2.1 Formation of Industrial Design Education in the West

According to Giard (1990), the conflicts between the Arts and Crafts Movement and the Industrial Revolution heavily formed the basis of the industrial design profession, and thus, its education. Most conventionally, emphasis on artistic and humanistic qualities of everyday life objects of the Arts and Crafts Movement and emphasis on the large number of mass-produced objects of the Industrial Revolution allied and developed each other in terms of industrial design. Impacts of the debates that were based on quality and quantity shaped the perception of industrial design heavily.

These debates on the practice of industrial design were also discussed over the education to be provided. Art, craft, apprenticeship, and guild-related features of the design discipline (Friedman, 2000) were combined with new production or manufacturing techniques, knowledge, and theories (Giard, 1990) in an academic field. While at first, industrial design education primarily consisted of exemplary arts programs that were presented with hands-on approaches, in time, developing technology and new social issues shaped industrial design education differently in different nations (Başar & Ülkebaş, 2011; Erkarslan, 2013; Clarson & Coleman, 2015). The following sections present industrial design education in the UK, France, Germany, Scandinavian countries, and the US (see Figure 2.6).

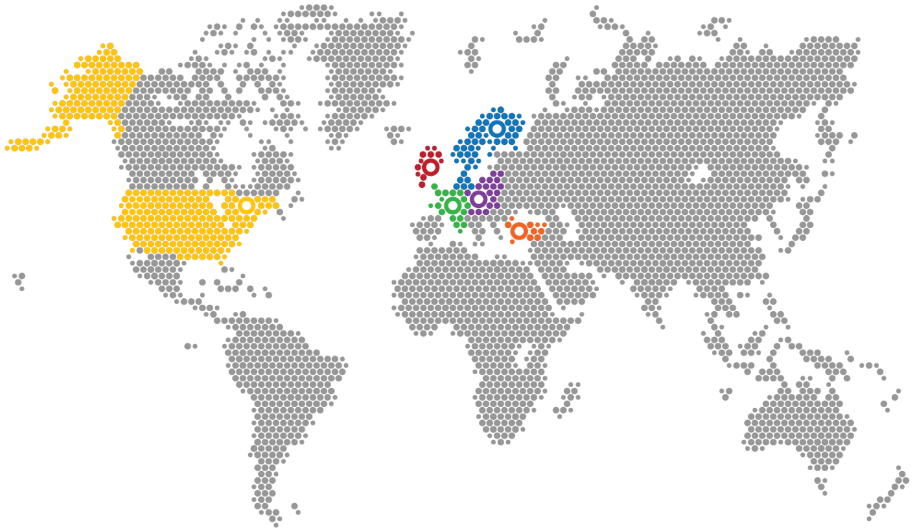

Figure 2.6: Industrial Design Education in the World

United Kingdom (UK)

Close relationship between industrial design with art, craft, apprenticeship, and guild tradition formed the focal point of industrial design education in Europe (Friedman, 2000; Friedman, 2002; Kolko, 2005; Başar & Ülkebaş, 2011). In time, apprenticeship was started to be applied in vocational training and art and design schools. Because of its well-established artisan guilds, its Arts and Crafts Movement, and its Industrial Revolution, perception of UK towards industrial design and industrial design education shaped the world (Emilson, 2014).

Industrial design education in the UK has its origins in 20th century industrialization and the capitalist economy (Quinn, 2011). This political and economic change enabled affordable goods with an ideology of improving living conditions of individuals and providing an equal world through mass production and modern design (Emilson, 2014). However, it also reduced diversity, individuality and rattled the traditional design approach (McCoy, 2006; Kelly, 2020). When this new development could not present a suitable design education strategy, the Government School of Design was established in 1837 (Quinn, 2011), which later on became the Royal College of Art (RCAa, n.d.) in 1896. It acted as a central design training school and art museum to extend knowledge on arts and principles of design among the nation with a distinct Arts and Crafts philosophy (RCAa, n.d.).

At first, the curriculum of art schools in the UK was mainly based on specific hands-on skills such as drawing, sculpturing, drafting, wood, and metalworking (Giard, 1990). Industrial design was not yet established as a discipline and was offered as a course under the rich craft tradition. In the following decades, with the global developments in modernization and industrialization, the core of education shifted from skills to knowledge (Giard, 1990). Because of the social and human rights movements, users and user needs became a focal point in designing (Zöller & Wartzack, 2017). Designing became as much as important as execution. That development led to the emergence of industrial design as a discipline. Over the years, industrial design education has broadened and well-sustained itself all across the UK.

France

Like the formation of industrial design discipline in the UK, in France, industrial design education was first formed under the fine arts and architecture disciplines. In 1648, École des Beaux-Arts was established as an art school concerning drawing, sculpture, painting, engraving, gem cutting, and architecture (Bonnet, 1996). The aim was to train young artists for decorating palaces by imitating classical arts. Later on, according to Green and Bonollo (2003), the Academie Royale d'Architecture, which was established in 1671, aimed to standardize French architecture education. The effects of industrialization spread across Europe, and French architecture education and its ideology were influenced heavily. As a result, to update and modernize education, École des Arts of Blondel was established in 1743.

All these art schools laid the foundation of French art and design education with the egalitarian, free-spirited notion of *école* and studio system (Carlhian, 1979). The formation of the studio system and the notion of école can be considered as the most crucial contribution of France to design education. This design education system separated design from guild organizations and master-apprentice relations, and a modern design education system started to emerge (Toprak & Hacıhasanoğlu, 2019).

French architecture education consisted of part-time design study and employment in the traditional atelier system (Green & Bonollo, 2003). New technologies, material, and production techniques from the Industrial Revolution presented new engineering-based theories and knowledge to education. The rise of modernity and mass production pointed out the essential features of industrial design and established industrial design as a discipline in France.

Germany

Bauhaus Design School (1919-1933) of Gropius can be considered as the core of German design education (Emilson, 2014; Novoa, 2018). Bauhaus Design School aimed to democratize industrialization by combining art and technology in the design studio settings. It initiated social change with design by discussing applying the master-apprentice relationship in design education (Novoa, 2018). In his Bauhaus Manifesto and Program, Gropius (1919) suggested that artists and designers should act as craftspeople or decorators and consider their social environment and history. He opposed to the traditional model since it developed passive students. Progressive design education model of Bauhaus offered a socially democratic environment and diverse study options for students using modern design language and mass production (Emilson, 2014). However, in 1933, Bauhaus school was closed under the pressure of the Nazi regime, having been considered as the center of communist intellectualism.

Today, Bauhaus Design School is widely considered as the start of formal design education. By presenting its social awareness and modernist approach, many schools such as the Ulm School of Design and the Hochschule für Gestaltung (HfG) were established using the curricula of Bauhaus Design School as guideline (Noel, 2020). All of the schools offered graphic design, industrial design, product design, and architecture education.

With the emergence of socialism, the amount of multidisciplinary education had increased, and schools added social sciences such as communication, sociology, psychology, and writing into their curricula. The German design education system and schools have added social issues to the arts, crafts, and craftspeopleship aspects of industrial design. In that sense, they contributed to the early phase of modern design and design democratization (Betts, 2007). Besides, they offered formal education with the university system and combined art with research to create modern industrial design education (Betts, 2007; Noel, 2020). Today, much world-renowned industrial design education has been established under the influence of teachers and ideologies from the Bauhaus school.

Scandinavian Countries

Compared to the European countries, in terms of design education, Scandinavian countries have a more contemporary perspective. While traditional Eurocentric design education mainly focuses on the product and designer, the focus of Scandinavian design education is slightly different. The emergence of contemporary Scandinavian design and the arrival of participatory design and co-design approaches are presented a more democratic environment for design practice and therefore its design education. Participatory design and co-design approaches have constantly been developing by influencing each other over the years (Sanders & Stappers, 2008). Both have strong connections with HCI and social movements. It was originated from the 1960s Scandinavian Industrial Democracy projects (Asaro, 2000) with the ideology of workplace democracy (Szebeko & Tan, 2010). This ideology was rooted from the reactions of Scandinavian trade unions and shop-floor workers to being neglected from the decision-making process because of the emergence of the IT systems (Gregory, 2003; Gioia, 2015). This issue led to the Scandinavian Participatory Design Movement, which was initially about increasing the involvement of users in the decision-making process (Beck, 2002).

The foundation of contemporary Scandinavian design, and therefore its design education, is established with an emphasis on user participation and designer skills on computer-based systems (Ehn, 1992; Asaro, 2000; Heylighen, Van der Linden, & Van Steenwinkel, 2017). In the late 1960s and early 1970s, with the radical political, social, and economic issues, the design and design education contexts changed inevitably. The hands-on approach in design in which the final product was considered as the output of design contradicted the modern design research and methods. By considering the book *Design for the Real World* by Victor Papanek (1971) as a guideline, Scandinavian designers and design students who were dissatisfied with Western design practice and education formed a new social and democratic design approach (Clarke, 2013). According to Lie (2016), Papanek stated the urgent need for interdisciplinary education that presents different perspectives in the design process. His seminars included themes such as education, disability, and challenges in developing countries. Since the development in Scandinavian design and design education primarily focused on the design process, inclusivity, and social issues (Bendixen & Benktzon, 2013), instead of mainly mentioning industrial design education, this section considered the formation and development of Scandinavian design education.

United States (US)

The emergence of the industrial design profession and education in industrialized, modern European countries has affected overseas countries. The early design activities in the US were established within arts and craft practices and guild tradition (Friedman, 1997). With the Industrial Revolution, this design activity evolved into a design profession in the 20th century. This evolution created types of developments in industrial design education as well (Başar & Ülkebaş, 2011). While the apprenticeship traditions continued within the art and design education slightly longer in Europe, in the US because of the economic transition from industrial to post-industrial economy, industrial design education moved into the universities during the first half of the century (Friedman, 2000). According to Friedman (2002), this shift in the economy created new needs for information and knowledge. Industrial design education shifted from being a part of art education to be a part of the science and research within the colleges of architecture and engineering.

Since the Bauhaus School was closed in 1933 in a Nazi regime, its prestigious academics were spread to the world, including the US. With the addition of the economic shifts and contemporary design approaches, as a result, the first formal industrial design education in US started in 1935 at Carnegie Technical College (renamed Carnegie Mellon University). Pratt Institute of Art in New York followed Carnegie Mellon University and started industrial design education. By offering university-level industrial design education, the US developed arts and crafts interactions within design education. It presented interactional models within industrial design by combining theory and practice through sponsorships for research (Toprak & Hacıhasanoğlu, 2019). According to Friedman (2000), the visibility of the industrial design profession in the US universities sustained the importance and position in the global market of the profession. Today, the industrial design education model of the US has a substantial impact on shaping the global approaches of industrial design.

2.2.2.2 Brief History of Industrial Design and Education in Turkey

In periphery countries, industrial design emerged in the academy rather than the professional practice (Tezel, 2011). The establishment of industrial design and its education in Turkey is traced back to the 1950s when Turkey had close social and political relations with the US because of the conflicts with the Soviet Union. Under the protection of US, critical developments have occurred from implementing *the Truman Doctrine* and *the Marshall Plan* to admission of Turkey to North Atlantic Treaty Organization (NATO) (Hasdoğan, Korkut, & Börekçi, 2021). These issues increased military and economic relations with the US. Under US protection, Turkey was involved in the International Cooperative Association (ICA), which aimed to improve local products and their market potential (Er, Korkut, & Er, 2003). This involvement made the Turkish local design scene more open to the US. Consequently, the Ministry of Education surveyed foreign, mainly German, schools of design, and proposed a similar design school model in Turkey during the 1950s (Doğu, Öğüt, & Er, 2015).

According to Celbiş (2006), by considering needs of the period and the Turkish state, in 1957, the State School of Applied Fine Arts (Devlet Tatbiki Güzel Sanatlar Yüksek Okulu, DTGSYO) (according to Başar & Ülkebaş, 2011; later named Marmara University) was established in Istanbul. Its first faculty members were either German or Turkish, and the school introduced the famous basic design education of Bauhaus (Şatır, 2006; Hasdoğan, Korkut, & Börekçi, 2021). German academics taught for training experts in fine arts categories such as painting, graphic arts, textile, ceramics, and furniture-interior design (Başar & Ülkebaş, 2011).

According to Er, Korkut, and Er (2003), in Ankara, with the aid of the United Nations Technical Assistance Administration (UNTAA), Middle East Technical University (METU) was established with US academics. During the 1960s, because of the critical social issues and problematic political setting in Turkey, the development of industrial design education was slowed down (Er, Korkut, & Er, 2003; Doğu, Öğüt, & Er, 2015). In 1969, industrial design education in METU was commenced by the appointment of Prof. David K. Munro as elective courses under the department of architecture (Hasdoğan, Korkut, & Börekçi, 2021). During the 1970s, Turkey was placed among the newly industrialized countries (Doğu, Öğüt, & Er, 2015), and industrial design education developed further. In 1971, School of Applied Industrial Arts (Uygulamalı Endüstri Sanatları Yüksek Okulu, UESYO) under State Academy of Fine Arts (Devlet Güzel Sanatlar Akademisi, DGSA, and later named Mimar Sinan Fine Arts University) was founded, and industrial design program was established under its interior design department (Küçükerman, 2011).

In 1979, the industrial design department was founded in the faculty of architecture at METU (Er, Korkut, & Er, 2001). During the 1980s, Istanbul Technical University (ITU) started preparations for establishing its industrial design department, and in 1989, ITU opened its industrial design department (Doğu, Öğüt, & Er, 2015).

Gained recognition of industrial design profession led to high number of industrial design graduates in Turkey (Ilhan & Er, 2016). However, this increase in the number of industrial designers caused an imbalance in supply and demand equilibrium.

Additionally, because of the uncertain limits of the profession, industrial designers cannot actively take roles in the industry (Yıldırım, 2019).

Professional industrial design organizations such as Industrial Designers Society of Turkey (Endüstriyel Tasarımcılar Meslek Kuruluşu, ETMK) (Hasdoğan, Korkut, & Börekçi, 2021), and Industrial Designers Association (Endüstriyel Tasarımcılar Derneği, ENTA) in Turkey aim to define the profession, roles of its stakeholders, and work for better working environments, as well as sustaining intellectual property rights and professional chamber for a democratic industrial design profession in Turkey (Korkut & Hasdoğan, 1998; Hasdoğan, 2009; Hasdoğan, Korkut, & Börekçi, 2021).

Over the years, with the emergence of contemporary design fields, the number of industrial design departments in Turkey has increased considerably. This increase led to the establishment of new industrial design departments. According to YÖK (2022), as of 2022, there are 32 undergraduate programs of industrial design in Turkey accepting students (see Figure 2.7). Most of these departments are located under (1) "faculty of architecture, (2) architecture and design, (3) fine arts, (4) fine arts and design, (5) art and design, (6) art, design, and architecture, (7) engineering and architecture, and (8) school of applied sciences" (YÖK. 2022).

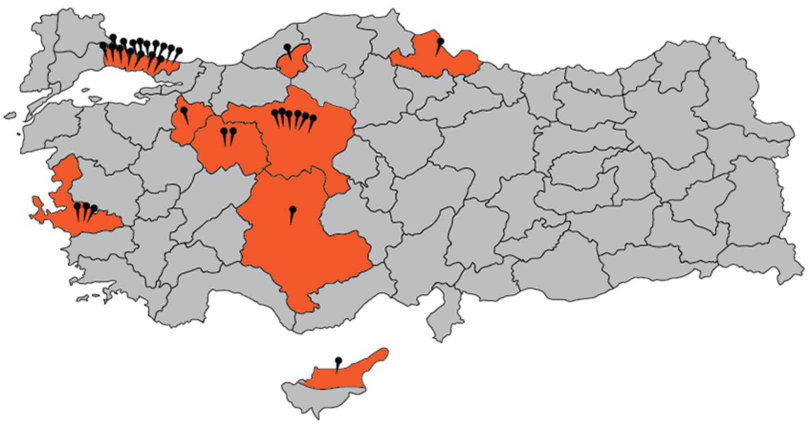

Figure 2.7: Industrial Design Departments per Cities in Turkey in 2022

While the quality and eligibility of the education remain in question, the context and the dominant approach of design education differ among departments and their founding members (Doğu, Öğüt, & Er, 2015). Graduates from the well-established, and traditional industrial design departments in Turkey, started to participate in the new industrial design departments. Combining their knowledge from industrial design education and their academic and professional experiences leads to new contemporary Turkish industrial design education approaches.

2.2.3 Evolution of Industrial Design Education over Time

Traditional industrial design practice and education that emerged with the understanding of modern society and the Industrial Revolution, as Kolko (2005) states, are based on arts and crafts and are defined as complex problem-solving and business planning activities. While the early version of the profession mainly dealt with essential aesthetics and forms, in time, it embraced business development and user-centered design, and finally, in the modern world, strategic planning, innovative product development, and interdisciplinary collaboration became parts of it (Kolko, 2005; Carey, 2020). The following three sections cover (1) traditional industrial design education, (2) changes in the traditional industrial design education, and (3) contemporary approaches in industrial design education.

2.2.3.1 Traditional Industrial Design Education

With the Industrial Revolution, industrial designers started to work for user needs and satisfaction by developing products that save time, create empathy, and increased a particular aspect of well-being (Kolko, 2005). Because of the needs of the society of that period, industrial design education mainly proposed studies regarding weight, structure, form, shape, and material with a guild and apprenticeship model (Overbeeke & Hummels, 2014). This traditional education model embraced the Bauhaus curriculum that primarily focused on craft training and aimed to educate and transform artists, painters, and sculptors into master craftspeople (Gropius, 1962).

Early modern features and studio systems of the design education ideology of Bauhaus formed the basis of industrial design education worldwide. Well-known American design education establishments such as the Rhode Island School of Design, Pratt Institute, and the Savannah College of Art and Design adapted this education model. In the road to contemporary industrial design education, an influential framework was *Elements of Design* by Rowena Reed Kostellow that introduced and focused on the critical relationship between industrial design education and basic design elements such as lines, planes, volumes, values, textures, and colors (Viemeister, 2002). Her design philosophy, theory, and program are still used and widely appreciated.

2.2.3.2 Changes in Industrial Design Education

In time, the traditional industrial design education needed to change following the progress in the profession. Developments in the new manufacturing techniques, materials, and technologies led to faster production. The design skills that traditional industrial design education provided were challenged. The high value given to the handcrafts, craftspeople, and artisans was shifted to cheap and fast manufacturing and designs (Kolko, 2005).

With the emergence of the information age and political and cultural changes, the practice of industrial design developed critically (Clarkson & Coleman, 2015). Approaches such as universal design, inclusive design, and design for all called for further discussions on the roles of designers and the involvement of users in project development. While traditional industrial design primarily focuses on developing small appliances suitable for mass-produced, new approaches put the user at the center and applied technologies for presenting solutions to wicked problems (Kolko, 2005). That wickedness of the design problems demanded new skills and approaches that could enhance industrial design education further.

2.2.3.3 Contemporary Industrial Design Education

Today, digital interactions cover a large portion of industrial design with UX and UI implementation. This development creates an emphasis shift from physical to digital artifacts (Oygür Ilhan, & Karapars, 2019). Many recent industrial design graduates prefer to work as interaction, UI, UX, and/or service designers (Kiernan & Ledwith, 2014; Süner-Pla-Cerdà et al., 2021). This professional preference leads to an extension of industrial design education by including contemporary praxes such as experience, interaction, and service design into the curriculum. In that sense, while industrial design education proposes a more socially aware model (Ramirez, 2011), it enables new experiences by designing digital products and interfaces (Kolko, 2011). The application of design tools into the industrial design curriculum is achieved by integrating modern maker culture through FabLabs, where students participate in interdisciplinary project development environments (Haldrup, Hobye, & Padfield, 2017).

2.2.3.3.1 Digitalization of Industrial Design Education

The digitalization of industrial design education has been a progressive process that has gained momentum with the help of high technological developments, just like the digitalization of industrial design profession. Over the years, the introduction of personal computers, smart technologies, and digital tools into the design process (Brown & Cooper, 1999) has largely shaped how industrial designers work (Qi, Xiongkai, & Hua, 2010). This development in the context of industrial design profession also shaped the context of industrial design education (Kolko, 2005; Carey, 2020).

In the past, industrial design education mainly focused on the design and development of physical products such as furniture and glassware. In that context, industrial design students mostly essentially used hands-on creativity-based design methods such as sketching, modelling, and physical prototyping in their projects

(Van Dooren, Boshuizen, Van Merriënboer, Asselbergs, & Van Dorst, 2014). These methods formed the core of the industrial design education. In these design activities, industrial design students acted as the sole creators of their projects (Valtonen, 2005), and encountered challenges related to time and budget (Lin & Chen, 2013). However, especially after 1970s and 1980s, with the introduction of personal computers, CAD (Cantamessa et al., 2020), HMI (Kang & Seong, 2001), and HCI (Fallman, 2003), industrial design education and profession started to be computerized, therefore digitalized, and added designing digital interactions, and products to their contexts (Wang, 2022).

The inclusion of digital interaction and digital products in industrial design education has led to an increase in the use of digital tools by industrial design students such as digital prototyping (Demirci & Hatunoğlu, 2021). Using digital prototypes allows industrial design students to test the ergonomics, functionality, and feasibility of their design projects in a digital environment (Bernardo & Duarte, 2022). In this way, industrial design students have started to avoid budget and time related limitations by making faster iterations through digital mediums in the design processes within the scope of their education (Oygür Ilhan & Karapars, 2019).

The widespread use of digital interaction and products in industrial design education has expanded design processes of students in a social context as well as a technical one. The traditional approach of the designer as the sole creator (Valtonen, 2005) in industrial design has increased the collaboration and co-creation activities of designers, especially with computer-related disciplines (e.g., computer science, IT, engineering) with increased digitalization (Dean & Loy, 2020; Lane & Tegtmeyer, 2020). In this way, it has broadened the perspectives of industrial designers on design by providing them with different methods, tools, and approaches as well as perceptions, values, and meanings. However, this has brought about the need to increase interaction with technological fields and disciplines through digitalization in industrial design education (Lane & Tegtmeyer, 2020). According to Dean and Loy (2020), this need for communication has been facilitated by the widespread use of digital platforms. Specifically, cloud-based collaboration platforms, such as *Miro*, enabling industrial design students to co-create projects at the same time from different locations, which allows harmonious content sharing and control of designs, facilitates healthier teamwork, and communication among students (Barrie, 2016).

The digitalization of industrial design education also developed the way students are taught. While in the past, students were mainly taught how to use traditional design tools, with the emergence of digital technologies, students are started to be taught how to use digital design tools for industrial design. Computer softwares, that cover three-dimentional modelling, CAD, two- and three-dimensional graphic visualization, and digital prototyping, are among the digital design tools that contemporary industrial design education covers (Aldoy & Andrew Evans, 2021). All over the World, many industrial design departments introduce students to the process of digital design and development through their higher education programs and prepare them for digitalized design practices in their professional lives (Oygür Ilhan & Karapars, 2019).

For instance in the US, Media Lab of Massachusetts Institute of Technology (MIT) (MIT, n.d.), and school of industrial design at Georgia Institute of Technology (GT, n.d.), are currently offering students courses and research options focusing on digital product design and development. Similarly, in the UK, design products department of RCA provides various digital product development research projects (RCAb, n.d.). In Netherlands, industrial design and industrial design engineering departments of Eindhoven University of Technology (TU/e, n.d.) and Delft University of Technology (TUDelft, n.d.) are offering undergraduate and graduate level digital product design and development programs, courses, and research labs.

Moreover, in Turkey, industrial design departments of METU (METUa, n.d.; METUb, n.d.), ITU (ITU, n.d.), Özyeğin University (Özyeğin, n.d.), and Kadir Has University (KHAS, n.d.) are acting as well-known establishments that include digital product design and development related must and elective courses, undergraduate, graduate, and certificate programs, and research laboratories and groups into their structures. These national and international programs have been shaped according to the digital design tools currently used as of the summer semester of 2023, and the current digital approach within the scope of industrial design education. The fact that digital fields and disciplines are in a constant development cycle shows that industrial design education will continue and develop in the coming years. As digital design tools continue to develop, they would eventually become even more impactful and thus, would lead and guide future industrial designers to create more innovative digital designs.

2.2.3.3.2 UX Practices in Industrial Design Education

Nowadays, the contemporary industrial design profession and education is constantly updating and expanding its context in the light of various social, cultural, technological, economic, economic, and environmental factors (see Section 2.1.2.1). The digital interactions and experiences of users with products have an important place in the industrial design profession and education, which has been digitalized to a certain extent with technological developments. UX practices focus on the digital interactions between the user and the product, the functionality and usability of digital products, and works to provide better experiences for the users of the products designed and developed (Branch, Parker, & Evans, 2021). UX practices (Hassenzahl & Tractinsky, 2006; Kou & Gray, 2019), which have their origins in the early HCI studies conducted decades ago, have led to studies on the functionality and usability of white goods products with simple interfaces and basic programs over the years (Karapars, 2004; Paris, 2016), then expanded its context and details with personal computers, small kitchen appliances, and smartphones (Qian, Visser, & Chen, 2011; Karapars, 2013), and most recently are discussed within the studies on mobile interfaces, online platforms, services, and applications (Feng & Wei, 2019; Lim & Soetantio, 2019). While the interaction design channel at the origin of UX brings aspects such as usability, performance, and efficiency to UX design (Branch, Parker, & Evans, 2021), the cognitive psychology channel adds aspects such as emotions and satisfaction (Morris, 2021). In this way, UX design brings knowledge, skills, and competencies from different disciplines in the product development process to set up people to have functional and fulfilling experiences with digital technology (Hartson & Pyla, 2018). The fact that UX was constructed with knowledge and practices from multiple disciplines decades ago and its continuous development shows that it does not have a coherent disciplinary definition and knowledge (Kou & Gray, 2019; Branch, Parker, & Evans, 2021).

Since the industrial design profession and education offers a product design and development process close to the context and activities of UX practices, many courses and programs for UX are included in industrial design education (Meyer & Norman, 2020). UX practices have attracted the attention of the industry especially in recent years and its place in the market as a profession group is gradually increasing (Getto & Beecher, 2016; White & Kapakos, 2017; Oygür Ilhan & Karapars, 2019). The lack of a stereotypical definition of UX or a fixed path on how to become a UX professional, and interest of the industry in UX professionals has attracted the interest of academia and has been the subject of various studies (Getto & Beecher, 2016; Yargın, Süner, & Günay, 2018; Branch, Parker, & Evans, 2021; Morris, 2021) (see Table 2.1).

Table 2.1: Research Studies on UX Pedagogy and Implementation in Education

Researcher(s)	Research Area	Research Focus
Getto & Beecher (2016)	UX Pedagogy	Academic UX Programs
Yargın, Süner, & Günay (2018)	UX Research Methodolgy	Graduate Level Course
Branch, Parker, & Evans (2021)	UX Degrees and Job Analysis	UX and UX-related Programs/Courses
Morris (2021)	UX Design	Multidisciplinary UX Minor
Getto, Potts, Salvo, & Gossett (2013)	Values and Approaches UX Programs	Experience Report on UX Programs
Gray, Parsons, Toombs, Rasche, & Vorvoreanu (2020)	Developing Course Sequence	Undergraduate UX Education

Aldoy & Evans (2011)	Conventional and Digital Design Modelling Tools	Undergraduate UX Education
Yargın, Günay, & Süner-Pla-Cerdà (2019)	UX Careers in Turkey	Undergraduate UX Education
Temor, Husain, & Coppin (2022)	Tools and Pedagogies for UX	Undergraduate Industrial Design Education
Bačíková (2015)	Difference between Knowledge and Practice in UX	UX-related Subject
Süner-Pla-Cerdà, Günay, Töre Yargın, & Ural (2021)	Careers in UX	Senior Industrial Design Students
Kang & Girouard (2022)	Impact of UX Interships	HCI Graduate Programs

Table 2.1 (continued)

Within the scope of current industrial design education, it is seen that various academic studies have been conducted to train UX professionals. These academic studies focus on researching, teaching, and implementing different aspects of UX practices at undergraduate, graduate, or certificate level, especially in digital products (Aldoy & Evans, 2011; Getto & Beecher, 2016; Yargın, Günay, & Süner-Pla-Cerdà, 2019; Morris, 2021; Temor, Husain, & Coppin, 2022). According to Branch, Parker, and Evans (2021), the holistic nature of UX requires a cross-disciplinary approach, which poses challenges for incorporating UX practices into design curricula. The fact that UX practices include tools, methods, and theories for different disciplines creates excessive knowledge content for the courses on these practices, making it difficult for UX designers to define the boundaries of the knowledge they acquire through lectures (Kou & Gray, 2019). This situation shows that courses for UX practices should be based on industry practices and students should learn through experience (Morris, 2021). When undergraduate and graduate level education dynamics for UX are examined, it is seen that university-industry collaboration and extracurricular activities have an important place in education (Getto, Potts, Salvo, & Gossett, 2013; Yargın, Süner, & Günay, 2018).

In the UX implementations within industrial design education, university-industry collaboration focuses on the experiences of students on the tools and skills used in UX practices in the market in addition to the academic perspective (Gray, Parsons, Toombs, Rasche, & Vorvoreanu, 2020; Meyer & Norman, 2020). University-industry collaboration is an approach applied in design studio courses in undergraduate industrial design education in different countries as it shows students how design problems are solved in the real-world UX process (Qian, Visser, & Chen, 2011; Yargın, Süner, & Günay, 2018; Börekçi, Hasdoğan, & Korkut, 2021). In undergraduate industrial design education, apart from design studio courses, must and elective courses in visual communication, ergonomics, or HCI also provide students with theoretical and practical knowledge on specific aspects of UX practice (Bačíková, 2015; Getto & Beecher, 2016; Süner-Pla-Cerdà et al., 2021). In addition to undergraduate industrial design education, graduate industrial design education offers courses specifically focused on UX research (Gray et al., 2020; Süner-Pla-Cerdà et al., 2021).

Nowadays, apart from undergraduate and graduate level courses and programs for UX practices within the scope of industrial design education, certain educational institutions (e.g., Arizona State University, Kingston University, Michigan State University) include professional graduate programs entirely for UX practices (ASU, n.d.; Kingston, n.d.; MSU, n.d.). These programs are generally based on practical knowledge and activities that train UX professionals according to market expectations. Similarly, in Turkey, Kadir Has University trains UX professionals with its user experience graduate program MIX (MIX, n.d.). In addition to UX implementations in academic environments, UX-centered online courses, certificate programs, internships, and camps in the market offer practice-based education to individuals who want to become UX professionals, including industrial design students (Flanagan & Getto, 2021; Kang & Girouard, 2022). Individuals who gain experience in UX implementation by participating in these extracurricular activities start working as UX professionals in the market with the theoretical and practical knowledge they receive (Yargın, Süner, & Günay, 2018). Due to the highly current and constantly developing structure of UX practices, many UX professionals gain competencies in the market in a self-taught manner (Getto et al., 2013).

2.3 UX Practice Methodology

The last main heading of the literature review explores the existing methodological aspects of UX practices, starting from UX involvement and implementations in the contemporary industrial design profession and education. To do so, the background and key principles of UX methodology are illustrated first. Based on the key principles of UX practices, prominent approaches and models for UX methodology are then presented. Within these models and approaches, some aspects come from the design discipline and aspects from the market or other disciplines. The definition, purpose, and processes of models and approaches such as agile methodology or design thinking, which have essential places within the scope of UX professions in the market, are explained at this stage. Heading then presents information about the most used essential methods within UX practices. These methods provide in-depth information about data collection and data analysis in the research, design, and development phases of the UX process. Finally, the heading provides information about collaboration within UX practices. This section provides information about interdisciplinary stakeholder engagement, cross-functional teamwork, and collaboration in the UX process, drawing from the literature.

2.3.1 Background and Key Principles of the UX Methodology

As mentioned earlier in Sections 2.1.3.3 and 2.2.3.3.2, UX can be summarized as the overall experience of a user when interacting with a digital product, system, or service (Farrell & Nielsen, 2014). It focuses on improving the functionality, usability, efficiency, and effectiveness of these products, systems, or services in line with the needs, emotional responses, preferences, and capabilities of the users (Norman, 1988, 2013). In UX projects, various stakeholders, including designers, developers, product managers, and marketers, work together according to their variety of skills and expertise in a cross-functional environment (Adams, Mann, Jordan, & Daly, 2022). A successful UX implementation would make the designed product, system, or service straightforward, user-friendly, and pleasurable, while a product, system, or service with a weak or absent UX implementation would lead to issues in understanding and interacting with the designs (Krug, 2013). To have a successful UX implementation, stakeholders should follow several key principles of the UX methodology in their user-centered design and development processes, as follows:

- The principle of *user-centered design* points out putting the user at the center of the design process and its activities (Keinonen, 2010). According to Lowdermilk (2013), user-centered design has roots in HCI and software design fields and emerged for developers and designers. Fundamentally, user-centered design is used for making digital products, systems, and services to meet user needs. Understanding user needs, preferences, and pain points is crucial to creating products that fulfill user expectations and present pleasurable usability scenarios and experiences (Norman 1988, 2013).
- *Empathy* is another critical principle in the UX methodology (Norman, 1988). To create a user-centered design process, stakeholders should be ableo empathize with user ando gain insights into their emotions and motivations, leading to UX projects are constructed with users (Wright & McCarthy, 2008). By empathizing with the users and gaining insights regarding the emotions of the users, stakeholders would focus on another vital principle of UX methodology, *emotional design*. With emotional design, UX projects improve aesthetics and visual design to evoke positive emotions among users, thus, making the user experience more engaging (Norman, 2013).
- Various research studies suggest that *flexibility* (Li & Nielsen, 2019) and *accessibility* are considered vital aspects of the UX methodology. According to Li and Nielsen (2019), flexibility in design ability to offer options for various user preferences and expertise to the process which leads to a more

inclusive, democratic, and user-centered experience. In addition to flexibility, accessibility is another vital principle in the UX methodology. Designing with a focus on the accessibility of the product should be considered to reach out to every possible user through digital channels (Savarit, 2020). Nowadays, with the emergence of an open-source environment, digital products, systems, and services should be accessible to increase the life quality of the users and to present various options for sustainable futures.

- With vital considerations of the concept of *usability*, stakeholders are able to design products by focusing on usability issues and user-friendliness. This consideration concludes by allowing users to accomplish tasks effortlessly while using the products (Krug, 2013). In terms of usability, another principle that comes front in the UX methodology is *simplicity*, which enhances the usability of the product, system, or services by facilitating the interaction and developing a better understanding of the product (Krug, 2013). The simplicity principle in the UX methodology is strongly connected with the principle of *consistency* (Li, Zhou, Luo, & Dong, 2022). The importance of consistency in design is based on its role in sustaining visual and interaction coherence throughout the product, system, or service (Saarijärvi, 2017). Presenting users with a particular sense of connection makes it easier for them to use the design.
- Interpersonal relations and social engagements among stakeholders include key principles of the UX methodology. Due to its multidisciplinary nature, successful UX practices require *effective collaboration* (Jones & Thoma, 2019; Adams et al., 2022). In UX practices, according to Gothelf and Seiden (2021), the foundation of an effective product development process is formed with collaboration among cross-functional teams. Collaboration provides that different perspectives are combined to create holistic experiences in UX practices. In these collaborations, stakeholders learn from each other and constantly follow the current UX practices trends (Jones & Thoma, 2019).

To keep up with the continuous evolution of the design approach, stakeholders should adopt the principle of *continuous learning.*

Over the years, as technology evolved and user expectations grew and differed, the UX methodology expanded to include a more holistic approach, and UX professionals follow a systematic process that involves research, prototyping, testing, and iteration to create user-centered solutions that are intuitive, efficient, and enjoyable to use (see Section 2.1.4). The UX methodology continues to develop, covering new technologies and methodologies to emulate the continuously-changing context of user needs and technological innovations.

2.3.2 Prominent Approaches in the UX Methodology

This section of the literature review, starting from the definition, background information, and several key principles of the UX methodology mentioned in the previous section, reveals the prominent models and approaches used in the construction of UX practices. The discipline and perspective inform these design models and approaches and the interdisciplinary nature of UX practices. This heading discusses; (1) user-centered design, (2) design thinking, and (3) Agile development as the most prominent approaches in the UX methodology.

2.3.2.1 User-Centered Design

The user-centered design approach has its roots in HCI and industrial design disciplines, and its focus on users and user needs makes it an essential part of the UX methodology. User-centered design materialized decades ago with the focus of the HCI discipline on user needs and preferences in the study of usability in computer interfaces (Abras, Maloney-Krichmar, & Preece, 2004). As a pioneering figure in user-centered design, Donald Norman suggested that designers should understand the cognitive processes users go through when interacting with a product, system, or service to create a good UX (Norman, 1988). To do so, users should be involved in the design process to improve the usability and effectiveness of the products, systems, and services (Norman & Draper, 1986).

Today, user-centered design is an essential approach in UX methodology that acts as an iterative design process in that designers consider and refer to the user needs in every stage of the design process. In UX practices, design teams involve users multiple times during the design process by conducting various research and design methods (e.g., surveys, interviews, brainstorming, and usability testing) (IxDFb, n.d.). In addition to the involvement of users in the iterative design and development process of user-centered design, the process also includes experts of multidisciplinary teams with diverse perspectives, knowledge, skills, and expertise (Abras, Maloney-Krichmar, & Preece, 2004). While there are many variations of the user-centered design process, the most common process has four main phases; (1) specify the context of use, (2) specify requirements, (3) produce design solutions, and (4) evaluate designs (see Figure 2.8).

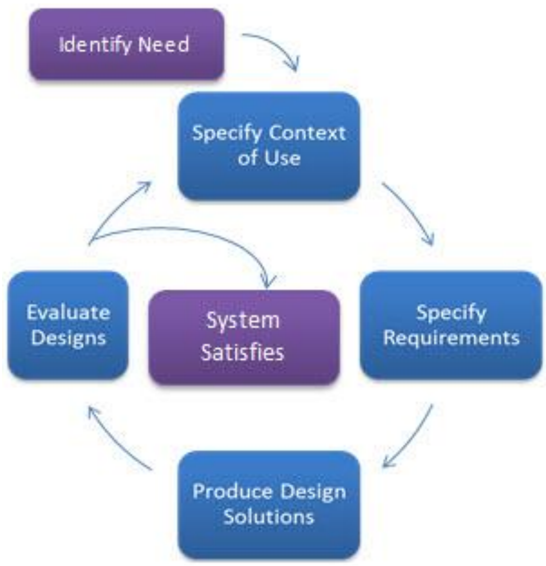

Figure 2.8: User-Centered Design Process (usability.gov, n.d.)

The iterative process of user-centered design starts with designers working as a team, specifying the context of use (usability.gov, n.d.). They focus on understanding the context users may use (IxDFb, n.d.). In the second phase specifying requirements, teams work on identifying and specifying user and business requirements that should be met to develop a successful product, system, or service. The third phase of the process contains design activities in which design solutions are developed. According to usability.gov (n.d.), the design phase might be conducted in more miniature stages depending on the project formed from a draft concept to a complete design. The fourth phase focuses on evaluating the outputs from the design phase in line with the user needs and requirements. Depending on how well-designed the product matches the relevant needs and requirements, the process could go further iterations of the four phases until the desired results are obtained (IxDFb, n.d.).

Based on the definition, context, and process of the user-centered design approach, it is seen that its use within the UX methodology has benefits such as (1) increasing user satisfaction, (2) improving the usability of products, systems, and services, (3) reducing costs by preventing redesigns, and (4) increasing market share by making designs more competitive (Canziba, 2018).

2.3.2.2 Design Thinking

In the UX methodology, like the the user-centered design approach, design thinking is vital. In a broad sense, the Nielsen Norman Group (NN/g) defines it as a direct, user-centric, creative problem-solving approach that leads to various competitive innovations (Gibbons, 2016). In its non-linear and iterative process, design teams try to understand users and their needs, investigate and identify their requirements, specify problems, and in light of this information, develop novel design solutions to prototype and test (Brown, 2008). Cross-functional collaboration, which includes designers, developers, product managers, and other stakeholders, is a fundamental part of the design thinking approach (Awomolo, Jabbariarfaei, Singh, & Akın, 2017). In UX, this collaborative approach ensures that diverse perspectives are considered, leading to holistic and well-rounded designs. According to Dam and Siang (2022), the design thinking approach focuses on understanding the users, helps to develop empathy, enhances the ability to question, guides to solving ill-defined problems, and provides ongoing experimentation through the design and development process in UX practices. Many research studies in the literature are agreed on the five stages of the design thinking approach as; (1) empathize, (2) define, (3) ideate, (4) prototype, and (5) test (see Figure 2.9).

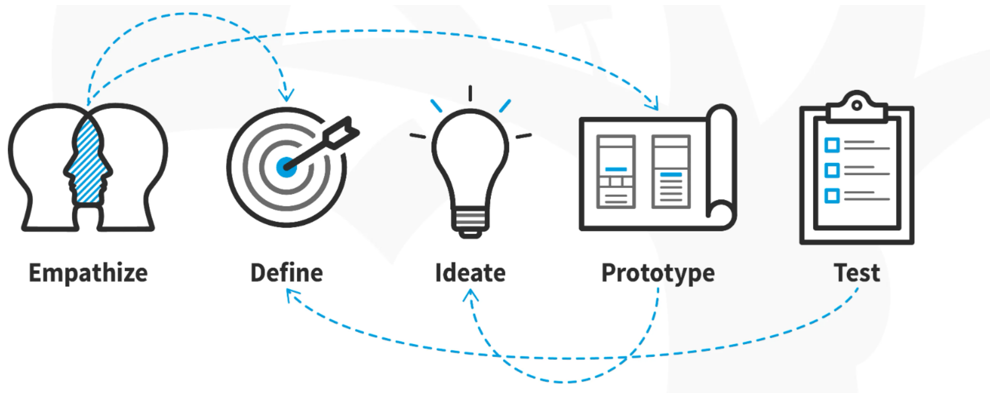

Figure 2.9: Design Thinking Process (Dam & Siang, 2022)

Empathize, as the first stage of the design thinking process, is mainly about understanding the problems, needs, and motivations of users (IxDFc, n.d.). To better understand these features, this stage commonly involves high interactions with the selected user group and conducting user interviews with them (Nasution & Nusa, 2021). The second stage, *define*, focuses on articulating the problem and presenting possible design aspects according to the user research findings from the empathize stage (IxDFc, n.d.). In the third stage, *ideate*, a wide range of ideas and potential solutions are expected to be generated in brainstorming sessions among stakeholders (Dai, 2022). The ideas, which are generated during this stage, are selected to be developed as prototypes. In the fourth stage, *prototype*, a selected idea from the ideation stage starts to be visible through prototypes to test and gather feedback (Nasution & Nusa, 2021). The fifth and last stage *test* is about experimentation and evaluation of the prototypes with users (Nasution & Nusa, 2021). Results of the tests with users are used to form a path to further product developments. According to the feedback from the users, products would be able to launch, or required improvements would be redefined and applied to the products until the satisfaction level is fulfilled (Dai, 2022).

Similar to user-centered design, design thinking is another precious and prominent approach in the UX methodology. Both approaches complement each other with well-structured frameworks focusing on creative problem-solving, ideation, and cross-functional collaboration. By combining the strengths of both approaches, designers improve their creative design and development processes of UX implementations by presenting novel, impactful, and user-friendly products to the users.

2.3.2.3 Agile Development

Among the approaches of UX methodology, Agile development is from the software development discipline that focuses on flexibility, collaboration, and iterative progression in the product development process (IxDFd, n.d.). Agile development emerged as a result of the problems experienced over the years in the complex and unpredictable process of traditional software development, which has a linear structure, by dividing the process into smaller and manageable parts and structuring it into cycles, and this structuring has revealed faster and more efficient working practices of teams (Brown, 2012; Bruun, Larusdottir, Nielsen, Nielsen, & Persson, 2018). The Agile Manifesto, which was created in 2001 with the discussions over the limitations of the traditional, linear, and plan-driven development methodologies (Savarit, 2020; Dziuba, 2023), mentions four core values of Agile development; "(1) "*individuals and interactions over processes and tools*, (2) *working software over comprehensive documentation*, (3) *customer collaboration over contract negotiation,* and (4) *responding to change over following a plan*" (Fowler & Highsmith, 2001, p. 34).

The Agile methodology focused on software development aims to adapt to the continuous updating of the product development process and content with the ever-evolving technology through the collaboration of cross-functional teams over rapid iterations (Brown, 2012; Rigby, Sutherland, & Takeuchi, 2016; Bartosz, 2022). Over the years, Agile development has expanded from software engineering to various disciplines and industries, such as management and UX design. The fact that the user-centered and iterative nature of UX matches Agile development has also facilitated this widespread use (Bruun et al., 2018).

In the stages of the Agile development process, Agile teams, which are cross-functional groups of experts, mainly follow iterative and collaborative short sprints in which they get continuous feedback from the users and continuously develop the product (Brown, 2012; Bartosz, 2022). While the members, process, and durations may vary depending on the Agile framework used (e.g., Scrum or Kanban) (Cajander, Larusdottir, & Geiser, 2022), the primary process of Agile development in UX practices is mainly based on concept, inception or identification, iteration or development, release, maintenance, retirement (Nehra, 2022). While several stages, such as concept, inception or identification, and iteration or development, of the Agile development approach have similarities with their counterparts in the user-centered design and design thinking processes, the Agile development process specializes in its post-design stages, such as release, maintenance, and retirement. In the strategic Agile development process, after products are released according to the user needs, business aims, and market demands, cross-functional teams continue to develop products. When the goal of the product is reached, it is retired by the teams to focus on developing new products (Eby, 2016).

Nowadays, Agile development has an essential relationship with UX methodology due to its user-centered, cross-functional, collaborative, fast, iterative context and process (Bruun et al., 2018; Savarit, 2020). Since this dynamic, collaborative, and inclusive nature of agile development enables continuous feedback from users, micro-management of the product development process, and rapid decision-making and implementation during the process stages, its integration with UX implementations contributes to UX practices (Dziuba, 2023). Moreover, the fast and iterative process of Agile development enables early recognition and reduction of product-related risks, thus meeting cost-effective business and market demands (Brown, 2012; Nehra, 2022).

2.3.3 Essential Methods and Activities in UX Practices

This heading of the literature review presents the essential methods and activities used by UX professionals in the processes of the prominent methodological approaches to UX mentioned in the section (see Section 2.3.2). This heading groups the most essential methods and activities in the UX practices according to their context, focus, and implementation areas as; (1) discovery and (2) delivery and provides detailed descriptions accordingly. However, according to academic and market-oriented sources on UX practices, the methods and activities implemented in the UX process are shaped by the specific product that will emerge more than once at different stages of the process (see Section 2.1.4). For this reason, the methods and activities mentioned in the following two headings have different usage practices according to different approaches, perspectives, and expectations in UX-oriented digital product, system, or service design and development processes.

2.3.3.1 Methods and Activities on Discovery

UX methodology-driven digital product, system, or service design and development processes begin with research and ideation stages that focus on discovering and exploring the projects (see Section 2.1.4). These phases provide background information for developing projects, mapping the process, and forming the foundation. Therefore, user and user needs are fundamental. Based on this knowledge, the research and ideation phases basically include understanding user needs, gathering insights, generating ideas, and laying the foundation for the design and development process (Nunnally & Farkas, 2016; Canziba, 2018; Savarit, 2020). Since data collection studies on users and user needs are concentrated in fields such as sociology, social anthropology, and psychology and focus on personal information, experience, culture, value, and meaning rather than context, the methods and research approaches used here are generally qualitative (Bargas-Avila & Hornbæk, 2011; Robinson, Lanius, & Weber, 2018). In addition, quantitative approaches and methods are used where research is carried out to reveal a hypothesis or validate an idea with the collected data (Savarit, 2020). In this way, UX methodology-oriented processes reveal a mixed-method field where two different approaches and methods are used. While the methods and activities used according to many different approaches and disciplines vary, according to the literature review, the most prominent research and ideation methods and activities in UX methodology could be summarized as follows:

User Interview

User interviews are one of the most prominent and used methods in the UX methodology (Alves, Valente, & Nunes, 2014; Robinson, Lanius, & Weber, 2018) that provide valuable insights into the perceptions, behaviors, values, cultures, motivations, and experiences of users (Matthews & Ross, 2010). These interviews are conducted either face-to-face or online, but in every case, as one-to-one conversations that help to develop a better understanding of user needs, problems, and expectations which a quantitative approach could easily miss to uncover. User interviews are highly constructive in connecting users and UX professionals to adopt a user-centered approach while creating intuitive and meaningful digital experiences (Alves, Valente, & Nunes, 2014).

In the process of interviewing, first, UX professional forms an interview guide that shows questions, themes, and tracks that are needed to be uncovered (Gray, 2009). During the interview, according to the responses from the interviewee, additional questions should be prepared to guide the interview (Merriam & Tisdell, 2016). Depending on the course of the digital product development process, especially after usability testing and after the products are launched, interviews are also conducted to get user feedback about their usage practices (Savarit, 2020). With the responses to these interviews, patches for fixes, updates, and maintenance are developed.

Many research studies emphasize the importance of audio and/or video recordings due to their ability to cover unwritten gestures that would be important (Savarit, 2020). Therefore, competent questioning and active interview listening are needed to reveal user perspectives to empathize. As a result, interviews have a massive force in the overall process by shaping design decisions, personas, journeys, and product design and development activities (Kerim, 2020).

Survey

Apart from user interviews, surveys are another well-known, widely-used, and important method in the UX methodology (Nunnally & Farkas, 2016; Robinson, Lanius, & Weber, 2018) that mainly are used to gather more extensive scaled quantitative data on user preferences behaviors, and demographics (maze, n.d.). However, they are also used in qualitative and mixed-method research studies with open-ended questions (Serpati & Loughan, 2012). By reaching greater masses, surveys present insights that complement qualitative research methods, enhancing the overall understanding of user experiences by revealing common patterns and outliers to inform design decisions (Savarit, 2020). Demographic data collected from surveys can be used to define the target user group and validate if the UX design is appropriate for them (Farrell, 2017). Additionally, surveys are used to gather usage data and feedback from users, which show insights into how users interact with the design, what types of usability problems occurred, and how to improve them to meet the needs of users. Depending on the research goals, surveys can be conducted throughout the process from conceptualization to the post-launch (maze, n.d.).

Contextual Inquiry/Ethnography

Contextual inquiry, including observations, is a highly valuable ethnographic method within the UX methodology; it focuses on revealing insights into user behaviors, needs, and actions, by observing or engaging with users in their environment while they are using a particular product, system or service (Nunnally & Farkas, 2016). This method helps UX professionals to identify pain points, future opportunities, and usability issues of the designs from directly observing users. Through direct observation, UX professionals have an opportunity to get holistic perspectives on the daily use of the product, system, or service they work on, which also leads them to get first-hand knowledge of the user needs and innovation design options for the further development (Goodman, Kuniavsky, & Moed, 2012). While there are naturalistic approaches where users are simply observed within the context of contextual inquiry, there are also studies that encourage research studies to communicate with users within this method (Nunnally & Farkas, 2016).

According to Savarit (2020), while the use of contextual inquiry has the advantage of providing a more comfortable environment by examining users in their natural environment and thus being able to collect more detailed user data, it also has the disadvantages of being time-consuming and more difficult to record data. Therefore, contextual inquiry is considered a crucial UX method that enables professionals to get insights into users within their natural environment. Conducting contextual inquiry in the process enhances the development of user personas and user (or customer) journey maps by presenting real-life examples (Goodman, Kuniavsky, & Moed, 2012; Nunnally & Farkas, 2016).

Focus Group

Focus group method and study have an essential place in UX methodology as they reveal a collaborative data collection process (Conrad & Alvarez, 2016; Savarit, 2020). Within the scope of this highly collaborative and dynamic method, individuals from diverse user groups come together to have conversations about specific products, systems, or services and share their perspectives on a common platform (Robinson, Lanius, & Weber, 2018). The collaborative nature of the focus group method leads to the insights gathered being collectively generated as a result of the perceptions and ideas of the participants influencing each other (Savarit, 2020). In addition to the collective insights generated in this way, focus groups contribute to UX practices by providing insights into the reactions of the users, their shared experiences, and group dynamics. Through focus groups, diverse user group members not only provide insights into the research process but also become a part of the design and development process by interacting with UX professionals and have the chance to play an active role in shaping the product (Robinson, Lanius, & Weber, 2018; Savarit, 2020). In this way, the focus group method helps UX professionals by providing a perspective for improvement and innovation in the designed or developed product (Goodman, Kuniavsky, & Moed, 2012). Apart from research and ideation phases, focus groups are also used in design and development. Especially in testing early design prototypes, focus group studies provide real-time user reactions and feedback (Savarit, 2020). As a result, the focus group method stands out with its dynamic and collaborative structure and contributes to the user-centeredness of the designs studied by providing real-time user reactions and perspectives to UX professionals (Conrad & Alvarez, 2016; Robinson, Lanius, & Weber, 2018; Savarit, 2020).

Diary Study

Diary studies, similar to the contextual inquiry method, have an important role in the UX methodology by generating longitudinal insights into the real-time experiences and interactions of the users with products in their daily life practices. (Bargas-Avila & Hornbæk, 2011; Farrell, 2017). In diary studies, participants document their thoughts, emotions, and interactions about the product, system, or service they use over an extended period (maze, n.d.). This method allows users to convey their own ideas about behavior, need, and pain points to UX professionals based on their experiences. The fact that diary studies continue over an extended period helps to present the experiences of the users in a more structured way by spreading them over a period of time (Goodman, Kuniavsky, & Moed, 2012; Savarit, 2020). The insights from this extended period help UX professionals to create a holistic user journey in the digital product development process (Goodman, Kuniavsky, & Moed, 2012; Canziba, 2018). Moreover, self-documented data of the participants can provide preliminary information about the usability of the design as well as issues that may arise in the long term (Bargas-Avila & Hornbæk, 2011).

Although the use of diary studies as a method has such benefits, relying entirely on records of the participants and the documentation of these records can create challenges for UX professionals (Savarit, 2020). In light of this information, diary studies contribute to UX methodology by involving users in the process with the data they collect and by providing real-time information about how designs are practiced in everyday life (Bargas-Avila & Hornbæk, 2011).

Persona Building

Persona building is a pivotal activity in the UX methodology. Within the scope of persona building, UX professionals create user archetypes with the data they collected from UX research on user behaviors, needs, preferences, and aspirations that they plan to use in their design projects (Goodman, Kuniavsky, & Moed, 2012; Harley, 2015; Canziba, 2018). This archetype user, which emerges as a persona, supports the product design and development process to have a user-centered structure with a diverse user base and enabling empathy (Harley, 2015). In addition, the realization of persona building at the beginning of the process facilitates the communication of different stakeholder groups in the later stages of the process by providing a shared understanding and definition of the user context (Goodman, Kuniavsky, & Moed, 2012). Persona building stands as a vital activity in the UX methodology, guiding and facilitating the design and development process among cross-functional teams by presenting clearly built possible end-users that communicate with the diverse user group and needs on common grounds.

User Journey Mapping

User journey mapping is a creativity-based activity within the UX methodology that enhances the overall user experience of the products, systems, or services and shapes them to be more user-centered (Endmann & Keßner, 2016). While personas focus on providing user demographics, journey maps focus on presenting the entire user-product interaction and experience over time (Howard, 2014). User journey mapping aims to present a graphic visualization of the entire user journey starting from the initial touchpoints to the final interactions, to develop a better understanding of the user needs, motivations, and pain points during the use of the designs (Kaplan, 2016; Canziba, 2018). Therefore, UX professionals learn from the user preferences in the process and plan further UX implementations within the overall product development (Howard, 2014). According to Endmann and Keßner (2016), user journey mapping as a group activity or workshop has nine steps; (1) defining personas, (2) preparing the user journey map with personas, the goal, and process information, (3) associate process with activities during the use of the product, (4) organize related activities, (5) identify tasks, (6) match activities and tasks, (7) assign gains of personas to tasks, (8) add documents to the tasks, and (9) identify further steps of the process. Based on these steps, user journey mapping provides guidance to UX professionals by revealing barriers, communication gaps, and problematic points in the product experience of the users. This guidance, in turn, facilitates the development of coherent and emotional UIs for digital products, systems, or services (Kaplan, 2016). Moreover, user journey maps provide a common workspace for cross-functional teams, strengthening collaboration and co-creation activities in the process. Ultimately, user journey mapping provides UX professionals with pain and gain points by visualizing the user-product interaction process through a detailed flow and contributes to the user-centered development of products (Endmann & Keßner, 2016).

2.3.3.2 Methods and Activities on Delivery

Unlike the previous section, this section focuses on the methods and activities used for delivery in the UX methodology involving digital product design and development and provides a summary. While the methods and activities in Section 2.3.3.1 are mainly used for exploration in the process, the methods and activities mentioned in this section focus on design implementation and are used in wireframing, prototyping, and testing activities and phases in the development stage of the process. Although the methods and activities mentioned in this section are mainly described in a chronological sequence, these methods and activities are interconnected according to the development process of the projects and the approaches adopted by the firms and cross-functional teams. For this reason, the methods and activities that will be discussed later in the section may progress simultaneously with each other and shape each other. While the methods and activities used according to many different approaches and disciplines differ, according to the sources from the literature and market practice, the most prominent design and development methods and activities in the context of the delivery of the UX methodology could be summarized as follows:

Designing Information Architecture (IA)

Information architecture (IA) is a vital and strategic activity in the UX methodology that improves the usability, accessibility, and effectiveness of digital products, systems, and services by presenting a visual representation of the infrastructure, features, and hierarchy of the designs (Nielsen, 1999; Dillon & Turnbull, 2005; Resmini & Rosati, 2012; Touré, Michel, & Marty, 2016). IA facilitates the intuitive and coherent navigation of the UI and UX experiences of users by incorporating properly organized information into product development that is centered on the user and user needs (Pivoker, n.d.). With a properly constructed IA, UX professionals can increase user engagement and satisfaction by quickly and argumentatively accessing the information and flow they are looking for within the digital experience (Resmini & Rosati, 2012). In the digital product development process, the IA, which is established early in the design phase, shapes the entire visual design, including the layout, configurations, colors, icons, and the overall interface.

Moreover, well-defined IA provides UX professionals with a precise and clean flow, helping to ensure that the digital product, system, and service to be developed as a precise and clean UX (Resmini & Rosati, 2012; Touré, Michel, & Marty, 2016). According to Pivoker (n.d.), the most fundamental elements of designing an IA focus on the hierarchical placing of every component and their labeling and display. During this labeling and hierarchical placing, UX professionals assign different shapes with different sizes or colors to specific requirements and functions (Resmini & Rosati, 2011).

An adequate IA is essential in developing user-centered digital products, systems, and services by straightening the usability and wayfinding of the design according to user preferences (Resmini & Rosati, 2012). Additionally, by clearly labeling the functions and requirements, IA enhances content strategy by guiding in prioritizing the information systematically (Resmini & Rosati, 2011). A successfully designed IA prevents costly redesign and redevelopment iterations during the UX practices.

Card Sorting

Card sorting is a generative method that is mainly used, especially in early IA and interface design studies, as it helps to organize IA (Nunnally & Farkas, 2016; Savarit, 2020). In this collaborative method, participants organize and categorize cards with various words and phrases on them according to content or concepts (Canziba, 2018; Savarit, 2020). In this way, UX professionals obtain information about the preferences and perceptions of users that emerge during the information structure. UX professionals also create a visual and structural relationship between users and designs through the insights users provide (Goodman, Kuniavsky, & Moed, 2012; Sherwin, 2018). The user-product connection created by UX professionals as a result of the card sorting method plays an important role in the organization and labeling of the activities and tasks of the digital product, system, or service. Card sorting can be shaped according to the design and can be used in two ways, open or closed card sorting (Goodman, Kuniavsky, & Moed, 2012; Savarit, 2020). In open card sorting, participants can freely organize cards as they wish, while in closed card sorting, card sorting is performed over predefined groups (Sherwin, 2018). Card sorting reveals patterns in how users naturally perceive and group the provided information. The user and UX professional interaction within this method also supports co-creation practices by providing a platform where participants can discuss their decision-making criteria (Canziba, 2018). In this way, card sorting creates user-centered designs and contributes to improve the usability of existing products.

Wireframing

Wireframing is a fundamental activity that guides the design and development of digital products, systems, and services within the UX methodology and serves as a bridge between UX and UI (Canziba, 2018; Simic, 2022; Wang, 2023). Within the scope of wireframing, UX professionals transform the design ideas generated as a result of the research and ideation stages into low-fidelity and then high-fidelity interfaces to describe the layout, structure, and functions, and thus prepare the designs for the development stage (Treder, 2013; Simic, 2022) (see Figure 2.10).

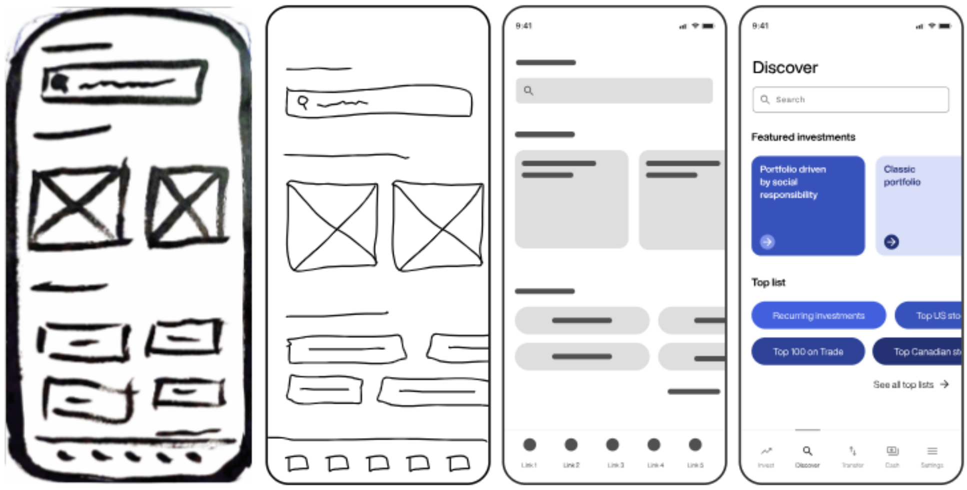

Figure 2.10: Low to High Fidelity Wireframes (Simic, 2022)

In this way, wireframing outputs basically present a clear representation of the product to be developed to stakeholders, including designers and developers (Gray, 2016). Wireframes can be produced in different ways, from low-fidelity to high-fidelity. While low-fidelity wireframes can be created using basic sketches made with pen and paper, high-fidelity wireframes can be developed with computer software-based interfaces and programs such as Balsamiq, Sketch, Axure RP, or Figma (Canziba, 2018). Most commonly, wireframing activity starts with information gathering and conceptualization. The conceptual design shaped in the light of this information is translated into low-fidelity wireframes based on sketches with a basic grayscale representation (Treder, 2013; Yudhanto, Pryhatyanto, & Sulandari, 2022). Low-fidelity wireframes emphasize content hierarchy and functional representations without aesthetic concerns. Later, design features such as text and images are added to low-fidelity wireframes under the name of content mapping (Wang, 2023). The wireframes, to which configuration elements such as buttons, links, and menus are added for user flow and interaction, go through an iterative design and feedback process with the collaboration of stakeholders. The designs enhanced with basic experiments are then transformed into visually detailed high-fidelity wireframes (Canziba, 2018; Simic, 2022). The documentation for the projects detailed with high-fidelity wireframes is prepared for the developers, and the usability testing process is started. Wireframing basically serves as rapid experimentation and iterations in the design process (Treder, 2013). Before proceeding to the development process, basic usability issues are solved with wireframing, and in this way, it is aimed to prevent major issues from emerging in the following process (Canziba, 2018; Simic, 2022).

Prototyping

Similar to wireframing, prototyping is another essential and iterative activity within the UX methodology that enhances the design and development of digital products, systems, and services (Canziba, 2018). According to Treder (2013), while prototypes are often confused with wireframes or mockups, they can be defined as interactive and functional middle-to-high fidelity representations of the designs that feature actual UI interactions. Prototypes developed in the light of wireframes allow stakeholders to visualize and test design concepts before developers take them into the full-scale development stage (Yudhanto, Pryhatyanto, & Sulandari, 2022).

Prototyping, just like wireframing, consists of many stages. A typical process generally starts with conceptualization. Then, with low-fidelity prototypes (or paper prototypes), UX professionals create a quick representation of basic functions (Canziba, 2018). Then, with the use of digital prototyping tools (e.g., Figma), low-fidelity prototypes become interactive (Canziba, 2018; Staiano, 2022). By adding several design attributions to the interactive prototypes, the functionality of the design is combined with aesthetic aspects. The prototypes are then subjected to testing iterations with users. The tests are diversified according to the features or expectations sought in the prototypes. Within these iterations, prototypes that receive user acceptance and are validated are delivered to developers for a much more refined development that includes coding (Canziba, 2018).

Mainly, prototypes facilitate the development of conceptual design alternatives by setting up stakeholders to experiment, get feedback, and further develop design ideas. At certain points, prototyping goes hand in hand with activities for wireframing, visual design, and usability testing (Pakanen, 2015; Pernice, 2016; Staiano, 2022). Wireframes can be worked on according to the feedback received on the prototypes, and the prototypes that are ready to be tested are subjected to usability testing in terms of the desired and researched aspects (Pernice, 2016). In addition to these studies, design teams continue to work on areas such as color, icon, and typography in order for the designs to have the desired identity (Pakanen, 2015). The fact that digital prototyping is open to faster and more cost-effective development compared to the coding stage in the further development stage is an example of its importance in UX methodology (Goodman, Kuniavsky, & Moed, 2012; Canziba, 2018).

Visual Design

Implications on the visual design play a crucial part in the UX methodology by significantly improving the success rate of the digital products, systems, and services (Hartmann, Sutcliffe, & Angeli, 2008; Moshagen & Thielsch, 2010). With the implications focusing on the graphical elements and the overall composition of digital products, UX professionals offer users intuitive and pleasing interfaces they can connect with. In this way, the work on visual design within the UX methodology is not only aesthetic and decorative elements but also increases the interaction and experience of the developed digital products with the user by evaluating them in a holistic way, as well as contributing to their usability and functionality (Moshagen & Thielsch, 2010; Tuch, Bargas-Avila, & Opwis, 2010).

Moreover, it increases the visibility of the products in the market, promotes the brand identity of the clients, and improves their business aspects (Schrepp, Held, & Laugwitz, 2006). First of all, visual design implementations are at the forefront of attracting the attention of users to digital products and eliciting emotional responses (Pakanen, 2015; Bollini, 2017). According to Pakanen (2015), products with visually intuitive and pleasing interfaces are used longer and interacted with more by user groups. Therefore, products with visually pleasing interfaces positively affect overall UX by increasing user satisfaction. The typography, color palettes, icons, menu, and overall layout that UX professionals focus on within the scope of visual design shape the interaction of users with the product, and providing an engaging experience facilitates the use of the product (Moshagen & Thielsch, 2010; Camargo, Barros, & Barros, 2018). Multiple research studies emphasize that design features, especially the contrast of colors and fonts used in digital interfaces, significantly shape the usability of the design and development of the products (Bollini, 2017; Camargo, Barros, & Barros, 2018).

Visual design implementations have not only user but also business-oriented impacts. Having a novel and attractive brand identity for products that would take place in the competitive market helps to achieve business-related goals (Schrepp, Held, & Laugwitz, 2006). Most of the visual design implications and activities on visual design are carried out through visual design softwares and tools such as Adobe Photoshop, Illustrator, and Figma at different stages of the UX process (Canziba, 2018; Staiano, 2022). The basic visual approaches created during the conceptual design and ideation phases are brought together with the users during the prototyping and testing phases of the products and updated based on the feedback received (Pakanen, 2015; Staiano, 2022).

Usability Testing

Within the UX methodology, usability testing (or user testing) enables UX professionals to evaluate the developed product and interface prototypes by introducing them to the user and continuously enhance the user experience by continuing to improve the products with the feedback they receive (Moran, 2019; Savarit, 2020). Through usability testing, designers, developers, and other stakeholders gain insights into user behavior, emotions, and preferences and use these insights to shape iterations to improve the usability, functionality, and feasibility of the designs (Goodman, Kuniavsky, & Moed, 2012). Usability testing has an essential place in UX methodology because it reveals real-time and real-world examples and practices about usability issues and especially reveals the instant reactions of users (Niranjanamurthy, Nagaraj, Gattu, & Shetty, 2014). The fact that users and user needs are at the center of these tests contributes to the user-centeredness of the designs developed. According to Moran (2019), the usability testing aims to identify existing problems, define possible design options, and gain insight into the behavior and preferences of users. These tests are carried out with prototypes developed in the process before the product is launched, as well as after the product is launched, and help in the development and maintenance of products by adding user insights (Canziba, 2018).

Usability testing is organized in sessions and proceeds as the UX professional, who acts as a facilitator, gives specific tasks to the user, and then receives feedback from the user about the task (Goodman, Kuniavsky, & Moed, 2012; Moran, 2019). According to Hertzum (2022), performing a common usability test consists of three phases focusing on preparation, execution, and analysis. The preparation phase covers the time before the test starts and includes test planning, developing familiarity with the prototype, user sampling, task, and equipment definition. The execution phase covers the testing process and includes giving instructions to users, receiving and observing user feedback, taking notes, and collecting insights at the end of the task. The analysis phase takes place after the test, analyzing and ranking the test data and reporting and working on redesign.

Although the flow above describes a common process, these tests vary depending on the products, systems, and services being tested. For instance, *A/B testing* is used in cases where user engagement or performance of more than one design is to be compared by testing (Savarit, 2020). In *remote testing*, the interactions of diverse user groups in different geographies in their natural environments provide information about different usage scenarios (Reeves, 2019; Hertzum 2022). *Tree testing* and *eye-tracking* focus on user information architecture and navigational structure in product usage (Savarit, 2020; Laubheimer, 2023). With these tests, users find specific information within interfaces through tasks and provide insights for optimizing the hierarchical structure. *Guerilla testing* provides a cost-effective and informal testing approach by offering a fast testing option in a real-world setting with minimal planning and resources (Savarit, 2020).

2.3.4 Collaboration in UX Practices

Up to this point in the literature review, detailed information on key principles, prominent approaches, essential methods, and activities within the scope of UX methodology has been presented. The processes involving UX implementations have dynamic and iterative processes (Brown, 2008; Hartson & Pyla, 2018; Sucala, Ezeanochie, Cole-Lewis, & Turgiss, 2020). Through these processes, UX professionals collaboratively design digital products, systems, and services to fulfill the needs of diverse user groups and provide meaningful and valuable user-product interactions and experiences (Law et al., 2009; Laubheimer, 2016; Canziba, 2018).

Many studies in the literature share the emphasis that collaboration in dynamic and iterative design processes of UX practices contributes to the user-centeredness of the designs developed by offering diverse expertise and perspectives (Abras, Maloney-Krichmar, & Preece, 2004; Brown, 2008; Sucala et al., 2020). In light of this information, the section describes collaboration in the UX practices, first by referring to the iterative design process, then to the Agile development approach and working in short sprints, and finally to the co-creation activities of cross-functional teams (Bruun et al., 2018; Savarit, 2020).

First, the iterative design and development process mainly includes design, prototyping, testing, and evaluation cycles in the UX practices (Brown, 2008; Canziba, 2018). Collaborative practices within the iterative process are fundamental as they enable the exchange of ideas from different perspectives and, thus, learning from each other and collective idea generation (Emmitt & Ruikar, 2013; Savarit, 2020). Especially the current structure of digital products, systems, and services and the continuous development of digital products, systems, and services with the developing technology makes iterative processes mandatory. In short and fast iterations, teams have the chance to collect data quickly for the projects they are working on, implement them quickly, and, most importantly, test them quickly and redefine the process by receiving feedback (Bruun et al., 2018; Savarit, 2020). Since user needs and requirements are constantly evolving and changing through testing, the iterative process and strong collaboration between stakeholders enhance the continuous product and overall experience. The iterative design process is widely accepted in UX approaches from different perspectives, such as user-centered design, design thinking, and agile development, due to its compatibility with UX methodologies and practices (see Section 2.3.2).

As mentioned in Section 2.3.2.3, Agile development has an essential place in UX methodology because of the flexibility and collaboration features it enables. Developing projects through short sprints, one of the core principles of Agile development, is highly compatible with iterative design practices (Bartosz, 2022). In the sprints, which are usually designed to last two weeks, stakeholders work on the necessary team tasks (Brown, 2012). This working approach strengthens collaboration and communication by enabling feedback at close time intervals based on this collaboration. In this way, stakeholders can closely follow the changing needs of users and Project requirements through effective communication (Bartosz, 2022; Dziuba, 2023).

In the iterative and collaborative processes that exist in UX practices, cross-functional teams bringing together stakeholders from different disciplines with their diverse skills, knowledge, and expertise ability are often preferred and contribute to UX practices in the areas of diversity and user-centered approach (Latzina & Rummel, 2003; Adams et al., 2022). Cross-functional teams include professionals with different perspectives and expertise from different disciplines, such as designers, developers, researchers, and product managers, and facilitate the development of the process through the co-creation of these different perspectives (Awomolo et al., 2017; Canziba, 2018). With this multidisciplinarity, UX professionals from different disciplines collectively contribute to various stages of the digital product, system, or service design and development process (Gothelf & Seiden, 2021). As mentioned in Section 2.3.3.1, collaborative methods and activities within the UX methodology promote a shared understanding, knowledge, and language. Therefore, the collective contribution of cross-functional teams to the design and development process ensures that the final products have technical solid feasibility, business goals, and user preferences from a holistic perspective (Hartson & Pyla, 2018). Within UX methodology and practices, cross-functional collaboration provides a user-centered mindset. It contributes to the overall design and development process since it has the ability to build design solutions based on user needs and design solutions based on diverse perspectives and expertise (Abras, Maloney-Krichmar, & Preece, 2004; Brown, 2008; Sucala et al., 2020). Collaboration within UX practices also allows different disciplines to learn from each other, leading to a more creative and innovative process (Savarit, 2020). Moreover, by enabling a common language and communication between stakeholders, collaboration prevents risks and dangers that may arise during the process. It ensures that the overall design and development process achieves its objectives in a healthy and fast manner (Robinson, Lanius, & Weber, 2018).

2.4 Theoretical Framework

Based on the aim of the thesis that is to explore the gap between industrial design education and UX professions to facilitate the transition of industrial design graduates into UX professionals, this chapter has developed a theoretical framework to understand the relationship between the current industrial design profession, education, and UX professions. Therefore, the theoretical framework of the thesis is constructed and analyzed through the mind map in Figure 2.1. The theoretical framework was evaluated under three main headings as (1) developments in the industrial design profession, (2) digital product development in industrial design education, and (3) UX practice methodology.

The first part of the framework was a review of the existing literature on the industrial design profession. Sources on how the definition, context, approaches, and methods of the profession have evolved over the years from traditional to contemporary have contributed to the research on how the industrial design profession has evolved and become contemporary. The arts, crafts, and physical product-oriented practices and the traditional monodisciplinary approach at the origins of the industrial design profession provided the starting point for the thesis. The following section, which was based on the development of the industrial design profession over the years, described the social, cultural, environmental, and technological developments of the industrial design profession based on many sources. Firstly, it explained how this development expanded the definition and context of the profession. Then it illustrated how it has transitioned from a monodisciplinary to a multidisciplinary structure. At this point, how people other than designers started to be involved in the design process was explained progressively from the individual participant scale to the organizational scale. Then, how contemporary industrial designers engaged in social engagement with different stakeholders in the design process was analyzed through collaboration, communication, and teamwork. How contemporary design fields have emerged, primarily due to technological developments, including interaction, UI, UX, and service design, have developed the industrial design profession. Based on these contemporary design fields, the first main title examined the design and development process and stages of designers working as UX professionals in the market.

The second chapter, the theoretical framework, focused on industrial design education and how it developed from its foundation to the present day. In order to do so, the chapter first examined the emergence of industrial design education by discussing the approaches of various countries such as the UK, France, Germany, Scandinavian countries, and the US. Then, due to the Turkish context of the thesis, the emergence of industrial design education in Turkey, in light of the implications in other countries, was explained. Following the information on how the education was formed, the scope of industrial design education and the development of the profession, as well as the social, cultural, economic, environmental, environmental, and technological factors over the years, were examined. Based on the technological scope of this thesis, considering the technological development of industrial design education, how digitalization, digital product development, and, therefore, UX practices are included in industrial design education were explored in detail at this stage of the framework. Additionally, the practices they include are exemplified and illustrated profoundly.

The last main heading of the literature review, after analyzing contemporary industrial design, UX professsions, and contemporary industrial design education, respectively, focused on UX practice methodology. In doing so, the chapter first touched upon the background and key principles of the UX methodology. Then a connection was sought with the mindset of designers working as UX professionals, especially with the influence of design-based UX methodology approaches. In addition, the decisive role of the software development discipline in the approaches was discussed. Then, the research and design methods and activities used in UX processes were illustrated, and information about tasks and roles was obtained. The last information on UX methodology emphasized the multidisciplinary nature of UX practices and the collaboration within this structure based on the UX process, methods, and activities were described.

The next chapter of the thesis describes the research design of the study and presents the methodological framework based on the theoretical framework established in this chapter.

CHAPTER 3

METHODOLOGY

This chapter presents the thesis research methodology in five steps. First, the chapter states the research approach and presents the research methodology. Then, it describes the data collection through three data collection methods of the research, and data analysis procedures with an emphasis on their coding processes.

3.1 Research Approach

When designing their research studies, researchers typically choose between quantitative, qualitative or a mix of these approaches for their research design (Creswell, 2009). While the research approach is chosen according to the research topic and aim, it is also impacted by the research questions and data gathering process. The quantitative approach and its research methods primarily collect small data from large sample groups and describe their results with statistical analysis techniques (Bryman & Bell, 2015). As a result, these research studies draw general conclusions based on large populations. While they have strength in presenting precise or even absolute results, they also have a disadvantage since they may not provide detailed information on relatively abstract concepts such as behaviors, meanings, values, or cultures (Eyisi, 2016). On the other hand, the qualitative approach and its methods generally focus on more general and open-ended questions. Qualitative research studies mainly deal with unfiltered or uncensored raw data and analyze them without statistical techniques (Creswell, 2009). Instead of gathering general conclusions about large populations, research studies with a qualitative approach explore the human behaviors, identities, experiences, values, and meanings of smaller populations. Social interactions, living experiences, and personal themes are core essentials in the qualitative approach (Gray, 2009; Babbie, 2014). According to Creswell (2009), while the quantitative approach tests or proves theories, the qualitative approach aims to discover or generate novel knowledge through a series of systematic and interpretative data collection and analysis phases. In many fields, research studies adopt a mixed-methods approach in which researchers combine both approaches and use their data collection methods to reach their aims (Todd, Nerlich, McKeown, & Clarke, 2004). There are different uses of these approaches, but they are mainly used to analyze the same questions to test and compare their results. They enrich the results if their results match or converge on the same conclusion.

This research deals with exploring and bridging the gap between industrial design education and UX professions, thus, it is constructed as an exploratory study. To achieve its aim, the research mainly focuses on abstract concepts like personal experiences and perceptions in the context of digital product development process and particularly its UX implementations in industrial design education. To gather information, online surveys with fourth-year industrial design students and semi-structured interviews with industrial design students, industrial design academics, and UX professionals were conducted to learn more about the preferences and knowledge in the digital product development process and UX practices of these groups of people. Additionally, a visual content analysis of graduation project submissions of industrial design students focusing on digital product development were carried out. In the literature, many research studies in which researchers explore the product development process adopt a qualitative approach because of the abstract nature and hypothesis of the studies. In the light of this information, this research adopts a qualitative approach also. As a result, data collection, sampling, and analysis processes are chosen and conducted accordingly.

The interests of the researcher on the topic stems from a longstanding interest for the digitalization of design education. Researcher, who has an academic background from different design disciplines, examined the studies on how digital products, services, and systems are taught and applied within the scope of industrial design education within the digitalizing design discipline. He started his doctoral thesis with the aim of contributing to the educational experiences of future industrial designers and ultimately improving the link between academia and industry. By shedding light on current digital product development and UX practices in industrial design education, researcher intents to empower the next generation of UX professionals from industrial design background to create innovative, user-centered digital products that will benefit society. The researcher conducted the field research of his doctoral thesis within the scope of the industrial design department where he was a graduate student. Within the scope of the field research, although he did not use a direct observation method, the researcher was in contact with the students working on digital product development in Section B of ID402 Graduation Project course during 2021-2022 Spring Semester. During the data collection process, he described the consent form with the students, took approval from the students, collected contact information, exchanged e-mails, monitored few weekly critiques, and participated in the final jury and graduation exhibition.

3.2 Research Methodology

This research investigates (1) the overall process of digital product development within industrial design graduation projects, (2) the current handling of UX practices (including research and design) in the process, and (3) key drivers, interpersonal relations, collaboration, and teamwork among designers and other stakeholders (e.g., designers, academics, professionals) during the digital product development process. Since the research deals with these topics, to gather the best possible data, (1) spreading out online surveys, (2) collecting and analyzing of submissions, and (3) conducting semi-structured interviews with students, academics, and UX professionals are adopted as the data collection methods for the research.

3.2.1 Data Collection Process

The first phase of the research explores the digital product development process of industrial design students in an industry-collaborated graduation project course, in which the outcomes of the course present possibly the most advanced level of student projects. Therefore, the study aims to develop a well-grounded understanding of the digital product development process within the educational context. The study is conducted with fourth-year undergraduate industrial design students at METU Department of Industrial Design. To conduct this research, first, an application was made to METU Human Subjects Ethics Committee (IAEK) on March 10, 2022; with their application form, an informed consent form (see Appendix A), and an early field research guide. The approval was granted on April 14, 2022 (Protocol No: 0197-ODTUIAEK-2022) (see Appendix C). With the approval of the academic team responsible for the graduation project course, data collection process of the thesis was conducted in the 2021-2022 Spring Semester and 2022-2023 Fall Semester.

During the data collection process, the following methods are used respectively; (1) Online Survey A (see Appendix D), (2) visual content analysis of graduation project submissions, (3) Online Survey B (see Appendix E), (4) semi-structured interviews with industrial design students (see Appendices O-P), (5) semi-structured interviews with academics (see Appendices Q-R), and (6) semi-structured interviews with UX professionals (see Appendices S-T) (see Figure 3.1).

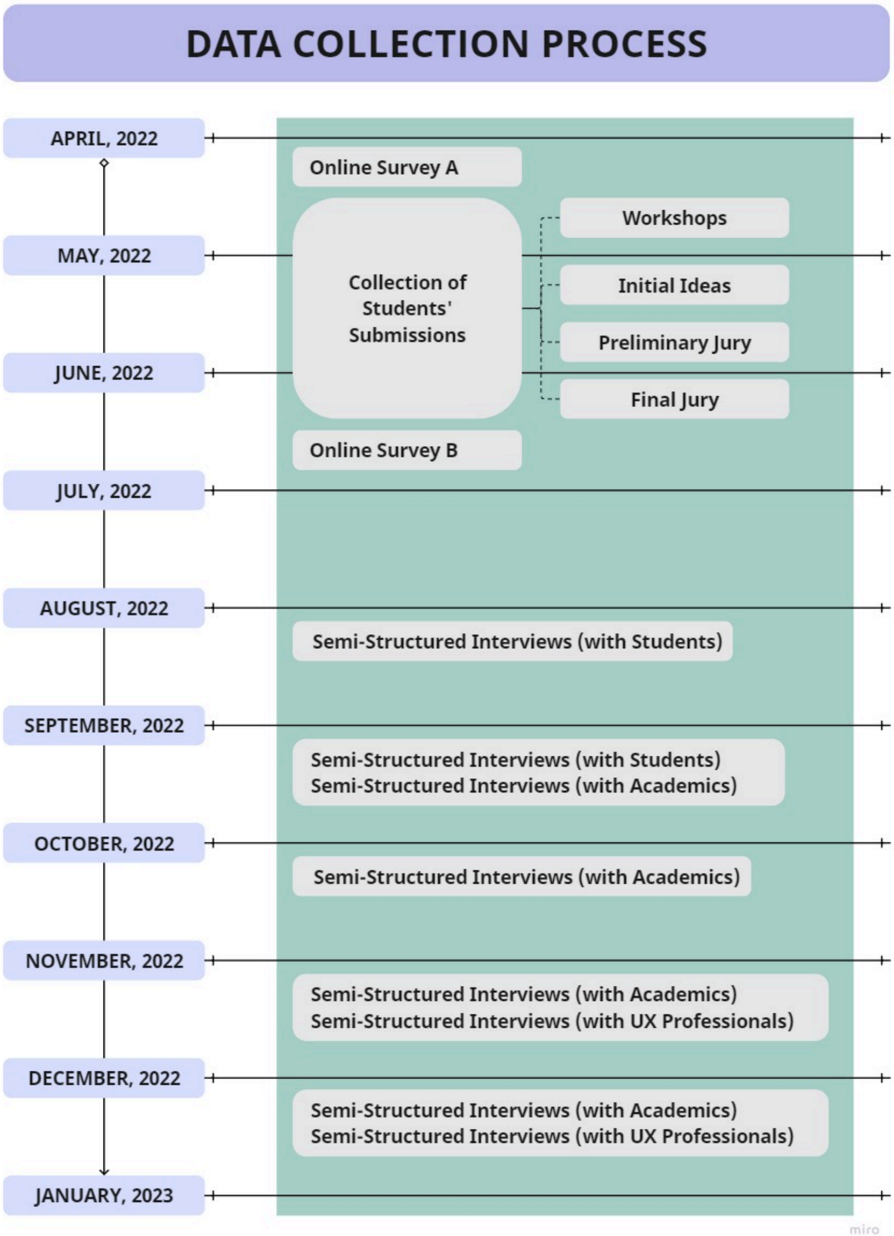

Figure 3.1: Timeline of Data Collection Process

3.2.1.1 Online Surveys

Conducting surveys is a widely used data collection method in various disciplines, such as science, technology, health, education, business, engineering, and design. Since researchers form the contexts of their surveys according to their studies, surveys can be used in research studies with qualitative (Braun, Clarke, Boulton, Davey, & McEvoy, 2021), quantitative (Dawson, 2016), and mixed methods approaches (Serpati & Loughan, 2012). For a very long time, researchers used printed versions of their survey and conducted their data collection face-to-face; however, global technological developments enabled first telephone surveys and then digital or online surveys (De Leeuw, 2005). In the digital age, using online survey products, such as Google Forms, Zoomerang, Survey Monkey, or Questionpro, is the dominant methodology (Marra & Bogue, 2006; Buchanan & Hvizdak, 2009). According to Yun and Trumbo (2000; cited in Marra & Bogue, 2006), using online assessment tools in data collection have benefits, such as lowering the cost and supporting the data collection process, since responses are automatically stored in the database with the ability to easy access and easy download, and reach larger masses easily while sampling.

In this research, conducting online surveys is the first data collection method. This research investigates the digital product development process. Since the foundation of the professional culture, process, and know-how are adopted in the education life, the digital product development process of fourth-year industrial design students acts as the primary research subject (see Section 1.1). Therefore, the sample group of the research was chosen as the 24 METU Industrial Design students who took the B section of the ID402 Graduation Project course in the 2021-2022 Spring Semester; and who carried out their graduation projects on digital product development collaborating with nine companies from different industries (see Table 3.1).

Table 3.1: 2021-2022 ID402 (Section B) Student List (Digital Product Projects)

STUDENT #	GENDER	FIRM	INDUSTRY
S1	Female		
S2	Female		
S3	Male	A	Finance
S4	Male		
S5	Female		

S6	Male		
S7	Female	B	Game
S8	Female		
S9	Female	C	e-Commerce
S10	Female		
S11	Female	D	Education
S12	Female		
S13	Female		
S14	Female	E	Digital Museum
S15	Female		
S16	Female	F	Software & Service
S17	Female		
S18	Female		
S19	Male	G	Production
S20	Female		
S21	Female	H	Automotive
S22	Male		
S23	Male		
S24	Male		

Table 3.1 (continued)

After defining the sample group, early visits to the ID402 Graduation Project course during their weekly sessions in March 2022 were made. In light of the design critics and design talks protocol of Online Survey A (Entitled: *Beginning of Process Survey for Graduation Projects with Digital Product Development*) (see Appendix D) was formed in Google Forms. It consists of 17 open-ended and completely structured questions. They are mainly about the experiences of participants on the subject, their digital design preferences, and their desired process for the graduation project. While structured questions help gather technical data and background information, open-ended questions help gather information on subjective aspects such as preferences on ideation, sampling, and user research. The last five questions in this survey are about the user selections, problem and need definitions, and opportunities and options for user involvement in the further phases of graduation projects of the participants. Online Survey A was spread out on April 28, 2022, for the first time. Submission was open until May 28, 2022. During this period, four reminder mails to students were sent out. At the end of the semester, 15 out of 24 students filled out Online Survey A with their valuable contributions (see Figure 3.2).

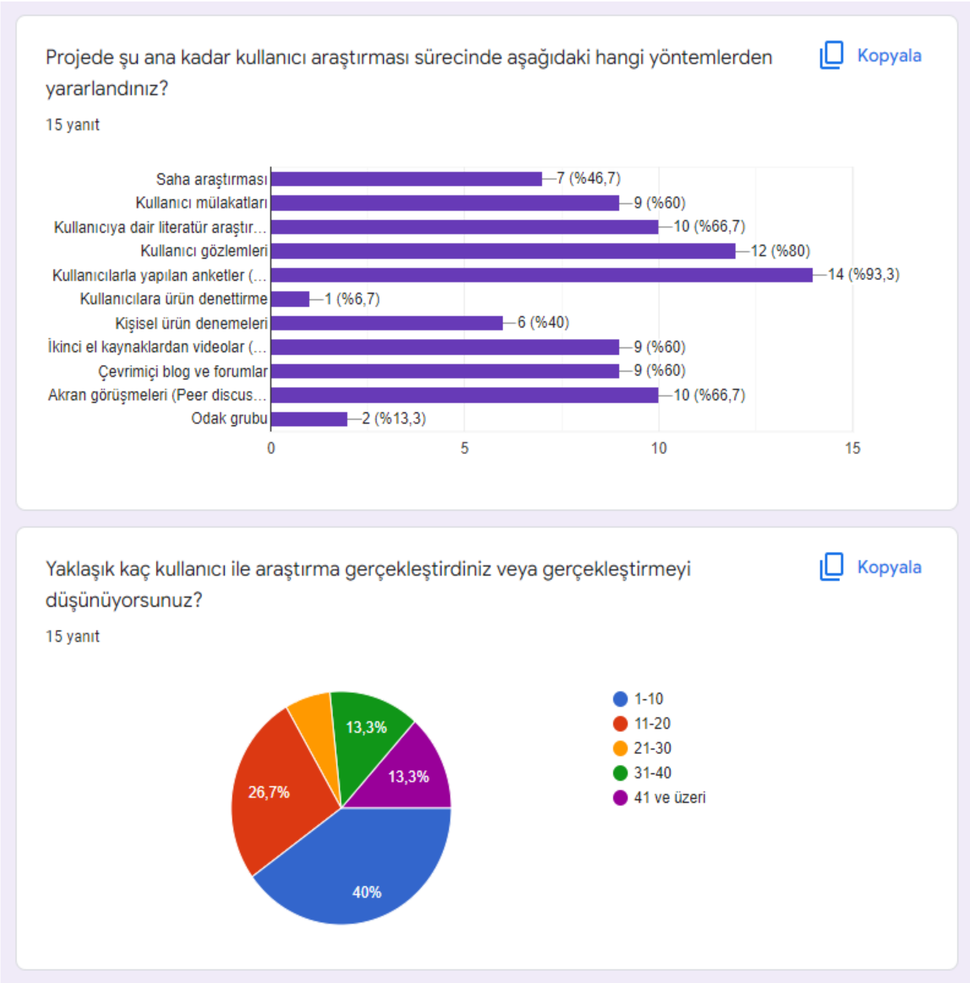

Figure 3.2: Partial Outputs of Online Survey A on Google Forms

During April and May 2022, according to the literature review and the analysis of the early outputs of the Online Survey A, the protocol of Online Survey B (Entitled: *End of Process Survey for Graduation Projects with Digital Product Development*) was formed in Google Forms (see Appendix E). This survey consists of 15 open-ended and completely structured questions. Structured questions gather data on the technical issues like types of methods or sources participants used during their processes. These questions complement open-ended questions by presenting the pick points of digital product development. There are questions on overall opinions of the participants about their projects, positive and negative issues that appeared during the semester, their interactions with stakeholders, and construction and use of their user profile. Online Survey B was sent out on June 10, 2022, to the 24 students selected at the beginning of the semester, and it was closed at the end of June 2022. During this period, four reminder mails to students were sent out. At the end of the semester, 9 out of 24 students filled out Online Survey B with their valuable contributions (see Figure 3.3).

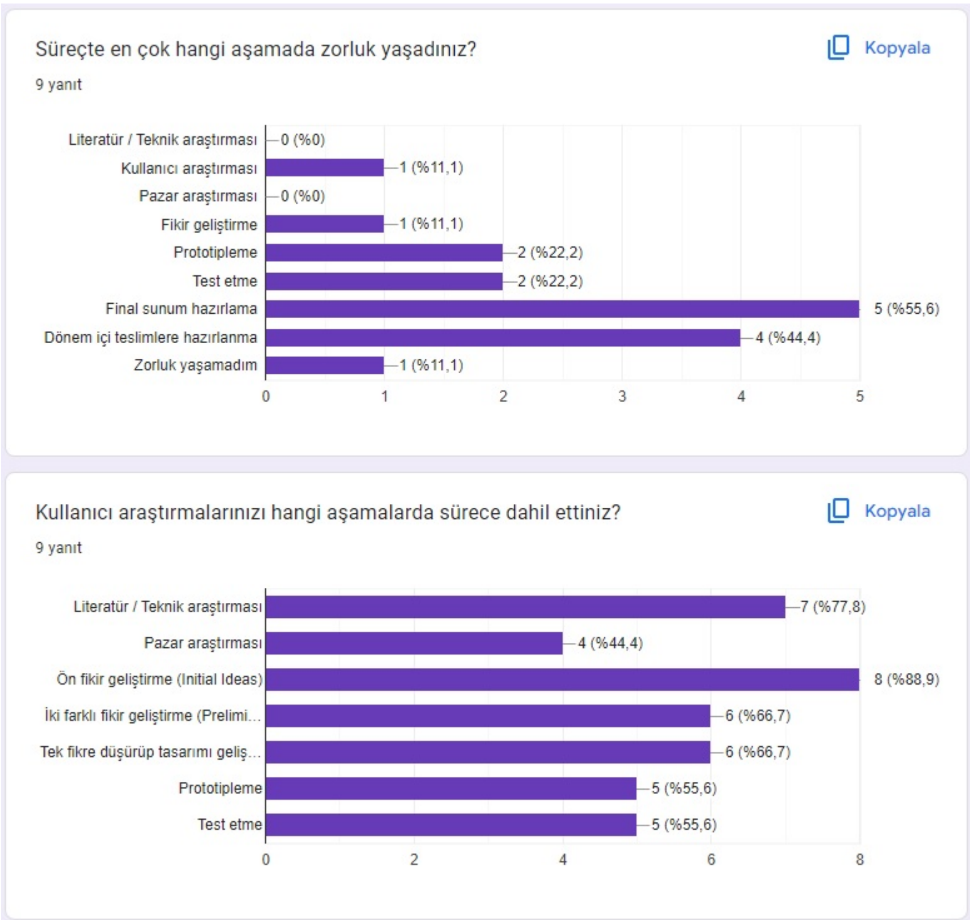

Figure 3.3: Partial Outputs of Online Survey B on Google Forms

Responses to both surveys, together with graduation project submissions of the students, were examined and used as a guideline while forming the protocol for the semi-structured interviews. Additionally, attending METU Department of Industrial Design Graduation Jury and Exhibition 2022 (dated June 21-23, 2022), presented insights on research and presentation techniques of the students by their own words, and additionally it provided useful information on evaluation approaches and comments of the academics on digital product development without doing any systematic data collection (see Figure 3.4).

Figure 3.4: METU Department of Industrial Design 2022 Graduation Projects Exhibition (dated June 21-23, 2022)

3.2.1.2 Visual Content Analysis of Graduation Projects Submissions

Content analysis is a research method that can be used in both qualitative and quantitative research to analyze the content of visual or textual data, such as interviews, articles, advertisements, and more (Forman & Damschroder, 2007; Miles, Huberman, & Saldaña, 2014). While quantitative content analysis focuses on analyzing the frequency of words, codes, or themes within the data (Riffe, Lacy, Fico, & Watson, 2019), qualitative content analysis focuses on interpreting the raw data and, by identifying themes and patterns within, illustrates novel data with new meanings (Mayring, 2019). Overall, the goal of content analysis is to identify themes within a data and answer questions by developing insights or frameworks into research studies (Miles, Huberman, & Saldaña, 2014).

Many researchers use content analysis as a research method in the fields of design and UX for understanding the needs, behaviors, and perceptions of the users (Greifeneder, 2010; Hamurcu, 2018; Chrysochou & Festila, 2019). Researchers gain insights on the user perception by analyzing user-generated contents such as user reviews, or tutorial videos or images of a certain product or service. With the help of doing a content analysis, while researchers can learn how users use the product, they also learn about what users prefer or what their dislikes or issues are regarding the product (Greifeneder, 2010). Thus, this analysis illustrates possible improvements of the products and services. Additionally, in the field of design, content analysis is used to analyze visual content such as pictures, posters, or videos. By coding and categorizing visual aspects of the raw data, researchers understand how users interact or visually perceive products (Bell, 2001). This visual content analysis enhances the visibility of different design representation styles and idea generation strategies within the raw data used by designers (Börekçi, 2017). Additionally, visual content analysis presents a non-biased data by showing the methods, experiences, and performances of designers within the overall design process (Daalhuizen, Person, & Gattol, 2014). This insight is helpful to shape design decisions of the designers for future projects.

3.2.1.2.1 ID402 Graduation Project Course Conduct

In this research, submissions to METU Department of Industrial Design ID402 Graduation Project course by 24 students were explored through content analysis method during 2021-2022 Spring Semester. Course supervisors approved the research and provided timetable of the course (see Appendix N) and the briefs of each step followed during the project development. 2021-2022 Spring Semester lasted 16 weeks, starting on March 7, 2022 and ending in June 24, 2022 with the last day of graduation exhibition and final jury. ID402 course was taught for 12 hours a week, and in several weeks, the advisor firm officials met with the students during the course hours and followed their critics and project development in detail. Excluding weekly design critics, seven groups of submissions made by the students were analyzed in the research; (1) *Workshop I: Project Elaboration*, (2) *Workshop II: Project Elaboration II*, (3) *Workshop III: Idea Generation*, (4) *Initial Ideas Jury*, (5) *Workshop IV: Constraints, Objectives, & Directions (CODs)*, (6) *Preliminary Jury*, and (7) *Final Jury*.

Workshop I entitled *Project Elaboration* (dated March 14, 2022) consisted of three parts; describing the scope and the statement of the project, assigning the keywords to statement of the project, and analysis of related products to the project (see Appendix F). Workshop II entitled *Project Elaboration II* (dated March 17, 2022) consisted of three parts; group discussion on project statement, group discussion on project analysis, and research planning (see Appendix G). Workshop III entitled *Idea Generation* (dated March 21, 2022) consisted of four parts; designing for creative crossovers, developing immediate ideas, developing radical and adventurous ideas, and continuing idea generation (see Appendix H). Following the first three workshops, *Initial Ideas Jury* (dated March 27-31, 2022) required the demonstration of the progress with an emphasis on the foundation and generating the ideas in the project (see Appendix I). This submission was graded internally by the course coordinators. Workshop IV entitled *Constraints, Objectives & Directives (CODs)* (dated April 4, 2022) consisted of three parts; identification of CODs, COD-based evaluation of two initial ideas, and re-evaluation of CODs (see Appendix J). *Preliminary Jury* (dated April 25-28, 2022) was the next assignment during the process; a separate set of requirements was defined for digital product developing students with customer journey map (CJM) including persona, scenario, touchpoints, feelings and emotions explained in annotations, and benefits respectively, IA, flow diagram, and concept and design system as the requirements (see Appendix K). This submission was also graded internally. Ultimately, *Final Jury* (dated June 21-23, 2022) submission required concept presentation board, technical presentation boards, CJM, IA, flow diagram, concept and design system, and either an interactive app/GUI/game design prototype or a product/app/GUI/game design animation or video (see Appendix M), again, specifically defined for digital product developing students. This submission was graded by the course instructors as well as external examiners forming a jury panel.

3.2.1.2.2 Analysis of Assignment Briefs and Submissions

According to the submission briefs, firstly, submissions of 24 students were sorted, in which submissions were categorized according to their owners, advisor firms, and assignments in a Microsoft Excel table (see Table 3.2). The first column represents the owner (student) of the submission, the second column represents the advisor firm that the student works with, and the following seven columns represent Workshop I, Workshop II, Workshop III, Initial Ideas Jury, Workshop IV, Preliminary Jury, and Final Jury submissions, respectively. This table only shows student submissions made. It is formed to make general data easy to read and does not include any data analysis. According to this table, the majority of the 24 students made their submissions regularly throughout the semester. In the table, students with delivery deficiencies are indicated with not applicable (N/A) in the relevant cells. Graded assignments are indicated in the green cells.

Table 3.2: Graduation Project Submission List

Student #	Firm	W.I	W.II	W.III	I.I. Jury	W.IV	P. Jury	F.Jury
S1	A	OK	OK	OK	OK	OK	OK	OK
S2		OK	OK	OK	OK	OK	OK	OK
S3		OK	OK	OK	OK	N/A	OK	OK
S4		OK	OK	OK	OK	OK	OK	OK
S5		OK	OK	OK	OK	OK	OK	OK
S6		OK	OK	N/A	OK	OK	OK	OK
S7	B	OK	OK	OK	OK	OK	OK	OK
S8		OK	OK	OK	OK	OK	OK	OK
S9	C	OK	OK	OK	OK	OK	OK	OK
S10		OK	N/A	N/A	OK	OK	OK	OK
S11	D	OK	OK	OK	OK	OK	OK	OK
S12		OK	OK	OK	OK	OK	OK	OK
S13		OK	OK	OK	OK	OK	OK	OK
S14	E	OK	OK	OK	OK	OK	OK	OK
S15		OK	N/A	N/A	OK	OK	OK	OK
S16	F	OK	OK	OK	OK	OK	OK	OK
S17		OK	OK	OK	OK	OK	OK	OK
S18		OK	OK	OK	OK	OK	OK	OK
S19	G	OK	OK	N/A	OK	OK	OK	OK
S20		OK	OK	OK	OK	OK	OK	OK
S21	H	OK	OK	OK	OK	OK	OK	OK
S22		OK	OK	OK	OK	OK	OK	OK
S23		OK	OK	OK	OK	OK	OK	OK
S24		OK	OK	OK	OK	OK	OK	OK

Since the raw data to be analyzed for visual content consists of the submissions of students including photographs, sketches, doodles, and templates, it was not found suitable to perform visual data analysis through Microsoft Excel, which is used to interpret analytical data. For this reason, a new board was prepared for the visual content analysis on the Miro digital platform, in June 2022, with the same format as in Table 3.2 (see Appendix V).

In this table, color coding method is used. The first two columns show the advisor firms and the students who carried out projects with these firms in a color-coded manner. In addition, relevant signs were made next to the names of students who participated in Online Surveys A and B, and those with the potential to participate in semi-structured interviews were marked. White diamond shape was used for Online Surveys A and B, while white triangle shape was used for semi-structured interviews. All the following columns show an assignment each. Below them are given information about the submission of the related students.

Visual content analysis of student submissions was carried out in the summer of 2022. First, briefs of all assignments were reviewed and processed on the Miro board, which was prepared in June. At this stage, first the brief was read in detail, and then the student submission related to the brief was examined, the most well explained student submission or submission extracts according to the brief were taken and placed in the table. Non-submitted assignments were marked in color red; assignments that responded to the brief and contained additional information or work were marked in color green. In the first stages, some students worked with hand drawing, while others delivered via computer.

In general, students had the most difficulty in the assignments of *Workshop II* and *Workshop III.* Although they have very strong studies about idea generation, they have had problems with the number of deliveries. For instance, many students had some difficulties to deliver the required number of different ideas in idea generation while some others submitted the required number of ideas but the last few of them were either very similar to each other or were completing each other. In addition, while studies on presentation techniques such as font and color were less common at the beginning, interests of the students in these areas increased towards the end of the semester. Additionally, there were students who made only written submissions towards to the end of the semester. As an early finding, visualization of the submission was perceived as the last-minute detail among students.

3.2.1.3 Semi-Structured Interviews

In the qualitative research approach, conducting semi-structured interviews is a common method for gathering data concerning identities, cultures, feelings, values, and experiences (Matthews & Ross, 2010). Semi-structured interviews could be conducted face-to-face, through phone calls, or via online video calls. In these unstructured conversations, researchers ask open-ended questions to participants and get information on their experiences and perspectives in their own words (Merriam & Tisdell, 2016). This semi-structured process allows the researcher to change the order of the interview questions and ask additional questions depending on the emerging issues during the interview (Gray, 2009).

In this research, the semi-structured interview method is the last data collection method. Firstly, semi-structured interviews were conducted with the METU industrial design students who participated to both Online Survey A and Online Survey B during their ID402 Graduation Project course. The selection of the semi-structured interview participants was based on the online survey answers as well as their outputs of their graduation projects. Therefore, at the end of the semester, whole design process of the survey participants was examined through their submission, concentrating on the visibility of digital product development and interaction with users (see Section 3.2.1.2). After the selection of the participants and forming the interview guide according to the early findings of online surveys and submissions of the students, semi-structured interviews with students were conducted during August and September 2022 (see Figure 3.3). These interviews lasted 105 minutes in total, with 35 minutes in average.

Table 3.3: Semi-Structured Interview Participant List (Students)

#	Gender	Firm	Date	Duration
P1	Female	C	August 9, 2022	35 minutes
P2	Female	A	August 22, 2022	38 minutes
P3	Female	D	September 12, 2022	32 minutes

The interview guide for industrial design students (see Appendices O-P) contains 13 open-ended questions, and they are formed under four headings, (1) industrial design education, (2) digital product development, (3) user research, and (4) wrap-up. In these interviews, questions further explore digital product development process of the students in a more accessible and informal way. Starting from the ideation phase, user research, development, prototyping, and testing phases were explored deeply in the interviews. Additionally, questions regarding the impact of social interactions with stakeholders were discussed to understand better the position of academics and UX professionals in the process. In this way, interactions and impacts of other disciplines, therefore other professional cultures, on the digital product development process were revealed.

Since the previous data collection phases were focused on industrial design students only, conducting semi-structured interviews started with the selected students. At the end of the third semi-structured interview with the industrial design student, according to the field notes, while they provided in-depth information regarding the research context, it was observed that the majority of the data was very similar to those gathered from the online surveys and collection of graduation project submissions. Therefore, conducting semi-structured interviews with industrial design students was cut short, and conducting semi-structured interviews with industrial design academics and UX professionals was started with the motivation of exploring the impact of past and present practical experiences on UX and digital product development process.

During 2022-2023 Fall Semester, between September 2022 and December 2022, 14 semi-structured interviews with industrial design academics who have experience in facilitating courses focusing on UX/UI, digital product development, and user research from multiple universities (i.e., METU, Atılım University, TED University, Özyeğin University, Koç University, and Kadir Has University) were conducted (see Table 3.4). These universities and departments were selected as their current course implementations focusing digital product development and UX practices. These interviews lasted 653 minutes in total, with 47 minutes in average. The interview guide for the academics (see Appendices Q-R) contains 18 open-ended questions formed under the same headings from the interview guide for industrial design students. In the interviews, academics shared their personal experiences and perceptions towards digital product development and the significance of UX practices in the industrial design education and curriculum. The importance of interdisciplinarity, the collaboration of educational institutions with industry, involvement of professional agencies and the courses they offer, and technology literacy were among the focal points of these interviews.

Table 3.4: Semi-Structured Interview Participant List (Academics)

#	Gender	University	Teaching Status	Date	Duration
P4	Female	U_A	Full-Time	September 27, 2022	27 minutes
P5	Female	U_A	Full-Time	September 27, 2022	53 minutes
P6*	Male	U_B	Part-Time	October 17, 2022	40 minutes
P7*	Female	U_B	Full-Time	October 17, 2022	54 minutes
P8*	Female	U_B	Full-Time	October 31, 2022	48 minutes
P9*	Male	U_B	Full-Time	November 2, 2022	50 minutes
P12	Female	U_B	Full-Time	November 7, 2022	46 minutes
P16	Female	U_B	Full-Time	November 11, 2022	45 minutes
P23	Female	U_C	Full-Time	November 24, 2022	41 minutes
P25	Female	U_D	Full-Time	November 28, 2022	71 minutes
P26	Male	U_B	Part-Time	November 29, 2022	48 minutes

P27	Male	U_B	Part-Time	November 30, 2022	40 minutes
P34	Female	U_E	Full-Time	December 16, 2022	56 minutes
P35	Male	U_F	Part-Time	December 19, 2022	34 minutes

* Academics who have experience in ID402 Graduation Project course.

Table 3.4 (continued)

While conducting semi-structured interviews with academics, at the same time conducting semi-structured interviews with UX professionals took place between November and December 2022. During this period, a total 18 semi-structured interviews were conducted with UX professionals who have work experiences in the fields related to digital product development and UX practices (i.e., game design, digital museology, e-commerce, automotive, finance, defense, software, and consultancy) (see Table 3.5). This participant group was firstly formed with advisor firm officials within the scope of ID402 Graduation Project course. Then, snowball sampling was used to reach UX professionals who worked in the advisor firm but were not involved in the graduation project process. Finally, considering the information given to the interviewed UX professionals about the scope of the research, their colleagues from different organizations were contacted and UX professionals who did not have experience in the graduation project process, who could be considered as external, were reached. In this way, the UX professional group within the scope of semi-structured interviews was finalized as a diverse group working in different fields and having different knowledge and experiences within the scope of graduation projects. In addition to their professional experiences in UX practices, most of these participants also have academic experiences as being either part-time instructors or lecturers in the several universities. These interviews lasted 699 minutes in total, with 39 minutes in average. The interview guide for UX professionals (see Appendices S-T) contains 20 questions. These questions are formed under five headings, (1) warm-up, (2) professional experiences, (3) industrial design education, (4) user research, and (5) wrap-up. These questions mainly focused on work experiences of UX professionals in an interdisciplinary setting. The impact of educational backgrounds and design culture on UX practices were deeply discussed in these interviews. Findings of these interviews reveal the relationship between design education and UX practices. Since there are many professionals with different backgrounds such as engineering, economics, psychology, anthropology, or other creative industries working in these positions, their data presents different perspectives on the subject. In that context, the impact of different educational backgrounds on UX practices in a work environment were also emphasized.

Table 3.5: Semi-Structured Interview Participant List (UX Professionals)

#	Gender	Industry	Date	Duration
P10*	Male	Game Design	November 3, 2022	32 minutes
P11*	Female	Digital Museology	November 3, 2022	38 minutes
P13*	Male	e-Commerce	November 7, 2022	36 minutes
P14*	Female	Digital Museology	November 7, 2022	25 minutes
P15*	Male	Automotive	November 8, 2022	28 minutes
P17*	Female	Automotive	November 15, 2022	56 minutes
P18*	Male	Finance	November 16, 2022	54 minutes
P19*	Female	Finance	November 16, 2022	41 minutes
P20*	Female	Automotive	November 16, 2022	25 minutes
P21*	Female	Automotive	November 17, 2022	23 minutes
P22*	Female	Automotive	November 22, 2022	37 minutes
P24*	Female	Finance	November 28, 2022	31 minutes
P28	Female	Defense	November 30, 2022	40 minutes
P29*	Female	Software	December 9, 2022	57 minutes
P30	Female	Finance	December 12, 2022	48 minutes
P31	Male	Software	December 12, 2022	43 minutes
P32*	Female	Software	December 15, 2022	31 minutes
P33	Male	Consultancy	December 15, 2022	54 minutes

* UX professionals who are also advisor firm officials in the ID402 Graduation Project course.

With a snowball sampling method (Merriam & Tisdell, 2016), a total 35 semi-structured interviews were conducted with industrial design students, academics, and

UX professionals. They lasted 1453 minutes in total with an average of 42 mins per participant. All the interviews were recorded via Microsoft Teams application. Microsoft Teams application provides the transcripts of the interviews with an approximately 80% accuracy. In addition to the video recordings of the semi-structured interviews, audio recordings were also taken for checking the video recordings. After conducting each interview, their transcriptions were double-checked via audio recordings, and their final transcription folders were prepared for coding purpose.

3.2.2 Data Analysis Process

The research adopts a qualitative approach, in which researchers are systematically analyzing and coding the data (Merriam & Tisdell, 2016). Different analysis methods such as thematic analysis (Given, 2008) and template analysis (King, 2012) can be used at various stages of the data analysis process, depending on perspective of the researcher, research aim, questions, approach, and goals (Flick, 2009). In qualitative research, the thematic analysis method identifies themes within a group of people or events (Given, 2008). These themes include and present the initial topics, ideas, and patterns of meanings regarding the main research area. Perceptions of groups of people and experiences are discussed heavily. Later, the identified themes are analyzed and coded considering the relevant studies in the literature (Saldaña, 2015). On the other hand, in the qualitative approach, the template analysis method focuses on the previously used or constructed templates, themes, and processes (King, 2012). Pre-created templates and outlines mainly act as guidelines in this method. Its common use comes from its flexibility according to the needs of the research in the analysis phase.

Coding is a vital part of qualitative research studies that helps researchers to organize and analyze their gathered data through several data collection methods such as interviews or observations (Elliott, 2018). Coding involves taking apart the collected data into pieces, assigning segments based on the concepts, and putting them together in a new and meaningful way (Creswell, 2009). In other words, by coding researchers turning raw data into meaningful outputs (Miles, Huberman, & Saldaña, 2014). Research studies emphasize several strengths of coding in qualitative data analysis regarding management, analysis, interpretation, and increasing reliability and validity of the data (Chowdhury, 2015; Linneberg & Korsgaard, 2019). In qualitative data analysis, coding helps researchers by organizing large amount of data. By categorizing data, coding enables researchers to see and define themes and their connections within the data. This process shows a way of drawing meaningful findings through the collected data in a novel form.

Since this research focuses on the design process and collects qualitative data through surveys and semi-structured interviews as well as design submissions including visual content, thematic analysis is adopted to identify preferences, events, experiences, methods, tools, and strategies, and coding is used in as the procedure.

After transcribing the collected textual data, a data analysis template containing the codes and themes formed from the transcriptions was constructed. According to Merriam and Tisdell (2016), in the coding process, researchers classify contents and organize the overall outline of their research plans. Nowadays, with the help of global technological enhancements and innovations, the coding process has become less complex and less time-consuming (Miles, Huberman, & Saldaña, 2014). In that sense, all the collected data were analyzed and coded through computer software for this research. Microsoft Excel and Miro digital platform were used for categorizing and analyzing the short answers of the online surveys. However, semi-structured interviews have much longer answers. Therefore, a more complex computer software entitled MaxQDA was used to analyze the data (see Figure 3.5).

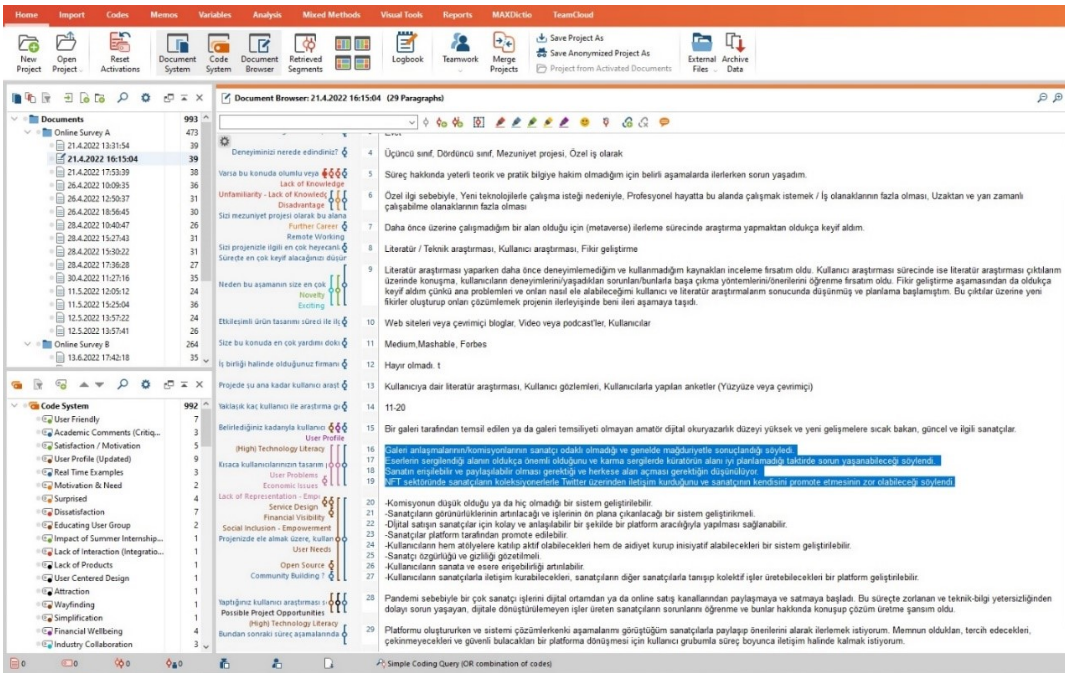

Figure 3.5: Data Analysis Phase on MaxQDA

3.2.2.1 Coding Process of Survey Data

The online surveys were formed and carried out in Google Forms (see Section 3.2.1.1) which presented their outputs through visuals. While the results of direct questions were illustrated in Google Forms, coding was needed to draw conclusion from open-ended questions. To do that, a coding process was carried out in the computer software MaxQDA between July and August 2023. During this period, coding was carried out in two cycles. During the first cycle, each answer of the participant was read and was assigned to keywords or draft codes. The relationship between keywords were analyzed and formed into several codes. While doing this, several codes were deleted, or they were combined into a larger one. At the end of the first coding period, relevant codes were grouped and formed under a code system (see Figure 3.6). The complete code table for online surveys in MaxQDA is presented in the Appendix U of the thesis.

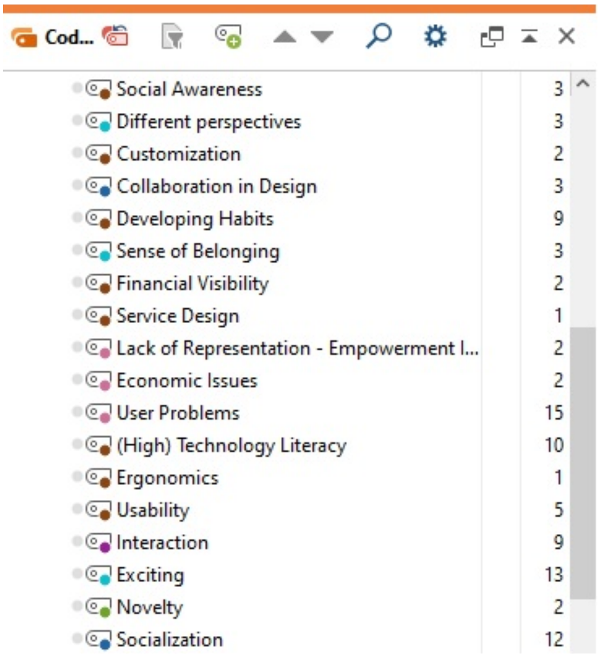

Figure 3.6: Code System for Online Surveys in MaxQDA

In the second cycle, a more detailed coding was carried out concentrating on the frequencies and relevancies of the codes to each other and the aim of the research. During this period, interconnections of the codes and their contexts were categorized with the relation of literature review. For instance, there are many research studies focusing on and defining the digital product development process and its stages. This thesis constructed its digital product development process according to an updated and summarized form multiple research studies as; (1) research, (2) ideation, (3) design, (4) development, and (5) launch. Additionally, in the second cycle of coding, a detailed color-coding was carried out to categorize the codes visually. As a result, a code map was constructed in MaxQDA (see Figure 3.7).

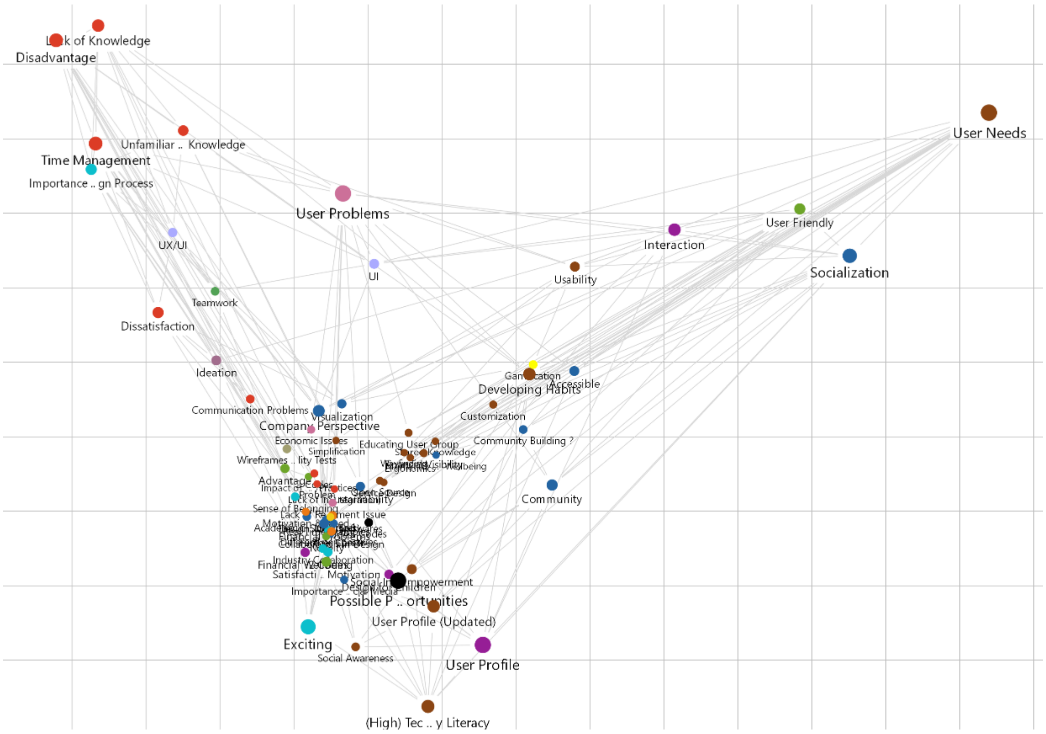

Figure 3.7: Code Map of Online Surveys from MaxQDA

However, the complexity of the code map created an obstacle while working on the results. Therefore, codes were arranged hierarchically as a code network on the Miro digital platform according to the code map to select the best suitable quotations for the findings and insights chapter of the research (see Figure 3.8). At the end of the coding process, the final outline of the online survey results was formed under three headings; (1) research process, (2) design process, and (3) key drivers in the digital product development process. After the final version of the outline was created with the help of the code network on Miro, the best quotations supporting the themes and aim of the research were selected and were translated into English to be added in the findings and insights chapter of the thesis. Original Turkish versions of the quotations and conversations are presented in the Appendix V of the thesis from number one to 67.

Figure 3.8: Extract of the Hierarchical Code Network on Miro Board

3.2.2.2 Analysis Process of Student Submissions

The visual content analysis of the student submissions was conducted in two cycles through the Miro digital platform (see Section 3.2.1.2). Before starting the visual content analysis, firstly, the digital product development processes of 24 students in the 2021-2022 Spring Semester ID402 Graduation Project course B section were defined and staged according to the project briefs and the course calendar. In the first cycle, all submissions of the 24 students were analyzed in detail according to what was requested by the course instructors in each assignment and how well the student submissions complied with the briefs. This analysis was intended to understand how the overall design process of the students was, what methods and strategies they used at which stage and how they reflected these in their design processes (see Appendix V).

The second cycle of visual data analysis involved a more detailed investigation of digital product development processes of the students through their project process portfolio submissons. Unlike the first cycle, in the second cycle, portfolios of the eight students were analyzed in detail. Several important factors influenced the selection of these eight students. First, one student with complete submissions from each of the eight advisor firms was selected. Then, the design processes of these students were analyzed by comparing them with the design briefs. How the students responded to the tasks in the briefs was analyzed in detail in this cycle. The grades that students received on their submissions were also taken into consideration during the student selection for the second cycle. In addition to these criteria, three of the eight selected students participated in the surveys and interviews. Three students only participated in the survey and the last two students were not involved in any additional data collection process (see Table 3.6).

Table 3.6: Students in the Second Stage of the Visual Content Analysis

#	Gender	Firm	Grade	Survey Participant	Interview Participant
S2	Female	A	AA	Yes	Yes
S8	Female	B	BA	No	No
S9	Female	C	AA	Yes	Yes
S11	Female	D	BA	Yes	Yes
S15	Female	E	BB	Yes	No
S17	Female	F	AA	Yes	No
S19	Male	G	BB	Yes	No
S24	Male	H	AA	No	No

In the second cycle of visual content analysis, in addition to the methods and strategies used by the students, how they constructed their research processes was examined. How they conducted user research and how many people they interviewed using which methods were detailed. In addition, the content of their research questions while preparing for user research was evaluated in terms of their richness, which questions they sought answers to and at what scale, and the answers they found were evaluated together. Apart from the user research phase, another phase that was evaluated in detail was the idea development phase that students carried out in the digital product development process. At this stage, it was examined how students transformed their research findings into design ideas. How many ideas the students generated and how they explored and reflected these ideas provided important data to the study.

3.2.2.3 Coding Process of Interview Data

The coding process of the semi-structured interviews was carried out similar to the coding process of the open-ended questions of the online surveys. Firstly, the audio recordings of the semi-structured interviews were listened to again, the transcripts were read once, and the main keywords and possible codes were marked. This stage was done entirely in Microsoft Word documents and manually annotated. Audio recordings and occasionally video recordings helped to recall the interviews and to understand unwritten gestures. This first reading phase led to the draft codes. According to this initial coding, the semi-structured reviews were categorized under three main headings (1) UX in industrial design education, (2) implementation of graduation projects, and (3) becoming UX professionals. Then the main codes and related notes and draft quotations were put into Miro software, which acted as a whiteboard, and a hierarchical mind map was created as a draft (see Figure 3.9).

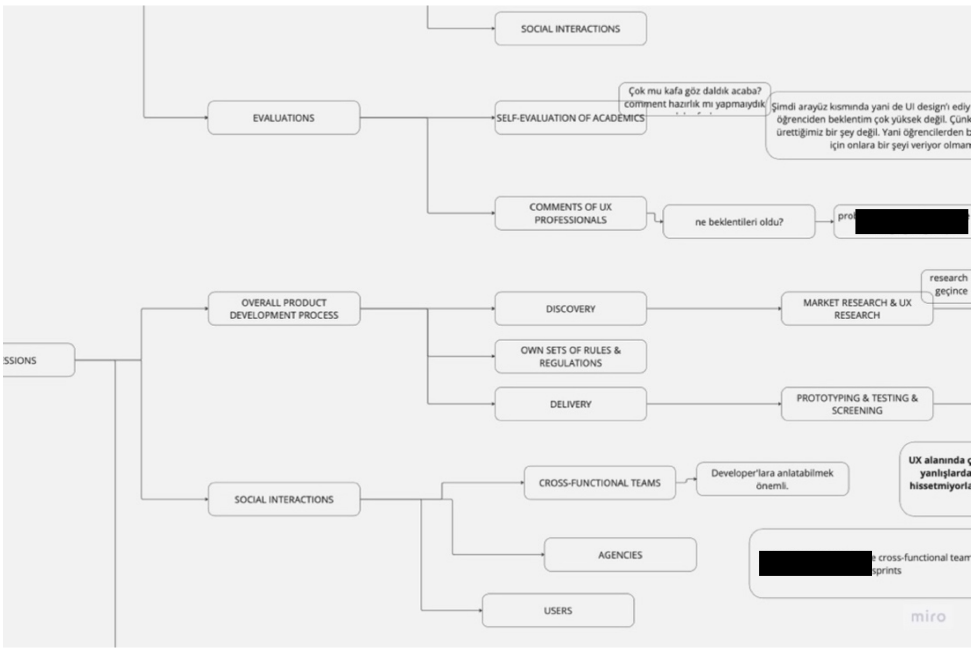

Figure 3.9: Partial Draft Code Map for Semi-Structured Interviews

Then, the transcription files with their codes and various quotations highlighted were uploaded to the MaxQDA software, as in the coding process of the online surveys. At this stage, each interview file was carefully read for a second time, and several keywords were assigned to the quotations. In this way a structured outline was created for Section 4.3 of this thesis. Since the coding phase of the online surveys was very similar to the process of the semi-structured interviews, the experiences there shaped and facilitated the coding process of the semi-structured interviews. For instance, in the coding process of the online surveys, the code map obtained through the MaxQDA software had a complex structure, and this approach was not followed in the coding process of the semi-structured interviews. Since the semi-structured interviews were the last method of the data collection phase of the research, the findings and insights of a certain part of the thesis were identified in this coding process. In addition, since the theoretical framework of the thesis, which was built on the literature review, was structured to a certain extent, the coding process of the semi-structured interviews was easier and faster than the analysis of other data collection methods. After the final version of the outline was created with the help of the notes and hierarchical code map on Miro, the best quotations supporting the themes and aim of the research were selected and were translated into English to be added in the findings and insights chapter of the thesis. Original Turkish versions of the quotations and conversations are presented in the Appendix W of the thesis starting from number 67.

3.3 Summary

This chapter illustrated the research methodology of the doctoral thesis. The chapter first presented its qualitative research approach due to its abstract, subjective, and experience-based context. Then, the chapter presented its research methodology by focusing its data collection and analysis processes. In data collection process part of the section, three selected data collection methods; online surveys, visual content analysis, and semi-structured interviews were presented through the reasons of selection, their sampling, and impletation processes, all in line with the sources from related literature. Second part of the data collection process section revealed the data analysis process of the research. This section explained the coding and analyzing processes with their stages. The section also described how the most suitable codes and quotations were selected to be used as the findings. Lastly, the section mentioned the translation of the selected quotations.

In the following chapter, findings from the field research and their insights formed accordingly, are presented under three headings; (1) findings from the online surveys, (2) findings from the analysis of graduation projects submissions, and (3) findings from the semi-structured interviews.

CHAPTER 4

FINDINGS AND INSIGHTS

This chapter presents the findings of the research and insights derived from these in three headings. These sections while illustrating the findings from the field research, also contain the insights that provide discussions formed considering the findings. First, the chapter illustrates the findings of the online surveys conducted with industrial design students who developed digital products as part of their graduation projects at METU Department of Industrial Design in the Spring Semester 2021-2022. Then, the chapter explains the analysis of the graduation project submissions and project process portfolios of the students. Lastly, the chapter describes the findings of the semi-structured interviews conducted with industrial design students, academics, and UX professionals.

4.1 Findings from the Online Surveys

As described in detail earlier (see Section 3.2.1.1), online surveys constituted the first data collection method of the thesis. How the digital product development process is handled in industrial design education has an important place in the research scope of this thesis. In this context, online surveys were used to obtain detailed information about digital product development process, and especially the UX research phase, of the students. To conduct online surveys, 24 students who developed digital products (fully digital and/or hybrid) in collaboration with the industry through eight advisor firms within the scope of the ID402 Graduation Project course at METU Department of Industrial Design were selected. Two online surveys (Online Surveys A and B) were distributed to these 24 students at the beginning of the semester (March 2022) and at the end of the semester (June 2022) to examine their digital product development processes concerning their graduation projects. This section of the thesis was analyzed through an outline (see Figure 4.1) constructed according to the responses of the students to these surveys.

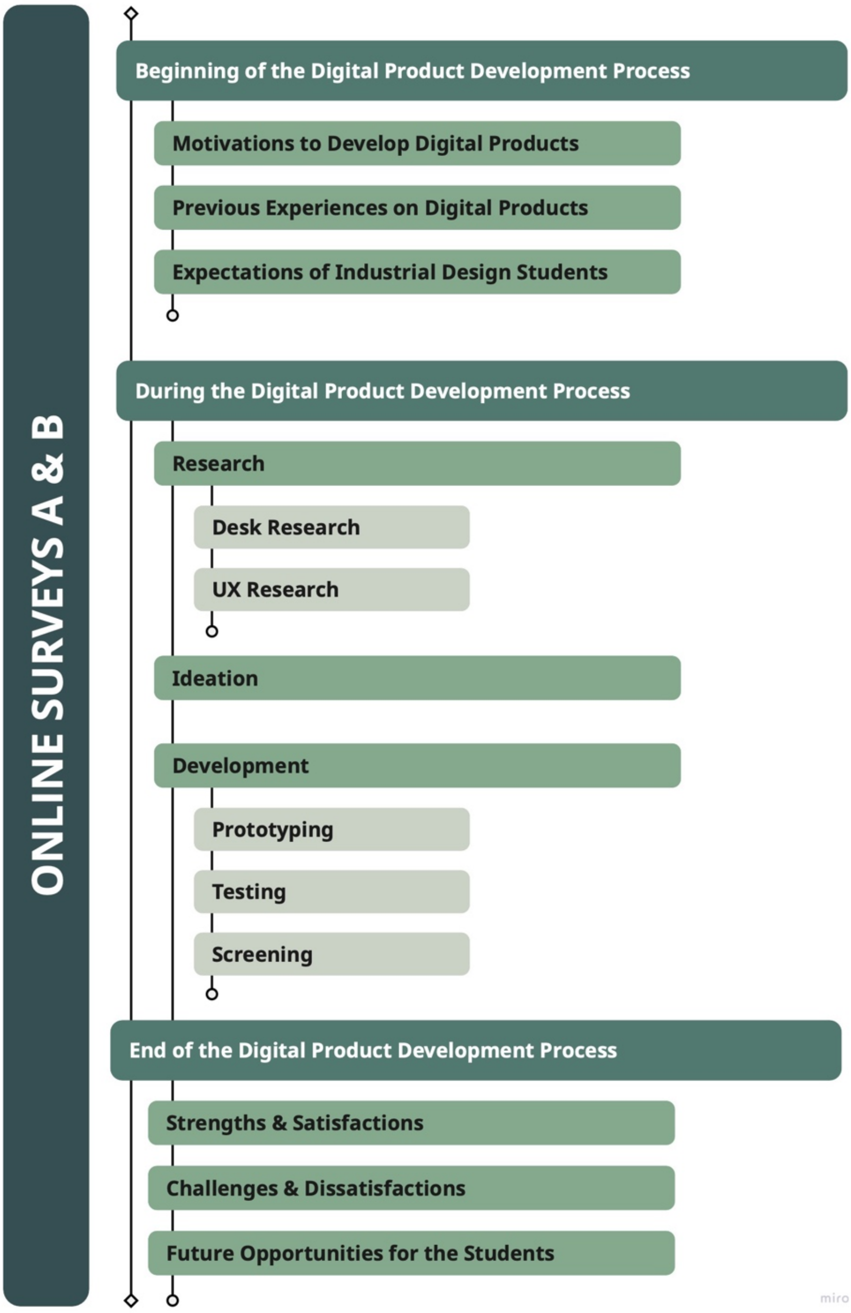

Figure 4.1: Outline of Online Surveys

As seen in Figure 4.1, the analysis of online surveys A and B is organized under three main headings; beginning, during, and end of digital product development process, and is explained through this flow. All quotations in this section have been translated from Turkish to English. Original quotations can be found in Appendix V.

4.1.1 Beginning of the Digital Product Development Process

The data for this section is mostly based on the Online Survey A that students filled out at the beginning of their digital product development process. The section describes; (1) motivations of students for working on digital product development, (2) past experiences of students with digital product development, and (3) expectations of students regarding the digital products they will develop as a graduation project.

4.1.1.1 Motivations of Students to Develop Digital Products

Nowadays, academic research with many industrial design students and graduates has shown that industrial designers are increasingly turning to UX professions that focus on digital product development (Kiernan & Ledwith, 2014; Süner-Pla-Cerdà et al., 2021). Examining the motivations behind this professional trend among industrial designers is one of the points that this thesis addresses. For this reason, the motivations of students who develop digital products for their graduation project have an essential place in the Online Survey A (see Figure 4.2).

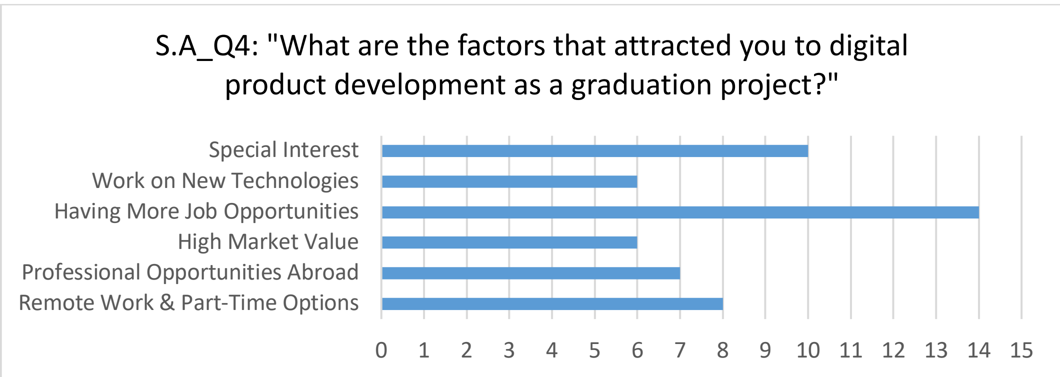

Figure 4.2: Reasons to Develop a Digital Product for the Graduation Project

As seen in Figure 4.2, the biggest factor in the motivations of industrial design students towards digital product development is the desire to work in this field in a professional sense and the high job opportunities in this field due to the current market focus on the field. Nowaday, many job openings for industrial design and product design disciplines are focusing on UX designer, UX researcher, and (digital) product designer. Job vacancies for traditional industrial design education, in which students are currently enrolled, are limited to certain industries (e.g., furniture, glassware). Another factor that stands out in Figure 4.2 regarding student motivations is their interest in new technology and the digital field. The fact that the surveyed students are more inclined towards job opportunity than special interest and willingness to work on new technologies provides information about the financial concerns of the students before they graduate. Students want to gain experience in this field in their graduation projects and take part in the market in a more confident way. Another factor that makes this statement valid is that students want to go abroad and/or prefer a flexible professional life by working remotely or part-time. Many of the areas associated with digital product development support remote working. Almost all of the digital product development process takes place online and in a collaborative setting through rapid iterations. This provides financial advantages and timesavings for both firms and employees. In addition, students who have adapted to flexible working in their design education show special interest in remote and part-time options of digital product related fields. Designers working long hours and working overtime in design offices and/or production-oriented workspaces are among the reasons why industrial design students prefer remote working.

When the answers to the open-ended questions in the survey were analyzed, it was seen that the students primarily associated their motivation with developing novel and creative solutions. Student #20 made the following comment about their motivations to develop a digital product as their graduation project.

[1] “The fact that there is no other product on the same subject, that it contains fun content because it is aimed at children, that it combines physical and digital solutions, that it is completely different from the projects I have done so far.” (S#20)

During their industrial design education, students learn to design creative and novel solutions to given problems by thinking abstractly. In this example, the motivation was primarily to design a digital product that is unique in the field. Another important motivation was the desire of the student to move towards a field that they had not tried before. Since the student has been creating projects based on tangible products for four years, the process of developing a digital product that has never been realized before is considered exciting by the student and this has a positive effect on their motivation to work. Another motivation for choice of the student to develop digital products for graduation projects is based on specific characteristics of the digital product development process itself. Student #14 made the following comment about the motivation for digital product development.

> [2] "[Motivation is] to be able to communicate with the user with instant feedback thanks to technology." (S#14)

In the process of designing a physical product, students test the physical mock-ups of the products first-hand and make updates by remaking the same product or updating the existing one. Student #14 stated that the rapid iteration of the process due to the nature of digital products had a positive effect on their motivation. Digital mock-ups designed in the digital product development process increase the motivation of students because prototypes and user tests can be done quickly and remotely, and they are cost effective compared to physical mock-ups.

Another motivation that students had when starting to develop digital projects was to produce fast and digital solutions for the well-being of the user groups they identified. Many students chose socio-economically marginalized communities as user groups. This choice was not a directive given to the students by course instructors or advisor firms, but was based on own initiatives of the students. Since the students know first-hand the problems and needs of certain communities in which they or their relatives live, their motivation was to develop digital products for these areas and to create design outputs as a result of fast and effective communication. Student #12 made the following comment on the topic.

[3] “I am excited about my potential to find solutions to the problems I have experienced during my university life.” (S#12)

Aiming to produce a service design-based solution to the problems faced by university students in their educational lives, the student experiences first-hand the problems and needs of the community in which they live. The idea of being able to produce current and digital solutions to the problems experienced by themselves and their immediate surroundings has an important place in the sense of belonging of the students to their project and their motivation to carry out the process. At this stage, the fact that students want to work with socio-economically marginalized communities such as artisans or farmers together with various NGOs in addition to their own communities shows that students carry the motivation of designerly ways of thinking, which can be described as socially aware and with higher values (Cross, 1982), into digital products.

According to the survey results, the final motivation for students to develop digital products is based on collaboration with the industry. Throughout the digital product development process, students carry out their projects with leading companies in the market. Students who have contact with advisor firms contribute to their professional portfolio as they develop their projects according to market standards. In this regard, when students were asked what excites them about doing a graduation project on digital product development, student #4 commented the following.

[4] “Working with many seniors in one of the leading companies in the financial sector of Turkey.” (S#4)

Many students stated that their motivation for studying digital product development was focused on future career options. Current market conditions and the fact that large-scale corporate companies provide students with good working standards have a guiding effect on these preferences. It is also seen that students want to gain work experience in leading companies in Turkey to be able to evaluate their opportunities abroad in the long term.

In the light of all this information, when the motivations of industrial design students to develop digital products for the graduation projects were analyzed, four main results were observed; (1) the desire to develop creative and new digital solutions, (2) fast, remote and cost-effective digital prototyping options in digital products, (3) the ability to develop digital solutions related to social awareness and inclusive high values, and (4) a high rate of future career opportunities with industry collaboration of digital product related fields.

4.1.1.2 Previous Digital Product Related Experiences of Students

The digital product development experiences of the students before starting their graduation projects was one of the points investigated within the scope of the early process survey. The subject-specific past experiences of the students provide information about how they approach their graduation projects, their anticipated process management, and possible project outcomes. All survey participants were students who had experienced digital product development prior to their graduation project (see Figure 4.3).

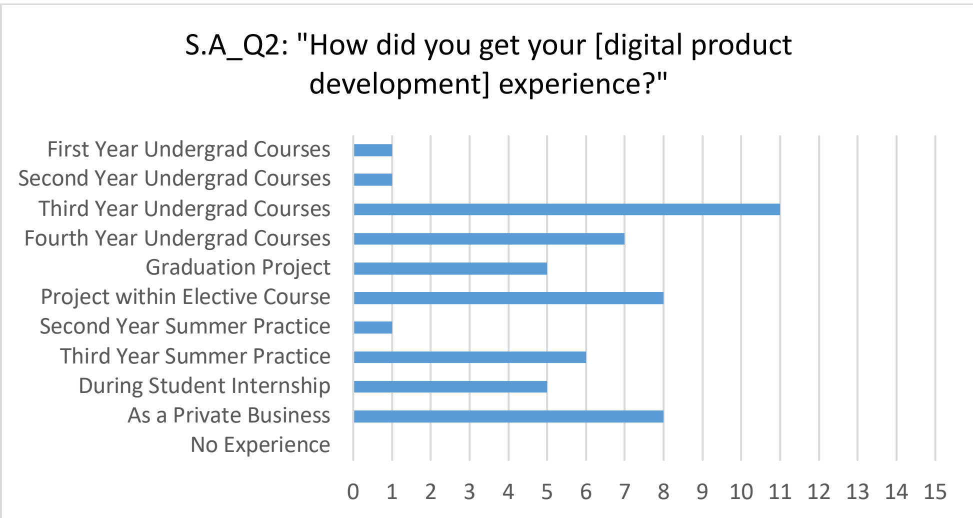

Figure 4.3: Previous Experiences of Students on Digital Product Development

According to Figure 4.3, acquaintance of industrial design students with digital product development in the educational environment is concentrated on the projects in the compulsory and elective courses they take in the third and fourth years. In addition, there are also some students who had digital product experience during their compulsory summer internships. It is seen that past digital product development experiences of the students have an impact on their graduation projects. Regarding this issue, student #4 made the following comment.

> [5] "The service design course at school, the elective UX course and the internship I did at [company name] had positive effects." (S#4)

According to the survey outcomes, the internships and compulsory or elective courses that students take before taking the graduation project course shape the digital product development processes in their graduation projects. Trial and error, which has an important place in design education, becomes visible among students at this point. It is seen that students construct the processes of their graduation projects based on the mistakes in their past experiences. Regarding this issue, student #10 made the following statement.

> [6] "I do not think UX/UI education is generally emphasized in our department. Elective courses have been opened in this field last year and projects have started to focus on this field. Therefore, we were a little lost in our first project. Like *What should we do?* or *How should we proceed?* How important even the smallest detail is in the interface field, and the importance of human behavior." (S#10)

Since digital product development and thus the intensive UX/UI process within it are not areas that students are familiar with within the scope of industrial design education, the process of introducing students to this field created difficulties due to lack of knowledge and lack of experience. If the students gain relevant experiences before starting their graduation project in the field with the guidance of lead designers and professionals, they start their graduation projects with the experience of project execution and this facilitates their process management. The lack of knowledge of students in the areas of digital product and UX/UI emphasizes the importance of peer learning and guidance from course instructors in the educational setting. Student #1 made the following comment about the digital product development project they conducted before their graduation project.

[7] "In the first [digital product] project I did in third grade, the process progressed as group work. I had many difficulties in distributing tasks and planning the project process in the field of UX, which I got to know with group work because I did not know about it. As I developed myself in this field, I realized that we were not sufficiently informed about the process before the first project and during the project process." (S#1)

Industrial design students have early experiences in the field of digital producs, UX, and UI by working in groups, experiencing these processes together and learning from each other. Quotation #7 also emphasizes the importance of course instructors guiding students. During their four-year education, industrial design students learn traditional product design under the guidance of course instructors and ensure their professional development. Although the processes, methods, and approaches of digital product development and UX/UI fields have similarities with traditional industrial design, they differ in many points. Students with internship and part-time work experience in the fields of digital product, UX, and UI have stated that they need differentiation in the functioning of the course project because they see the different approach of the market to these fields. At this point, they stated that some of the routines they are used to in industrial design education should be open to changes within the scope of digital product, UX, and UI projects.

Past work experiences focused on digital product, UX, and UI have an important place in the information given by industrial design students about their past experiences. Students have experienced a strongly interdisciplinary working environment different from their own design education in the organizations where they worked as interns or part-time. At this point, student #12 made the following comment.

[8] "In my private work experience, I had many problems in speaking the same language with customers and software developers. There are points where real life and the education I received at school and the experience I had at work are very different." (S#12)

Industrial design students spend most of their education life in the studio environment within their own community. Therefore, after spending a certain amount of time together, students develop a common professional language and unspoken rules. The interdisciplinary nature of digital product development and especially UX/UI fields brings different jargons and different activities. It takes a certain period for students to adapt to this professional jargon and communication style. For this reason, students who have internship or work experience before undertaking a graduation project have a higher command of the digital product development process. Having past experiences enables them to master the design activities and jargon used in the process of digital product development.

The fact that industrial design students had experience in digital product development, UX, and UI contributed positively to their graduation projects. In the light of this information, the following results emerged in the survey outputs; (1) previous experiences have a shaping role in the design of digital product development processes in graduation projects; (2) lack of knowledge in the context of digital products has visibly emphasized peer learning; (3) unfamiliarity with the digital product development course instructors and guidance from advisor firms seems to have an important place for students in project development; and (4) previous experiences have introduced students to the interdisciplinary nature of the UX profession by introducing them to professional jargon and activities.

4.1.1.3 Process Expectations of Industrial Design Students

The results of the survey also revealed the expectations of the students before starting the digital product development process. According to the results, expectations of students from the digital product development process are based on creating creative and novel solutions to real-life problems, similar to traditional industrial design process. All the students who participated in the surveys said that they want to bring manufacturable and usable digital products to the user. In addition to their comments on the overall digital product development process, students also had expectations from the specified stages of the process (see Figure 4.4).

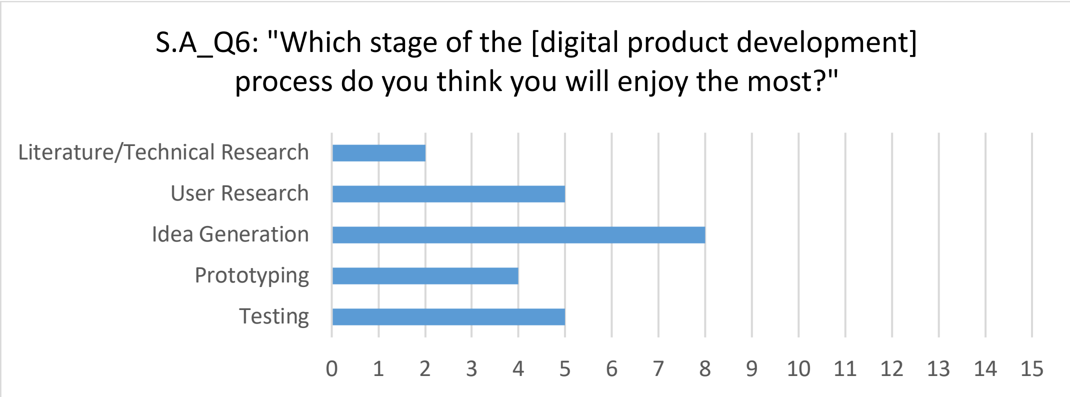

Figure 4.4: Project Expectations of the Students

As can be seen from Figure 4.4, students are mostly interested in the idea generation stage of digital product development. The main reason for this is that students frequently benefit from idea generation in their industrial design education. Since the user research prototyping and testing phases are integrated into the processes of students in digital product development, there is a lack of knowledge about these areas among students. Student #20 made the following comment on the idea generation stage of the process.

> [9] “Being free to come up with ideas keeps my brain fresh and I enjoy being able to dream.” (S#20)

The majority of students like to think freely and come up with solutions to the problems they find. In doing so, they are able to design their own processes. The flexibility to work in different places, at different times, listening to music or doing other things during the process shows the general interest of students in idea generation. Following the idea generation stage, students enjoy user research and testing stages. Within the scope of industrial design education, user research is an area where students have a certain prior knowledge. The aspects of creating sustainable futures for humans and enhancing well-being of humans in the job description begin to instill the importance of the user and user research in industrial design students at the beginning of their education. Abstract thinking feature of the design discipline and having knowledge about subjects from other fields also has an impact on how students approach to user research. In this regard, student #1 commented the following.

> [10] "It [user research] broadens my perspective on the subject I am going to design and helps me at the ideation stage. It allows me to develop ideas by learning things I do not know about the user." (S#1)

In their responses to the survey, students stated that the user research phase opened their horizons in digital product development processes. Students who interact one-on-one with the user gain knowledge in areas that they did not know of before or did not have the opportunity to experience before. This situation prepares the students for their future professional lives and improves their vocabulary in a positive way. In addition to this, another positive effect of the user researches designed by the students is that, thanks to the insight they provide, students could provide novel ideas to the idea generation process. Testing, just like user research, is another digital product development process that attracts attention of the students and involves high expectations. Testing is the stage where students could come together with the end-user or sample group after the research. Student #10 made the following comment on the subject.

> [11] "In the testing part, I am satisfied with the experience of the project I have created. Things that are not noticeable on paper are noticed in this process, the choice of color, or the location of the buttons..." (S#10)

At the beginning of the digital product development process, students conduct an exploratory process towards the problem statement and design solutions they have identified with desk and user research stages. With the research outputs obtained from these stages, students move on to the implementation stages by building the concept and design development processes and validate all these process outputs with testing. This creates an exciting expectation among the students in the testing process as they see their designs working and being implemented first-hand.

Expectations of students from the prototyping stage regarding their processes are interpreted in terms of project development. Since the design implementation process after concept development proceeds through prototyping in digital product development, students see this stage as a real-time problem solving activity. Regarding the subject, student #17 stated their ideas in the following comment.

> [12] "The ideas can change a lot when they go to prototype. It can create other ideas or problems. That is why starting a prototype seems difficult at first, but I think it is fun to solve problems or realize new potentials as you get into it." (S#17)

In the digital product development process, students do not interact with their products until the prototyping stage. In the prototyping stage, students start to see their products, which they have handled under the name of concept and design development, in real time for the first time. At this point, they start to construct the usability of the product without meeting the user. Just like in a tangible product design, prototyping in digital products brings about changes in the products. The design, which is built during the concept and design development process, comes to the final stage according to production techniques in the prototyping stage. In this way, enhancements related to the product reveal new potentials.

Industrial design students start their digital product development process with the technical and literature research phase. This is an exploratory stage and includes market research related to the product they will develop. It attracts a great deal of attention of the students among the stages of the digital product development process, but it is not as prominent as the design implementation stages. Nevertheless, the importance of the technical and literature research stage is evident to many students, as it is a process that they often construct in their traditional industrial design education. Student #9 made the following comment on this topic.

> [13] "While doing literature research, I had the opportunity to examine sources that I had not experienced and used before. (...) Forming new ideas on these outputs and analyzing them took me to the next stage in the progress of the project." (S#9)

For many students, the technical and literature research is a stage in the concept and design development process that presents them with real-life product opprotunities. As can be seen in quotation 13, students expect the technical and literature research stage to lead to novel idea generation. In this way, students are guided by how products with a similar starting point are constructed in the market and how they are positioned by the market.

In the light of all this information, the expectations of industrial design students from the digital product development process were evaluated through stages. Accordingly, in the technical and literature research stage, students expect to construct a novel idea generation and examine the market response of their ideas through market research. In the user research stage, they aim to learn about end-user problems and needs and to develop the empowerment and diversity aspects of their projects. With idea generation they expect to figure out how to materialize the research stages. In the prototyping stage, they start to see their concept design in a digital realm, and with the testing stage, they progress their process expectations by seeing the feasibility of their project.

4.1.2 During the Digital Product Development Process

The second stage of the online survey results examines digital product development processes of the students within the scope of research and design implementations. Accordingly, the research outcomes are described in this section under the headings of (1) research, (2) ideation, and (3) development.

4.1.2.1 Research Stage

The research stage is the first stage of the digital product development process of industrial design students. Students work on technical, literature, market, and user research at this stage. According to the survey outputs, technical, literature, and market research data were collected and analyzed under the title of desk research.

The works of students on field research have an important position in the scope of the thesis and is analyzed in detail under the title of UX research.

4.1.2.1.1 Conducting Desk Research

Conducting desk research covers the research outputs, including technical, literature, and market research, that industrial design students started to conduct on an individual scale at the beginning of their digital product development processes. Online Survey A, distributed at the beginning of the semester (see Figure 4.5), gathered information regarding the sources that the students planned to use in their research processes, while Online Survey B, distributed at the end of the semester (see Figure 4.6) collected information on the sources they used during the semester.

Figure 4.5: Preferences of the Students on Possible Research Sources

According to Figure 4.5, websites, online blogs, videos, and podcasts, which are digital resources, are the resources that almost all students most likely prefer in the digital product development process. The fact that the fields of digital product development, service design, and UX/UI design are currently prominent fields, the interdisciplinary nature of these fields, and the fact that these fields originate from the market rather than academia have led to a density of digital-based resources in these fields. Since academic resources and books in these fields are built on written narratives, they do not rank first in usage preferences of the students. According to the survey results, the digital resources that students are most likely to make use of are course content and online blogs of institutions (e.g., *Userspots, Design Experience Community, Service Design Network, NN/g*) that provide education in digital product development service design, and UX/UI. In addition, students benefit from *Youtube* videos, especially for their technical research on prototyping and testing. These videos include usage videos for prototyping software such as *Figma*. Students aim to enhance concept development and design implementation processes through these resources. In addition to these resources, it is seen that there is a high number of students who plan to use the user groups they have identified as resources. With one-to-one interaction, students start conceptualizing the digital products they intend to develop by first getting user information.

Students who provided information about their possible resource use at the beginning of the semester, provided information about the efficiency of the resources they used in Online Survey B. The outputs of this survey (see Figure 4.6) provide information about how the resource use students provided in the first survey evolved over the semester.

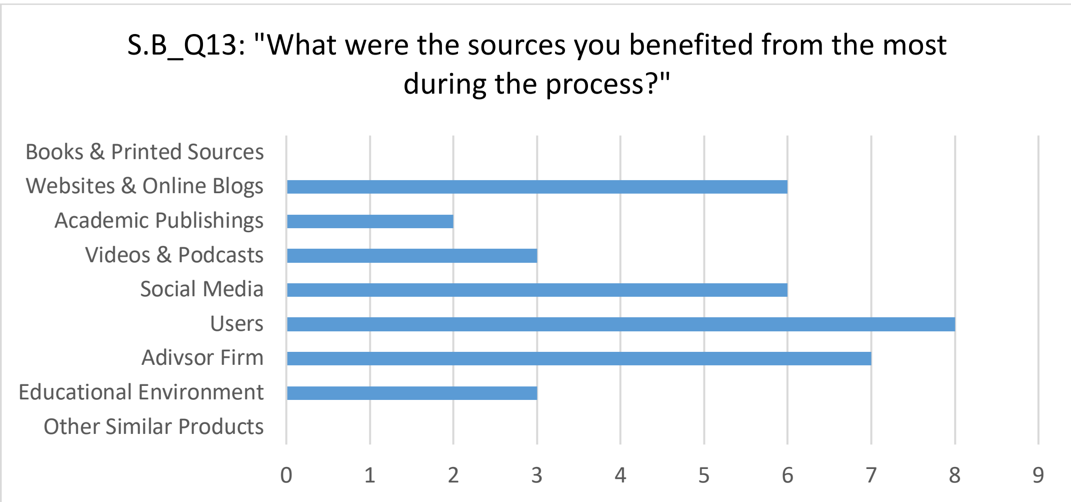

Figure 4.6: Sources that Students Benefited the Most

When the answers given by the students in Online Survey B were analyzed, it was seen that the most utilized resources in the process have shifted from websites and online blogs to users and advisor firms. At this point, the past experiences and guidance on project topics of users and advisor firms guided students more than written sources. Websites and online blogs were the most frequently utilized sources, even though their ranking dropped. The use of social media also increased in intensity compared to the first survey results and was used by students with the frequency of websites and online blogs. Related to this issue, student #11 made the following comment.

> [14] "Social media platforms, where people express their most common complaints, have been very useful for me. I was able to look at current problems and problems over the years and even the solutions created by students. These resources were helpful as I had the opportunity to observe a mass mind." (S#11)

As seen from quotation 14, social media platforms provide first-hand information for applications and production as they illustrate user comments. In the case of digital product development, this contributed to usability and provided market research feedback to the students. On the other hand, students trying to develop digital products, especially in specific communities, had difficulties accessing written resources. This situation led to focusing on the user and the advisor firm as project resources. The shortage of written resources, especially in specific communities, led students to emphasize online resources where they could see user comments and approaches. Student #22 presented the following concerning this issue.

> [15] "Since much information in the field of cargo is not given out by cargo companies, I could not find a lot of written sources. So I talked directly with the users, advisors, and teachers." (S#22)

Student #22 stated that students who develop digital products for specific user groups have difficulty in finding written resources. Students working in a current and new field have difficulties in finding written sources. In addition to the difficulties of finding open-access resources, many industrial design students do not have enough experience conducting academic research. This situation has led students to concentrate on user research in the studies they designed within the scope of desk research. Generally speaking, in the context of digital product development, desk research is considered by students as a stage that provides preliminary information for UX research and concept design stages. Rather than being handled by the students in one go, this research stage becomes a point of the whole process with UX research, which is carried out in iterations at necessary points.

4.1.2.1.2 Conducting UX Research

UX research constituted most of the research stage during the graduation projects. With the data they collected after the desk research, the students worked on identifying the user groups, the problems experienced by the groups, and the solutions they needed in the face of these problems. In light of all this information, the UX research conducted by industrial design students was analyzed under four main headings; (1) identifying user profile, (2) facilitating field study, (3) defining user problems, and (4) determining user needs.

Identifying User Profile

Students first identified a user profile in the UX research stage. When the answers of the students participating in the survey were examined, it was seen that the user profiles selected were composed of (1) families with children, (2) Generation Z (GenZ), (3) METU community, and (4) socio-economically marginalized communities. Among these, students tended to construct user profiles mostly on families with children and GenZ. When the reasons for these preferences were analyzed, three main conclusions were reached; (1) the impact of the advisor firms, (2) the impact of personal experiences/interests, and (3) the impact of future career opportunities.

Some of the advisor firms that the students collaborated with in the course provided various keywords to help the students at the beginning of the process. For instance, advisor firm A, a leading company in the financial sector, provided students with the keywords GenZ, cashless society, and financial well-being. This guidance from advisor firms enabled students to define problem areas and project statements faster than others, especially in the project elaboration stages. A striking point was revealed by the projects of students with similar user groups working with the same advisor firm. When the assignment grades and user groups of the students were analyzed together, it was seen that the user profiles of the students working only with the user group directed by the advisor firm were not specified enough, and this situation affected the project processes. In this context, it was observed that the projects of the students who worked with the user profile suggested by the advisor firm and added additional features to the user group they determined were differentiated and specialized. For example, student #2, collaborating with advisor firm A, defined their user profile as shown in the following statement.

> [16] "GenZ, age 18 and more, uses more than one bank, has money indirectly or directly (scholarship, family support, or employment), is social, has many friends, or participates in events with friends." (S#2)

Student #2 used the GenZ community requested by advisor firm A as the basis of their user profile. In addition, the student customized the project in terms of project statement and problem area by adding the participation of the group in social events and socialization practices among themselves to the user profile. This situation allowed the project to be differentiated from the other GenZ user profile student works.

Apart from advisor firm guidance, it was observed that personal experiences and interests of the students significantly impacted their user profile identification. Some students took a group they were a part of while defining their user profile and used their own experiences to identify a problem specific to this group. Especially in education, students designed their service-design-oriented digital products for students living on campus. This preference facilitated data collection and allowed students to demonstrate their empathy skills. For instance, students #11, #12, and #13, who developed the project in collaboration with advisor firm D, identified the university students of a specific educational establishment as the sample group. However, they differentiated their projects by integrating their personal experiences and interests as additional functions. Student #11 worked on designing a service for university students to schedule, select, and withdraw courses; student #12 worked on designing a service for on-campus transportation for the same group of students; and student #13 worked on displaying the social and cultural activities of the students on campus.

While identifying their user profile, students incorporated their interests and personal experiences based on advisor firm guidance. While advisor firm support shapes the project elaboration to a large extent, students also use their interests as a driving force. For instance, student #9, who collaborated with advisor firm C in the field of e-commerce, defined their user profile as shown in the following.

> [17] "Amateur artists represented by a gallery or without gallery representation who are digitally literate, interested in new developments." (S#9)

Considering the guidance of their collaborating advisor firm, student #9 set out to develop a project on the visibility and marketing of a specific community. At this point, personal interests came into play to customize the project. While another student working with the same firm focused on social responsibility projects through NGOs, student #9 worked on a digital platform project that empowers amateur artists and artisans and enables them to present their products to the market. In this respect, the only common point of the student projects in advisor firm C is that they are socially aware of digital platforms.

Another point that students paid attention to while determining user profiles in digital product development projects is future career opportunities. When current job opportunities for UX professions are examined, it is seen that many companies in this field work on the well-being of children. Since children and families with children have a significant market share, UX positions focus on this area, especially abroad. Because of these opportunities and many students who want to do a graduation project on digital products (see Section 4.1.1.1), many students preferred to use children of a specific age range and/or families with children as user profiles. In addition to future opportunities abroad, other factors that attracted students to work in these fields were that working with children is more visual, creative, free, and gamified.

Facilitating Field Research

After determining their user profile within the scope of their project, the students conducted field research to identify the problems and needs of their users and to advance their project. Within the UX research stage, field research was carried out with various methods as a result of social interactions with the user profile that the students identified within the scope of their projects. Based on the desk research outputs, the students received various ideas about research design from the advisor firm officials and course instructors in their weekly critique. These directions were based on project ideas of the students and which UX methods could be applied based on these ideas. Although all the students had some experience in digital product development, the majority of them did not have any formal UX research experience on their own, so the guidance of the course instructors and especially the UX professionals at the advisor firms had a crucial influence on the research design of students. Students generally receive comments from the advisor firms and course instructors on the data collection methods they will use and the research questions they will formulate within these methods. In this way, the students who prepared for the field research were able to choose from the existing research methods the ones that were suitable for their project and construct research (see Figure 4.7).

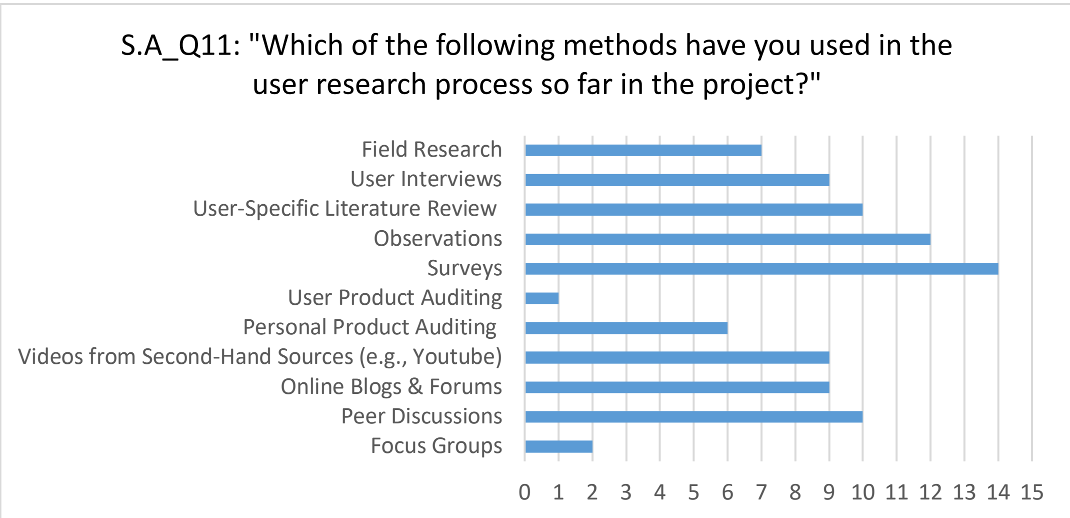

Figure 4.7: Research Method Preferences of Students

According to Figure 4.7, the research method that industrial design students were most likely to use at the beginning of digital product development processes was surveys. When the user profiles of the students who prefer to use surveys were examined, it was seen that most of them choose university students and GenZ group. Survey studies for this group were conducted online and the high technology literacy level of the user group had enabled students to spend the data collection process faster and more effectively. In addition, the fact that these user profiles have new generation technological equipment (e.g., laptops, tablets, and mobile phones with good internet reception) to follow the surveys and answer them comfortably also has a positive impact on the UX research process. Students working on a graduation project based on the user profile of socio-economically marginalized communities had a different approach. The fact that surveys can be conducted online has also facilitated the work of students, especially in the digitalized research processes after the pandemic. Students who can obtain data by distributing surveys rather than building a face-to-face process with the user often preferred the survey method.

After survey, observation was the most preferred method that students thought to use. It was observed that the students who thought of using observations as a data collection method were mostly the students who were planning to make hybrid projects. Specific to hybrid projects, students especially thought of examining the interaction of children and socio-economically marginalized community members with the product. Student #14, who developed a gamified hybrid product for music education of children and used the observation method within the scope of UX research, was found in the following comment.

> [18] "Since I observed the learning processes of children, I had an idea about how to create content for the game/product I will design and how it can be used [with the observation method]." (S#14)

Student #14 conducted an observation instead of a survey or interview method for the accuracy of the data since student was working with children. In this way, the student had the opportunity to experience the interaction of children with existing products as an outsider, and evaluated and used the outputs of their observation in the idea generation process. The illiteracy of the children and the differences in the use of technological products also played an important role in the preference of the students to use the observation method.

After observation, user interviews were another method preferred by the students. Especially the students who developed digital products for the community they were in preferred to use the interview method. Unlike surveys, students who used the interview method collected data in one-to-one communication with the users they identified and in this process they were able to obtain additional information from the users about their project areas. Student #2, who interviewed GenZ within the scope of UX research and designed research through videos, podcasts, and online blogs, made the following comment on his research.

> [19] "I can directly feel the interaction [with the user] and see the tangible results of my research." (S#2)

Student #2 had one-to-one interaction with the user during the interviews. Unlike other methods, the one-to-one interaction also provided the student with visual information on the usage practices of user and enabled him to receive instant feedback on his questions about the product. This situation was also effective in creating preliminary information for the testing phase that the student would carry out with the users in the later stages of the digital product development process. During the interview process, the student, who experienced the product usage practices of their selected users, contributed to the development phase with interviews.

Apart from these methods, the methods that students have started to use or plan to use within the scope of UX research include literature and product reviews that they can perform individually. Some students think of trying existing products individually or together with the user in their UX research processes. This experimentation both provides first-hand experience to the user and provides a kind of preliminary study and/or pilot study experience before user testing with the user. Apart from this, students also stated that they can do peer discussion and focus group in this process. These methods show that students are aware of the importance of peer learning in the process. Based on these methods, the structure of the methods chosen by the students also varied according to the number of participants (see Figure 4.8).

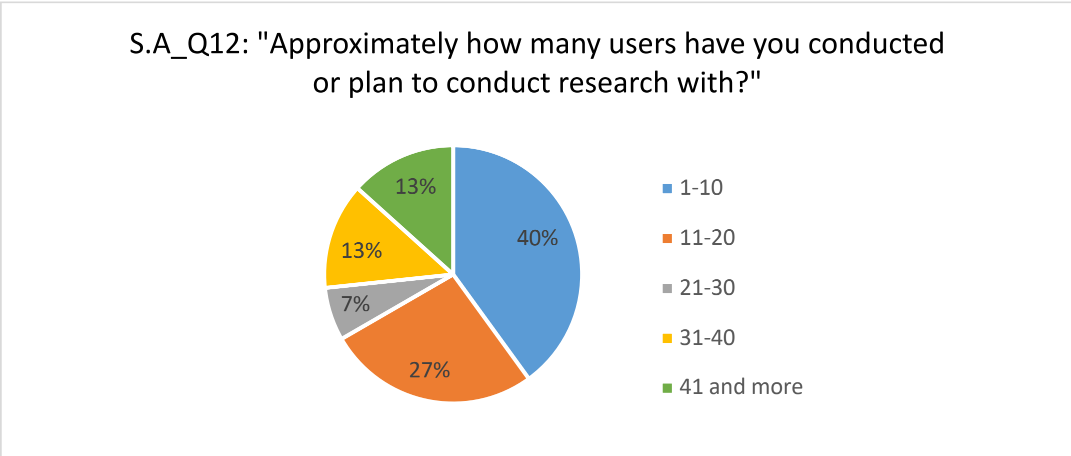

Figure 4.8: Research Participant Numbers of the Students

As can be seen in Figure 4.8, almost half of the students who participated in the survey stated that they aim to interview between one to 10 users. When the methods that the students who made this choice were examined, it was seen that the interview method was predominant. The fact that the interview method is built on qualitative data causes the interviews and the transcription and analysis processes of these interviews to take longer time compared to other methods within the scope of research design. For this reason, many students use between one and 20 participants when using the interview method. The fact that students who identify a specific user group (e.g., socio-economically marginalized communities) have more limited access to the user and the data they seek through this group is more specific has also limited the number of users. This situation led many students working in these fields to the interview method. In addition, when the method preferences of the students who planned to interview more than 20 users were analyzed, it was seen that the intensity was in surveys. Especially students who develop projects for the use of students within the university campus prefer this method. The high rate of access to users and the high technological literacy of the users they identified enabled students to benefit from surveys as a data collection method in UX research in these and similar fields.

Students designed their UX research based on the user profiles they identified and decided on data collection methods. The students prepared field research guides in accordance with the data collection methods they determined and conducted their field studies at certain stages of the digital product development processes during the semester (see Figure 4.9).

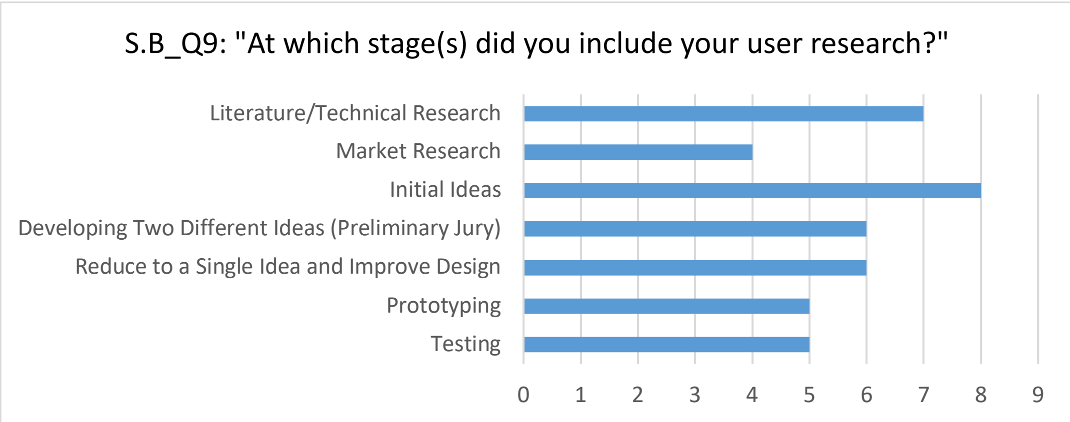

Figure 4.9: Implementation of Research in the Process

As can be seen in Figure 4.9, the students conducted UX research at more than one point during the digital product development process. Although there are assignments for UX research in the process, they are not homogeneously distributed in the process calendar. Submissions for UX research were generally included in the submissions for project elaboration at the beginning of the semester. As can be seen in Figure 4.9, the desk research that students conducted at the beginning of the semester under the name of project elaboration coincided with the time when many students also started to design UX research in line with their outputs. In addition, many students continued to interact with users during the initial ideas process and created their initial ideas simultaneously with this research. After entering the concept and design development processes it was observed that interaction of the students with users decreased, if not ended. However, students started to focus on UX research again during the prototyping and testing phases. At this stage, students started to present their early products to the users and received feedback about their products. Although there was no UX research schedule distributed in time plan of the course, as seen from the Figure 4.9, students conducted UX research on their own initiative at many points in the process. Regarding this issue, student #1 made the following comments.

> [20] “At each stage, I rechecked my research outputs and tried to identify the aspects that contradicted my research or contradicted my user base while building iterations.” (S#1)

The comment of student #1 showed that the students constructed UX research at more than one point in the process. The students advance their process by identifying user problems and needs through UX research and by doing this in certain iterations, they have created a cycle for receiving feedback from users. The continuous user interaction that emerges from the process of UX research helps users to have a say at every stage of the design process and helps the process to be more inclusive and democratic.

In the light of all this information, students conducted UX research with certain iterations in line with the needs of their projects throughout the digital product development process. Online Survey B, distributed at the end of the semester, provided students with information about the UX research methods they found most effective compared to the methods they used at the beginning of the semester (see Figure 4.10).

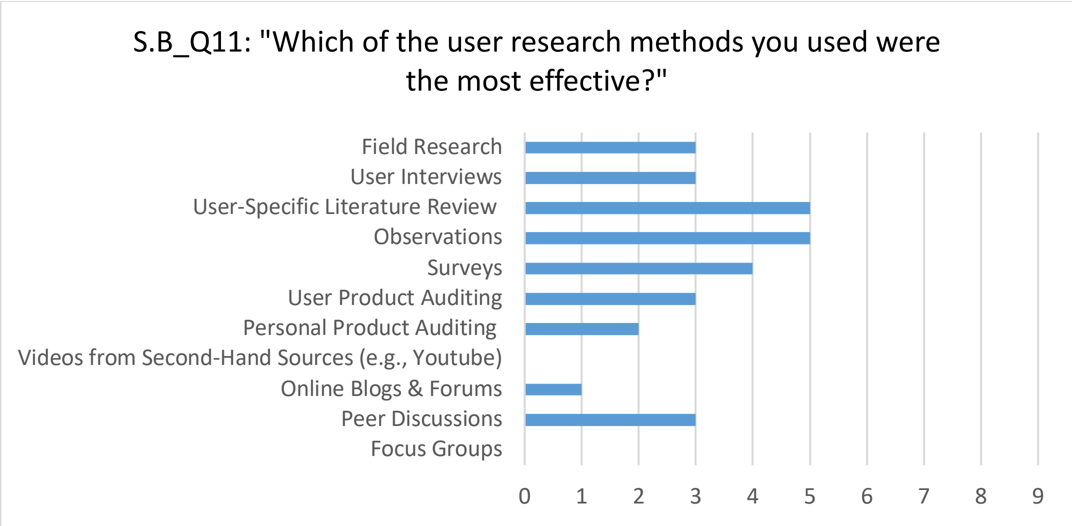

Figure 4.10: Research Methods that are Most Beneficial for the Students

According to Figure 4.10, it is seen that observation is considered as one of the most effective method used by the students in the UX research they designed in the digital product development process by interacting with the user. Especially students working with users with specific needs such as socio-economically marginalized benefited from the observation method. Student #22 commented on following with his own UX process.

> [21] “I spent a working day doing shadowing and interviewing with a cargo deliverer.” (S#22)

Student #22 conducted observation by spending a day with a cargo deliverer as he developed a hybrid project about the daily work life routines of cargo deliverers. Since the student was not a member of the user group, he preferred shadowing, which is a type of non-participant observation. By conducting this observation, the student had the opportunity to observe the user in his natural environment and had the opportunity to learn daily life practices that could not be obtained through interviews or surveys.

After observations, surveys were another data collection method that students found effective. Especially students with large user groups (e.g., GenZ, university students) used online surveys to get quick feedback and enrich their data by reaching many people. Interviews and peer discussions were other methods that students who developed a project specific to GenZ found effective. Interviews and peer discussions were intertwined in some cases as the students were part of the user profile they determined. After conducting interviews at the beginning of the process, students held more informal peer discussions later in the process and prepared their digital products for user tests. Student #2, who developed a project for GenZ aiming to improve financial well-being, made the following comment about the UX research process.

> [22] "The process started with interview, [continued with] field research and ended with mini discussions. Although there was no holistic test at the final stage, I tried to test my piece-by-piece flows with the prototype to find out what they felt close to the alternatives." (S#2)

Social interactions, whether formal or informal, constitute an important data collection method that students construct in certain iterations throughout their digital product development process. Many students, such as student #2, kept in touch with their user groups and tried to involve them in the process of developing their graduation projects. In the research and concept stages, this involvement was beneficial for idea development, but in the later stages, this social interaction contributed to the design development processes of students through prototyping and user testing.

Defining User Problems

After the students identified their user profiles within the scope of UX research in digital product development processes, they defined the problems of the user group they identified. These problems are intended to provide insight to the students based on the project statement before proceeding to the concept and design development process. The students showed for which problems they would develop the digital products before determining which needs of the users they would respond to. In this context, when the survey outputs were analyzed, it was seen that user problems were grouped under five main headings; (1) lack of representation, (2) having financial issues, (3) difficulty in accessing information, (4) lack of efficient products, and (5) having usability issues.

When the survey responses were analyzed, it was seen that the project statement and user groups have a socially aware aspect. As a user group, students tend to work in specific communities (e.g., farmers, amateur artists). Diversity, empowerment, and social inclusion of these communities have an important place in project statements of the students. One of the problems that students encounter in the digital product development process for these users is their lack of representation in society. Students aim to solve this lack of representation problem with the digital products they develop. While giving information about the user problem they identified, student #9 made the following statement.

> [23] "In the Non-Fungible Token (NFT) sector, artists communicate with collectors via *Twitter*, and it can be difficult for the artists to promote themselves." (S#9)

Student #9 identified the challenges of artist visibility in the digital art scene as a user problem in their graduation project, which the student aimed to respond with a digital product. The ability of the artist community to make themselves visible and promote themselves through other digital mediums has emerged as a user problem, according to UX research outputs of student #9. The topicality of NFT and digital art fields and the fact that representation and promotion are done in digital media leads to the differentiation of representation among artists. Student #9 aimed to provide a common ground for amateur artists with the socially inclusive online platform it would develop as a project and thus to empower individuals by strengthening the representation of the members of this community. Similarly, student #10, who worked on the visibility of NGOs, commented on the representation of user groups and communities.

> [24] "[Individuals] Not knowing the conditions for volunteering and how they can benefit [from NGOs]." (S#10)

Student #10 developed their digital product project for NGOs and individuals interested in collaborating with NGOs. As seen from quotation 23, NGOs form part of the user group identified by student #19. Proper representation issues of NGOs formed one of the user problems identified by the student for their project.

Another area that students identified as a user problem is the financial problems of their user groups. Since most students chose GenZ, students, and communities with no fixed income (e.g., freelance artists) as user groups, they considered the gaps in the habits of saving money and obtaining funding of these groups as a problem area. Student #4 expressed the user problems they identified as follows.

> [25] "Not being able to save money in an unstable economy, not being able to find detailed information about what to invest in." (S#4)

As seen from quotation 24, student #4 based the project statement of their graduation project on improving the financial wellbeing of GenZ, and developing sustainable payment habits for them. Since GenZ constitutes a user group with a very high level of technological literacy, solving the problems related to this financial issue with digital products and services facilitates the concept and design development processes of students with guiding insights. Another user problem mentioned by students within the scope of financial issues is related to raising funding for projects with a production background. Student #3, who developed a digital financial product for agriculture, described the user problem they identified as follows.

> [26] "Financial distress. Difficulty in accessing materials needed for production. Paying monthly bills like a salaried employee. Worries of being unable to repay loans. Product marketing after harvest." (S#3)

Student #3 aimed to empower farmers by making them visible on a large scale with the help of a digital product. The student also aimed to make access to raw materials of farmers healthier and faster through digital channels. The product the student developed in this way aimed to contribute positively to the well-being of the user group both socially and financially.

Another user problem identified by the students based on their user profiles was the difficulties in accessing information. Especially for students working on digital products for service design, user groups having difficulty in accessing certain information is considered as a significant user problem. The confusion and difficulties experienced by the users in accessing any function or relevant current information in the designed product caused the designed digital product to have problems in responding to user needs. Regarding this issue, student #13 made the following comment.

> [27] "The variety of activities and student societies, students do not know which is right for them. Students not being able to meet people with common interests, not being able to reach the right resources or authorized people." (S#13)

Starting point of the project is the lack of a platform that provides relevant information to students for student #13, who aimed to enable university students to follow student communities and events on campus and thus increase student socialization on campus. The problem background of the project is that the relevant information is distributed by students through multiple mediums or spread by word of mouth. In the UX research process, the student defined the problem as the difficulties of students in accessing the information on the subject based on their research with other students on campus, and they advanced their graduation project accordingly.

The lack of knowledge of the user groups identified by the students in their project areas on various topics was also among the user problems, just like the difficulties in accessing existing knowledge. Student #17 commented on the lack of knowledge in the user group they identified.

> [28] "My project is to create a platform to encourage the efficient use of energy resources at home. The children in my user group are generally unaware of or do not care about this issue." (S#17)

The project of student #17 is a digital app design that aims to introduce children to sustainability and turns the appropriate use of everyday life resources into a developing habit in a gamified way. The guidance of parents on the subject is essential but may not be enough for the children to develop the sustainability-related habits. Considering children as the user group first allows the user problem to be addressed in a gamified way. The lack of knowledge of children on the subject is considered as a user problem in the project.

Another point that stands out among the user problems identified by the students is the lack or deficiency of the number or quality of relevant products in the market. Many students examined similar products in the market research they conducted within the scope of desk research. They also included research outputs related to these products in the project elaboration phase at the beginning of the process. The lack of efficient products was a user problem that emerged with the discussions that the students had, especially after the market research, and they received feedback from users on this issue through UX research. At this point, some students concluded that there were no similar products in the market covering their product concepts.

> [29] "Carsharing apps are not integrated into vehicle displays." (S#23)

Other students who had similar products in the market with same function of their project examined them while defining their user problems. Student #20, who defined the problem based on the shortcomings or differences of the products available in the market, made the following comment.

> [30] "The products on the market are not well thought out and not designed with the user at the center; therefore, I think these features will be used, making my design highly preferable. At the same time, biology, which is my subject, is a subject that is not included in science museums; I saw that it attracted the attention of children, and I think it will be preferred." (S#20)

As seen from quotation 29, before defining the user problem, student #20 questioned the efficiency of the products in their field in the market research they conducted for their project. In addition, when the student tried similar products in the market, they made an inference that the products were not user-friendly. From this point of view, the student aimed to improve their project through the points they determined to make the existing product more effective. The student also aimed to increase the visibility of the product in the market by producing additional function solutions for the user group they determined.

It was seen that the last major user problem they identified within the scope of their research was in the field of usability. Problems in the usability of existing products in the market are one of the points that students pay attention to in their projects. Regarding this issue, the students examined the user comments on existing similar products and received feedback from the users in their own UX research. Accordingly, they defined the current user problems they identified in their projects. The following description of student #20 gives some insight into the topic.

> [31] "[Children] need simplified content and explanations; they prefer to play more and put learning aside. They need products [on the market] that are easy to use and understandable." (S#20)

According to this comment, the student who developed a project for children and families with children drew attention to the usage characteristics of existing products. The student stated that in the visual and gamified products on the market, moving away from the primary function causes user problems. For this reason, they tried to ensure the product was user-friendly and non-distractive, especially for children. Another problem mentioned by the students within the scope of usability issues was the communication of user flow of the product with the user. Student #11 made the following comment on the importance of communication between the user and the product.

> [32] "Mixing of old and new information in the system, interconnected information not organized in a useful way, poor communication of information to the user (no use of mixed media)." (S#11)

Student #11, who developed a digital product based on service design, stated in their research on a similar product that the weakness in the categorization of information damages the interaction of the product with the user and its usability. This situation was also included as a user problem identified by the student in the research phase. Poor user interaction with the product negatively affects its usability and causes a decrease in the user preference rate for the product. In this field, user-friendliness is of great importance in digital products, just as student #20 stated in quotation 30, and it significantly shapes the product development processes of the students.

Determining User Needs

After performing the identified user profiles and defining their user problems stages based on their user profiles, industrial design students determined user needs. When the survey outputs on this subject are analyzed, it is seen that the user needs that the students discussed in their projects corresponded to the user problems they defined. In this case, it was observed that the students who created user needs as responses to the user problems defined in this situation also identified complementary small user needs. As a result, the user needs identified by the students in the digital product development process are grouped under four main headings; (1) sustaining social inclusion and empowerment, (2) improving financial wellbeing, (3) strengthening socialization, and (4) developing user-friendly digital products.

The lack of representation that students identify as a user problem matches with social inclusion and empowerment within the scope of the user needs they determine. The ease of access of the users to digital products is a point that students consider when developing socially aware projects. Primarily representing a particular community and introducing and including it to the greater masses is made easier through digital products. Student #9 made the following statement regarding the user needs they decided to address in his digital platform project, in which he set out to represent and empower amateur artists.

> [33] "(...) A system should be developed to increase the visibility of artists and highlight their work. (...) Artists can be promoted by the platform. (...) Artist freedom and privacy should be respected. (...) Accessibility of the users to art and work can be increased. A platform where users can communicate with artists, artists can meet other artists, and produce collective works can be developed." (S#9)

With the help of the digital platform, the student identified a user need for the social inclusion of amateur artists and artisans, which he identified as the user group. Here, the student aims to contribute positively to the financial wellbeing of the user group by enabling artists to promote themselves and their work without other intermediaries. At the same time, trying to provide a social environment where artists can speak a common language and share themselves and their work shows that the student is trying to use digital products as a socialization tool. In this way, student #9 identified social inclusion, socialization, and improving financial visibility as user needs. Among the student projects, it is seen that apart from individual users, some include organizations in the user group. Student #10 explained that he tried to provide social visibility to individual users and organizations with the digital product he developed through the following statement.

> [34] "From an NGOs perspective, trying to reach more users, advertising, and social media activities. Providing more donations and income (...) Product sales, income, and donation gains of NGOs. Reaching volunteers for financial and moral support." (S#10)

Most of the students focused on specific communities as user groups. Student #10, in their project, addressed user needs at both the individual and organizational levels by making NGOs part of the user group instead of a user group consisting only of individuals. The student identified social support at the organizational level as the need of NGOs, just like social inclusion at the individual level. Social visibility by promotion through social media platforms was a user need identified by the student on the organizational scale. In this way, NGOs could increase the number of members by promoting their events through the same platform with individual users. Additionally, a digital platform would be helpful financially to NGOs since the donation function is available. Through digital product development, individual users become part of organizations and/or communities they feel they belong.

Similar to sustaining social inclusion and empowerment, improving the financial well-being of users is a significant user need to be identified among students. Improving financial wellbeing was constructed from the financial issues as a user problem that students had previously identified. It is seen that developing new habits is a prominent option. Student #4 explained the user needs they decided on for their project as follows.

> [35] "Accessing detailed information about the stocks/projects they will invest in, creating a savings habit [for GenZ]." (S#4)

Student #4 focused on accessibility and creating habit options to improve financial well-being as a user need. Student #4, who identified GenZ with high technology literacy rate as the user profile, emphasized information needs and developing habit requirements of the user group before different aspects, such as usability in digital product development. In digital products for older or younger age groups or communities with special needs, user-friendliness, usability, and UI design aspects are considered priority points within the scope of user needs. Differently, due to knowledge and skills of GenZ in using technological products, accessing information, and developing habits were prioritized by students as user needs in digital projects for GenZ. In addition, student #1, who developed a project for GenZ, emphasized the information need of the user group with the following comment.

> [36] "Feeling alone in the investment process, in the investment decision-making phase. Therefore, being unable to carry out a logical analysis process." (S#1)

Since financial issues are not topics that GenZ is active on an individual scale, the lack of knowledge and information problem is considered at the forefront. At the same time, determining user needs in digital product development. GenZ, who have just started earning their individual income, feel a lack of formal knowledge while gaining economic independence. The fact that members of the GenZ are social individuals and act with peer learning also meets a need of user in terms of digital products. For GenZs with high social interaction rates who act by learning from each other, digital products can benefit from socialization while improving their financial wellbeing.

As reflected in improving financial well-being, many students mention another point when determining user needs is the need for socialization. Students prefer to use the digital product and environment as a socialization tool when developing digital products. Primarily through their open-source environment, digital products meet the socialization needs of users. Student #13 defines the user needs of their service design-based digital product developed for university students with the following statement.

[37] "Meeting new people from different departments, socializing, gaining new experiences, and having a pleasant time. It helps to maintain physical and mental health. Being with a friend can be a source of motivation and encouragement to continue." (S#13)

Like the other student projects, the project of student #13 is unique among similar projects by including an additional function. Student #13 added the promotion of socialization as an additional function to their digital product, which will also serve as a student information system. Student #13, who identified university students as a user profile based on their UX research and experiences, considered the socialization disconnect between university students a user problem and proposed eliminating it as a user need. To do this, they used the course system and student communities as tools and turned the need for knowledge and experience sharing among students into an opportunity. Another critical point in this example is that the student aims to contribute to mental wellbeing with the digital product. For mental wellbeing, the student evaluated the socialization user need of their project. Student #1, who developed a finance-oriented digital app project for GenZ, described a similar user need determination with his comment in the following.

[38] "Socializing the [app usage] process. Since GenZ tends to manage processes and learn from each other, I designed my product to socialize the process." (S#1)

GenZ, including students, tend to learn and improve themselves through socializing and especially through social interaction between each other. The comments of student #13 in quotation 36 and student #1 in quotation 37 prove this detail. As a result of this situation, the students emphasized strengthening socialization in the user needs they decided in the digital product development process.

The last common user need decided by industrial design students focuses on the usability of digital products. The lack of efficient products and usability issues under the heading of user problems identified by the students overlap with the need for user-friendly digital products under the heading of user needs identified by the students. On this topic, the first point that students who developed products specific to user profiles paid attention to was the importance of accessing certain functions.

Access to functions and transition between functions are of great importance in the usability of digital products. While talking about their user needs in relation to this topic, student #11 emphasized the following aspects.

> [39] "The user can easily access the information they are looking for, exchange information with the system, reduce the stress of course selection, find elective courses according to their own interest." (S#11)

Student #11 has developed a digital product that involves the design of a service for university students to select and inform about courses. The main function of this design project is to provide users with access to specific information to add, drop, and get additional information regarding course structures. Therefore, student #11 decided that the primary user need is easy access to the course information system. Since the course information system is used among university students not only during the course selection and add-drop periods but also throughout their university life, it is of great importance that students have easy access to this service and that the service is user-friendly. This has a significant impact on the mental well-being of university students. Student #11 prioritized this user-friendliness while determining the need in their graduation project, taking into account the UX research process with university students and their past experiences.

While analyzing the survey outputs, it was also seen that there were students who handled usability differently within the scope of user needs. Since university students, which is the user group of Student #11, generally share many usability aspects in common, it was possible to talk about a general interaction network specific to the digital product. However, it was observed that the students who formed the user profile from the extreme groups constructed usability and user-friendliness differently within the scope of user needs. Student #19, who worked on the design of an application that parents and their children use together, made the following statement about the usability approach within the scope of user needs.

> [40] "Since my user group is a family, I can say that my biggest need is to provide an understandable, usable and satisfying experience for both children and adults. The same goes for ergonomics, children and adults should have the same experience." (S#19)

The fact that children and adults are on different ergonomic scales makes approach of student #19 to usability different from the other students. Apart from ergonomic differences, there are also significant differences in terms of technology literacy within the user profile, which has led to specializations in the elaboration of the digital product. The fact that children and families perceive and use the digital product in different ways reveals the differences in experience between users. In order for student user groups to meet on a common ground after the experience and share their experiences with each other, customization and adjustability were included in the project within the scope of usability. This shows the different ways in which students can evaluate usability within the scope of user needs.

4.1.2.2 Ideation Stage

Students working on digital product development as part of their graduation projects followed ideation stage after research. Research and ideation stages were interconnected since ideation took place simultaneously with the research at many points during the digital product development process. According to the responses of students to the surveys, ideation stage included mainly two activities; identify and generate. In the ideation stage, students used the insights they gathered from the desk and UX research stages under the activities of problem identification and idea generation.

The interconnection of research and ideation stages in the digital product development process was first seen in problem identification. Students carried out their main work on problem identification within the scope of UX research (see Section 4.1.2.1.2). At the beginning of the process, the students determined the user profile and user problems and user needs based on this profile. During the field research in this phase, many students started to ideate simultaneously. Regarding this issue, student #9 made the following comment.

> [41] “User [experience] research and idea development were two highly important stages. As they interacted with each other in the process, they caused the project to progress in a cumulative way.” (S#9)

The simultaneous execution of the research and ideation stages served as a control mechanism for the design decisions made by students. In such a manner, students had the chance to support every idea they developed for their projects simultaneously with their users. The extent to which the solutions created by the digital product ideas could respond to the problems identified simultaneously has been strengthened by the combination of research and ideation. Concurrently during the ideation stages, the comments of the advisor firm and course instructors provided guidance in terms of the development of problem identification and idea generation. Considering this social interaction, the students were able to receive feedback from the advisor firms and course instructors they collaborated with, in addition to the user groups they had identified, and thus were able to shape their concept development. When the responses of the students were analyzed, it was observed that the critiques given by the advisor firms and course instructors differed from each other in terms of content and guided the students in different areas. While the critiques of course instructors focused more on design decisions, the critiques of advisor firms were more focused on the development process rather than the ideation stage. Following the comment of student #11 on the ideation stage provides information on the subject.

> [42] “(...) Without them [course instructors], I would get lost in the process and it would have been difficult to say that the phase is over. Also, their measured way in design decisions, both telling me where things were not working as if they were on the same team with me and their encouraging words were useful for my motivation or improving my design.” (S#11)

As could be seen from the comment of student #11, course instructors mainly critique the design decisions of students in the digital product development process. In the traditional product design process in industrial design education, course instructors also critique the design decisions of students, especially in the ideation phase. According to the survey outcomes, this approach, which is accustomed by instructors and students in the formal industrial design education process, has been transferred to the digital product development process as well. Since the stages following ideation in the product development process are focused on production, the guiding critiques for design decisions are mostly focused on ideation. Another point that stands out in the comment of student #11 is related to the social approach of course instructors to students. Many students mentioned the impact of constructive criticism from course instructors during the process. These constructive criticisms increase the self-confidence of students who are not familiar with the digital product development process, and thus, positively affect their motivation. Learning from each other as an aspect of the professional culture of industrial design also emerges in the studio environment with teamwork and collaboration regarding digital product development.

In the ideation stage, the critiques given by the course instructors to the students were mostly about the design decisions, while the critiques given to the students by the advisor firms focused on the market response of the projects, the visibility of the projects in the market, and the manufacturability regarding possible production techniques of the projects. In response to the critiques from the advisor firm with whom they collaborated on their graduation project, student #2 made the following comment.

> [43] "Advisor firm officials tried not to be too directive, they tried to question realism and applicability, and to include examples they had encountered in the sector." (S#2)

Many students indicated the areas where advisor firm comments were concentrated. Within the scope of the ideation stage, advisor firm comments generally cover the market and UX research stages and the initial ideas developed by the students based on these stages. Advisor firms gave comments to the students on the realism of their projects and their equivalents in the market. In addition, it was observed that the comments of the advisor firms focused on sharing market experiences as well as comparing product examples from the market. During the critiques, advisor firms started to share their experiences about the professional life equivalents of the digital product development process with the students through the initial ideas. Ideation critiques also reveal the educational background of the officials from the advisor firm and the interdisciplinary nature of the UX professions. The presence of experts from different disciplines has become one of the factors that cause design decisions to take a back seat in the critiques that students receive from advisor firms. When the digital product development processes of students were analyzed as a whole, it was observed that the comments from the advisor firms focused on manufacturability as the process progressed. While the comments of course instructors and critiques focused on design decisions during the ideation process, the comments of advisor firms focusing on manufacturability became more prominent when the students moved to the development stage with an emphasis on prototyping, wireframing, and screening.

Within the ideation stage, in addition to the critiques of course instructors and advisor firms towards the product development, industrial design students also made various evaluations about the ideation stage based on their experiences. Students are familiar with the ideation stage to a great extent thanks to their experiences from their formal industrial design education. The situation has improved the progress of the digital product development processes of students. When the students were asked to make inferences about the digital product development processes, student #19 made the following comment about the ideation stage.

[44] "The part of thinking completely free and conceptual excites me." (S#19)

Abstract thinking and freely sketching, which are among the main elements of design disciplines, have essential places in formal industrial design education. Therefore, the students reflected the approach they were used to in the ideation stages for four years to the digital product development processes and stated that being able to progress similarly increased their motivation. Like the comment of student #19, many students stated that they were excited to develop ideas freely in a flexible working environment. According to the survey responses, it was found that during the idea development process, students were able to carry out other activities simultaneously, such as listening to music, eating, or socializing among peers. Thus, the students were able to adapt their own free and flexible design processes that they had individually formed in their formal education to their digital product development processes and were satisfied with this situation. On the other hand, there were also students who stated that this situation had negative effects on the stage, and thus, on the overall digital product development process. Regarding the issue, student #5 made the following comment.

> [45] "I think I lost a lot of time during the idea development process. After the feedbacks I received, I constantly searched for new ideas and repeated processes such as benchmark market research for each new idea." (S#5)

When the course content and assignments were analyzed, it was seen that a large part of the digital product development process was devoted to the research and ideation stages. Additionally, the fact that students were more familiar with desk research and ideation stages, from their formal industrial design education, than digital product-driven development stages had a shaping effect on time management of the students. Many students spent more time on research and ideation and less time on concept and design development in their individual processes. The fact that student #5 returned to research at the end of each new idea they generated within the scope of ideation refers to the execution of the process stages with short iterations within the scope of UX practice and shows that the process could evolve towards UX professions direction within the industrial design education.

According to the survey responses, the ideation stage mainly progressed simultaneously with the research stage and spread over a large part of the digital product development process. Although the critiques received at the ideation stage focused mostly on design decisions, critiques of the advisor firms also integrated market experiences and market interests into the projects and gave information on how digital product development process works within UX professions to the students.

4.1.2.3 Development Stage

In the digital product development process, after the research and ideation stages, development is the stage where students work on their concept and design. In the light of the survey outputs, the development stage was analyzed under three phases; (1) prototyping, (2) testing, and (3) screening, respectively.

4.1.2.3.1 Prototyping Phase

In the digital product development process, students started the development stage with prototyping. When the prototypes developed by the students within the scope of their projects were analyzed, it was observed that the outputs consisted largely of wireframes prepared through *Figma* software. Within the scope of industrial design education, working on digital products instead of physical products started to differentiate the prototyping approaches, methods, and activities of students by digitalization. Student #17 made the following comment about the prototyping phase in their development stage during the course.

> [46] "When the ideas are prototyped, they can change considerably. They can reveal other ideas or problems. That is why it seems difficult to start prototyping at first, but I think it is fun to solve problems or realize new potentials as you get into it." (S#17)

The first detail about the prototyping stage was concentrating on the connection between ideation and prototyping stages in the digital product development process. As seen from the comment of student #17, students start to see bits of the finalized version of their projects when they start prototyping their generated ideas from the ideation stage. Similar to the physical prototypes they work on in their formal industrial design education, the wireframe-based digital prototypes they construct through software such as *Figma* shape their digital projects. Since wireframing and digital prototyping are relatively new work areas for industrial design students and course instructors, lack of experience and knowledge in these work areas caused students to shy away from prototyping at first. Later, as they built experience on

Figma software, students started to get accustomed to digital prototyping through trial and error. In addition, according to the survey results, the students who had their student internships in the field of digital product had an easier prototyping process by benefiting from their experience in producing digital solutions in the market.

Another detail that stands out in the prototyping phase is the interaction of the students with the users. Students interact with users during the prototyping phase and present the user needs they identified at the beginning of the semester to the users through their prototypes and shape their project development accordingly. Student #2 provided an example of interactions between students and users during the prototyping process with the following comment.

> [47] "They [users] will guide the progression of my ideas to improve the experience (with prototypes) and provide insights into areas that I can improve, overlook or create opportunities for." (S#2)

As student #2 stated, many students tended to create insights into the development of their projects with their prototypes. Keeping the needs and desires of the users up to date in the project context through prototyping before usability testing contributes to the digital product development process. In addition, the interaction with the users during the prototyping process enabled the students to provide the user needs, and the points where these needs touched the project, and to point out the overlooked aspects so that the process could proceed on a more fundamental basis. Thus, the students made a preliminary preparation for the testing phase with the user interactions they kept alive during prototyping.

4.1.2.3.2 Testing Phase

In the development stage of the digital product development process, students developed prototypes through *Figma* software and then moved on to the testing phase in which they evaluated the usability of their prototypes. Just as students start to see their final products with the prototyping phase, they started to see whether the products they had developed responded to the user needs they had identified with the testing phase. According to the survey outputs, it was seen that many students were excited and enjoyed the testing phase. When asked for their opinions about the stages of the digital product development process, student #13 made the following comment.

> [48] "In testing, I understand much better whether I respond to the needs of the user or not, so I think it is the most useful and enjoyable phase." (S#13)

Accounts of many students about the testing phase were focused on user needs as in the example of the comment of student #13. Creative problem solving within the culture of the industrial design profession is also valid in developing design projects for digital products. Students involve users in the design process by solution testing. At the point where users are involved in the process, students not only collected data on whether the products they developed responded to user needs or not, but also had the chance to get feedback from their user groups on the visual and usability aspects of their products. The students, who included users in the testing phase, also had the opportunity to experience the interdisciplinary structure of UX professions and digital product development in the educational setting as they collaborated with course instructors and advisor firms. In this way, all stakeholders played an active role in different design stages of the product and contributed to the democratization of the process.

Another striking point about the testing phases of the students was that many students evaluated prototyping and testing together. When the survey outputs were analyzed, comments of the students about prototyping and testing generally included both phases. Many students described the development stage with simultaneous prototyping and testing iterations. The following comment of student #10 is a case in point.

> [49] "Although it was not a holistic test at the final stage, I tried to test my flows piece-by-piece with the prototype with the users to find out to which alternatives they felt close." (S#10)

As seen from the comment of student #10, students inspected the prototypes they developed in interaction with the users during their testing phases and continued to improve their projects considering the feedbacks they received. This situation showed that students interpret the prototyping and testing phases as one, and through short and fast (or partial) iterations instead of independent assignments. In industrial design education, the fact that students interpreted the prototyping and testing phases as a whole and constructed them as iterations in their digital product development processes supported the development process to proceed through short and fast iterations in return for UX professions.

Having past experiences in the field of digital product development also provided insights about the process management of many students. The process evaluation of student #19, who has a student internship experience in digital product development, has set an example on the subject.

> [50] "It was quite easy to do user research. We could easily test the prototypes we made through *Figma*. But as a process, in my experience, I realized that I was doing very similar things repeatedly, so I did not feel enough satisfaction and excitement." (S#19)

Having past experiences in the field of digital product development enabled the students to master the relatively new fields of digital prototyping and testing and thus facilitated the progress of their processes. The differences in the way UX professions and industrial design education perceive the digital product development process had a shaping effect on the process management of students as seen in the comment of student #19. Although having past experiences facilitated the process flow, it caused students to fall into repetition at certain points and negatively affected their satisfaction levels about the process. In addition, students who did not have any experience in digital product development or any UX experience also made different evaluations about the testing phase. At the end of the semester, student #11 evaluated their own digital product development process with the following comment.

> [51] "[In case of starting the same process again] I would spend much more time on the detailing part because in my project, when the wireframes started to be detailed, the product started to take shape and new possibilities emerged that I could try in user tests, but since this started towards the end of the project, I did not have the chance to inspect my product to the extent I

> wanted. I realized that I enjoyed the process of dealing with the details, but time was running out." (S#11)

Students without digital product development experience had problems especially in digital prototyping. Many students had problems in adapting to a relatively shorter development stage after the long research and ideation stages they spent during the semester. The students, who had a trial-and-error process in the field of digital product development, which they had just met, had problems with time management due to this reason. While some students completed the process without testing due to time management related issues, some students stated that they could not perform testing and therefore validation at the rate they wanted. This situation affected the testing phase and caused disruptions in the finalization of the digital products of students and negatively affected the product detailing. At this point, many students agreed that they would like to have had a longer development process.

4.1.2.3.3 Screening Phase

Screening was the last phase of the development stage of the digital product development process after prototyping and testing. The students who developed prototypes of their digital products through *Figma* software and tested them with their user groups went through the screening phase to make their digital products ready for their final jury presentations. In the screening phase, students received critiques regarding the context and visualization of their digital products and finalized their product presentations accordingly. When the survey outputs were analyzed, it was observed that within the scope of the screening, techniques of presenting the concept and design aspects of the digital products as well as the user experiences students constructed varied. Within the scope of industrial design education, many students have worked on physical product designs and have gained experience and knowledge about presentation techniques by presenting these products with a hands-on approach in juries. On the other hand, students with digital products have differentiated within the scope of screening by using *Figma* prototypes, prototype photos and videos containing user scenarios to present their products and user experiences in the digital environment. This type of approach, which students developed on their own initiative within the scope of screening, provided different insights. Student #5 made the following comment on the subject.

> [52] "In my presentations, I preferred to explain [my product] through the screens I used, but I should have written the features next to these screens. An explanation would have been good for missed readings during the presentation [for the jury members]." (S#5)

The impact of lack of knowledge and experience of industrial design students in digital product development was also observed in the screening phase. Since the students were familiar with presenting their physical products from before, traces of trial-and-error approach were observed in digital product screenings. Many students felt a need for guidance in the presentation technique designed through *Figma* screens and expressed this need by exemplifying it through their own projects, such as student #5. At this point, insights on the impact of experiences of course instructors and academic jury members on digital product development were also observed. Apart from students, course instructors are also relatively new to screening and assessing digital products. For this reason, as stated by student #5 in their comment, the need for additional information display in a screening process built on *Figma* screens was mentioned by many students. Since digital product development and UX professions are created and developed in an interdisciplinary professional environment rather than design education, screening and assessment criteria are only recently introduced to design education. Since course instructors and academic jury members have years of experience in tangible product design, this group has very detailed knowledge and experience on how to screen and evaluate products. This shaped the tendency of the criticisms received by the students in the screenings of digital products. The following comment of student #3 is a case in point.

> [53] "I was able to receive evaluations [from the course instructors] not on the experience and concept ideas I presented, but more in a visual sense." (S#3)

The screening phase was designed to allow students to receive feedback and finalize their projects before the final jury. Since the course structure and assignments were largely focused on research and ideation, students were able to concentrate on design development in a relatively shorter period at the end of the semester. For this reason, in the screening context, many students stated that they felt the critical need in the areas of experience design, prototyping, and testing. Since there were also students who had time management problems in the class, and among these students there were also those who could not perform usability testing, the screening expectations of the students consisted of critiques focused on technical areas (e.g., wireframes, IA, user journey mapping). At this point, many students stated that the critiques they received during the screening process were based on design decisions and visualization, just as student #3 stated in quotation 53. In the light of this information, it was learnt that there is a need to focus on technical details within the scope of screening as a prospective comment among the students.

According to the findings from the survey, students mainly concentrated on research and ideation stages in the digital product development process within industrial design education. This situation resulted in less time for the digital prototyping and testing stages, which students were not familiar with. Almost all the students who participated in the surveys agreed that the length and content of the process stages should be emphasized in the development stage by organizing them in short iterations. This insight provided by the students based on their experiences overlaps with the digital product development process within the scope of UX professions.

4.1.3 End of the Digital Product Development Process

Industrial design students presented and exhibited the digital products they developed within the scope of ID402 Graduation Project course in 2021-2022 Spring Semester at the METU Department of Industrial Design 2022 Graduation Projects Exhibition held on June 21-23, 2022. While the outcomes of both the Online Surveys A and B, in which students evaluated all stages of the digital product development process until the final jury, Online Survey B focused mainly on the process evaluations of industrial design students. For this reason, the first question of the survey simply asked students to evaluate their digital product development process as part of their graduation projects (see Figure 4.11).

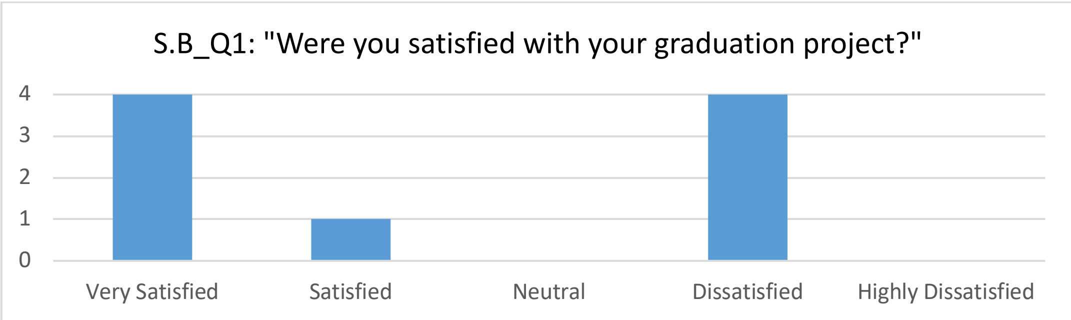

Figure 4.11: Satisfaction Level of Students

As seen from Figure 4.11, half of the students who participated to the survey were very satisfied or satisfied with their digital products as their graduation projects. According to the survey responses of the students, there were no students who were not at all satisfied with their graduation project and no students who expressed a neutral opinion. However, almost half of the overall number of students were generally dissatisfied with the digital products they developed. The following two sections present the satisfactions and dissatisfactions of students with the digital product development process and explain the reasons behind their responses in detail in Figure 4.11, while the third and last section presents future opportunities for industrial design students.

4.1.3.1 Strengths and Satisfactions of the Students

According to the surveys, it was observed that satisfactions of students within the scope of their graduation projects was focused under process-oriented and result-oriented satisfactions. According to the students, acquiring much new knowledge in the digital product development process and working on products that would provide solutions to their everyday life problems have created satisfaction towards their processes. Regarding the subject student #11 made the following comment.

> [54] "I learnt a lot that is the main reason. I chose a topic that I enjoy working on and I am satisfied with the process because it is a user group I am a part of and because I like the organization that the product will serve." (S#11)

Many students, such as student #11, stated that they were pleased to be able to experience the product development process in a field they had not experienced before. The trial-and-error approach and broadening horizon by learning from different disciplines have combined as the reasons for satisfaction of students within the digital product development process. Another important point that stands out in quotation 54 is the impact of user group selection on student satisfaction. When the students focused on a community they were in, their satisfaction with the overall design process increased. This could be explained by the fact that students felt a sense of belonging and that they organized a process in which they tried to solve the problems they experienced in their everyday life practices. Therefore, students had the chance to construct their processes based on both their own experiences and the insights they gained from their close environment. When the motivations, experiences, and expectations of the students at the beginning of the process were analyzed within the scope of Section 4.1.1, it was found that finding solutions to their own problems and acting within their own communities had a visible impact on the process. The fact that the aspects mentioned at the beginning of the process were interpreted as satisfaction by the students at the end of the process showed how the design approaches of students evolved through the digital product development process.

Another important point among the satisfaction of students towards the process was based on their interpersonal relations and communication among other stakeholders. According to the surveys, effective communication methods between students and course instructors and advisor firms positively affected the students regarding a product development process that they had just met. Within the scope of digital product development process, student #4 exemplified the effect of communication with other stakeholders, such as course instructors and advisor firms, with the following comment.

> [55] "I received very positive and constructive feedback. Since I was already an employee of the firm at the same time, I did not have to get used to it." (S#4)

Many students, such as student #4, stated that their communication with their course instructors and advisor firms affected their digital product development processes in various ways. During the process, students stated that they generally received positive feedback from other stakeholders with whom they collaborated. Working on a product group that they were relatively new to in a crucial process such as a graduation project that affects the graduation status created a challenging and concerning situation for many students. In this case, the comments and critiques of experts who have academic and/or market experiences on digital products are of essential importance for the students and seriously affect their processes. In this regard, many students stated that the comments and critiques they received were constructive and that this constructiveness positively affected their digital product development process and increased their satisfaction. A striking point in quotation 55 was the market experience in addition to effective communication. As student #4 stated in their comment, working with the advisor firm during the graduation project process has both strengthened communication and increased the knowledge and meaning transfer about the process. This transfer helped to develop an individual level of know-how for students in terms of UX professions and digital product development. During the graduation project process, while working on digital product development in the educational environment, experiencing the market approach within the scope of UX professions visibly increased the satisfaction of the students during the process.

The fact that digital product development is a relatively new field for industrial design students has made them question this new design process. Short and fast iterations within the scope of digital product development visibly emphasized the importance of the process in the design activity. Regarding this issue, student #2 made the following comment and emphasized the importance of the design process.

> [56] "These experiences, which were very positive for me, created new questions about both experience and digital products in my perception of industrial design, which is identified with physical product design. It taught me to look at projects as a process rather than just an output and that there is no such thing as a result." (S#2)

The striking point in the comment of student #2 was based on their emphasis on the importance of the design process. Since industrial design education is intensively based on physical products, although it includes similar design stages and activities, there are many points where digital products are specialized. The facts that digital products are in constant development and change, and that the design process continues continuously even after the products are launched within the scope of UX professions, and that the product is updated by receiving improvements even after the product is released have created an important difference between physical and digital product design processes. Satisfaction of student #2 with the process was comparing the process design they received in the education with the process design in the market and identifying the differences and interpreting them under their own process approach. In this way, interpreting information from different fields and forming their own approach formed the satisfaction of the student towards the process.

According to the surveys, while satisfaction of most of the students was based on their processes, there were also result-oriented satisfaction among students. In student projects, satisfactions based on the resulting products were more context-oriented than visualization-oriented. In Section 4.1.1, motivations, experiences, and expectations of the students at the beginning of the process were analyzed. The analysis revealed that many students were orientated towards socially aware projects and aimed to enhance the wellbeing of individuals in various contexts. At the end of the process, it was seen that the students who were satisfied with the digital product they developed were satisfied because they were able to develop socially aware projects. The following comment of student #3 presents a relevant example.

[57] "I believe that I have designed a concept that can solve the problems of our country related to agriculture and production and that can support our farmers in this process, and it makes me happy." (S#3)

Satisfaction of student #3 with their digital product was seen to have a socially aware context behind it. The enhancement of wellbeing for all living beings in the definition of the industrial design profession was recognized in the social context of the graduation project of student #3. The emphasis on social inclusion, empowerment, and diversity in the contexts of the projects of the students who developed socially aware projects like student #3 were the points where the students expressed their satisfaction regarding the resulting products. In addition to their satisfaction with their processes, students also expressed result-oriented satisfaction that the context, aim, and goals they set at the beginning of the semester were visible in their products without changing at the end of the process and had the potential to positively affect the wellbeing of the users.

4.1.3.2 Challenges and Dissatisfactions of the Students

In the surveys, students were asked evaluation questions about the digital product development process they went through within the scope of their graduation projects. In Section 4.1.3.1, as a result of these evaluations, the points where the students were satisfied in the process are stated. When the challenges experienced by the students within the scope of formal industrial design education are examined, the outputs for the stages of the process match the digital product development process of the students. In the surveys, students indicated the points that they would want to change if they started the digital product development process again (see Figure 4.12).

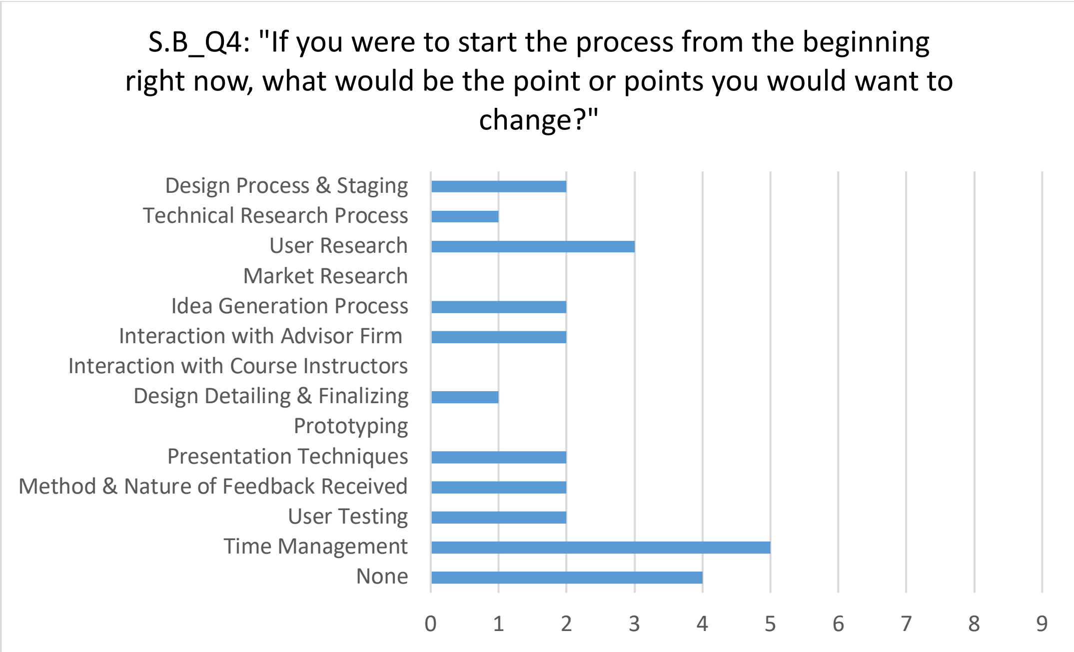

Figure 4.12: Assesments of the Students on the Process

According to Figure 4.12, time management was the point that industrial design students had the most difficulties and wanted to change the most in the digital product development process. After the students who wanted to reconstruct their time management, the most common response of the students was not to change any point. This represents the group of students who are satisfied with the graduation project. Looking at Figure 4.12 in general, it was seen that students also want to made relative changes in the field of user research. This situation is matched with the student insigths stating that they could not organize a proper research process. In addition to Figure 4.12, students indicated the stage or phase in the digital product development process where they had the most difficulty (see Figure 4.13).

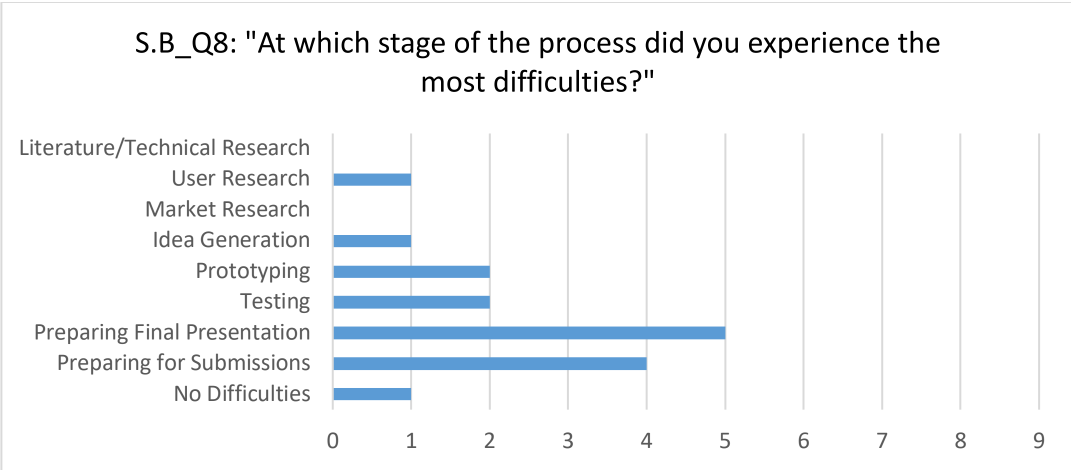

Figure 4.13: Most Challenging Points in Digital Product Development Process

As seen from Figure 4.13, preparing for the final jury and assignments was the stage where students had the most difficulties. Since industrial design students are able to design their own process in a flexible learning and designing environment within the scope of their formal education, they lack of knowledge and experience about the process of digital product development. As for the aspects from which the students were dissatisfied regarding the digital product development processes, it was observed, from Figures 4.12 and 4.13 with open-ended answers, that the reasons were mainly concentrated under time and process management. Students work in a flexible learning and designing environment in formal industrial design education. Over the years, they have built their own timeline and process management according to given project briefs and followed design phases. Since digital product development has its own stages and methods, students have encountered various challenges in this newly experienced field and certain points that they had difficulties in have emerged. While explaining their dissatisfaction with the graduation project development process, student #10 made the following comment.

> [58] "The research process was kept very long, but I think there was not enough time left for design." (S#10)

One of the main points of dissatisfaction of the students towards digital product development was the time management brought by the adaptation to a new process.

Many students stated that they had problems with time management while working on assignments and preparing for submissions during the semester. The point where the students agreed on this issue was the research process that covered a significant part of the semester. Since students were familiar with research from their industrial design education, most of them were able to solve this stage in the expected time or in a shorter time than expected. However, since many students did not have a hands-on interaction experience with digital products, they stated that they needed a relatively longer development process. This comment about the process and time utilization is one of the factors that created dissatisfaction. The following comment of student #3 provided additional information about how the time management problem was reflected in the development stage.

> [59] "I had a bit of difficulty for time and did not have the opportunity to test my product with users." (S#3)

In addition to the comment of student #10 in quotation 58, student #3 stated that they completed the process without being able to test their digital product with the users due to the time management issue. Among the dissatisfaction of the students, it was seen that there were also issues related to the management of the design process within the scope of the course. Regarding this issue, student #2 made the following comment.

> [60] "Progress in process management was lacking in the steps required for the UX project. Here, more time was spent on visual design, which caused both me and the people interested in my project to criticize the visual balance rather than an experience interpretation. Therefore, my project was weaker than I expected in terms of experience, and I found myself struggling with the visual design, which was an undeveloped part." (S#2)

As can be seen from the comment of student #2, students emphasized the points where the digital product development process differed from the physical product process. The fact that they were not familiar with this process and the comments and critiques they received during the process were oriented towards visualization rather than experience, may have negatively affected the ability of students to construct the process in the direction they wanted. In addition, the perfectionist nature of industrial design students who were not familiar with the digital product development process has become visible at the points where they were dissatisfied. The advanced knowledge and experience of both students and course instructors on design decisions caused the criticisms to focus on these areas. The technical development phases including UX and UI remained in the background more than design in the critiques. In the light of this information, the fact that the design process does not have an absolute end, the lack of knowledge and experience in the field, and the inability to manage the design processes to the extent they wanted, are the points where students were dissatisfied with the digital product development processes. The following comment of student #2 exemplifies the challenge to process management through the feedbacks from course instructors.

> [61] "In the whole process, there was a limitation on the number and variety of diverging ideas at the beginning. We stayed in divergence for a very long time. This shortened the time to work on a qualified idea in more detail and successfully in the converge phase. Since the feedback was received from different lecturers every week, rather than the number of people, one request and the other could be contrary to each other. I would reorganize the balance of time and progress in research." (S#2)

As seen from the example of student #2, students reported a challenge in the digital product development process regarding the distribution of time allocated to assignments and stages of the process. In some cases like the one from student #2, students received different design critiques from different course instructors led to fragmentation of the design critiques and created dissatisfaction for the students within the context of process management. In addition to course instructor comments, there were also students who stated that advisor firm guidance was a challenging point in process management. In this regard, student #5 made the following comment.

> [62] "*Why the company will be involved in my project, what kind of profit it will make?* It put me in a dead end. At the beginning of the project, my company argued that being a pioneer in sustainability and ensuring the loyalty of GenZ is much more important than financial gain, but towards the end they started to talk about capital concerns. It was a process that demoralized me,

and I tried to find a middle ground to get their will and not to throw my project away.” (S#5)

Similar to the guidance of course instructors in quotation 61, in quotation 62, student #5 questioned the place and expectations of advisor firms in their projects. As can be seen from the comment of student #5, there were cases where advisor firm expectations and student expectations did not match. This interaction of advisor firms created a challenge by creating confusion in digital product development processes of students.

In addition to the critiques of course instructors and advisor firms within the scope of process management, the lack of technical knowledge of students about the digital product development process and the inability to meet these deficiencies with assignments within the scope of the course in proportion to the needs of the students were also seen among the points that caused dissatisfaction among the students. The following comment of student #5 indicates that the points of dissatisfaction are the lack of assignments in technical areas.

[63] “Terms that have never been used before; for example, I think that the lack of a study on the technical side of UI, such as *customer journey map, information architecture*, affects the learning and development process badly.” (S#5)

Similar to the comment of student #2 in quotation 60, student #5 stated that the lack of knowledge and experience in digital product development caused dissatisfaction in their projects. In the comment of student #5, the point of difference regarding dissatisfaction was based on the professional language and jargon brought by UX professions. Industrial design students are not familiar with the language used within the scope of UX professions, and they acquire familiarity with this language because of resource research and communication with advisor firms. Since this way of learning progresses with the process and additional work cannot be done on it, it may prolong the project process of the students or cause difficulties in addressing the points they want at certain stages. This situation was among the dissatisfied points that students stated about the digital product development processes they experienced within the scope of their graduation projects.

4.1.3.3 Future Opportunities for Industrial Design Students

At the end of the digital product development process, students were asked about their future goals for UX professions and digital products. All students who participated in the survey stated that they would like to pursue UX professions that include digital products in the future. When the reasons behind the professional preferences of students based on their graduation projects were analyzed, three main topics stood out; (1) high potential of creativity in the UX and digital product fields, (2) flexible work options with higher salaries of UX and digital product fields, and (3) ability to raising awareness to specific user groups in open-source environment.

Nowadays, it is observed that industrial design graduates are largely oriented towards digital product and UX fields. This situation was also observed in the survey outputs of the thesis. The high technological literacy of the students and the fact that they closely follow the digital market have increased their ability to design and research in these fields. In addition, the inherent limitations of physical product design positions were another factor that pushed students to design in digital areas. Student #4 made the following comment on the subject.

> [64] "Yes, I have been working in this field for a year. I have been working in this field for a year now and I aim to continue in this field because the industry in Turkey is underdeveloped, so entry-level industrial designers usually work as *copycats,* and they cannot be very innovative by doing guaranteed work. In the digital channel, I think it is more likely to rise and use the potential because the cost is much lower." (S#4)

Students have mastered the activity, methods, and process of physical product design through the compulsory, elective, and internship courses they have taken as part of their industrial design education. Students who get a job in design offices avoid this field for long periods of time because they do side jobs such as technical drawing and detailing of products designed by the senior designer or co-designer in the firm rather than designing. Student #4 also mentioned this problem in their comment. The fact that senior designers dealing with physical product design are relatively behind the new graduates in the digital field has paved the way for the new generation of industrial designers to make novel designs for digital projects. In addition, the digitalization of professions and fields of work today paves the way for new graduate designers who want to work in digital products and increases the potential of their long-term career goals. This situation has also paved the way for students to turn to professions involving digital product related UX.

Another reason why students prioritized digital product development in their future career plans was the flexible working options with higher salaries aspect of this field. Student #10, who stated that they would prefer UX professions in their future career, explained the reason for this preference with the following comment.

> [65] "Yes. UX/UI design is a field that I plan to continue and improve myself. There is the possibility to work remotely, there is a relatively more comfortable working environment and the salary is generally higher." (S#10)

The comment of student #10 is an example of the reasons for students who want to turn to UX professions as a career. Especially after the Covid-19 global pandemic, companies working in digital fields have increased the motivation of their employees and contributed to their financial wellbeing by switching their departments in professions dealing with digital products to remote and/or hybrid work. In contrast, hands-on approach and the need for workshops of the physical product design have restricted the working environment of graduates. This situation has also attracted students who are used to working in a flexible environment in industrial design education by designing their own design process to digital professions. In addition to this, the increasing interest of the market in digital professions has increased the demand for positions in these fields and thus their salaries.

According to the survey responses, another reason why students want to pursue digital product development as a future career is the ability to raising awareness to specific user groups in open-source environment. The open-source nature of the digital world increases the visibility of users and strengthens social work. Student #11 made the following comment on the subject.

> [66] “Yes, that is why I chose this project. I think UX gives people a voice. I want to work on UX because I want people to be understood and heard. Also, since problem solving has shifted to virtual in our age, I want to work in this field to make life easier for more people and spend their time in a better quality.” (S#11)

Contextually, UX professions focus to improve the wellbeing of specific groups by putting the user and their needs at the center. Student #11 stated that these professions are a chance for people to have a voice and be empowered in this way and placed this social approach at the center of his future career goals. The accessible nature of the digital products and the inclusive nature of the digital environment provided the most suitable option for realizing this social approach in the design context with the open-source environment. Digital product development and UX practices, with all these characteristics, offer good job opportunities with the potential to raise the living standards of industrial design students, and in this way, students in the current market are mostly oriented towards them.

4.1.4 Summary of the Online Surveys

This section of the thesis is based on the responses to two online surveys distributed to 24 industrial design students who designed a graduation project involving digital product development. Fifteen students responded to the survey distributed at the beginning of the process and nine students responded to the second online survey distributed at the end of the process. The outcomes of the section analyzed digital product development under three headings; beginning, during, and end of the process. In the light of this information, the analysis of both online surveys presents the following insights about the digital product development carried out by industrial design students within the scope of their graduation projects.

- The answers regarding the beginning of the digital product development process were analyzed based on the motivations for digital products, previous experiences, and project expectations of the students. It was observed that the motivation of industrial design students for the process was mainly to produce fast and digital solutions to the problems of the user group they identified. Many students mentioned their motivation to develop a socially aware product at the beginning of their projects. It was observed that many students had previous experiences in digital product development through student internships and elective courses. These previous experiences enabled the students to adapt to the process more easily and to construct their own interpretations of certain phases. Students who lacked experience and knowledge improved their process through peer learning and trial-and-error.

- Students started the process with desk and UX research. After getting background information on market interests and digital products with desk research, students determined user profiles based on their research. Many students focused on a community they are a member of as their user profile. Some students preferred to work on children, families, and socially marginalized communities. The students who started field research after the user profile mostly utilized survey, observation, and interview methods. Lack of knowledge and experience of the students in research methods came to the fore at this point and caused them to collect data in ways they did not want to. As a result of the field research, the students identified user problems mostly based on information deficiencies and usability issues in digital products. The user needs identified by the students based on user problems emphasized the themes of creating user-friendly products, socialization, developing habits, and empowerment.
- Students conducted the ideation stage simultaneously with the research. In the ideation stage, which they are used to from formal industrial design education, students received critiques from course coordinators about their design decisions, while they received critiques from advisor firm officials about the production, technical, and market requirements of their designs.

- Development stage of the students included prototyping, testing, and screening phases. Students had the approach of simultaneously progressing prototyping and testing phases like research and ideation. They tested the prototypes they prepared on *Figma* software. Students who lacked knowledge and experience in digital product development had difficulties in this phase and had to skip some phases such as testing. Some students realized at this stage that the information they collected in the UX research phase was incomplete or incorrectly analyzed. After the prototyping and testing phases, students moved on to the screening phase for the final jury. Since many students were presenting digital products for the first time, different screening approaches were seen among the students. While some students edited the layout based on the screenshots they took from their prototypes, some students preferred to prepare videos especially to explain the scenario and usability.
- According to the end-of-process evaluations, many students who were satisfied with their projects were satisfied because they produced novel digital solutions to their problems in a contemporary field. In addition to this, it was also seen that among the satisfaction of the students was to experience UX professions thanks to the advisor firms.
- It was found that the main point that students found challenging and caused dissatisfaction in the process was time management. Students with digital product experience interpreted their processes according to the briefs they received and had a more comfortable process.
- Students saw the digital product development and UX practices they experienced within the scope of their graduation projects as a career option. The reasons for this preference were remote, part-time, freelance working options, more positions and salaries, and overseas job opportunities.

4.2 Findings from the Analysis of Graduation Projects Submissions

The analysis of the graduation projects submissions constitutes the second set of findings of this thesis. This analysis examines the digital product development processes of METU Department of Industrial Design senior students in the Spring Semester 2021-2022 ID402 Graduation Project course. Therefore, the analysis of this section is based on the assignments given to the students during the semester, and their project process portfolios.

4.2.1 Exploration of the Student Submissions through Assignments

The assignments of the semester are; (1) *Workshop I*, (2) *Workshop II*, (3) *Workshop III*, (4) *Initial Ideas Jury*, (5) *Workshop IV: Constraints, Objectives & Directions (CODs)*, (6) *Preliminary Jury*, (7) *Final Screenings,* and (8) *Final Jury*. This section presents their results accordingly.

4.2.1.1 Workshop I: Project Elaboration I

Workshop I entitled *Project Elaboration I* was the first assignment of the course and it was conducted in March 14, 2022. Workshop I consisted of three parts, (1) defining project scope and statement, (2) stating statement keywords and phrases, and (3) doing product analysis (see Appendix F). The purpose of defining the project scope and statement was to accurately describe the design area that students will be working on. While doing so, students were asked to consider possible problems, opportunities, or user needs they intended to address within their projects. In the second part of the workshop, students were asked to underline all the keywords or phrases in their project statement that could be expanded upon. While doing so, they needed to make lists of related concepts, ideas, or keywords that could be helpful to improving their understanding of the design task. Lastly, students were asked to make six inspiring and notable product analyses related to their project statement including product image(s) and annotations of strong and weak points of the products. While doing this they were asked to concentrate on functionality, usability, aesthetics, target users, scenarios, materials, cost, and any other points that they found worth mentioning.

All 24 students whose projects were analyzed submitted their works in this workshop. Out of the 24 students, six students made incomplete submissions in which they did a general product analysis without a clear project statement or keywords that should be based on ideas or chain of arguments. The submissions of the remaining students were based on written narratives rather than visual narratives as the content of the workshop was based on research, analysis, and concept development (see Figure 4.14). Although the course instructors stated in the brief that the students could act through visual narrative, at this stage, the students generally experimented and uploaded mind maps through Miro digital platform (see Figure 4.15).

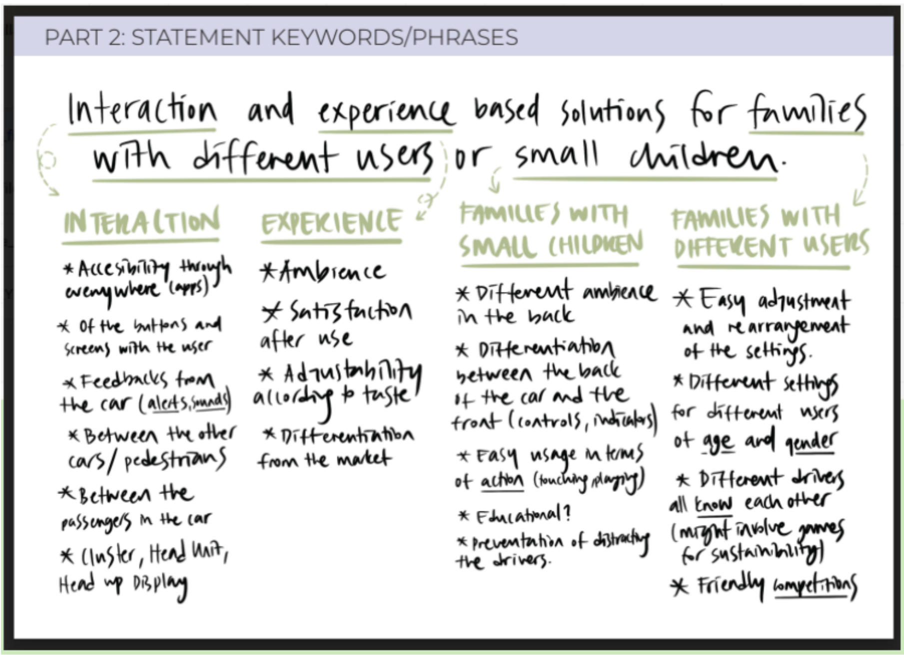

Figure 4.14: Written Expressions of Student #21

Figure 4.15: Project Statement and Related Keywords of Student #3

A striking point about the first two parts of Workshop I is related to the advisor firm. Some advisor firms provided students with specific keywords and sample group suggestions. It was observed that the students working with these companies came up with much clearer project statements and keywords than the other students. For instance, Advisor A provided students with keywords such as *cashless society* and *GenZ*. As a result, the projects of some of the students working with advisor firm A were shaped together with the advisor firm.

In the third part of the workshop, the course instructors asked from the students to come up with six novel and intriguing product analyses based on the project statement and keywords they had identified. In this part, students made more use of visual expression methods compared to the first two parts. While doing product analysis, many students formed their analysis illustrated through photographs and screenshots of online applications. Another striking point here is that some students used social media accounts (i.e., *Twitter* or *Instagram*), AR and VR technologies and videos while doing product analysis (see Figure 4.16).

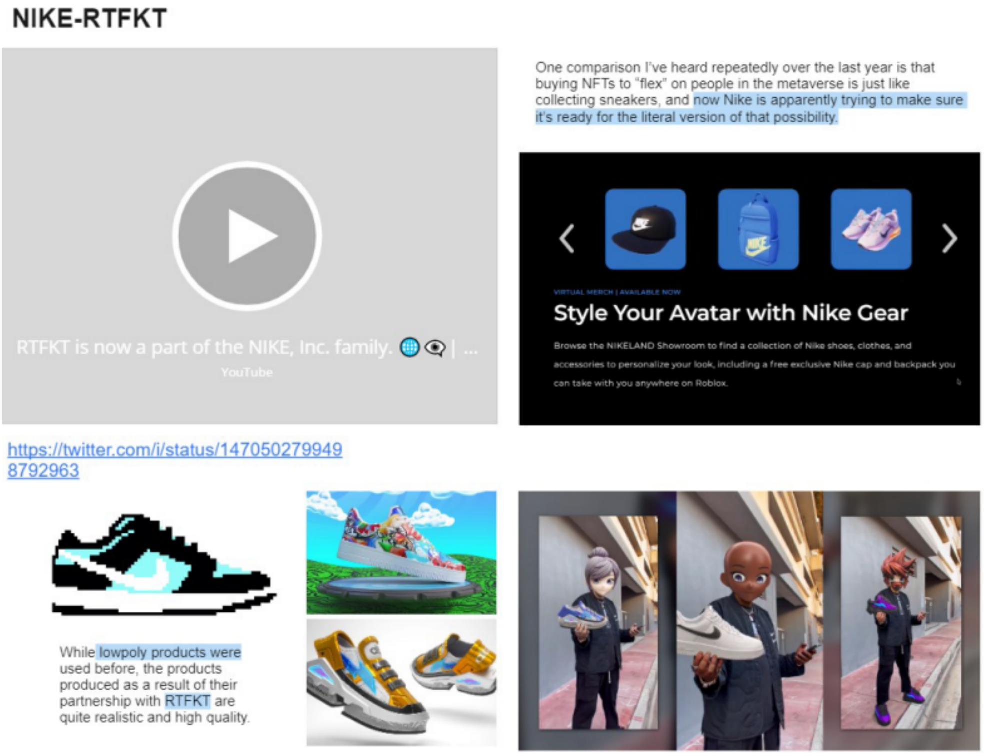

Figure 4.16: An Extract of the Product Analysis of Student #9

Although the use of social media and different mediums was not included in the design brief, it exemplified that, students took initiative in their research process. Use of social media and different mediums showed that the students had advanced technological literacy and followed current design trends in an open-source environment. In addition, the use of social media and different mediums of student demonstrated how they were able to find related problem areas and media and how they transferred them into problem areas in their projects. This situation presented an example on how industrial designers broadened their scopes by learning from different disciplines in their undergraduate education. This situation plays an important role in design processes and self-expression of the students. At this point, the influence of advisor firms was again observed. It was observed that students working with advisors based on online sales such as e-commerce had more detailed product analysis outputs based on visual examples compared to others.

Considering this information, the following can be said to summarize the analysis of Workshop I submissions of the students:

- During the research and concept development phase, students prefer to work in written form rather than using visuals.
- The fact that the advisor firms were able to express their expectations from the students and the projects well, had a good command of the process and were prepared for the challenges that emerged during the process, had a positive effect on digital project development processes of the students. Healthy interaction with advisor firms during the research and concept development phase at the beginning of the digital product development process shows that students experience a more comfortable and faster preliminary research process.
- Using several technologies such as social media and AR/VR provides students with first-hand data and real-life visuals, especially in the product analysis phase, which includes market research.
- The use of social media and digital platforms (e.g., *Miro*) in the digital product development process shapes written narratives of the students.

4.2.1.2 Workshop II: Project Elaboration II

Workshop II entitled *Project Elaboration II* was the second assignment of the course, and it was conducted in March 17, 2022. The aim of this workshop was to gather insights to support idea generation. Workshop II consisted of four parts, (1) group discussion on project statement, (2) group discussion on project analysis, (3) presentation of creative crossovers, and (4) research planning (see Appendix G). In the first three parts, students discussed their project statements, product analyses, and design ideas in groups. They presented their researches to each other, and they gave their opinions to one another. According to their group discussions, they revised their processes. In the last part of the workshop, students were asked to do their research plans in two steps. In the first step, they were asked to write down what they do not know about their project areas, and they were asked to provide possible solutions to how they would learn about them. In the second step, students were asked to work on their user research plans with an emphasis on the role of user research as to replace presumptions with evidence from the field. In this step, students were asked to present which research methods they would use in the field, and depending on the data collection method they chose they were asked to present their research design.

In Workshop II, 22 out of 24 students submitted their works. Since this workshop was similar to the previous one in terms of content, students similarly carried out their assignments based on written narratives on Miro digital platform. At the end of the peer reviews, students started to follow various ways to explain their narratives and presentations. An example of this is the use of post-it notes to define keywords in the digital environment, similar to their product design education in which they use pens and real post-its to show their ideas (see Figure 4.17).

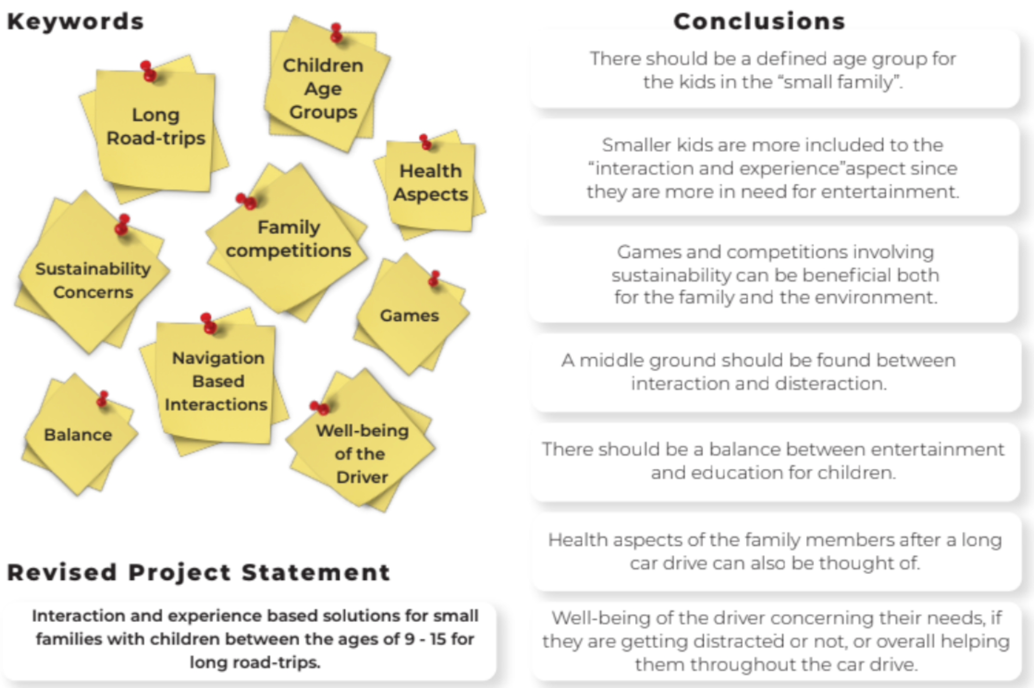

Figure 4.17: Group Discussion Outputs of Student #21

At this point, color-coding was another strategy that students used to explain their projects, which were updated at the end of peer reviews, more easily (see Figure

4.18). For instance, at the end of group discussion, Student #11 revised their project statement and categorized reviews according to the owners. Color green indicates their ideas, while color yellow shows reviews of one peer, color blue shows reviews of another peer, and color red illustrates suggestions of academics.

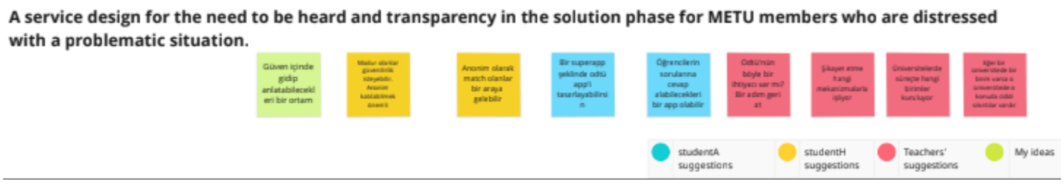

Figure 4.18: Peer Reviews and Revised Project Statement of Student #11

In the research design part of the workshop, among many data collection methods, seven data collection methods were mentioned, interview, survey, observation, focus group, shadowing, cultural probe, and diary study. Among these methods, conducting interviews was the main method that students chose in their user researches. Seventeen students preferred to use interview as the user research method in their project proposal. Fourteen students chose to use online surveys as their data collection method. Eight students preferred to use observation in their user research, while four students preferred to use shadowing as their data collection method. Two students mentioned using diary studies and one student each mentioned focus group and cultural probe. When preferences of the students on user research methods were analyzed, it was noticed that the method preferences of the students working with certain advisor on certain industries were specialized. For instance, all the students from advisor firm H stated that they wanted to use shadowing as the sole or one of their user research methods. This advisor firm is in the automotive sector. This preference showed that the industries have an impact on the user research phase in digital product development process.

In light of this information, the following can be said to summarize the analysis of Workshop II submissions of the students:

- Apart from learning from academics, advisor firms, and themselves, group discussions enabled peer review and thus learning from each other for students.
- Students started to reflect the various presentation techniques they learned to use hands-on to the digital environment. An example of this is the post-it presentation of keywords that students revised based on group discussions. Color-coding was used among students to classify their ideas with project attributes.
- Workshop II shows perceptions of the industrial design students on user research methodologies; most of them constructed their data collection on interviews. However, most of the students combined two, or in some cases, multiple methods in their user research phase.
- Advisor firms seem to have tendencies to use several data collection methods specific to their industries.

4.2.1.3 Workshop III: Idea Generation

Workshop III entitled *Idea Generation* was the third assignment of the course and it was conducted on March 21, 2022. The workshop consisted of four parts, (1) designing for *creative crossovers* (this was the umbrella theme for the semester), (2) developing immediate ideas, (3) presenting radical and adventurous ideas, and (4) continuing idea generation (see Appendix H). The first part of the workshop required a group discussion in which students discussed how creative crossovers could be interpreted within graduation projects. Depending on the findings of the discussion, students were required to form a mind map. In the following part of the workshop, students were asked to develop fast ideas in-between a systems level to partial solutions. In that part, scenario building and empathy modelling were presented to students as possible supportive methods to express ideas. Students were required to generate as much diverse and many ideas as possible. In the third part of the workshop, students were asked present potential design solutions considering the needs of their specific user groups. Diversity and novel design contribution were expected from students. From this part of the workshop onwards, the user group that the students identified and the user research they conducted became essentially visible in the project development. The final part of the workshop was continuing idea generation. According to the findings of the previous parts of the workshop, students were asked to review and revise their design solutions by making sketches.

Twenty out of 24 students made full submissions for Workshop III. In this workshop, students used the Miro digital platform for group discussions as in the previous two workshops. Many students submitted only verbal or diagrammatic submissions without any visualization. The majority of the students who did visualization, on the other hand, used a representational use of elements such as clip-art or icons that they bought ready-made from the online environment to represent users. It was observed at this stage that several students started to present their ideas, including project statement, keywords, user profile, and early concepts in a visual format and system (see Figure 4.19).

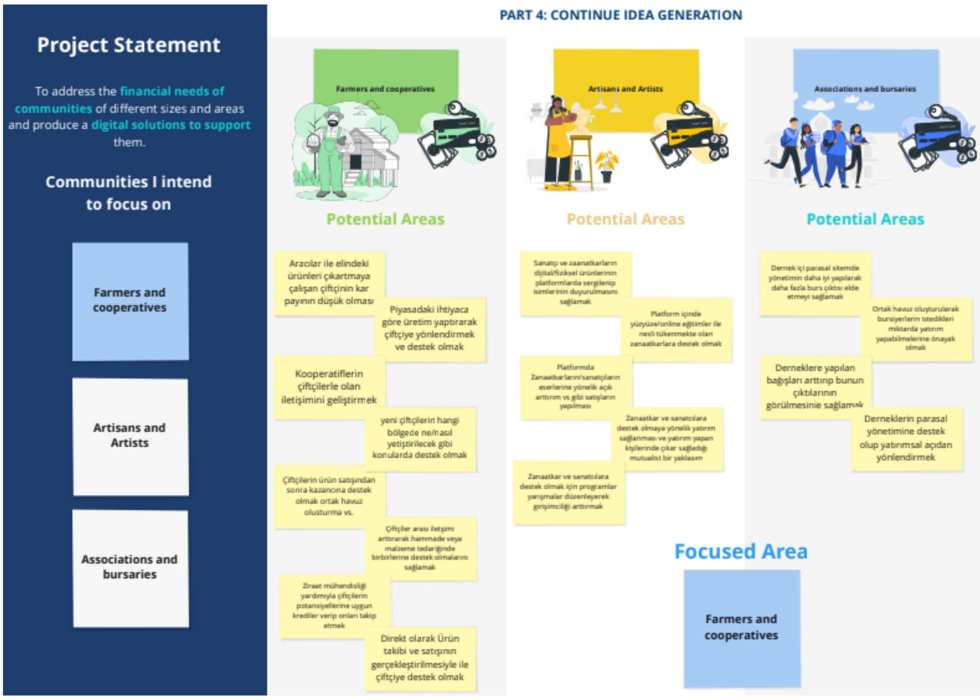

Figure 4.19: Workshop Presentation Format of Student #3

Figure 4.19 presents the project statement of student #3 with highlighted keywords, focused area, and potential project areas in a formatted way. Another important aspect of this account is that student #3 presented several potential user groups in their submission. At this workshop, several students started to specialize their projects according to different communities they chose to work on. For instance, in the account above, student #3 chose *farmers, artisans,* and *associations* as their possible special user groups. To strengthen the visual communication, student #3 associated their possible user groups with illustrations. Therefore, student #3 linked their design opportunities with specific user groups.

As it could be seen from Figure 4.19, there are students who clarified their project statements and their decisions about their research areas and presented these decisions in a certain order. In addition, it was also observed that some students included the outputs of their early UX research findings in their submissions. Students who were able to conduct UX research between Workshop II and Workshop III started to shape their project elaborations by including their research outputs in order to strengthen their presentations (see Figure 4.20). For instance, while student #20 presented their survey outputs in their submission, student #9 conducted several interviews with their volunteered participants and illustrated their outputs in their submission. Students used their UX research in decision-making processes for solution areas.

Figure 4.20: Early Survey Outputs of Student #20

Sketching was the most visible aspect of Workshop III. Sketching in the idea generation process is a frequently used method in industrial design education. Students present their concepts, ideas, and designs by making sketches in different ways. This is also the case in the digital product development process. Within the scope of Workshop III, students illustrated their products and demonstrated their user scenarios based on their UX research by making sketches. At this point, while some students made their sketches using pen and paper (see Figure 4.21), some students prepared their sketches using digital tools and added these to their presentations (see Figure 4.22).

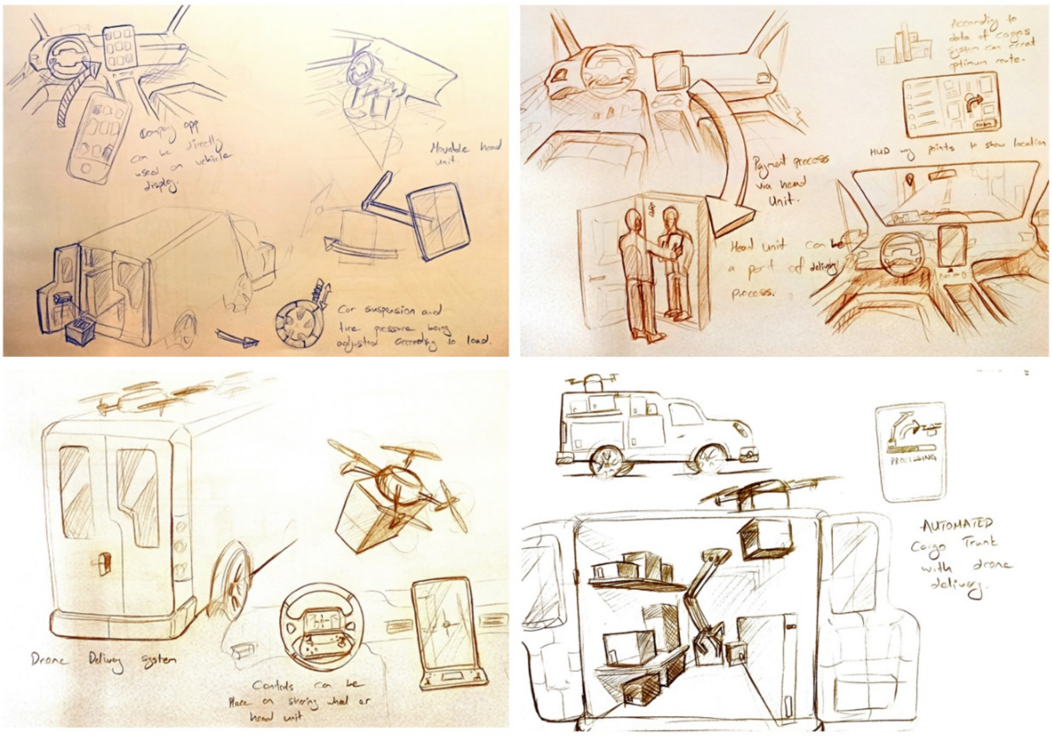

Figure 4.21: Idea Generation Sketches of Student #22

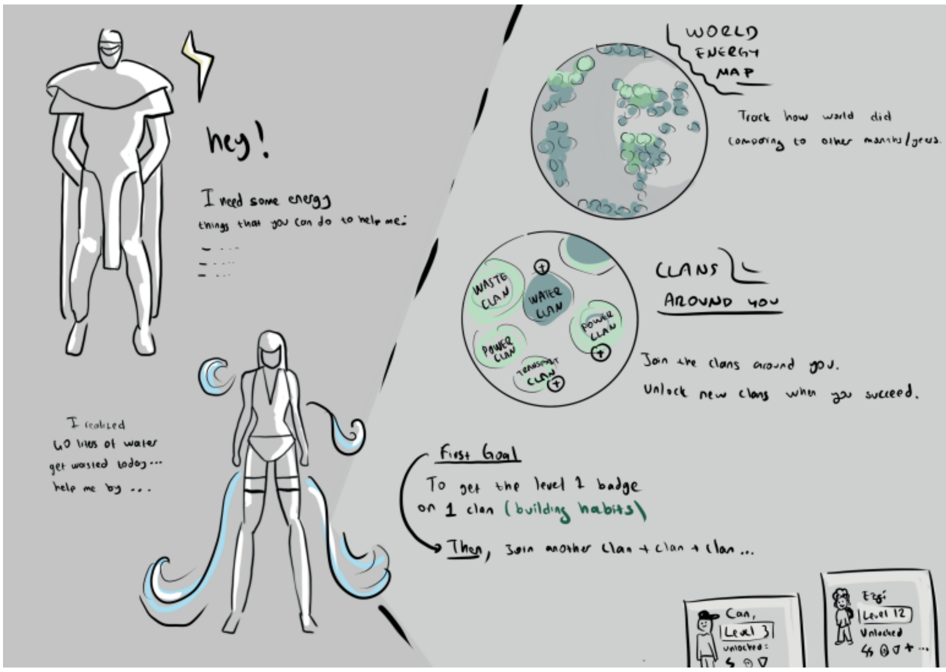

Figure 4.22: Early Character Sketches of Student #17

Figures 4.21 and 4.22 provided information on the concepts, early design ideas, and scenarios of the students, while also providing insight into how their projects specialized. Student #22, working with advisor firm H from the automotive sector, develops a hybrid project by introducing a UI design concept along with an in-car dashboard design. While the sketches in this phase provided descriptions of the context of the project, the delivered UI and scenario visualizations described the service design of the project. As can be seen from Figure 4.22, student #17 differed from student #22 at this point. Student #17 conducted a digital product development project with advisor firm F, which provides services in software and service design. The sketches of student #17, whose keywords include *gamification* at the forefront, contained character designs and storyboarding rather than possible product design options. At this stage, visualizations on UI with low fidelity wireframes and IA were also found in the submissions of students working on digital product development (see Figure 4.23).

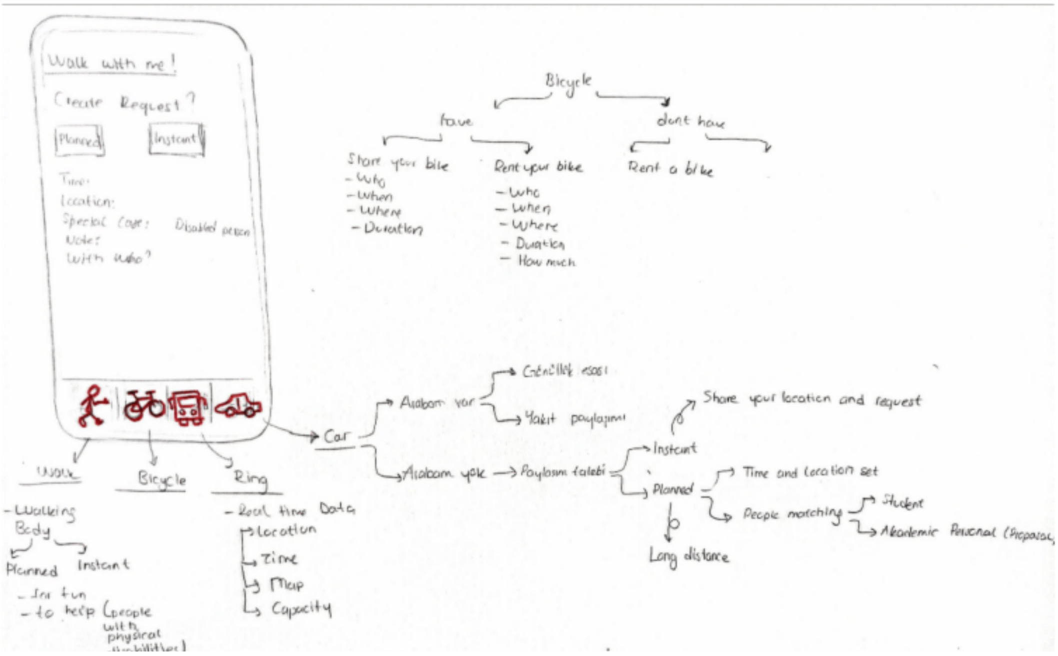

Figure 4.23: Low-Fidelity Wireframes, Flows, and Early IA of Student #12

In Figure 4.23, as in the other figures from Workshop III submissions, the impact of advisor firms on digital product development was observed. Student #12 conducted a project with advisor firm D in the field of education. Since the students working with advisor firm D were working on a product/service to improve their university life on campus, their deliverables in idea generation included various mobile application wireframes, flow diagrams, and IA.

In light of this information, the following can be said to summarize the analysis of Workshop III submissions of the students:

- After determining the project statement, keywords, and user groups, students started to present their submissions in a visual format.
- Visualizations and narratives for the user groups clarified for the project started to be seen in the deliverables.
- The outputs of the user research were also included in the submissions, shaping the project development and specializing the projects of the students working with the same advisor firm.

- Sketching played an essential role in idea generation in the digital product development process, user for reflecting concept theme, developing scenarios, and representing the contexts, users, and interactions involved.
- Advisor firms also played an effective role in the types of sketches and methods used. There is a common language in the method and approach in the submissions of the students who meet with the same firm.

4.2.1.4 Initial Ideas Jury

Initial Ideas Jury was the fourth assignment of the course. It was conducted in March 27, 2022 and March 31, 2022, and it was graded internally by the course instructors. The aim of the jury was to see how the students built the foundations of their graduation projects and how they developed them to the current point where they needed to generate novel initial ideas. In this jury, it was expected from students to submit their project statements, images of user groups, keywords that described attributes of users, infographics from UX research, and hand-made sketches of eight strongest design ideas. Jury submissions were evaluated by the course instructors according to the following criteria; (1) quality of project grounding, (2) diversity and quality of design ideas, and (3) quality of communication (see Appendix I).

Each student made full submissions for the Initial Ideas Jury. In this jury, many students started to express their ideas with some visuals for the first time. In the first three workshops, it was observed that students who did not submit their works, submitted incomplete works, or submitted only written narratives, visualized their ideas for the first time in this jury. In addition, when the submissions were evaluated in terms of presentation techniques, it was observed that almost all of the students had an established layout. It is also evident in this jury that almost every student used a particular method or several methods to construct a user study and analyze its outputs (see Figure 4.24).

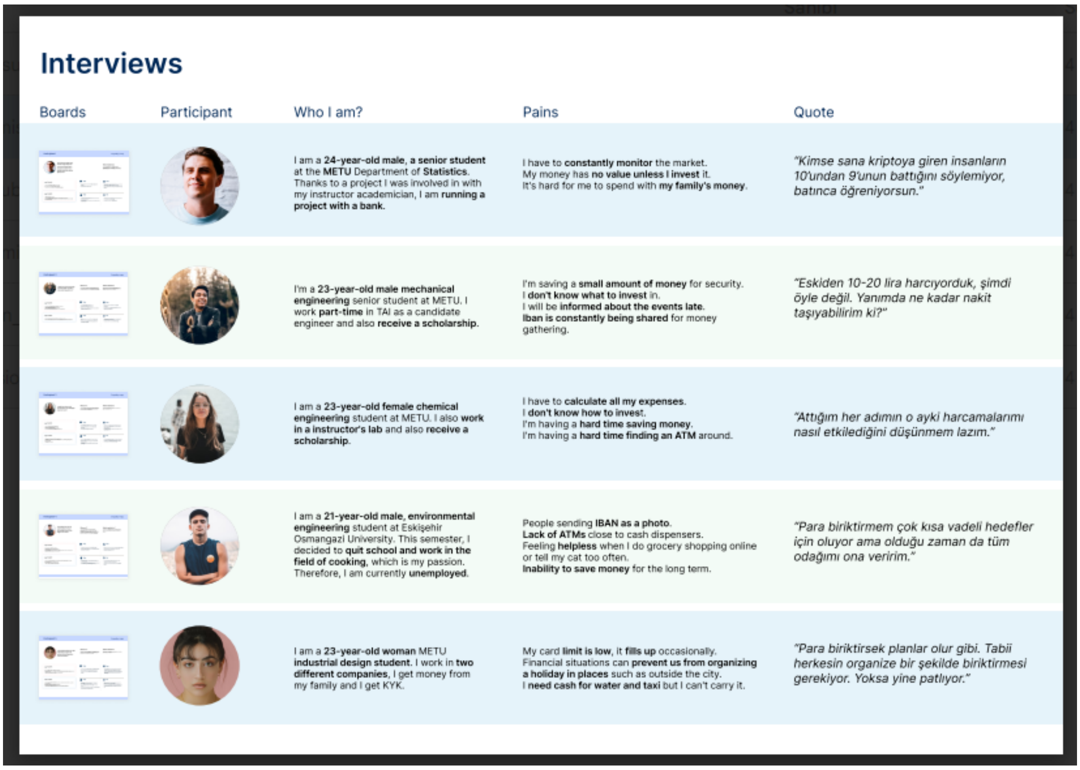

Figure 4.24: UX Research Findings of Student #2

According to the jury submissions, it was seen that students mostly used interview and survey methods. After analyzing the outputs of their UX researches, students started to use them in their idea generation phase. When the ideas proposed by the students at this stage were reviewed, it was seen that some students had difficulty in presenting eight independent and novel ideas. When the submissions of the students who had difficulty in presenting eight ideas were reviewed, it was observed that the last two, three ideas of the students were very similar to each other or complimentary to each other; students found it difficult to diversify their ideas at this workshop.

While the number, quality, and visual expression of the ideas presented in this jury varied among the students, it was also observed that some keywords were commonly used by the students in defining the problem domain and generating solutions. Some firms, such as advisor firm A, provided a variety of keywords to guide the students, but students who did not receive any keyword suggestions from their advisor firms chose some keywords specifically (e.g., *sustainability, design for children, social* *awareness,* and *gamification*). One of the ideas that student #17 presented combined some of these keywords in their project (see Figure 4.25).

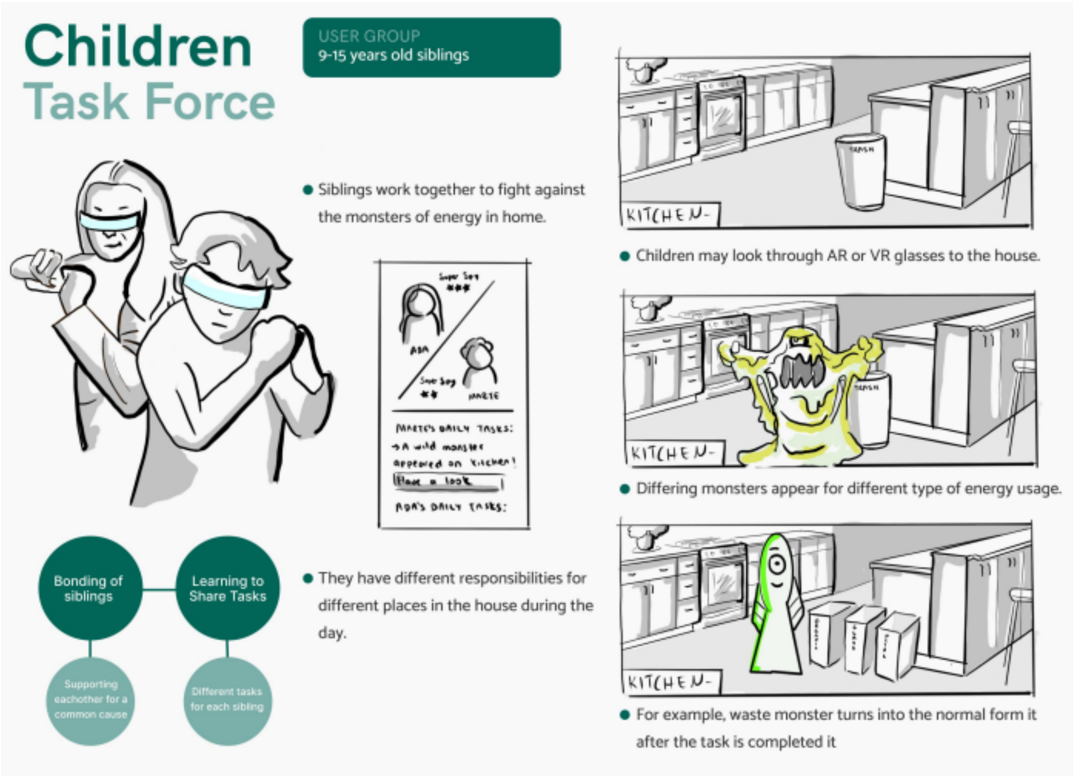

Figure 4.25: Design Idea of Student #17 that Combined Gamification, Sustainability, and Design for Children

After the UX research phase for families with children, student #17 chose the digital product they designed as a mobile application that can be used by children with their parents. This application aimed to teach children the concept of sustainability in a gamified way by using AR/VR to teach them how to use the natural resources around them efficiently. As can be seen from the example above, in this submission, student #17 presented sketches and design proposals in multiple different areas from UI design to character design with a precise design language.

When the submissions of the Initial Ideas Jury were analyzed, it was seen that many students presented their project statement, keywords, and UX research outputs in a detailed and clear way. When they came to the point of presenting eight different ideas, it was seen that visualizations were a little more in the background. In the projects that only proposed service design through a mobile application, the idea proposals continued through written narratives and storyboards, and these proposals were represented through mobile screenshots (see Figures 4.26 and 4.27).

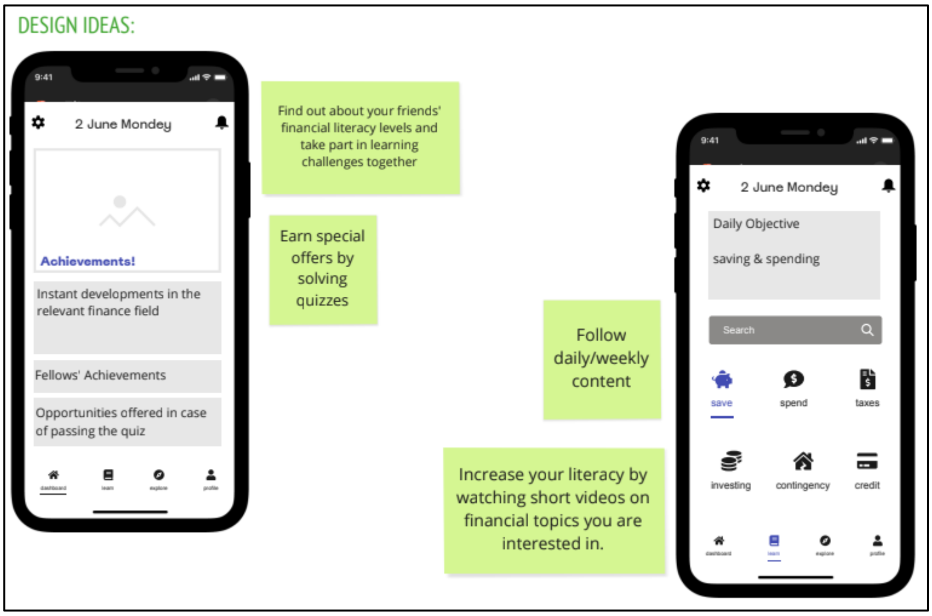

Figure 4.26: Early UI Design Visualizations of Student #5

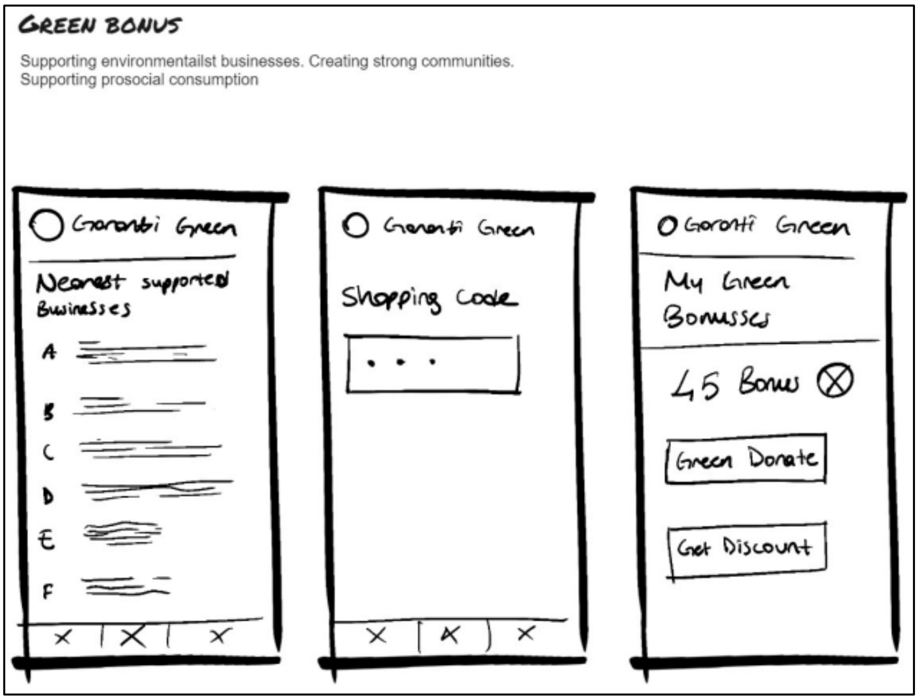

Figure 4.27: Early UI Design Visualization of Student #6

As can be seen from Figures 4.26 and 4.27 and the overall jury submissions, students spent the idea generation process efficiently. At this stage, while some students, such as student #5, used digital templates or icons in their visualizations, other students, such as student #6, based their submissions and presentations on their own hand drawings in a digital medium. The common point in these submissions was that the students prioritized function over visualization at this stage. As can be seen from these two examples, both projects have a specific project statement, various keywords, user groups and objectives. They presented these points in a simple way in their projects. In these and similar student submissions, clear product functions and system analyses were seen, but no detailed color, font, or logo suggestions were seen yet.

In light of this information, the following can be said to summarize the analysis of the Initial Ideas Jury submissions of the students:

- Project statements, keywords, and design approaches of many students were clear at this point. As can be seen from the jury submissions, these students were developing their projects based on the results of their UX research.
- Presentation techniques of many students were almost completely constructed at this point. A consistent layout was seen in student submissions.
- As can be seen from jury submissions, although many students were successful in terms of idea development, they had difficulty in producing eight ideas. When the student submissions were analyzed, while the first few ideas were diversified and novel, towards the end the number of submissions decreased, or the last few ideas were very similar to each other.
- It was observed that *sustainability, social awareness,* and *design for social innovation* were among the prominent concepts in many student projects. Although these were not given to the students by their advisor firms, there were a visible tendency to approach the projects with these common values.
- In addition, socio-economically marginalized communities (e.g., *farmers, artisans,* and *couriers*) and children and/or parents, as user groups were also

highly popular among students showing a level of sensitivity and awareness among students.

- *Gamification, inclusiveness, interaction,* and *collaboration* were also among objectives that many students focused on for their projects.
- For students who worked on designing a digital application, visualization was considered a little less than the other projects. While function and usage areas were more prominent in these projects, design elements remained at a more basic level.

4.2.1.5 Workshop IV: Constraints, Objectives & Directives (CODs)

Workshop IV entitled *Constraints, Objectives & Directives (CODs)* was the fifth assignment of the course and it was conducted in April 4, 2022. In this workshop, students were asked to use a technique of prioritization to determine the more important (fixed or non-negotiable) and less important (optional or fully negotiable) design considerations in their projects. They needed to identify constraints, objectives, and directives (CODs) that would lead them towards an effective exploration of the design solutions. CODs would help to define the specifications of the product or service that students were designing. According to the workshop brief:

- *"**Constraints...** are obligatory requirements. The word "must" is used to emphasize the strength of the statement. Constraints often come from manufacturing resources, essential user requirements, principle functionality, legislation, official standards, and conventions.*
- ***Objectives...** are less forceful requirements than constraints. These are expressed as statements that the designer strives to achieve as much as possible. Objectives often come from marketplace trends, aspirations of users, and strategies for product differentiation.*
- ***Directives...** are goals that are desirable, but not urgently important. In other words, they can contribute to a more successful product, but success can also be achieved without them. Directives often come from lower priority user*

requirements, trendsetting decisions, add-ons, and the personal values and style of the designer." (see Appendix J).

In the workshop, students were asked to compile and develop two diverse ideas based on the comments and feedbacks from the Initial Ideas Jury in three parts, (1) identification of CODs, (2) COD-based evaluation of two initial ideas, and (3) re-evaluation of CODs. In the first part of the workshop, students were asked to work individually by writing down their latest project statement and defining multiple and specific CODs according to their projects. In the second part, they were asked to form groups and briefly discuss their project statements, CODs, and their two ideas that they compiled and further developed. Peer review was only present in this part. Group members were asked to evaluate ideas of their peers considering whether their ideas addressed their CODs, and whether additional (or rephrased) CODs were needed. In the third part of the workshop, students were asked to work individually on their statements and CODs and prepare an updated CODs table or list.

Twenty-three out of 24 students made full submissions for Workshop IV. When the submissions of this workshop were analyzed, almost all the students submitted written narratives without any visualization. Only one student (Student #5) described their CODs through written narratives in their submission but reinforced this narrative with a layout and various visualizations (see Figure 4.28).

Figure 4.28: CODs Boards of Student #5

As seen in Figure 4.28, the student reinforced their design language and narrative by using various visualization tools (e.g., vectoral pictures and color-coded post-its). In the other submissions, the students followed the same style of expression that they used in the first two workshops, with some students using paper and pencil and others using digital written-based submissions on the CODs of their projects (see Figure 4.29).

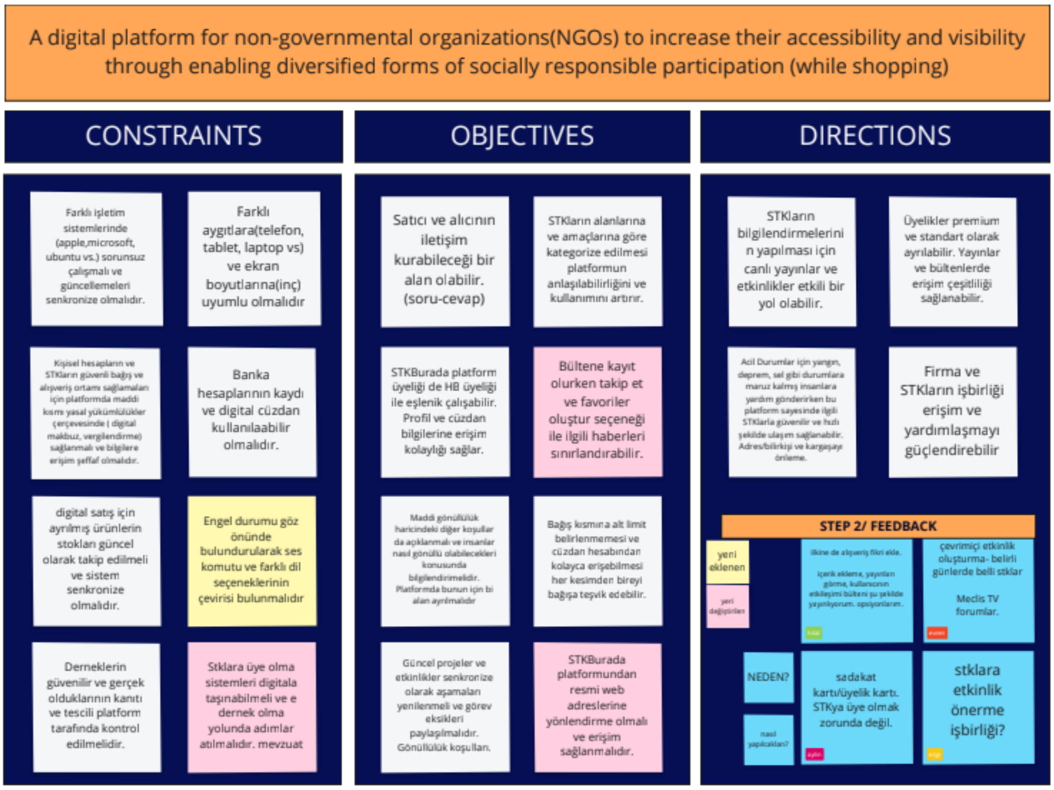

Figure 4.29: Detailed CODs Board of Student #10

In Figure 4.29, insights on both the current project statement and the CODs prepared by the student can be obtained from a single board. An additional essential point was that the student also color-coded the peer reviews obtained by the end of the discussions in the workshop. In this submission, student #10 used red post-its to identify the ideas that changed and yellow post-its to identify the new ideas that emerged after the discussions. In the *Step 2: Feedback* section, student #10 color-coded each peer review as a box and used a different color for each comment and its owner.

In Workshop IV, no visual improvement was observed in general. While examining the student submissions, it was observed that the students made their submissions but generally simplified them. The CODs they presented in their submissions was not strengthened with any sketches or visuals. When the submissions of the students in this workshop were analyzed in terms of content, some of the keywords seen in the Initial Ideas Jury became more visible in detail. *Gamification, inclusiveness, sustainability,* and *collaboration* were among the keywords found in many graduation projects. Furthermore, it was seen that advisor firms have an impact on the development of CODs as well. Especially in the submissions of students working with advisor firms A and D, a common tendency on using the keywords *collaboration* and *gamification* was seen. These keywords were taken as goals by the students in their design ideas.

The most important point of Workshop IV emerged when the CODs developed by the students for their projects were analyzed. At this stage, most of the students addressed the concepts of *inclusiveness, user-friendliness, motivational,* and *trust* (or *privacy*) in the constraints section. According to the students, these concepts were considered as musts, and they shaped their projects. In addition, *collaboration* and *gamification* were seen as important keywords in many projects. However, when the COD tables of the students were analyzed, it was seen that these concepts were mostly included in the objectives or directives sections. After a certain point in the project development, these concepts were used interchangeably. When the submissions were analyzed, it was seen that the constraints section was the most fully constructed section. Although the students had well-established opinions about directives, most of them had a vague understanding of objectives. Many ideas in this section were repeated in either constraints or directives sections.

In light of this information, the following can be said to summarize the analysis of Workshop IV submissions of the students:

- After the Initial Ideas Jury, there was not much of a visual development in the student submissions. Students simplified their submissions, while most of them appropriately submitted their works. None of them combined their CODs with sketches of their ideas, pictures, or so on.

- Students made a lot of use of color-coding when classifying the ideas, they presented through written narratives.
- When the CODs in the student submissions were analyzed, *inclusiveness, user friendliness, motivational,* and *trust* (or *privacy*) were seen as musts by the students, and they had an important place in the constraints section.
- In addition, the terms *collaboration* and *gamification* had been very important in the project statements so far, but at this stage, they were either in the objectives or directives sections. These terms were interchangeable between these two sections.
- In the student submissions, constraints contained many ideas, while directives contained fewer ideas. In addition, the objectives section was less structured and the ideas it contained were seen in other sections.

4.2.1.6 Preliminary Jury

Preliminary Jury was the sixth assignment of the course. It was conducted on April 25, 2022 and April 28, 2022, and it was graded internally by the course instructors. In the Preliminary Jury, it was expected from students to demonstrate progress in developing two coherent design concepts. In this jury, it was also expected from students with GUI or app-only projects to get familiar with the relevant software (e.g., *InVision Studio, Figma,* or *Adobe XD*). Students were required to submit their (1) customer journey map (CJM), (2) IA, (3) flow diagram, and (4) concept and design systems. The jury brief described the content of the *CJM* as follows:

- ***"Persona:*** *A brief description of the persona including age, sex, occupation, digital literacy level, lifestyle, marital status, education level, etc.*
- ***Scenario:*** *A scenario integrated into the CJM. The scenario should address user actions and goals. The scenario may be described as a timeline consisting of pre-service, service, or post-service phases.*
- ***Touchpoints:*** *Description of physical, digital and human elements that are in touch with the target user at different phases.*

- ***Feelings and emotions explained in annotations:*** *Description of feelings and emotions that users face at different phases and why they feel that way.*
- ***Benefits:*** *The benefits and opportunities that the solution provides the users with at different phases of the journey"* (see Appendix K).

In the preliminary jury brief, course instructors also defined what they meant by IA, flow diagram, and concept and design system. According to the brief, IA was considered as a visual representation of the app structure that organizes and displays the features and the hierarchy among them. *Flow diagram* emphasized all the critical tasks designed for the app, using traditional flow chart notation and symbols. *Concept and design system* acted as an introduction to the app, by showing its design system including; color palette, typeface, icons, buttons, notifications, visualization, main features, target users, social, technological and cultural context. For the concept and design system, students were also expected to show the visual identity of the design project (or app in many cases) that shows name and logo, with the objective of the project, major opportunities, main operational features of the user interface and flow of the tasks. Preliminary jury submissions were evaluated by the course instructors according to the following criteria, (1) design contribution/innovation with usage scenarios and sensitivity to user needs, (2) bond between project statement, supportive research, user requirements, and design concepts, (3) evidence of prioritized features amongst the concepts, and (4) quality of communication.

Each student made full submissions for the preliminary jury. When the student submissions were analyzed, the first point that stood out was the presentation techniques of the students. At this stage, almost all of the students made well-established preliminary jury submissions with a visible flow of information within their projects. Only some students who developed hybrid projects had deficiencies in IA and flow diagrams. Other than that, the visual expression language, layout, colors, and fonts used by the students made the projects look professional.

When the preliminary jury submissions were examined respectively, the first assignment examined was the CJM. Regardless of the advisor firm or project type, all students submitted a CJM containing the required insights. In this submission, the CJMs of the students who developed a project for a specific activity such as a game presented a storyboard showing the relationship between persona and scenario, while the projects that focused on a specific service presented a CJM with motivations and opportunities (see Figure 4.30).

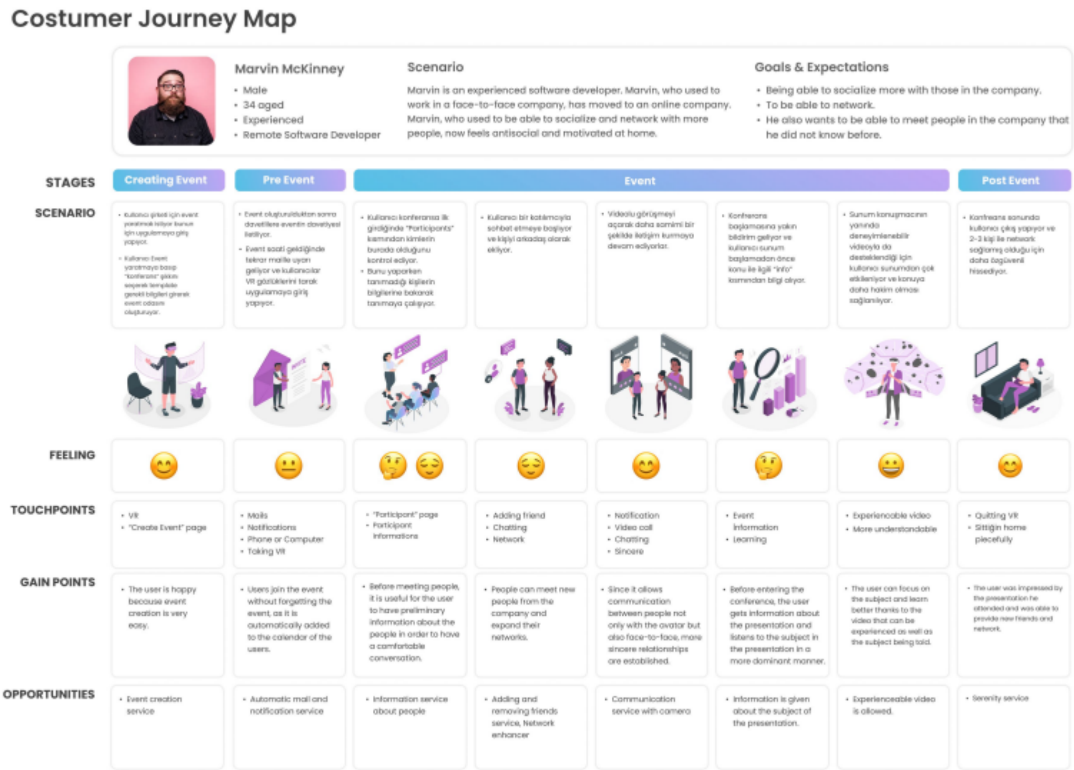

Figure 4.30: CJM of Student #16 (Service Design Project)

In Figure 4.30, student #16, focusing on a specific service, started with a persona that they constructed first. In a simple way, they showed the aspects of their persona, user scenario, and user goals and expectations from the product in relation to the stages of user journey. In order to facilitate the narrative and strengthen the flow of information, they divided the product usage process into stages and positioned the detailed scenario stages under them. Another point that strengthened the narrative and facilitated the follow-up was the utilization of visual narration in these stages. Especially in the feelings line of the table they presented, they mapped the stages with an emoji, which contributed to narration of the student. Ability of the students to map all stages of the product usage process with touchpoints, gains, and opportunities on this table also made the sheet successful.

Following the review of the CJMs, the second point examined was IA. At this point, student submissions started to reveal their differences from each other by showing their specialized features. Since points such as persona and scenario in the content of CJMs were used for all projects, CJMs differed mainly in terms of presentation techniques. Unlike CJMs, IA submissions showed great differences on a project-specific basis. The IA presented by a student working on game design (see Figure 4.31) was different from that of a student presenting an app with service design (see Figure 4.32), or a hybrid project with system design (see Figure 4.33).

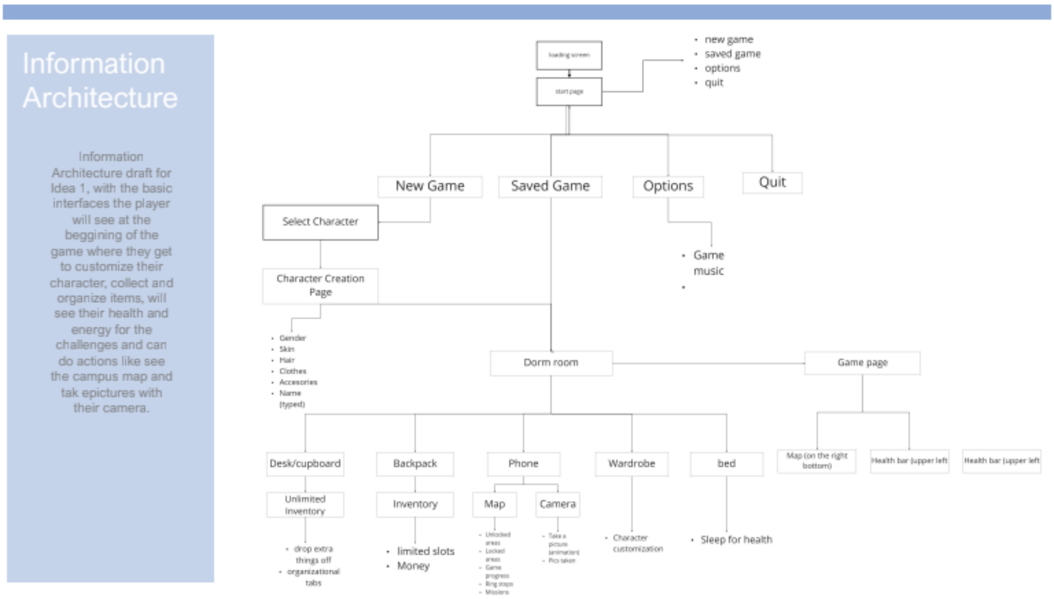

Figure 4.31: Draft IA of Student #7 (Game Design)

Figure 4.31 belongs to student #7 who developed a digital product development project involving game design. As can be seen from the example, the game design has created certain needs, and these needs have shaped the IA presented by the student. The student defined four headings, *new game, saved game, options,* and *quit*, in a basic way through the main menu design. The functions were organized under these four main headings. Under the *new game* heading, user preferences to be used in the game were located and were expected to be used throughout the gameplay.

Under the *saved game* heading, it was aimed to continue the game from the place where the game was left. In the *options* heading, sound and visual changes that would affect the game functioning were included. This heading has an impact on the overall user experience by its customization aspect. The *quit* option was used to close the game completely.

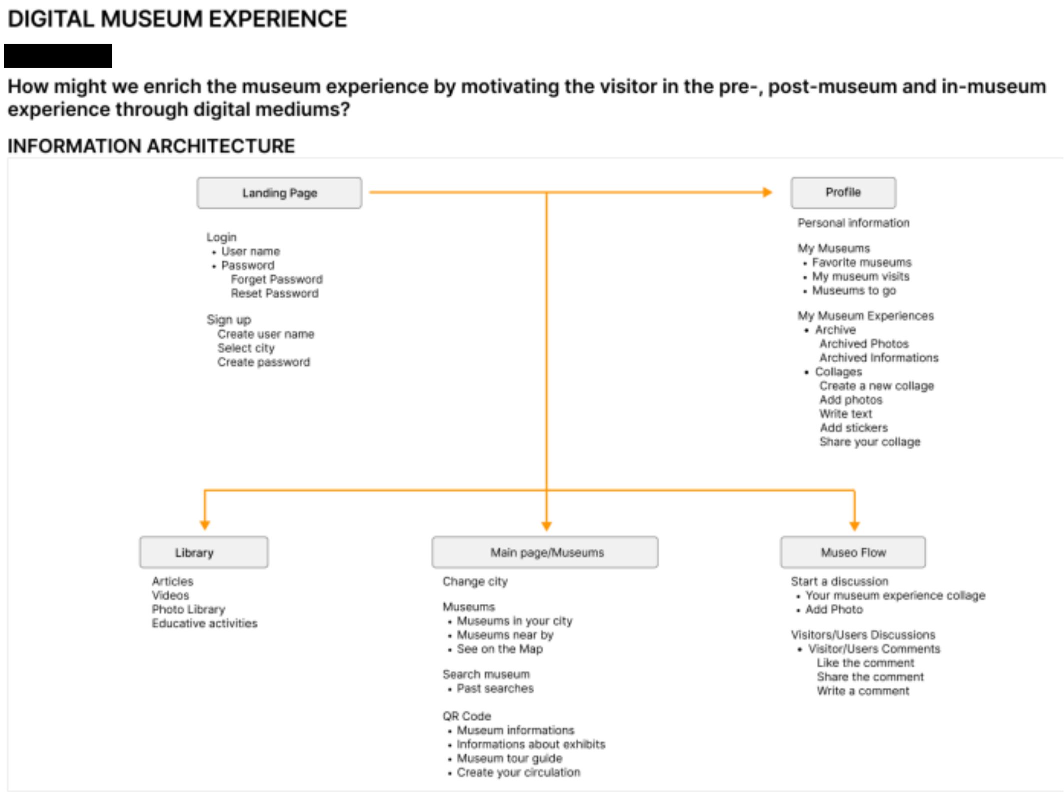

Figure 4.32: Draft IA of Student #15 (Digital Museum Service Design)

Figure 4.32 shows a service design app presented by student #15 in the context of digital museology. Unlike the game app in the previous example, this IA included points about working as a digital platform. The landing page is the common point between the two examples. Here, profile information with a basic schema is shown. Library and main page/museum tabs were designed for the user to create and improve their current museum experience. The tab called *Museo Flow* covered the experience sharing of the user after the museum experience. The IA, which was built on a single function (game) in the previous example, is different here due to the specialization of the project and the advisor firm.

Figure 4.33: Draft IA of Student #20 (Hybrid Car Infotainment/Mobile App)

Unlike the two examples above, the example in Figure 4.33 shows the IA of the hybrid project of student #20, which worked in tandem (car infotainment and user mobile app). The special feature of this example is that it shows two IAs, one below the other, allowing readers to follow the app usage process and functions simultaneously. The work of the student working with advisor firm H, a company from the automotive industry, was more structured and compact than the previous examples. The limitations imposed by specific functions and the practice of driving a vehicle were reflected in the IA and shaped the project.

Flow diagram was examined after CJM and IA within the scope of jury submissions. At this point, many students combined the user needs they identified in the UX research process with the user scenarios they prepared and grouped them under the functions of the digital products they prepared. Then, students submitted a flow diagram based on their IA (see Figure 4.34).

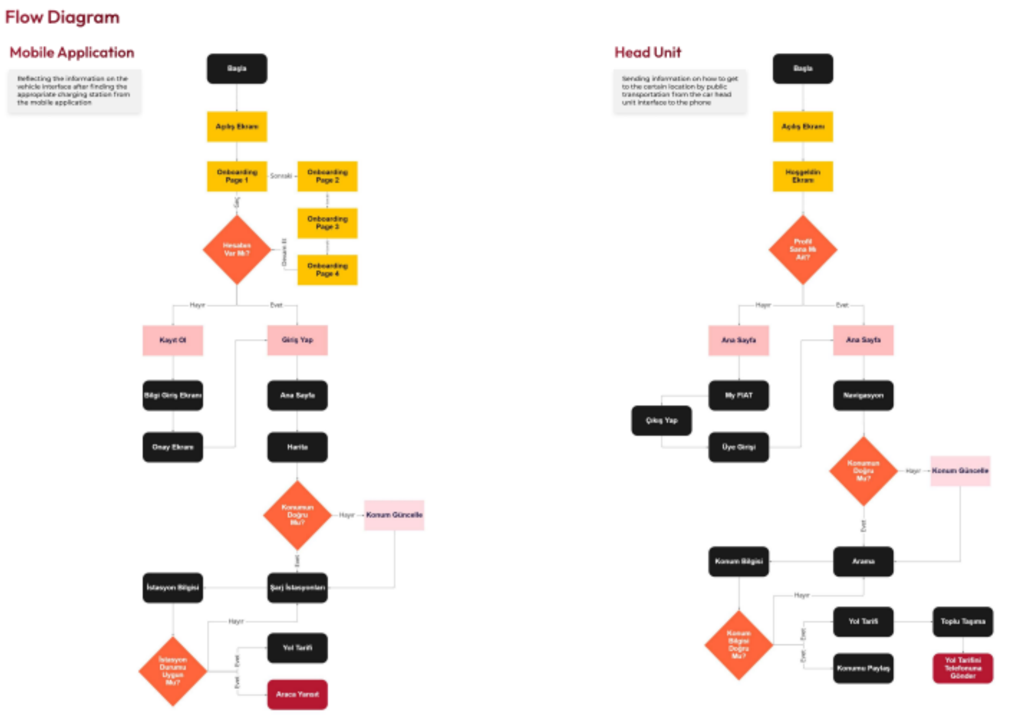

Figure 4.34: Two Flow Diagrams from the Hybrid Project of Student #24

In Figure 4.34, student #24 worked with advisor firm H (from automotive industry) to create a mobile app project that works in conjunction with an in-car head unit. Here, the student presented the flow diagram of the head unit and the flow diagram of the mobile app side by side with the same visual language. This approach made it easier to follow the flow of the presentation and created a more powerful narrative. An important point that stood out in the flow diagrams was that the student explained the functions and flow by grouping and placing them in a hierarchical manner. The student organized the functions hierarchically in the flow diagram and achieved this by assigning different sizes, colors, and shapes to the functions. This made it easier to explain the flow diagram, which was constructed through a schematic expression.

The last assignment examined in the preliminary jury submissions was concept and design system. Looking at the submissions, it was observed that the outputs of the students regarding this stage were a little behind the other jury requirements in terms of completeness. Although all students made their jury submissions, not all of them had outputs for concept and design systems. When the submissions with outputs for this requirement were examined, it was observed that the students generally worked on fonts and colors. A common feature seen in many submissions was that the students presented the visual elements such as font, color palette, and so on, that they chose in their first project proposals (submitted in the initial ideas jury) by changing only the dominant color in their second project proposals. Some students kept the visual elements the same at this point and only changed the project name. In terms of logo design, many students preferred to use only a single capital letter and did not apply a design approach from scratch. Although all these design approaches were seen on submissions, the majority of the students did not provide any information about the reasons for these choices in their submissions. This situation questioned purposes and validity of the design decisions. In general, this gave the impression that the students left the concept and design system requirement to the end. In addition to these examples, there were submissions that provided examples of visualized design options such as logo design, font, color palette, button layout, and so on, from scratch (see Figure 4.35).

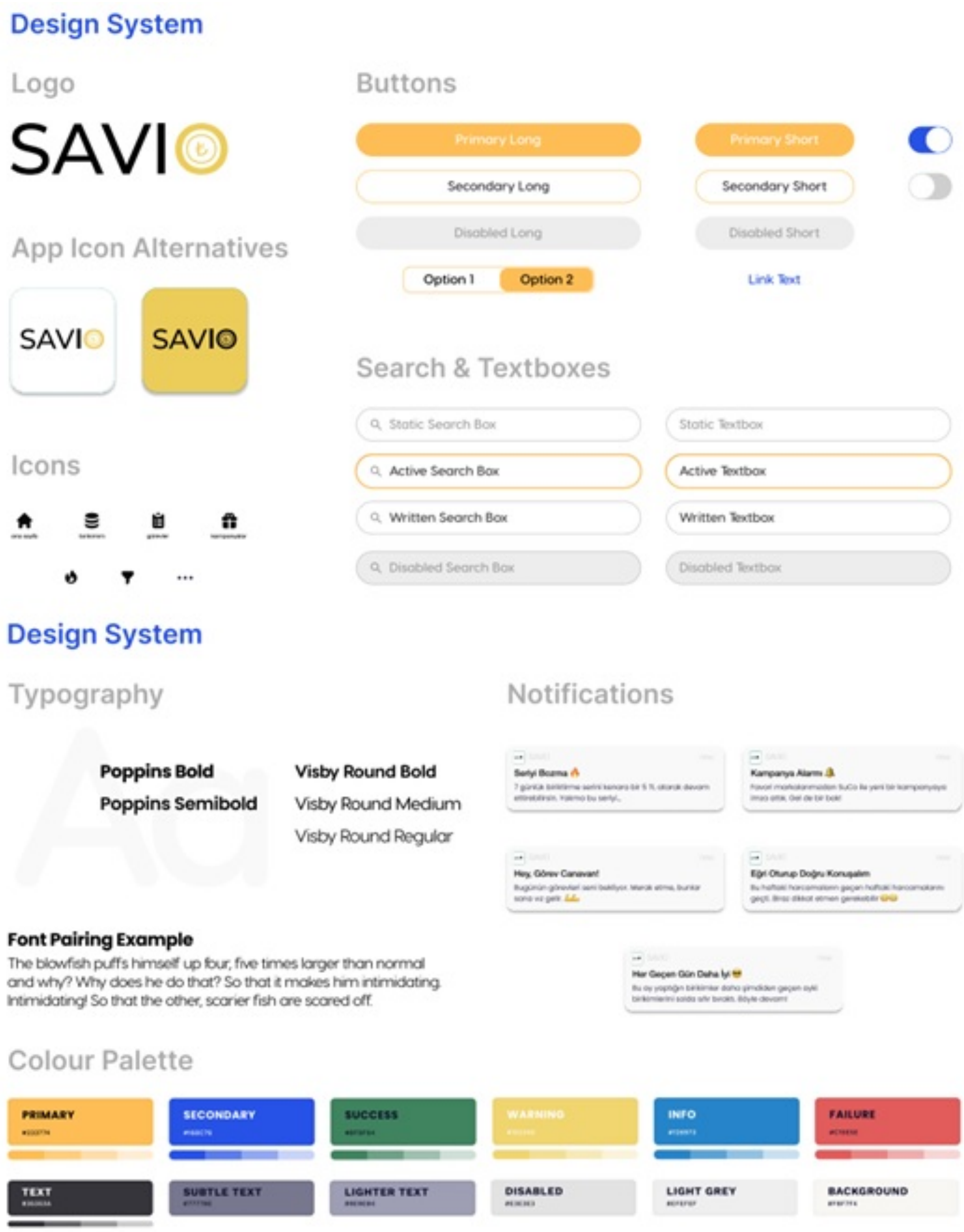

Figure 4.35: Concept and Design Systems Presentation of Student #4

The logo designed by the student was one of the main points that made the concept and design system submission of student #4 stand out from the other submissions. In addition to the name of the project, the logo uses the current Turkish Lira symbol to indicate that the project is for the finance sector. In addition, the student presented alternative icon options for how the application would appear in the app stores where the application meets the user. Giving information about which colors on the color palette will be used for what purpose and where in the application, and making the same explanations for the user font played an important role in detailing the project. Another successful point was the use of emojis in the notifications in the application. This project was designed to produce financial solutions for GenZ. By incorporating emojis into the design language, the student not only customized the project, but also applied a memorable design approach that would connect with the new generation user group.

In light of this information, the following can be said to summarize the analysis of preliminary jury submissions of the students:

- By the time students reached the Preliminary Jury stage, it was observed that most of the students had an established layout and had mastered various presentation techniques specific to the sectors.
- Since the students had worked on scenario building in their four years of industrial design education, they made successful CJM submissions based on their experiences. Some students used graphical expression methods to strengthen their narratives, while others made use of various ready-made images and icons. These ready-made illustrations are widely used in UX sector as a visual representation style. Especially the CJMs of digital projects working on a service design were very detailed and met the requirements of the jury brief at every stage.
- It was observed that when it came to IA, the student projects became more specialized. This specialization was based on the change in the advisor firms and thus design areas of the students. At this point, students categorized their ideas for user problems and design solutions, which they updated with the outputs of their UX research, and presented them schematically through IA. However, because of the technical nature of the IA visualization was not a primary concern or focal point of the students.
- Flow diagrams, just like IA, were shaped according to the project areas of the students and the working areas of the advisor firms. Many students turned

the IA diagram into a flow through functions and buttons. At this point, they displayed shapes of different colors and sizes on a hierarchical plane in order to facilitate their narratives and increase the readability of the flow charts.

- Within the scope of concept and design systems, it was observed that students used various visualization methods by presenting different colors, fonts, logos, and app screens. At this point, many students applied the concept and design system they prepared for their first design idea to their second design idea by changing the project name or color. Another striking point is that many students did not provide any explanation or reason for their color, font, or other visual decisions. This gave the impression that the students left working on the concept and design system until the later stages of their design process.

4.2.1.7 Final Screening

Final Screening was the seventh assignment of the course. It was conducted in two sessions, the first session on May 23, and May 26, 2022 and the second session on May 30, and June 2, 2022. All final screening sessions were graded internally by the course instructors. Final Screening was an essential process during which course instructors and students discussed finalization and presentation of the graduation projects. The assignment comprised two stages; (1) *Final Screening for Design Details* (May 23, and May 26, 2022), and (2) *Final Screening for Presentation* (May 30, and June 2, 2022). Students who satisfied the requirements of both Final Screening stages received permission to exhibit their projects in the annual graduation projects exhibition (see Appendix L).

The Final Screening for Design Details stage took place as a scheduled critique with course instructors with an objective to discuss the details of graduation projects in a pre-given template of 90x110cm, landscape, black and white printout. These details included; scenarios, final decisions on visual elements, product controls, and GUI designs. Additionally, students were asked to bring their 3D CAD models, product renderings, and GUIs, apps, and games. In the Final Screening for Presentation stage, students were given feedback on how to communicate effectively their final design proposals. Submissions were graded in relation to project completeness, messages, layout, graphics, language, and general communication quality. Content and layout presentation boards were differed between product design projects and digital product design projects. Students with digital product projects were asked to submit the following components in their boards; (1) name and logo of the project with a finalized project statement, (2) CJM including persona, scenario, touchpoints, feelings and emotions explained with annotations, and benefits, (3) concept and design system, (4) IA, and (5) flow diagram.

It was observed that students used screenshots from their project prototypes to fulfill the Final Screening for Design Details requirements. In doing so, they applied more than one different narration method. The majority of the students narrated the entire flow of their projects with separate screenshots and did this in the form of a slideshow. When the submissions made in this way were examined, it was seen that the narratives including the whole flow explained with 60-70 slides and had the resemblance of a booklet. Instead of doing this, some students grouped the screenshots they took under certain function or user flow headings and made them into a board to facilitate their narration (see Figure 4.36).

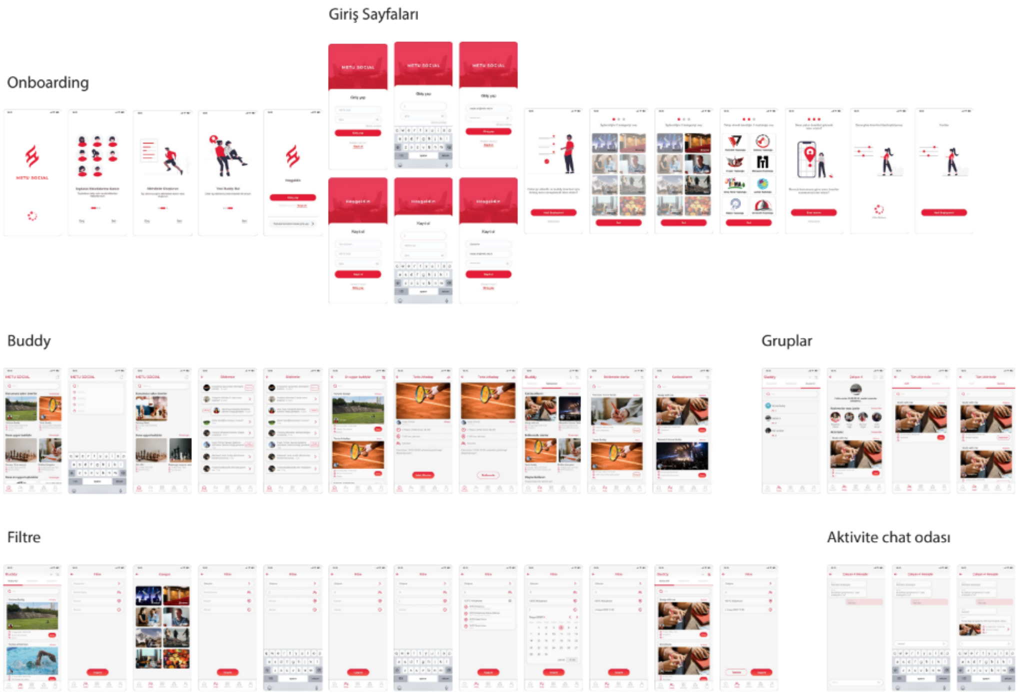

Figure 4.36: Final Screening for Design Details of Student #13

In Figure 4.36, student #13 took screenshots of all their proposed user flows and categorized these screens under certain headings such as, onboarding, login, *Buddy*, groups, filters, and activities or chat rooms. This way of expression made it easier to follow the user flows and user scenario that the student has designed. Additionally, this narrative showed the relationship of the screens with each other and facilitated editing in case of any product update. In addition to presenting through slides and screenshots, another method of expression chosen by the students was the through wireframes of the prototypes they prepared (see Figure 4.37).

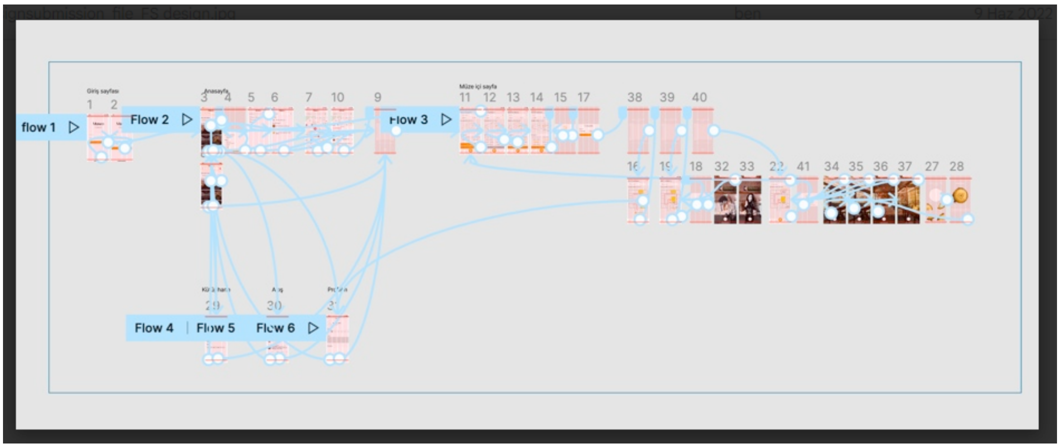

Figure 4.37: Wireframes on Figma of Students #15

In Figure 4.37, it is seen that student #15 prototyped their project using *Figma* software, and presented their user journey through the wireframes of their prototype. This approach differed from the others in that it constructed the flow through a slightly more technical presentation. While in the other examples, the students were acting through a finished presentation narrative; in this example, the student presented a real-time technical flow of applicability of the product. When the submissions of Final Screening for Design Details were analyzed in general, it was observed that the outputs were formed as visuals prepared to be used in the Final Jury submissions. Under the title Final Screening for Design Details, students visualized the technical details of the projects based on their prototypes and clarified the project details by taking a final critique before the Final Jury.

When the Final Screening for Presentation stage submissions, which is the last stage of the Final Screening, were analyzed, it was observed that students focused on presentation layouts. In these submissions, most students submitted a final presentation board. In line with the critiques, they had received in the previous stages, students had reached definite ideas on many points of their submissions and displayed them on this board to receive a final critique before submission (see Figure 4.38).

Figure 4.38: Final Screening for Presentation Submission of Student #4

In Figure 4.38, student #4 presented a relatively completed layout for the Final Jury. Their project statement, product name, CJM, and descriptions of various features of the product were coherently placed on the board. The student also blankly marked on this board the points where they would place the screenshots that they would update according to the critiques they received during the Final Screening. This stage acted as a guiding assignment for the student on how to introduce the tasks to the jury through the boards and how to explain them. Additionally, when the submissions for the Final Screening for Presentation were explored, it was seen that there are some students who did not work on layouts, but rather submitted works on how they would present the information on their technical presentation boards (see Figure 4.39).

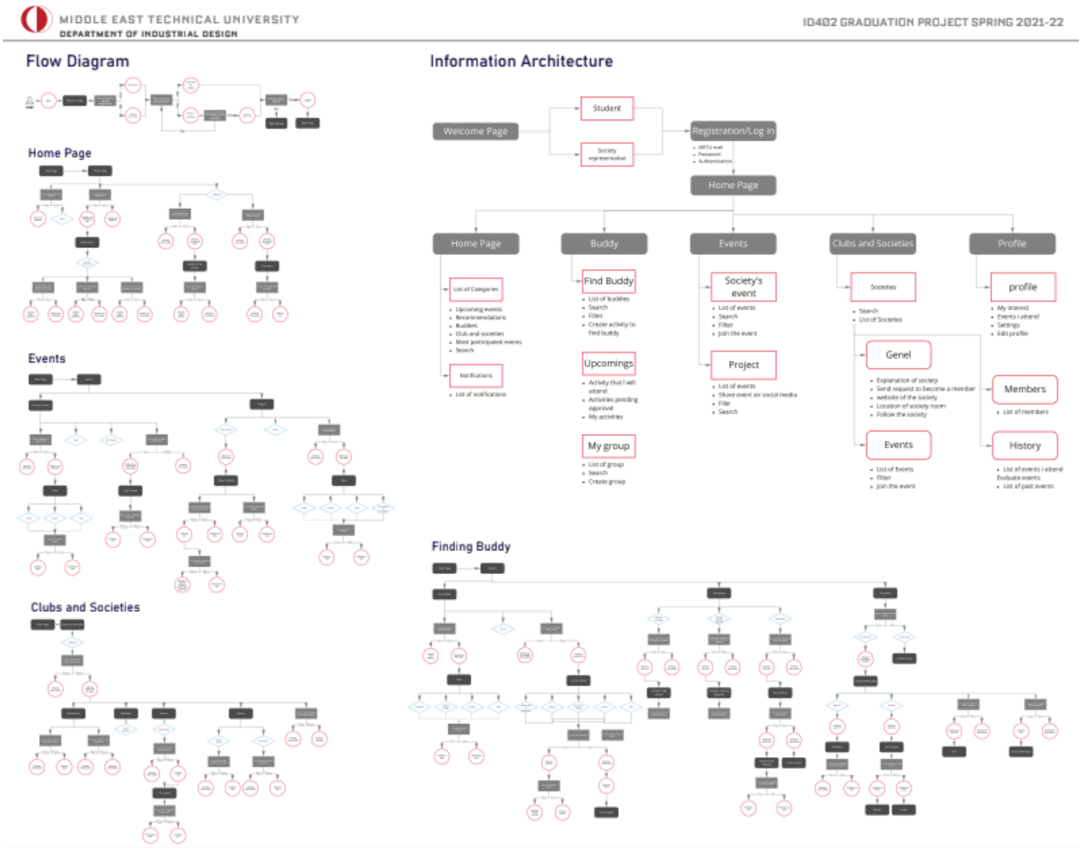

Figure 4.39: Final Screening for Presentation Submission of Student #13

As can be seen in Figure 4.39, unlike student#4, student #13 did not submit a layout in the Final Screening for Presentation submission but the content to be placed on the layout. The critiques they would receive would be based on the content. Student would update their project accordingly, and as a result, this board would take the form of a final jury submission on a layout. The student considered this stage as a guiding point again for design feedback and the content of the design critiques they received differed. Thus, it was observed that the two stages of the Final Screening assignment would merge after the critiques and shape the Final Jury submission.

In light of this information, the following can be said to summarize the analysis of Final Screening submissions of the students:

- It was observed that the Final Screening for Design Details stage was about the presentation content related to the design features and Final Screening for

Presentation stage was about the graphical layout of the boards related to presentation techniques.

- The Final Screening was essential to help students with layout control and content control. In addition, the assignment helped the students to prepare their final boards and leave time for prototype development. This situation reduced the final jury load of the students.
- It was observed that almost all projects were ready for the final jury. While some of the students corrected the content of the designs they prepared according to the critiques, the others prepared their final presentation layouts according to the critiques they received on the project content.

4.2.1.8 Final Jury

The Final Jury was the eighth and last assignment of the course. It was conducted in-between June 21-23, 2022, and it was graded with the participation of both internal and external jury members. Internal jury members were the five course instructors (two full-time instructors, one part-time instructor, and two research assistants) and three external jury members from the department. There was full participation from the advisor firms. In the Final Jury, students were compulsorily required to submit a concept presentation board, a technical presentation board, an interactive app/GUI/game design prototype, and could also submit a product/app/GUI/game design animation or video. Additionally, students with GUI/app-only projects were required to submit their (1) CJM including; persona, scenario, touchpoints, feelings and emotions explained with annotations, and benefits, (2) concept and design system, (3) IA, and (4) flow diagram within their two submission boards (see Appendix M). The Final Jury deliverables were analyzed in terms of concept presentation board, technical presentation board, and prototypes or videos, respectively. Since all students within the scope of the thesis had GUI/app projects, CJM, concept and design system, IA, and flow diagram submissions were examined in detail in their final submissions, similar to the preliminary jury. All 24 students participated in the final jury. Since the Final Jury requirements differed for each project, this was also reflected in the submissions.

Concept Presentation Boards

Within the scope of the final jury submissions, concept presentation boards of the students were examined first. In these submissions, the students explained their projects in general terms and most of the submission items requested from them throughout the semester were explained on this board. On this board, students indicated main features with their project title, project statement, CJMs with persona, scenario, touchpoints, emotions, and benefits explained with annotations. Although these boards mainly illustrated common jury requirements, the differences in the context and use among projects revealed differences in the concept presentation boards. For instance, a concept presentation board for a mobile application project (see Figure 4.40) showed significant visual differences compared to the board for a website project for service design (see Figure 4.41).

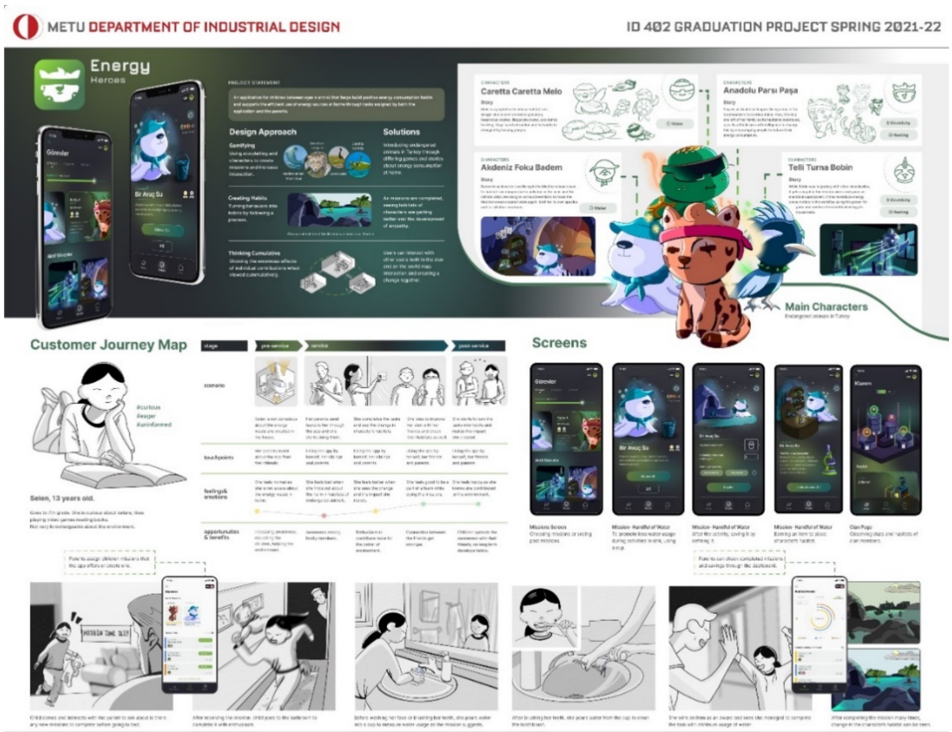

Figure 4.40: Concept Presentation Board of Student #17 (App Design)

Figure 4.40 is the concept presentation board of student #17 that aimed to introduce the concept of sustainability to children and incorporate it into their everyday life practices in a gamified way. The visualizable thematic content of the project was combined with the motivation of the student for their project. In addition to the written narratives, the student prepared a board containing all the data required within the scope of the assignment by adding their own designed characters and user scenario storyboards. Therefore, this board was sufficient to express the main outlines of the project. The concept presentation board of student #11, with a different focus and narrative, is another successful example from the Final Jury submissions (see Figure 4.41).

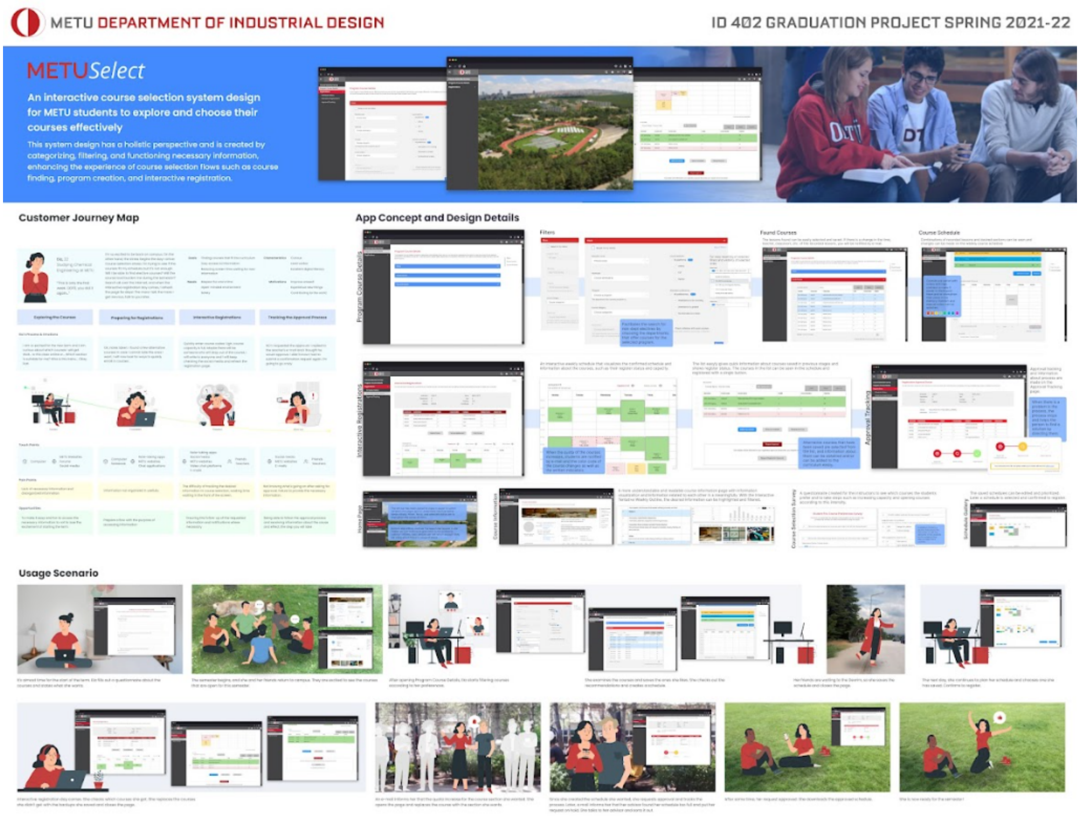

Figure 4.41: Concept Presentation Board of Student #11 (Website Design)

In Figure 4.41, student #11 worked on the design of a website for pre-registration, course selection, and schedule management of university students. Although the project is based on more written narratives and structured systems than a gamified app for children, student #11 managed to express the jury requirements in a visual way by creating their own language. The common feature of both submissions was the horizontal boards with the project description, statement, and brief horizontally on top of the board. Apart from this, student #11 preferred a hybrid narrative method by combining their own drawings with backgrounds made of photographs in the user scenario. In the project narration, a role-playing approach emerged as the student started from their own experiences.

Concept presentation boards illustrated current and finalized outputs of workshops and juries of the students. Concept presentation boards presented the final versions of outputs that were developed through the weekly critiques and peer reviews that students had received throughout the semester. For this reason, while concept presentation boards summarized and illustrated the project in general, it was observed that these boards were sufficient to explain the main features and outlines of the project, however in different ways.

Technical Presentation Boards

In industrial design education, students take many courses on designing, manufacturing, and presenting tangible products during their four years, and in studio courses, they demonstrate their knowledge and skills through their semester projects. In a common design project, students illustrate technical drawings and production details of the product they have designed through technical boards. Industrial design students are used to designing tangible products and presenting them with concept boards, technical boards, and physical prototypes within the scope of their formal industrial design education. For students working on digital product development, these drawings were replaced by IA and flow diagrams. The most differentiating point for students carrying out digital product development projects was observed on the digital prototypes they presented based on their IA and flow diagrams. In this context, students exhibited the IA and flow diagrams they prepared on the technical presentation boards required in the final submissions (see Figure 4.42).

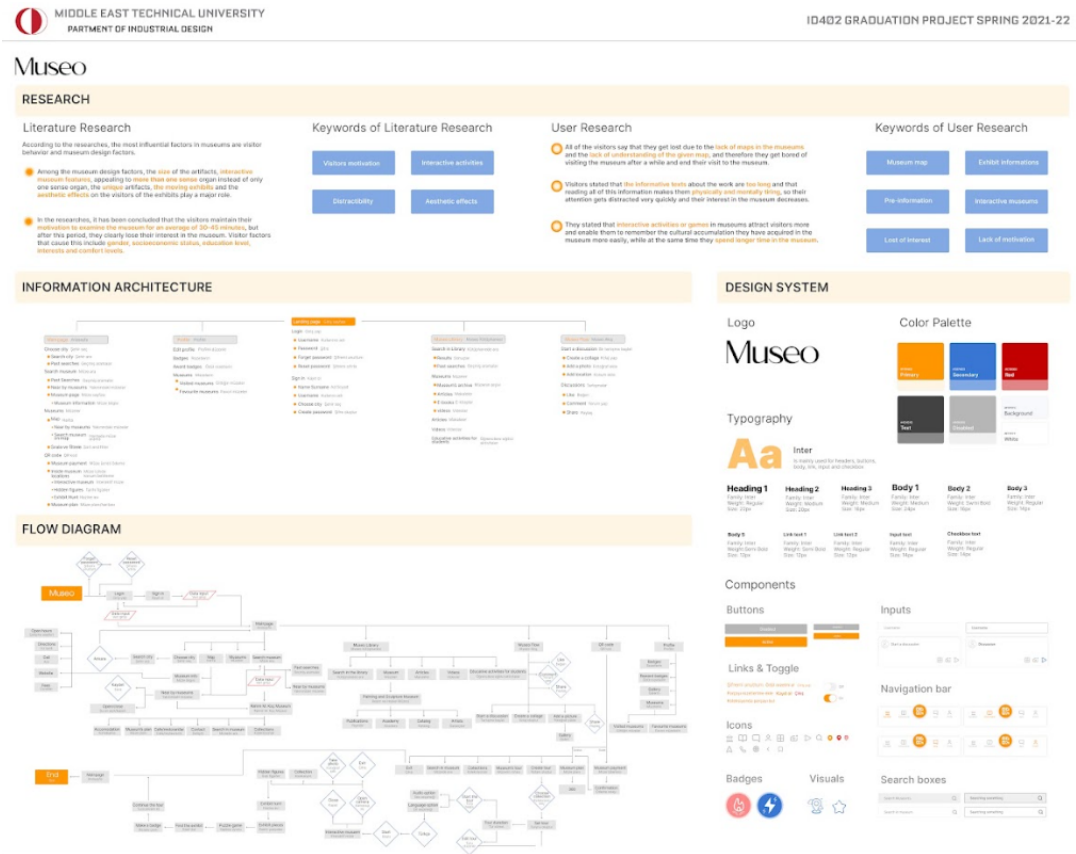

Figure 4.42: Technical Presentation Board of Student #15

As can be seen in Figure 4.42, creating IA and flow diagrams in the layout size that they were used to use in mainly tangible product design presentations led to visible visual changes in presentations of the students. The technical drawings and physical mock-ups, which students and course instructors were normally well versed in reading, were replaced by IA and flow diagrams without any tangible prototype outputs. When the student submissions were analyzed, it was seen that IA and flow diagrams filled most of the technical presentation boards. On these boards, students started their presentation with research outputs, then they continued with IA and flow diagrams were placed on the board one after the other. In this way, the flow diagram constructed in the IA could also be followed with the flow diagrams.

When the technical presentation boards were analyzed, one of the main features that caught the eye was regarding UX research outputs of the students. Students had already explained their UX research outputs in previous assignments. The reason why these outputs were at the forefront in the final jury submissions was that the students incorporated UX research findings into the transition from stating the project statement to presenting the design solutions in their presentation flow by using a visual language (see Figures 4.43 and 4.44).

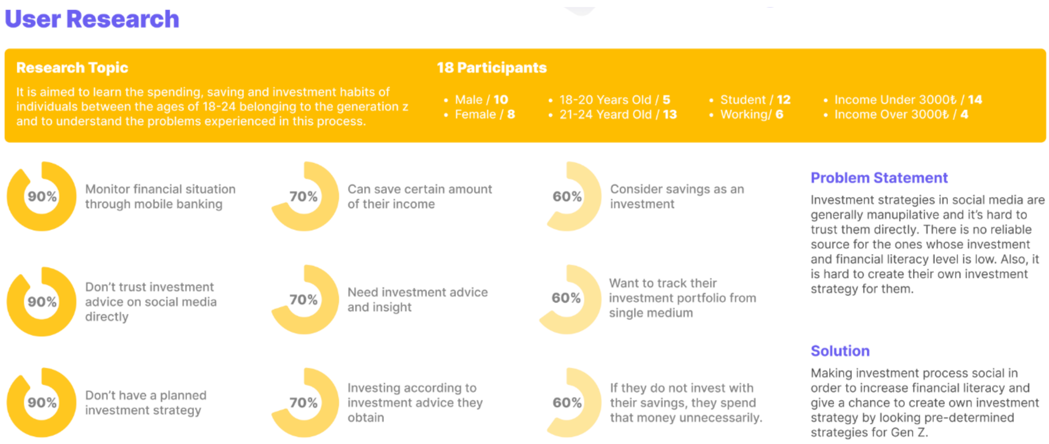

Figure 4.43: UX Research Findings of Student #1 from Final Jury Submission

Figure 4.44: UX Research Findings of Student #18 from Final Jury Submission

In both Figures 4.43 and 4.44, students presented their UX research outputs in a specific visual language that matched their design theme. In the first example, student #1 first shared their research topic in a frame and the demographics of the UX research phase they conducted. Underneath, they summarized their outputs using a donut chart, and described their problem statement and solution based on these results. Student #18 made more use of visual narrative and presented the UX research data by summarizing it with keywords rather than written narratives using multiple and different chart types. Another striking point is that student #18 used various icons to define the profile of their user group. Overall, the UX research outputs provided a brief and visual introduction to the product usage scenarios built on the technical presentation board.

Another point worth mentioning on the technical presentation boards is under the concept and design system. Within concept and design system, students showed color palette, logo, font, and screen visuals they developed for their projects. The outputs for all these features can be seen in previous student submissions. Although these visual preferences of the students were included in their boards, for most of them, the association with the project remained in the background at this point. When the concept and design system sheets were analyzed, it was seen that advisor firms had a great influence on some of the submissions (see Figure 4.45). For instance, it was observed that students working with advisor firm A, from the finance sector, developed projects based on the colors and fonts of the firm. Similarly, students working with advisor firm C, from the e-commerce sector, developed their projects with the font their firm uses.

Figure 4.45: App Icons of Students #5, #6, #4, #3, and #17, respectively

It was observed that some students designed app icons for their app projects in addition to their assignments. As can be seen from Figure 4.45, the app icons designed by the students contain various differences within themselves. The order of the icons above was ordered from textual use to visual use. Students #5 and #6 used names and letters in their icon design. Student #4 represented their logo in the icon by using an abstracted letter based on the logo they created. Students #3 and #17 worked on visuals in their icon design. The submission of student #3 included the Turkish project name *Yonca* (Clover in English) and an abstracted clover design logo based on this name. In addition to these works, student #17 did not use any typeface in their work, and created the app icon by abstracting a character figure they designed within the scope of their project. All these works were the own initiatives of the students based on the jury requirements. They were included in their technical presentation boards and explained how digital products would be reflected on the user in the market after the product launch.

Digital Prototypes and/or Videos

Since the students or jury members were not able to take the product in their own hands and test it with a first-hand experience, students were required to make additional submissions (i.e., digital prototypes and/or videos) to best represent their digital designs, also substituting for a lack of a physical model. In this context, students who developed prototypes used various prototyping software, especially *Figma* software. At the time of the analysis, there was no access to the prototype links, but it was possible to watch the prototypes being used through videos. As part of the final submissions, all students submitted submissions with digital prototypes or videos.

The final item of the submission was the project videos that lasted between one-to-three minutes. It was observed that perhaps the most powerful form of expression was through video. Videos displayed the experience of the person who will use the product from a first-person perspective and provided a narrative close to the real experience. All of these narratives showed how the students handled while presenting the technical aspects of the digital products they developed. Even though preparing videos was not a must requirement among the jury submissions, 14 out of 24 students preferred to also use videos in their presentations. This decision of the students visibly facilitated their project narratives and made them interesting for the audience (see Figure 4.46).

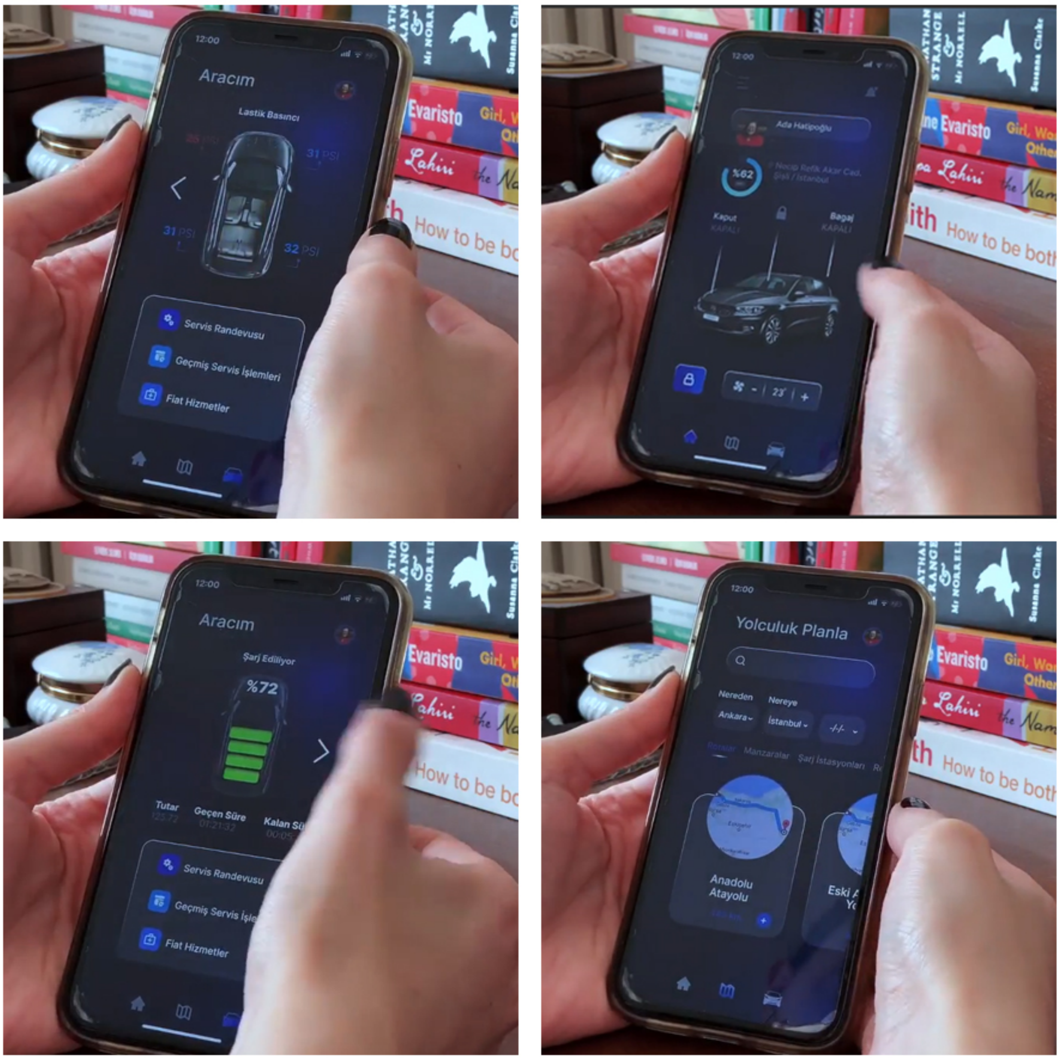

Figure 4.46: Prototyped Design of Student #21 (Video Screenshots)

In Figure 4.46, student #21 recorded the user scenario and showed the user using the product over their digital prototype. Showing the product usage in real time not only provided a manual for the usability of the product, but it also explained how the IA and flow diagram developed on paper were implemented on the product itself. Video also gave the impression of an advertisement emphasized on the CJM. This made a commercial presentation to the target user group to whom the digital product was introduced in line with the information received from the advisor firm. In a way, this presentation made the product for both consumer use and market use. This video touched on many product-oriented points related to the project of the student.

Figure 4.47: Project Implementation Process of Student #1 (Video Screenshots)

Additionally, some of the videos produced by some students provided information about their digital product development process. As seen in Figure 4.47, student #1 provided insights about the wireframing, prototyping, and user testing phases that follow desk and UX research in the digital product development process. Since the course has been designed within the scope of traditional product design education for many years, the process has been different from the digital product development process. In a 14-week process, as seen from the briefs and submissions of workshops and juries, the focus was on concept development, idea generation and user research stages. The product implementation part of the process (including wireframing, prototyping, and testing) was carried out by the students in the three-to-four-week period between preliminary and final jury. For this reason, only a limited information about wireframing, prototyping, and user testing processes of the students was obtained through the student submissions. As can be seen from the submissions, the students are familiar with the concept development and idea generation processes, and these points in the video of student #1 created visual content about how the implementation process of the product took place. This provided insights to understand the project implementation process in addition to the concept development and idea generation processes.

Another detail that stood out in the videos was the effect of advisor firms on video contexts. In their product videos, most of the students first gave general information about their projects and then explained the user scenario through role-playing or real-time product use. Sectors of the advisor firms shaped the videos. For example, it was observed that the videos of students working with advisor firm H from the automotive sector were based on product advertisement. In the case of the student working on service design with advisor firm D from the field of education, it was seen that the video was based on a role-playing explaining the usage scenario. In general, the use of video strengthened the narrative of the projects and enabled the audience and the product to connect more quickly.

In light of this information, the following can be said to summarize the analysis of final jury submissions of the students:

- The majority of the students updated their concept presentation boards in the light of the critiques they received during the semester and finalized them with visual elements. Apart from the required information in the content of the concept presentation boards, the diversity of the application areas (e.g., mobile app and websites) and contexts of the projects and the differences in the visual expression approaches of the students made the concept presentation boards differentiate from each other.

- In the technical presentation boards, UX research outputs were visualized and used to present information flow in a written way that strengthened project prototypes.
- While exploring the concept and design system submissions of the students, it was observed that some students designed app icons for their digital products. This tendency shows that there is a sensitivity between some advisor firms and students towards the market visibility of digital product development. It is also seen that the brand identity of the advisor firm was made visible through visualization.
- There is a preference among students for the use of video for their presentations. With the videos, students strengthened their narratives by explaining the usage flow of the product they developed with real-time use. In addition, video usage of the students provided insights about the implementation phases in their digital product development processes.
- Depending on the approach of the advisor firms, it was observed that the videos were specialized within themselves. While the videos of the students doing hybrid projects had advertising features, it was observed that the students who developed projects based on service design presented videos showing storyboarding based on scenarios.
- In wrap-up, it was observed that the final jury submissions explained digital product development process and content of the students in detail. The students met the internal and technical expectations of the final juries with their presentations. Since this submission was based on the final output rather than the process, it was seen that the project process portfolios of the students described the process.

4.2.2 Project Process Portfolio Review of Selected Students

Within the scope of the ID402 Graduation Project course, students were also asked to submit a project process portfolio at the end of the semester. Their portfolios show in detail how they experienced the digital product development process through stages. Since perhaps the most important task for students who want to work professionally in UX-related fields after graduation is to create an efficient portfolio, the project process portfolios prepared by the students within the scope of the course were analyzed. For this analysis, eight students, one from each advisor firm (see Table 4.1). The selection of these eight students was as diverse as possible, with some of the students having participated in the survey and interview, and some not having participated. The students who participated in the survey and/or interview were given priority in the selection. One student was selected for receiving top grade for their portfolio, another student was selected for the overall qualities of their final submission despite receiving a moderate grade for their portfolio submission.

Table 4.1: Student List for Portfolio Review

	Firm	Sector	Project Type	Digital (D) or Hybrid (H)	User Group
S2**	A	Finance	App	D	GenZs
S8	B	Game	App-Based Game	D	VR Gamers
S9**	C	eCommerce	Online Platform	D	Local Artists
S11**	D	Education	Website	D	University Students
S15*	E	Digital Museum	App	H	Museum Visitors
S17*	F	Software & Service	App	D	Children (Age 9-16)
S19*	G	Production	Interactive Exhibition	H	Families with Children

S24	H	Automotive	Interface Design	H	16-24 Age Group

*Students who participated online surveys.
** Students who participated both online surveys and semi-structured interviews.

Table 4.1 (continued)

Portfolios are one of the most influential elements that shape the professional lives of industrial designers. Industrial designers submit their projects to a specific audience (e.g., hiring managers, jury members, or selection committees) through portfolios and have them reviewed. Since designers do not usually present their projects verbally in this process, it is essential for portfolio evaluations that the projects are legible and understandable. At this point, research of the NN/g on user-experience careers entitled *User Experience Careers What a Career in UX Looks Like Today* provides detailed information (Krause, 2019). According to this research, in the UX professional hiring process, managers want to see especially three points in UX portfolios, which are, (1) starting point of the project with an opportunity and value for a user and the organization, (2) selection criteria of the design elements and their categorization, and (3) ability to see the messy research and design process outputs, rather than only seeing the finished product (Krause, 2019). In addition, the visual language used in portfolios also has an important place. Ashwini (2015) emphasized the importance of the visual language used in UX portfolios by saying that a visually distracting language should not be used and that the visual language used should not get in the way of research questions and solutions.

Students were informed at the beginning of the semester that a project process portfolio was expected from them at the end of the semester. This portfolio was decided to be a multi-page digital booklet (A3 landscape) version of the Miro board on which the students worked on their projects throughout the semester. The portfolios were expected to have an archival quality and show how the graduation projects evolved from concept to final product. The criteria for portfolio evaluation were threefold; (1) depth and breadth of work across the project (e.g. research, ideation, concept development, and finalization), (2) quality of sketches and/or visuals (including digital and hand-generated), and (3) overall care and attention (e.g. order, visual attractiveness, consistency).

Project process portfolios of the students were analyzed according to above qualifications. In this context, the portfolios were first examined through the starting point of the graduation project with the possible opportunity and value for a user and the organization. Since one student working with each advisor firm was selected for the portfolio review, the starting point of the students and the contribution and value of the products to society differed from each other. When portfolios of the students were analyzed, it was seen that the students explained their project statements and starting points by referencing news from online sites (see Figure 4.48).

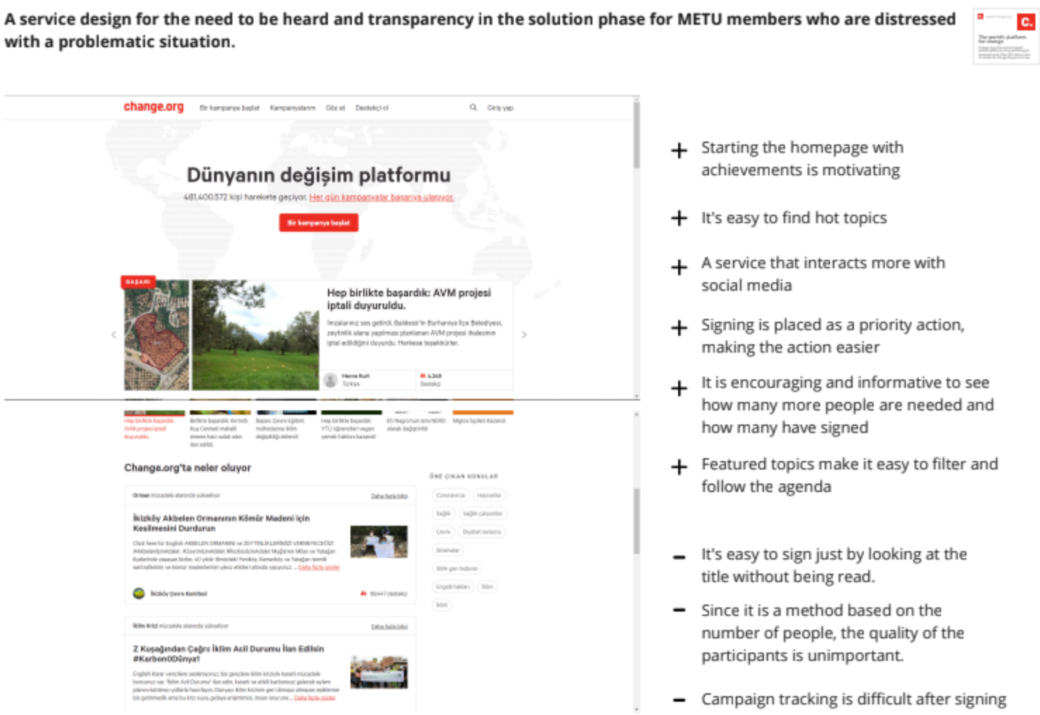

Figure 4.48: Project Description Slides of Student #11 in their Portfolio

In Figure 4.48, student #11 has developed a service design project and has researched announcement and event tracking systems for specific communities. Student #11 strengthened their project statement by giving examples from everyday life, then they identified the advantages and disadvantages for their project and added them to their presentation. Thus, by illustrating the starting point of their project with real life examples, they made the problem area more visible and started to show the possible contributions to the user group or organization they chose. In addition to this, students who focused on a more specific concept and the specific terminology of the advisor firms they worked with were found to use more detailed narrative techniques in their portfolio slides (see Figure 4.49).

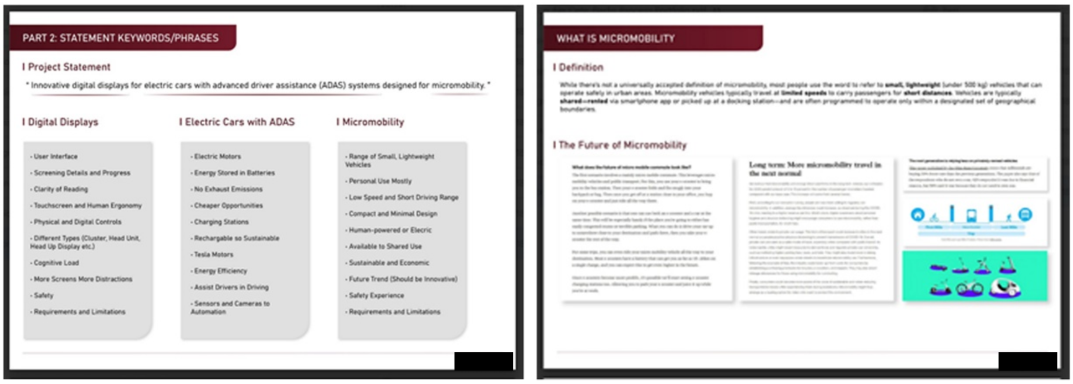

Figure 4.49: Project Statement and Explanations in Portfolio of Student #24

Figure 4.49 shows the slides of student #24 explaining the starting point of his project. In the first slide, after illustrating the project statement, the student categorized it into important keywords as in the workshop assignments. In the same slide, they collected the statements that they found related to their project for these keywords under headings and prepared the starting point of their project for idea generation. In addition to the example of student #11, student #24 added a slide to their work to explain the term micromobility to non-disciplinary audiences and referenced it with academic sources to show academic interests in the subject in addition to its place in everyday life in a visually intriguing way.

Another point in the analysis of student portfolios was the selection criteria of the design elements and their categorization. Especially the students who developed digital products on app and online platform development explained their design elements in detail in their portfolios. Since the users of products such as mobile apps or online platforms can have more than one function, the categorization of product features played an important role in these projects, and this was reflected in the portfolios where students showed their project development (see Figure 4.50).

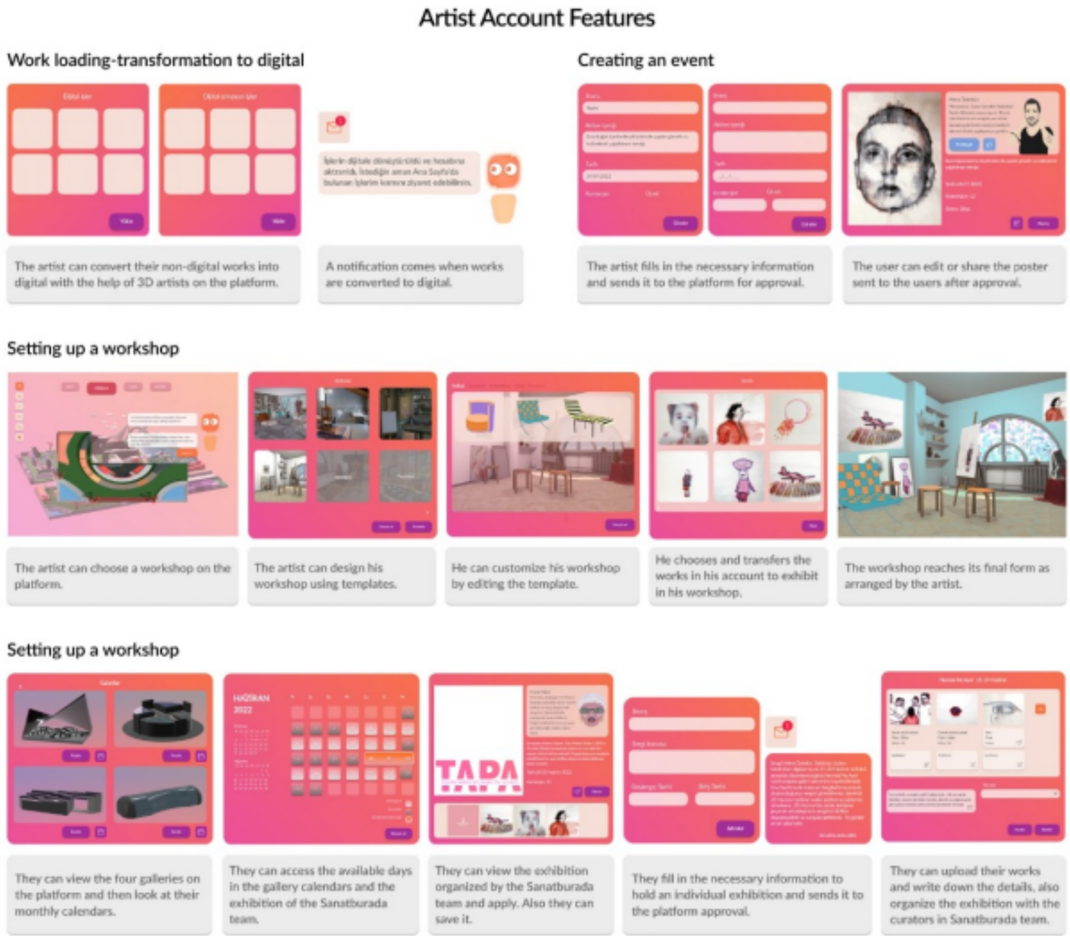

Figure 4.50: Design Features Categorization of Student #9

As a graduation project, student #9 developed an online platform that functions as a digital art gallery aiming to empower local artists. Figure 4.50 shows the board describing how the functions map the areas that artists logging into the online system can navigate within the platform. Here, the student determined the design features according to the UX research findings based on the project statement and presented them by combining with the user journey. In a project that offers multiple user flow options, design feature categorization is defined by matching with functions. In addition to this, it was also observed that in digital project examples such as game design, which is built on a main flow, the design features narrative could be built on a single linear narrative (see Figure 4.51).

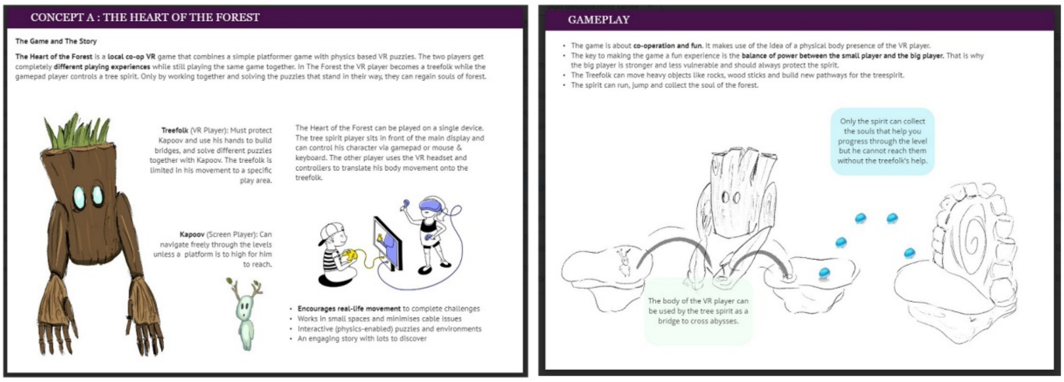

Figure 4.51: Game Design Idea Development of Student #8

In Figure 4.51, unlike the previous example, student #8 explained their design features through a single linear narrative. Student utilized the storyboard while explaining their design features in his project. First, they explained the concept and design stages of the character that the user would use during the game. Then they showed how the user could use this character during the game and finally they created a storyboard that illustrated the game process. In this way, unlike the previous example, student #8 tried storyboarding for process and usage instead of a template presentation while explaining the design features in their portfolio.

Another point that considered in the portfolio reviews was how the students explained their design process through the stages with a visual language from draft conceptual sketches into finalized digital products. As the course instructors emphasized at the beginning of the semester, the main purpose of the project process portfolios is to see how the students make use of time until the final product and how the product has come from the concept stage to the final point. Since the boards in the final jury presentations were about the technical and concept design of the final products, the portfolios were the most suitable option that could describe the project development. Most of the students who presented narratives through slides in their portfolios explained their project processes through the assignment outputs they submitted during the semester (see Figure 4.52).

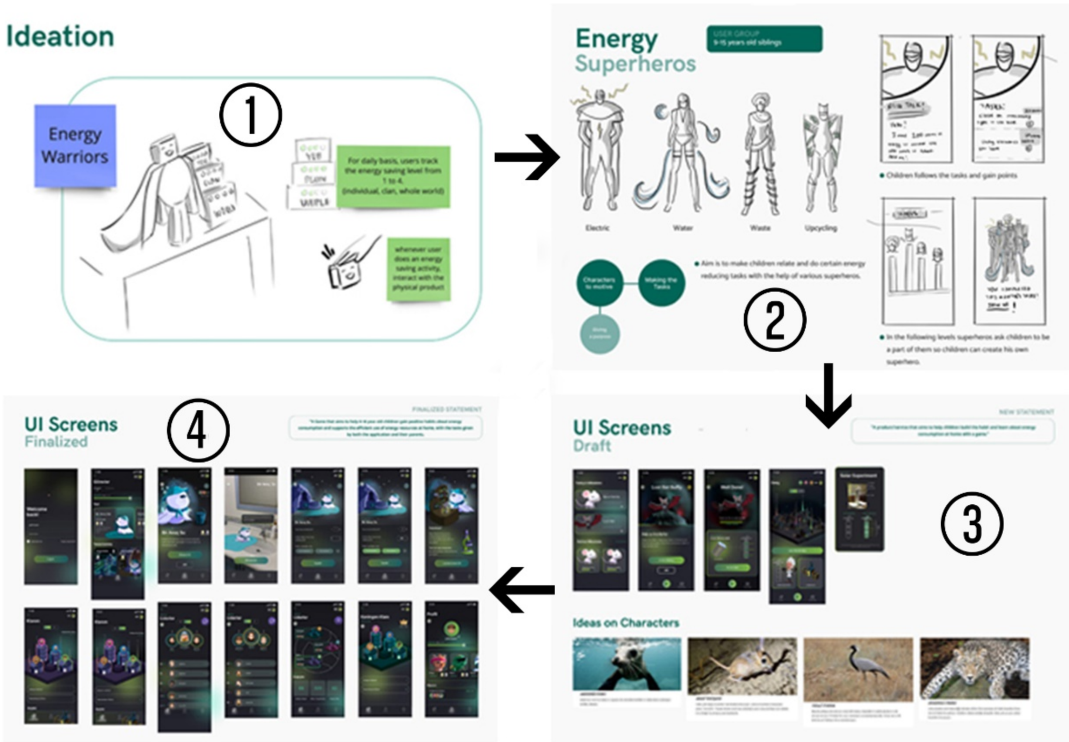

Figure 4.52: Design Development of Student #17 through Portfolio Slides

Figure 4.52 shows the character and screen development in the gamified app developed by student #17. The first slide shows the simple character modeling that the student sketched in the ideation phase and the outputs of how and for what purpose they intended to use this model on post-its. The character design, its content, and use appeared in a more detailed way in the second slide. The use of a playing card based on superheroes was sketched in a screen format at this stage. In the third slide, it was seen that the student combined the concept of sustainability with endangered species and organized their superhero designs accordingly. In the last slide, the student finalized their characters and explained the UI screens in stages with the app. This example successfully fulfilled the desired task within the scope of the project process portfolio, as it was able to explain in detail how the concept sketches in ideation evolved into a prototyped and finalized app. In their portfolios, students not only described the process of the products they developed, but also independently described the progression of the different phases with their slides (see Figure 4.53).

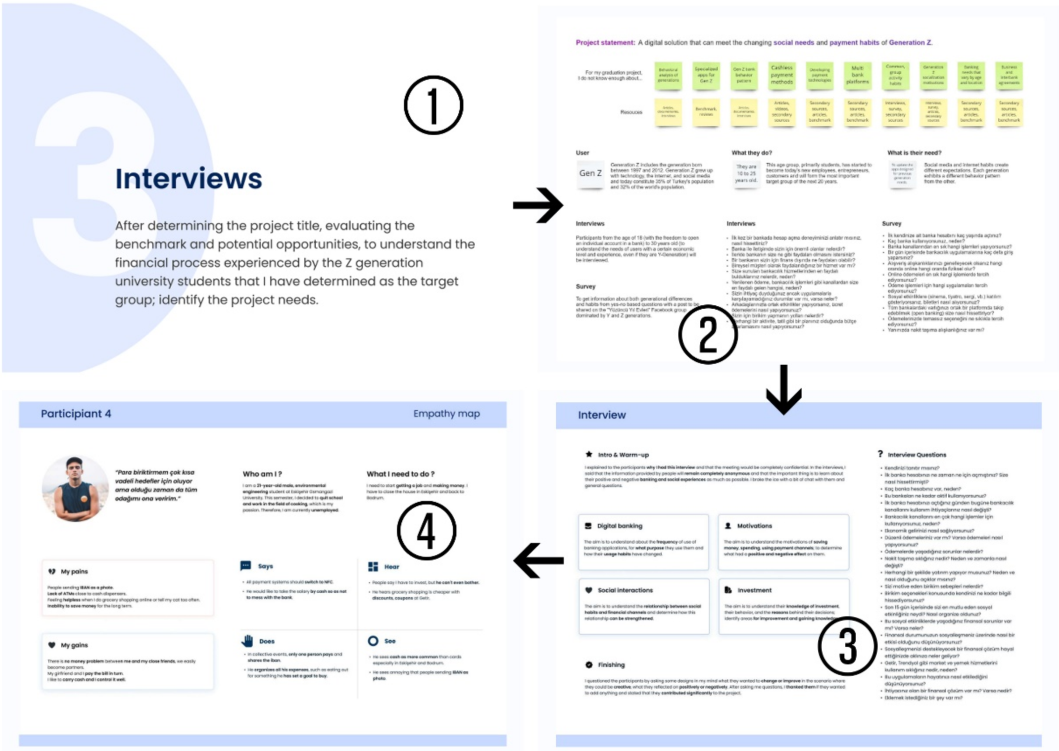

Figure 4.53: Interview Slides of Student #2

Figure 4.53 shows the slides that student #2 prepared for the interview phase that they designed in their UX research phase. The most important feature that made the narrative of student #2 strong was the visual language they prepared. In this portfolio, each stage of the digital product development process was divided with a title slide. The first slide in Figure 4.53 served as an interview introduction. The second slide described the project statement, user group, user needs, and how to collect data in a draft way. The third slide served as an interview guide and indicated which topics or themes the questions were related to. The fourth and final slide described an interview conducted by the student. The important point here is that the slide did not present a full interview transcription but rather the interview outputs through icons and short quotations. Another important point here is that the identity of the interview participant was anonymized and symbolically described in a way that created an imprint with the interview outputs. This example taken from the portfolio of student #2 is considered a successful example because it shows how student construct their process narrative through stages and how they could explain this with a visual language without getting in the way of the portfolio content.

Just as in the assignments through the semester, there were differences in the way students visually described their processes in the portfolios. The fact that the projects were digital-oriented and the workshop and jury requirements during the process were based on detailed narratives rather than visualization led some students to construct their process narratives through written narratives (see Figure 4.54).

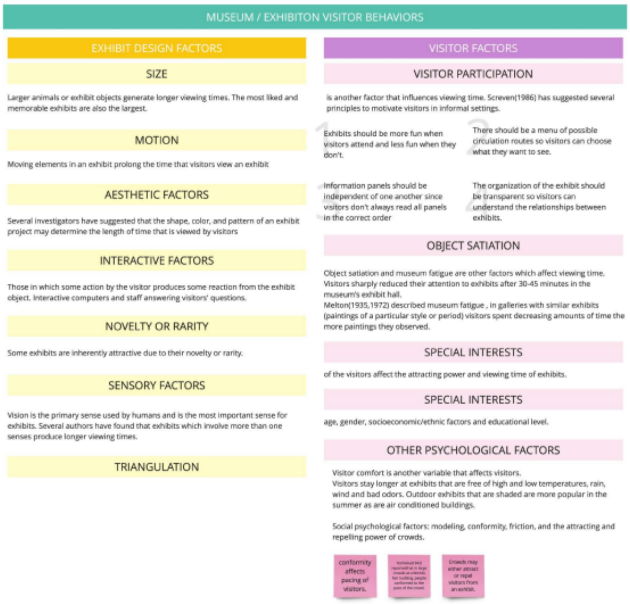

Figure 4.54: Written Narratives on Portfolio of Student #15

In Figure 4.54, student #15 described the behaviors of the user group they chose for the app they would develop in the physical setting they chose through a written narrative. In this example, instead of using any sketch, graphic, or stock image, the student presented their analysis as written narratives in a color-coded way. Here, the fact that the project content also supported the written narratives showed that the student could express themselves better in this way, and the student left the visualization to later points in the project development process. When the visualizations in portfolios of the students were examined in detail, it was seen that many students used mixed techniques by placing their hand drawings on digital sheets (see Figure 4.55).

Figure 4.55: Mixed Techniques Use of Student #8

In Figure 4.55, student #8 presented his character design sketches with color experiments in the digital environment and showed possible character development options through mixed techniques. Many students started the project development process by using paper and pencil instead of drawing in the digital environment, and after reaching certain design decisions, they switched to drawing in the digital environment. This showed that the habit of sketching with pencil on paper that students acquired in traditional industrial design education continues in the digital product development process. This situation also varied depending on whether the projects were digital or hybrid. This was also seen in the prototype visualizations of students who developed hybrid projects (see Figure 4.56).

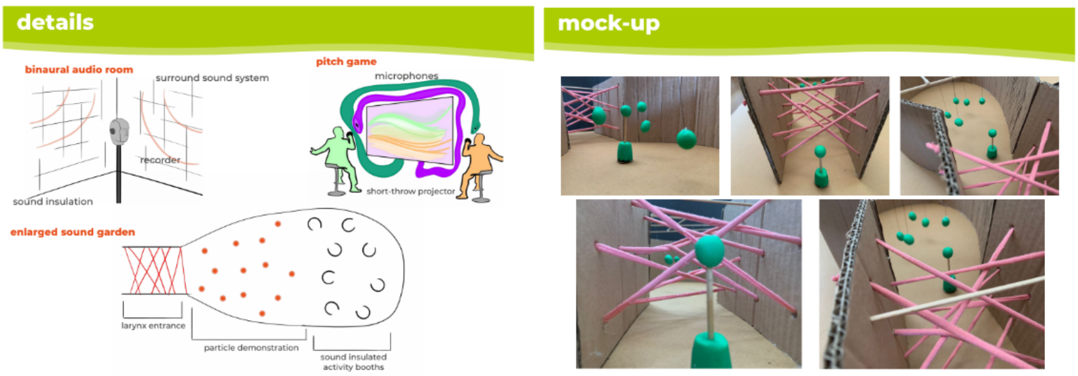

Figure 4.56: Mixed Techniques on Project Illustrations of Student #19

Figure 4.56 shows the sketch and physical mock-up photos of exhibition design project of student #19. The student developed their sketches showing the project details in digital environment and added them to their portfolio slides. Here, unlike other examples, there was a physical mock-up presentation brought about by being a hybrid project. The student did not present the mock-up prepared for the tangible leg of the hybrid project as modeled in digital environment during the process. As in the previous example, the practice of making mock-ups in traditional industrial design education was reflected in digital product development process of the students. The student started the process by making physical mock-ups and after clarifying certain design decisions, they started modeling in digital environment. This led to a full digital expression only in the parts of the project towards the final jury. At the end of the portfolio reviews, it was seen that most of the students started the project development process by making sketches with paper and pencil and when the projects were clarified according to the critiques, they switched to working completely in digital environment.

In light of this information, the following can be said to summarize the review of project process portfolios of the students:

- In the project process portfolios, students constructed a more detailed narrative than the assignments they submitted during the process. In the portfolios, they presented detailed visual and written data, especially in the field of UX research.
- In general, students described the process in a sequential way through the assignments. In addition to this, it was observed that there were students who grouped their data according to their own processes and constructed a process or constructed a narrative based on the weekly schedule.
- In addition to students who constructed their portfolios entirely through digital elements as a narrative language, there were also students who presented mixed techniques portfolios by adding their hand drawings and/or handwritten notes to their digital portfolios.
- As seen in the workshops at the beginning of the semester, it was also seen in the portfolios that the students had strong research and concept process.

Problem area definitions and research outputs of the students based on these problem areas enriched their portfolios. The fact that many students based their problem areas and possible solutions on higher principles also showed their social awareness.

- Presentation of design features in their portfolios served as a bridge between ideation and project development of students. At this point in their portfolios, students started to show the design approaches they had acquired in traditional industrial design education.
- Students showed the importance of the design process in their portfolios by describing the transition from sketches to the final product in detail. Their presentation techniques and language of expression also facilitated the reading of this transition in a visual way.

4.2.3 Summary of the Graduation Project Submissions

This section of the thesis analyzed in detail the ID402 Graduation Project course coverage of 24 students studying digital product development in Spring Semester 2021-2022 through eight assignments tracked throughout the semester. In addition to this analysis, the section also reviewed the project process portfolios submitted by the students at the end of the semester, detailing their project development process, on eight students selected from each advisor firm. The outcomes of the section analyzed digital product development in terms of content and presentation. In the light of all this information, the analysis of graduation project submission of the students presents the following insights about the digital product development carried out by industrial design students within the scope of their graduation projects.

- Advisor firms, with which students collaborate on projects, seem to have an essential influence on the methods of the digital product development process. There are different research methods that are specific to the firms and therefore to their fields of work (e.g. shadowing is prominently used in the automotive industry). This shapes the way in which students working for specific firms develop ideas and representations of products. The specific visual language used by the company and its industry also leads students to evaluate their projects in this way. This is how students create the brand identity of the digital products they develop.

- Students conduct design research in digital product development processes without experiencing formal design research. This situation affects especially the UX research stages of the students. The methods and research questions designed by the students to get insights from users fall below the desired quality. For instance, open-ended questions remain in the background in the interview questions prepared by the students and detailed information cannot be obtained from the users. In cases where detailed information is obtained, students who do not have a healthy analysis experience fail to contribute the insights they collect to the project development to the desired extent.
- The process schedule of the students also differs from the digital product development process that the market has established. Students are particularly focused on the concept stage, which includes problem identification and idea generation. This does not allow students to do long iterations of project development, including prototyping, testing, and screening, in their project calendars.
- Digital product development processes of the students proceed mostly through written narratives based on the process calendar. Visualized narrative takes a backseat to verbal narrative in project processes of the students. In this case, the design elements used by the students, including color palettes, fonts, and presentation techniques, are only briefly mentioned at the end of the calendar.
- Among the students, it is seen that there are students who evaluate higher design principles without any guidance from course instructors and assignment briefs. Many students take care to make socially aware projects and at this point, works that can be considered within the scope of *Sustainable Development Goals* of the UN are emerging.

4.3 Findings from the Semi-Structured Interviews

In this section, the findings from semi-structured interviews (see Section 3.2.1.3), as the final data collection method of the PhD research, and the insights generated from these findings are presented. The findings in this section are mainly based on the responses of three industrial design students, 14 academics, and 18 UX professionals in a total of 35 in-depth semi-structured interviews. Among these interviews the ones that were conducted with academics and UX professionals acted as main data collection areas. The student interviews conducted within the semi-structured interviews were evaluated and used as exemplifications presented to strengthen the comments of academics and UX professionals in a secondary role. These 35 interviews were conducted between August and December 2022 via Microsoft Teams, a fully online software. The data was analyzed through an outline (see Figure 4.57) constructed according to the responses of the industrial design students, academics, and UX professionals to the semi-structured interviews.

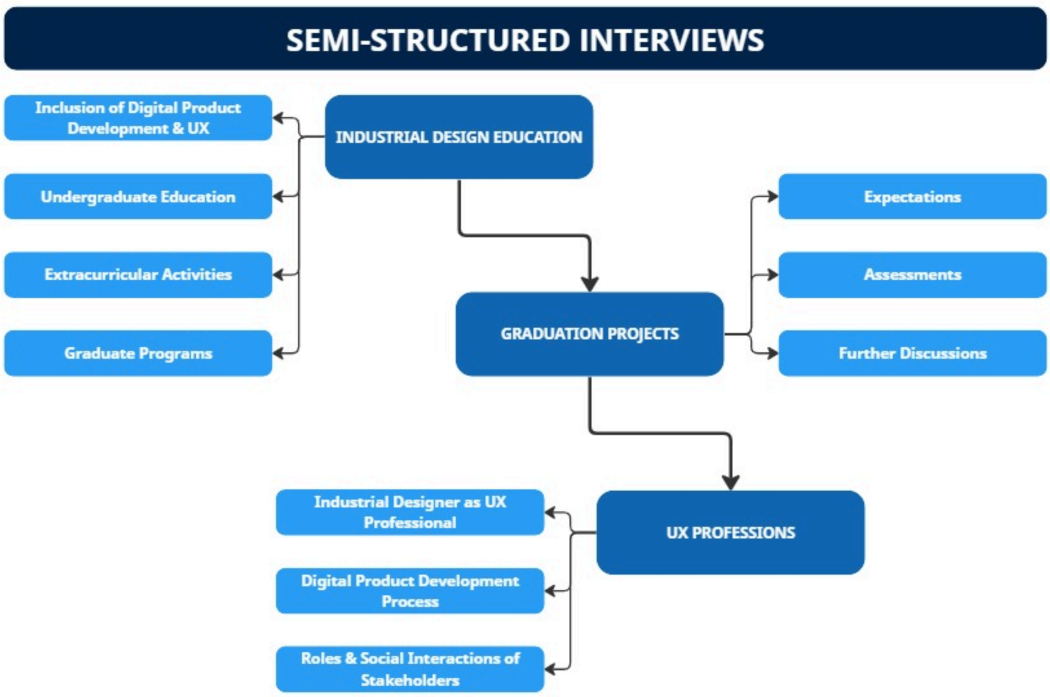

Figure 4.57: Outline of Semi-Structured Interviews

As seen in Figure 4.57, the analysis of semi-structured interviews with industrial design students, academics, and UX professionals are organized under three main headings; (1) position of digital products and UX practices in industrial design education, (2) evaluation of ID402 Graduation Project course process and outcomes, and (3) qualifications and key aspects for UX professions. These headings are explained through this flow. All quotations in this section have been translated from Turkish to English. Original quotations can be found starting from quotation #67 in Appendix V.

4.3.1 Digital Products and UX Practices in Industrial Design Education

Nowadays, it has been observed as a result of academic studies and market researches that the impact of digital product development and UX practices within the scope of industrial design undergraduate and graduate education is becoming more and more prominent. Many industrial design departments are trying to include these areas in their curriculum at certain capacity and with certain points and carry out the educational implications of these areas in co-operation with the industry as much as possible. This section analyzes the ways in which digital product development and UX practices are addressed through the curriculum of METU Department of Industrial Design. In addition, the comments of academics and UX professionals who participated in the semi-structured interviews, who have experience and knowledge on how these areas are implemented in other higher educational establishments, provided detailed information on the subject. In the light of this information, the section provides insights into (1) the place of digital product and UX practices in industrial design education, (2) how these areas are implemented in undergraduate curriculum, (3) how these areas are addressed in graduate degrees, and lastly, (4) how these areas are included in the extracurricular activities of students.

4.3.1.1 Inclusion of Digital Products and UX Practices

It was observed that discussions on the extent to which digital product development and UX practices are or should be included in the scope of industrial design education, was greatly emphasized in the semi-structured interviews. In terms of their fields of study, industrial design academics provided more detailed information on the subject than UX professionals. Since all the academic interviewees are individuals who carry out studies on digital product development and UX practices to some extent, and carry out courses and projects in these fields, it has been formed that these fields should be included within the scope of industrial design education based on their own experiences and comments. The following comment of participant #5, who is an academic faculty member from an industrial design department, on the place of digital product development within the scope of industrial design education is an example.

> [67] "Any product that will improve the quality of life of its user in a functional or hedonic context falls within the scope of industrial design. Therefore, we have to incorporate this into education. Although there are still some academics who criticize this by ignoring industry 4.0, our full-time academic staff believes that education should go in this direction. We believe that the production and design process of the digital product should be as important as machine production methods and materials." (P#5)

Industrial design mainly includes product development to improve the living standards of users and to offer sustainable futures. Based on this aspect in the definition of the profession, participant #5 stated that digital product development should be within the scope of industrial design, and therefore this field should be included in industrial design education. Another prominent point in this comment was the emphasis on the necessity of the profession to keep up to date. In the current digitalized world, industrial designers need to develop the context of their profession by following technological developments and trends. The desire to have knowledge on the design and production processes of digital products has provided insight that designers who will develop products related to these fields can broaden their horizons by gaining knowledge from other disciplines. In addition to the inclusion of digital products within the scope of the industrial design profession, and thus education, many participants argued that UX practices should also be included in industrial design education. Regarding this issue, participant #12, who is an academic faculty member from an industrial design department, made the following comment.

[68] "All [products], including physical products, are interfaces. You must approach it a bit like that. User research is not just a process for digital products. It is something that should be integrated into the development process of any product. (...) I feel like maybe courses like user experience should be must courses in the curriculum, there is a need for it. I do not think it is an option for students to be interested in it anymore. I mean, I think there never was. Even if everything remained physical, I think it could somehow be better integrated into education." (P#12)

The highlight of the comment of participant #12 was that physical products, similar to digital products and mobile applications, require user research. The fact that physical products include UX practices just like digital products shows the necessity of including UX in industrial design education. Another important point in quotation 68 is that UX practices should be included within the scope of must courses in industrial design education. Today, as the intensity of use of digital products and the employment rate are high, participant #12 said that these areas should be made compulsory instead of being elective.

Many participants stated that digital product development and UX practices should be included within the scope of industrial design education for the reasons mentioned. In contrast to these views, there were also divergent opinions that these digital products should not be considered within the scope of the industrial design profession and therefore within the scope of industrial design education. Participant #14, who is an official from one of the advisor firms with an industrial design background, provided an example of this with the following comment.

[69] "Now, industrial designers do not design the applications anyway. So I think there is a confusion of concepts here. Because an industrial designer cannot design an application anyway. (...) The only thing an industrial

designer can do is to design the furniture of a kiosk, for example.... Am I making myself clear?" (P#14)

Participant #14, a participant carrying out a project with teamwork in a collaborative working environment, emphasized the traditional roles of industrial designers based on product design with their comment. In an environment where each discipline works in its own field during the project development process in collaboration, it has been observed that the main expertise of the industrial designer concentrates on physical product designs, such as furniture, based on their formal education rather than developing digital products. In response to this approach to digital product development, which requires different skills and knowledge among industrial designers who have fully mastered physical product design within the scope of four years of formal industrial design education, the following comment of participant #4 provides a possible explanation.

[70] "Actually, I think it is a traditional approach [digital product development is not our field]. It is a way of thinking that I find a little bit conservative, like industrial design only covers physical product design." (P#4)

Participant #4, an academic faculty member from an industrial design department, provided their own explanation for the view in quotation 69, stating that it is a necessity that industrial design education should include digital products. They argued that an industrial design that only involves designing physical products is a traditional and a relatively conservative idea. In addition to the views on digital products from industrial design departments, the views of UX professionals also emphasized the importance of the industrial design profession in the field of UX practice and stated that it should be evaluated within the scope of education. It has been observed that industrial design graduates working as UX professionals support the opinion that these fields should be included more intensively in education. Regarding the issue, participant #29 made the following comment.

[71] "Maybe if we were in a foreign country, education of [university name] would still be good. For example, if we lived in Germany… But because of the economy in Turkey, production is very costly. Nobody wants to produce anything and unless something physical is produced, I have no place. In a

world where you are a physical product designer... Naturally, when you look at this, it is very valuable to give this education at the undergraduate level just for students to adapt to the current world, and unfortunately, I think the main problem right now is that undergraduate students are getting acquainted with this in their last year." (P#29)

The highlight of the comment of participant #29 was that they emphasized due to the social and economic issues, digital product development should be included more intensively in industrial design education. Academic circles have argued that industrial designers should be able to follow and adopt global developments and apply technological developments to their own practices from an academic perspective. They also evaluated digital product development and UX practices in industrial design education through this framework and made approaches to adapt them to education. In addition to this, UX professionals with an industrial design background made inferences based on the social and economic issues of the society they live in and stated that digital product development and UX practices should be intensively included in education. The production costs that were mentioned in quotation 71 and the shaking of the place of physical product design in the market have increased the attentiton of industrial design graduates towards digital product development. Therefore, they believe that a more homogeneous spread of academic studies in these fields in the four-year education would be more beneficial for the skill and knowledge development and employment of industrial designers.

Lastly, it was observed that the influence of *écoles* has an important place in the comments on the position of digital product development and UX practices in industrial design education. Many industrial design departments in Turkey were founded and structured on different educational approaches through different majors in different periods (see Section 2.2.2.2). This has had an impact on the established école and has led to differences in the approaches of industrial design departments to the profession and its education. Regarding a technical university, participant #7 made the following comment.

[72] "If we take our department as a basis, industrial design is heavily weighted towards physical product design. In our department, there is already a

> tendency not to go beyond the traditional structure in general, so I do not think digital product design has much place in our department." (P#7)

Although technical universities, whose academic staff are mostly trained in traditional product design, are working in the field of digital products, there are still question marks in their approach to the field. The fact that these institutions have a fixed design approach over the years and that the field of digital product development has gained rapid momentum in recent years also affects the approach of these institutions. Similarly, comment of participant #2 presents an example on the discussion on another technical university.

> [73] "In [technical university name], I know when students go to to ask if they can do a digital project, academics say *we are product designers*, and the same thing happens in the other section of our class. As if we need to make a digital product connected to a product... We need to change this perception. What you call experience design is not digital or physical. Everyone has an experience." (P#2)

Quotations 72 and 73 illustrated the impact of the écoles and design approaches of two different technical universities on digital product development. Comments of the participants indicated that the physical product development approach to digital product development, which has a strong relationship between form and function in technical universities, takes a back seat according to their écoles. Additionally, participant #17 exemplified the difference in approach between departments through the industrial design education of technical university and a fine arts-oriented university with the following comment.

> [74] "Actually, in our [technical university name], function always goes together with aesthetics. (…) [Fine arts-oriented university name], for example, looks at it as *I just put it there and it is done.* I mean, apart from aesthetic concerns, why did I put the button there?" (P#17)

In terms of digital product development, unlike technical universities, the approach of fine arts-oriented universities is described as focused on aesthetics. While technical university graduates focus on the product as an experience based on the relationship between form and function, this comment that fine arts-oriented universities develop projects based on aesthetic concerns shows how differences in écoles have an impact on digital product development. This is also visible in the orientation of industrial design graduates towards UX professions. Industrial design graduates from fine arts-oriented universities generally prefer not to pursue a career in these fields. Participant #18 sets an example with the following comment.

> [75] "UX teams are 90% from industrial designers. By the way, there is such a department in [name of fine arts university], which is very interesting. They used to admit students with a special aptitude test. But I have never seen anyone graduated from there working in the industry so far. There are people mostly from [technical university name] and [another technical university name]." (P#18)

As seen from the comment of participant #18, industrial design graduates of fine arts universities generally do not have same high rate of interest on digital product development and UX professions as the graduates of technical universities. In this way, the different écoles and design approaches of the universities are observed not only in education but also in choosing career paths for industrial design graduates.

This section includes discussions on whether digital product development and UX practices should be included in industrial design education. Semi-structured interviews revealed that many industrial design departments are currently incorporating these fields into industrial design education through various courses. According to many participants, emphasis of the industrial design profession on trying to provide users with better living standards and sustainable futures shows that digital product development should be included in its scope in a digitalized world. Additionally, it was also observed that there is a smaller number of relatively traditionalists who think that digital product development should not be within the scope of industrial design. When the main reasons for this approach of participants to the subject were questioned, it was seen that the educational approaches of the institutions where industrial design departments were established and their écoles had an impact. While the industrial design departments of technical universities are more likely to focus on digital product development and UX practices, the approach of fine-arts universities to these fields is relatively in the background. According to the semi-structured interviews, the industrial design departments that cover these fields the most are relatively newer, have interdisciplinary academic staff, and are established and operated with highly strong market and industry relations.

4.3.1.2 Implementations in the Undergraduate Courses

The heading of this section shows how digital product development and UX practices are implemented in current undergraduate industrial design education and how they are processed and evaluated within this implementation. In this context, the section is organized as a flow through (1) must courses, (2) elective courses, and (3) summer practices.

4.3.1.2.1 Must Courses

Since industrial design education is mainly based on physical products, students are generally not introduced to digital product development and UX practices at the beginning of their formal undergraduate education. It has been observed that after students acquire certain basic skills and mindsets in their product-oriented industrial design education, several courses are started to be carried out in these areas and some competencies are started to be acquired by students. Semi-structured interviews revealed insights that digital product development and UX practices are generally introduced in the ergonomics course, and then started to be practiced in the third- and fourth-year industrial design studio courses. Participant #16, who is an ergonomics course coordinator in an industrial design department, made the following comment about introducing students to digital products and UX practices.

> [76] "It [ergonomics course] starts with physical ergonomics. It starts with physical relationships. Then we focus on cognitive ergonomics, where they acquire certain background knowledge about interaction with digital interfaces, usability and its reflection on the product, product-user experience. In the user research part, they learn about the methods they can use to analyze this interaction and practice them." (P#16)

Many academics who are course instructors in industrial design departments have stated that they start their digital product, and especially UX practices, with the ergonomics course. Just like the second-year studio, the ergonomics course in physical product design-oriented education starts by explaining the relationship between the physical product, product ergonomics, and the product-user relationship. The scope of the course also includes insights into the basic physical products and user relationship that is touched upon in the second-year studio course. Areas such as interfaces with digital features are addressed within cognitive ergonomics and introduced to students in an integrated way with physical product design. As seen from the comment of participant #16 in quotation 76, the course also presents an environment where students are introduced to the basic background knowledge of UX research. According to the semi-structured interviews, industrial design students start to work on digital products in the third-year studio in the light of the cognitive ergonomics and basic product-user relationship knowledge they acquire in the ergonomics course they take in the second year. Participant #1, who designed a digital product development process within the scope of the third-year studio, set an example with the following quotation.

> [77] “We started the first digital product development process in the third-year studio of [academic name]. It was an interface we produced for children in the field of art or sports. When I look at it now, it does not seem very sufficient, but they gave a lot of space to the research part. We had that stage well established. In the graduation project, especially in the last two years, I can say that there has been a transition to the field of UX/UI by the academics.” (P#1)

Participant #1, who had internship, must, elective course, and graduation project experience in digital products stated that the research process was covered in detail, but there were inadequacies in the project. This comment was also made by many participants in the context of the graduation projects. The importance given to research within the scope of industrial design studio education has continued in the same way in digital products, but the novelty of the process and its specific skill and knowledge requirements have taken their place in third- and fourth-year projects as factors shaping the process. Another striking point in quotation 77 is that the increased intensity of industrial design studio education in the areas of digital product development and UX practices was also observed by the students. The comments on the fact that digital product development was covered in the third-year studio, but not in sufficient detail, also came from the academics of the industrial design department. Participant #7 made the following comment on the subject.

> [78] "It is only given as a graduation project [digital products] in the fourth year. But this is very vague for students, there is a serious lack of knowledge. Because we inform them on physical product design, but digital product design has very different requirements. We have very few courses that can fulfill those different requirements and create the background." (P#7)

Participant #7 commented that the skill and knowledge requirements of digital product development are introduced in industrial design education, but they are not sufficient to carry out a whole project process. Since students learn to master the physical product design process during four years within the scope of must courses, participant #7 stated that digital product development should be strengthened not only as a graduation project in the fourth year but also with elective courses that address multiple points during the education process. In this regard, while cognitive ergonomics and user research are taught in the ergonomics course, digital product development and UX practices are not taught directly in related courses. Student work on design principles, color, and texture in the first year *Basic Design* courses are said to have a great impact on their skill and knowledge development in the context of UI. Participant #6, an academic in an industrial design department, made the following comment on the equivalence of digital product development in industrial design education.

> [79] "When you look at a screen, you can only judge whether it is good or bad from a graphical point of view. What is that? It is the training we receive in Basic Design. So *is the hierarchy of this right? Is the alignment right? Contrast* and so on and so forth." (P#6)

In Basic Design, the must studio courses of the first year of industrial design education, students are introduced to basic design principles and work on mainly two-dimensional and simple three-dimensional works. Since UI studies are mainly two-dimensional mobile or computer screens as layouts, concepts such as hierarchy, alignment, and contrast that students learn in their basic design education are of great importance in digital product development. The fact that industrial designers are introduced to these concepts at the beginning of their formal education paves the way for them to continue as UX professionals in their professional lives and becomes an aspect that positively affects their adaptation processes.

In the light of this information, it has been observed that many industrial design departments, similar to each other, have started to include digital product development and UX practices on top of traditional product design education with the help of various must courses. It has been observed that industrial design departments that act with this approach generally have a perspective originating from a technical university, a perception of a well-established école, and clear design approaches based on these. On the other hand, it has been noticed that a few departments, especially those that are relatively newly formed, have multidisciplinary academic staff, and more active industrial collaborations, incorporate digital product development and UX practices into industrial design education in a different way. Some departments have a different approach to contemporary design practices. Participant #25, who has both an academic position and field experience as a UX professional in one of the departments with this different approach, made the following comment about the must courses in the undergraduate education of the industrial design department where they work.

> [80] "There is a design research course in the first year, I teach it. The purpose of having it in the first year... You cannot teach it in the best way because it is in the first year, but the approach here is that the designer is not an artist or egocentric designer as it is called in the market. Students understand the user well and learn things that are useful for them. Therefore, you need to understand the user in every aspect before you even put it on paper. Therefore, there is a course in the first grade that instills this. Then there is the normal ergonomics course." (P#25)

Participant #25, an academic in a department with a different approach from the general industrial design departments in Turkey, presented a different must course structure with their comment. Many participants of the semi-structured interviews agreed on the importance of design research methods in digital product development and UX practices. In the graduation projects and online surveys analyzed in this thesis, it was emphasized that students have difficulties in collecting data from users while conducting field research. The lack of courses on the necessary data collection methods, question posing, and effective observation skills caused students to have problems at different points of the digital product development process and negatively affected their projects. The approach described by participant #25 addressed this gap in a different way by offering a different curriculum from other interviews. Another important point that stands out in quotation 80 is that the designer should interact with the user rather than focus on making art. The importance of user interaction at the basis of digital product development and UX practices is reflected in industrial design education and built on this aspect. Participant #30, a UX professional with a degree in industrial design, made the following comment on the approach of the industrial design department.

> [81] "For example, there were two friends from [university name]. They were continuing their education after the second or third year, completely separated. Like from the digital interactive side, or from the service design side, and from the physical product side... I think such a separation made a lot of sense to me after the basic design education was given and something was put on it. Because if I had not spent the last two years trying to design buses, if I had studied digital design instead, I would be two years ahead now." (P#30)

The comment of participant #30 provided a different perspective on specialization within industrial design undergraduate education. Industrial design students, who take four years of must and elective courses focusing on different aspects of digital product development and UX practices, continue and finalize their education by grouping under industrial design education to focus on the specific and detailed skills and knowledge of these fields. Another point that makes quotation 81 stand out focuses on the reference of participant #30 to their undergraduate education.

Industrial designers working in the field of UX practices, where finding a job is highly competitive, are aware of the importance of being experienced in digital product development. It has been observed that students who have taken courses, summer practices, and internship experiences in this field want to focus on these areas in their studio courses. For this reason, it is not seen as a preferred option for industrial designers who have determined that they will continue their career in the field of UX professions in their student life, to build and experience their portfolio on physical products in their senior years.

When digital product development and UX practices are examined in the context of must courses in industrial design undergraduate education, it is concluded that (1) basic design courses develop students towards GUI, (2) ergonomics courses develop students towards cognitive ergonomics, product-user relationship, and user research, and (3) third- and fourth-year studio courses (including graduation projects) develop students towards process and product design. It has also been observed that industrial design departments are influenced by écoles in their approach to these areas. In addition to this general approach, although fewer in number, it has been observed that some relatively newly established industrial design departments have a different approach with their customized course system structures for interaction and service design focused on user and industry relations.

4.3.1.2.2 Elective Courses

According to the semi-structured interviews, it was observed that courses on digital product development and UX practices in industrial design education are currently concentrated mostly through various elective courses. This section mainly discusses what kind of courses are included in elective courses, their objectives, processes, assessment criteria, and outcomes. Participant #25 summarized the elective courses focusing digital product development and UX practices in their industrial design department as follows.

[82] “Students are taking prototyping classes like in Scandinavia. They take coding classes. They learn some *html*, some *java*… Then there are UX courses. There are interaction design courses. There is spatial interaction course.” (P#25)

As Participant #25 stated in their comment, it was observed that industrial design students are given software courses in terms of digital products. Coding has an important place especially in digital product development. Even if industrial designers are not expected to code like software developers within the scope of UX professions, having basic coding knowledge and skills is considered as an advantage. Such courses provide a professional knowledge for industrial designers working as UX professionals and have the potential to help them communicate more effectively with other departments they will work with in the workplace. In this way, through elective courses, industrial design students are introduced to the coding language of digital products. In industrial design departments, elective courses related to other fields other than coding and engineering disciplines are also offered within the scope of digital product development and UX practices. The following comment of participant #5 is a case in point.

[83] “I try to cover these topics [digital product development] in the design management/marketing course. (...) Production methods should be covered by including electronic and digital production methods if necessary.” (P#5)

The interdisciplinary nature of UX professions and the fundamental importance of market interests in these fields are explained to industrial design students through elective courses that provide information through business and marketing. In the elective course coordinated by participant #5, the precise process of digital product development is presented to students from a marketing perspective outside of design. In addition, the terminology and jargon of UX professions includes many points from the field of marketing, which has led to students gaining knowledge in this field. Another important point in quotation 83 is the need for knowledge on digital production. In the semi-structured interviews, many participants stated that there should be courses on digital production in industrial design education, just like the physical manufacturing methods and technical knowledge on production that they learned in the manufacturing course. The comment of participant #5 in quotation 83 is an example of such approach.

In addition to courses that introduce students to coding and marketing perspectives within industrial design education, it was also observed that courses referring to specific stages of digital product development were also designed. Participant #6, who coordinates an elective course on UX design process with their industrial designer background, stated the purpose and characteristics of their course with the following comment.

> [84] "My goal is to create successful UX'ers who will also work in the market. (...) What makes the difference in the success of UX'ers in the workplace is not based on the screens they draw, but the shape they take in the organization, the way they manage other people and the project. Knowing what to do, what negotiations to enter into, knowing when to give up and when to push. These are actually 50% or 60% of the job." (P#6)

Participant #6, who is a part-time faculty member from the market, developed the UX design course from a market-oriented perspective rather than full academic lectures, aiming to provide industrial designers with the skills and knowledge that can make them stand out in the market by being aware of market needs. Within the scope of the course, students learn to become familiar with process facilitation and negotiate with professionals from different disciplines. This emphasizes the essential position of process management in digital product development and UX practices. Similarly, participant #25, who similarly coordinates a market-oriented UX course, summarized the functioning of their course with the following comment.

> [85] "For example, we opened an elective customer experience (CX) course, in which, someone from the market, who is the head of the department in a big corporate company, comes and explains. In the Introduction to UX, there is a founder of an agency that conducts ethnographic research or other kinds of field research and provides consultancy to large companies to improve their services mixed with strategy." (P#25)

When the elective industrial design courses for UX practices were analyzed, it was seen that almost all of them have the participation of UX professionals from the market. Since these courses aim to prepare students for the market, it is of great importance for UX professionals to share their experiences and processes with students. Another point that stands out in the comment of participant #25 is the involvement of agencies in the courses. UX professionals from agencies improve the research skills of industrial design students by sharing their market experiences and process management approaches, strategies, and methods with the students regarding the ethnographic research they conduct within the scope of digital product development. From this point of view, it is possible to make an inference that academics and UX professionals have an excellent command on the research processes of students. Students who gained early research experience through elective courses gained the ability to go through the process more smoothly with the help of agencies and UX professionals. In addition to the market-oriented UX course context of participant #25, participant #6, who similarly joined the academy part-time from the market and conducted a UX design course, demonstrated how they introduced students to the digital product development process with their following comment.

> [86] "In the content of the course, I actually made them apply the design thinking methodology week by week. (...) Friends, we will do this for 14 weeks, until this. We will stay here. We are now in this step of this methodology. Therefore, think from here, don't think beyond, I stopped the students who were progressing directly. When I said that we are at this step now, in fact, when they developed the project every week, at the end of the semester, they realized that they had already produced a professional work." (P#6)

Participant #6 emphasized the importance of process management during the semester with their comment. Industrial design students learn to master the design thinking approach during their undergraduate education through must and elective courses in which they carry out different projects. The design thinking approach, which designers acquire in education and which forms the basis of their professional practice, also manifests itself in the market in the design and execution of digital product development processes (see Section 2.3.2.3). Although the design thinking approach is not followed in written form in the courses in industrial design education, students instinctively internalize the approach. Following design thinking in written steps in an elective course helps students to make the connection between education and UX professions easier. The course process management was also positively influenced by the fact that the course process was parallel to the process in the market, and that the students acted simultaneously in this newly experienced process. Although the students had some knowledge about the approach and process, their own practices within the process stages of UX professions and digital product development were more easily internalized by the students in this way. Although the students and course coordinators were generally highly satisfied with the process and outcomes of the elective course, participant #26, the co-coordinator of the course, made a self-assessment in relation to process management with the following comment.

> [87] "We made a bit of a mistake by putting the whole process. Even though the outputs were very good, the students were very tired. I remember many students said they were studying this course more than their studios... I think it would be better to focus on a few more specific steps rather than doing the whole process from start to finish. The product is not finished and released. That design never ends, it is actually a circular process. Maybe we should focus on half a cycle." (P#26)

Process management helped to facilitate course processes of the students as the stages were designed and monitored in parallel to the market in detail, but the adaptation time was a challenge for the students as the specific knowledge, methods, and strategies of this process were new concepts for them. This was evidenced by the fact that students spent more time on the elective than on the studio course. In addition, participant #26 stated that the development process does not end after the digital product is launched. Unlike physical product design, many patches and enhancements can come to digital products after they are launched, so the process can be reflected to students by taking this into consideration. Diversifying and elaborating the processes of digital product development and UX practices by dividing them into parts and creating more than one course was also a comment made by other participants in the semi-structured interviews. In quotations 82, 83, and 85, different academic faculty members have shown that this option is being actively experimented with in their industrial design departments. In general, the meeting of UX professionals from the market with students as part of elective courses did not stop at teaching students the process and sharing experiences. UX professionals met their future colleagues by seeing the approach of the students, and students had the chance to share their projects and portfolios and made future networking within the scope of their education.

In the semi-structured interviews, insights were obtained on how digital product development and UX practices are formed and how they function in industrial design undergraduate education in Turkey through elective courses. In addition, the course instructors made some self-assessments about the implications of these areas in education based on their own experiences and student feedback. In light of this information, the elective courses in industrial design undergraduate education mainly consisted of courses on different disciplines of UX professions. In addition to engineering-based prototyping and coding courses, marketing-based courses developed students in the context of professional jargon and effective communication. The project courses for the UX process were generally taught in stages with professionals from the market based on the design thinking methodology. The specific knowledge and skill requirements that the process brings with it suggested that it would be easier for students to teach the process in different ways in multiple courses. In addition, the market collaboration in the elective courses provided students with different perspectives and networking options.

4.3.1.2.3 Summer Practices

Within the scope of industrial design education, students acquire their gains in digital product development and UX practices through summer practices in addition to must and elective courses. Playing an active role in the real-time project process carried out in the market within the scope of summer practices and gaining hands-on experience with the necessary tools prepares students to become UX professionals who can work in the market. Many industrial design departments in Turkey offer computer internships to students at their faculties before they do an internship in the market. In these computer internships, students who learn tools on digital prototyping and digital visualization generally receive critiques with the short design projects they develop. In this way, students who have the opportunity to experience the tools before they are released to the market have the option to bridge their summer practice and the student internship or freelance working experiences they have performed or will perfom in the market. Participant #1 made the following comment about the computer-oriented summer practices offered in industrial design departments.

> [88] "In this field [UX/UI tools], for example, *Figma* training is given to second graders in computer internship. Because I saw that academics want to integrate them more into education." (P#1)

In industrial design education, summer practices for computer programs are generally designed to model physical products in digital environment such as *Rhino, Photoshop,* and *Illustrator* to create effective project presentations through advanced visualization tools. Especially in recent years, the increase in interest and orientation towards digital products and UX practices has revealed the necessity of providing students with information about the use of the necessary tools and shaped the content of computer literacy-based internships within the faculty. Students who learn the principles of two-dimentional and three-dimentional design within the scope of Basic Design courses in the first year, who are introduced to digital products within the scope of cognitive ergonomics with the ergonomics course in the second year, have the chance to gain digital product prototyping experience in the second year summer practice within the faculty.

In addition to the computer internships in the second year to improve computer literacy, the office summer internship in the senior year supports students to gain hands-on market experience in digital product development and UX practices. Industrial design departments, which focused on physical product design as an office internship for many years, have started to include internships in the digital environment with the impact of the emergence of the contemporary design approach and the Covid-19 global pandemic. Regarding summer practices in design offices, partipant #23 made the following comment.

> [89] “Students can also do an office summer practice in interface design, for example. We pay attention to this, we do not oppose it. Therefore, we tell students who are interested in this subject to do it.” (P#23)

Within the scope of industrial design education, it is commonly accepted by academics that market experiences are essential for students to learn the interdisciplinary structure, specific processes, tools, and activities of UX professions. Within the academic course semesters, students can gain academic knowledge in the fields of digital product development through elective courses that they must take and elective courses that they choose to take. Based on the comment of participant #23, just as students can choose elective courses according to their interests and needs during the course periods, students are expected to take the initiative to do internships within the scope of summer practices, and in many industrial design departments, it is accepted that these internships are specialized in UX/UI fields. The purpose of summer practices in offices in the market is to allow students to experience work environments in their areas of interest before graduation and to help students to draw their future career paths by supervising work practices. In this way, students gain many professions by doing their summer practices in this way. Participant #7 made the following comment with summer practices in the field of digital product development.

> [90] “For example, most students are already working somewhere as interns. They are learning one way or another, I should say by rising through the ranks.” (P#7)

The comment of participant #7 basically summarizes the summer practices described in the section. Trial-and-error has an important place in the undergraduate education of industrial design students. Within the scope of summer practices, in addition to their academic knowledge and experience, students get to know the market approach and experience a trial-and-error learning process as part of a real process. In addition, the fact that digital product development is an interdisciplinary field emerging from the market requires students to gain intensive experience before graduation. If the students who have done their summer practice in this field decide that they are interested in the field, they have had the opportunity to increase their experience with extracurricular activities in parallel with their education and to improve their education process in this field.

4.3.1.3 UX Experiences as Extracurricular Activities

During the long lockdown process, that started with the Covid-19 global pandemic that took place in the 2019-2020 academic year, digital product development has become an area where many industrial design students have gained work experience simultaneously with their undergraduate education, owing to its openness to remote working (see Section 4.1.1.2). Before the pandemic, digital product development and UX practices had a relatively small place in industrial design education and the knowledge in this field was based on market practices, which caused students to have an intense need for knowledge. For this reason, students started to gain experience in the market through part-time working, long-term student interships, and freelancing while earning an income. According to the semi-structured interviews, experiences of the students under extracurricular activities are categorized under three main headings, (1) online courses/certificates, (2) long-term student internships, and (3) freelance working experiences.

The university education that started to be conducted online during the lockdown period paved the way for the digitalization of design projects of the students. Students who developed digital projects with online education explored various methods, tools, and approaches on these newly learned fields through online research articles, books, and videos. Since digital product development and UX practices have online-based tools, mediums, and approaches and are very current topics, participating in online UX courses and certificate programs has been a path followed by many students. On this topic, participant #34 made the following comment.

> [91] "Students also get information from these places because they think that in this increasingly busy lifestyle, without doing UX certification, internship, and a lot of things at work, it is as if they cannot progress at this point in their career." (P#34)

UX certificate programs have a structure completely designed by large-scale company officials from the market and employees related to the field. On the one hand, these programs contribute to the network development of students as they offer a collaborative learning environment. In addition to these features of certificate programs, the more traditional and formal structure of academic education is lagging in meeting need of the students for practical knowledge of the market. The fact that there are few UX or digital product programs in the academic sense also allows these certificates to appear more effectively on the student resumes. For these reasons, as participant #34 mentioned, students tend to participate in extracurricular activities to gain UX experience.

Apart from online certificate programs, long-term student internships were another method of gaining experience preferred by students. Within the scope of this thesis, many of the students whose graduation projects are analyzed in this thesis have gained student internship experience within the scope of the advisor firms they collaborated with. These experiences introduced the students to the market, helped them to develop their design portfolio and helped them to plan their future career paths. The following comment of participant #8, one of the academicians who evaluated the graduation projects within the scope of this thesis, provided insights into the student internships that industrial design students have performed as extracurricular activities.

> [92] "Some advisor firms hired students as interns during the graduation project. I think the process went much better for them. I think those who have not done similar projects before, or those who have not worked part-time, or those who have no experience had more difficulties." (P#8)

The comment of participant #8 indicates that students who have long-term experience of working with advisor firms during the graduation project process have a better command of the digital product development process and go through many stages more easily than inexperienced students. The students who participated in the online surveys conducted as part of this thesis also had similar perceptions to participant #8 (see Section 4.1.3). If students are able to do internships where they can experience more than one stage of digital product development, they have the chance to transfer their experience and knowledge to their projects in their education. The specific knowledge of digital product development and UX practices provided additional guidance to the students, enabling students without experience in these areas to get ahead, especially in process and time management. Additionally, students had the opportunity to increase the market perspective in their projects as well as professional networking opportunities by doing student internships at the firms they collaborated with for their graduation projects. In addition to the students who gained experience in digital product development and UX practices through online certificate programs and student internships during their undergraduate education, a group of students preferred to gain experience through freelancing options. Participant #29 made the following comment about industrial design students gaining freelance experience in these fields.

> [93] "The students were very good. Because they all worked freelance during the pandemic, and since they were far away, most of them found freelance jobs related to UX and they were very well equipped. Most of them already found jobs after graduation." (P#29)

The comment of participant #29, who had the opportunity to examine graduation projects and get to know many students, states that students with freelance experience deliver successful project outputs. The focal point in the comment is that the students took freelance jobs on their own initiative during the pandemic process and improved themselves by gaining experience about the process with these jobs. The aspects of having knowledge from different disciplines and expanding the horizon in this way, which are also included in the culture of the industrial design profession, came to the fore in extracurricular activities. Students who gain knowledge and experience in digital product development and UX practices through freelancing can show these gains in their undergraduate industrial design education, and many of them can find a position as UX professionals in the market based on these studies. Therefore, UX experiences gained by the students on their own initiative, under the name of extracurricular activities, paralleled their undergraduate education and served as a bridge that could help them step into the market.

4.3.1.4 Implementations in the Graduate Programs

Semi-structured interviews provided insights into how digital product development and UX practices are addressed in graduate level programmes. For some time, industrial design departments in Turkey have started to work intensively on these areas at the graduate level in collaboration with other disciplines as well as various firms from the market. Research and testing that form the basis of these studies have been integrated into industrial design education through research groups and laboratories established under the themes of interaction and usability, especially in various research universities in the European countries. In the following quotation, participant #25 provided information about early studies on digital product development and UX practices in industrial design education, based on their experiences in graduate education abroad.

> [94] "Industrial designers started the interaction problem resulting from the digitalization of the product and the digitalization of classical industrial design products under the name of usability. I think they established usability labs at [name of a university in the Netherlands] for the first time. At that time [name of a university in the UK] and [name of a university in the Netherlands] had usability labs. (...) I was in Finland at that time [2008]. I took a course on interactive prototyping. At that time, [name of telecommunication company] was huge in the whole country and was working with universities to design smartphones. In other words, by designing and prototyping in master courses in the industrial design department and writing the code. I also worked in a project course where you test it somehow with writings, for example." (P#25)

The comment of participant #25 gave information about the formation of usability laboratories under industrial design departments. During that period, white goods products with basic programmes played a driving role. The basic problems that such products experience in the field of user interaction are also reflected in the design processes of the products. Participant #25 also shared their own experiences on how digital product and usability themes are handled in the current graduate level industrial design programmes. The important point here is that a leading telecommunication company in its field used graduate level industrial designers and academic environment in the product development process. These areas covered practical and theoretical perspectives in a graduate level educational environment. Participant #25 used their design background to bring their expertise in coding and digital prototyping, and additionally, they were introduced to a usability testing process based on early written narratives. This comment provided a first-hand resource about the basis of the studies carried out in graduate level industrial design education today. The basics of market-oriented digital practices of graduate level studies and research studies based on written narratives are exemplified here.

In parallel with the usability laboratories established in research universities in Europe, well-established technical research universities in Turkey have also carried out graduate level studies in the fields of digital product and usability. Participant #25, who has experienced industrial design at the graduate level in universities both in Turkey and abroad, made the following comment about the period when these fields were integrated into the courses at the graduate level.

> [95] "Firstly, it started at the graduate level, I mean, that is how it would have been anyway. People working on that subject in graduate school started to create such courses... In fact, [names of academics] opened a very good course in 2004 or 2005. I also took it [course code with 500s], we read articles such as digital design, its research methods, user research methods, maybe test methods, etc. and we did projects... Some of them did design projects. Some of them researched existing products like me. On top of that, they wrote the usability report. They opened such a course." (P#25)

The first point that stands out in quotation 95 is that participant #25 stated that studies on digital product development and UX started at the graduate level. Digital product development and usability, which are market-oriented interdisciplinary fields, have been integrated into education by designing research with market collaborations rather than basic undergraduate education. This integration process has used educational methodologies and tools by considering the market approach and has been included in industrial design education because of graduate level research. The comment also provided information on how these areas were addressed early in the graduate level courses. As seen from the comment, in the courses opened for these fields, graduate students conducted written research on academic research articles at that time and designed design projects based on these academic studies.

The course structure prepared for the graduate level has expanded and diversified under various updates and specializations over the years. When the current industrial design graduate programmes are examined, it is observed that various must and elective courses have been opened in the fields of digital product development and UX. Participant #12 set an example with the following comment about the courses opened for these fields in graduate level industrial design departments.

> [96] "For example, we take research methods in master's degree. These are not very user-orientated. In other words, it is something that focuses on the difference between quantitative and qualitative, where research methods are examined more generally, more general information is given, and information such as how to conduct a literature search is given." (P#12)

Graduate students of industrial design departments generally start their education with a research methods course. This course focuses on qualitative and quantitative research methods rather than being user-orientated, as participant #12 mentioned in their comment. Within the scope of the course, it is generally explained which type of data collection methods are used in which type of research, and information is provided on how the literature review should be organized. The similarity of this course under the name of research methods with user research methodology focuses on the methods used. Even if the user focus is not a topic in research courses in a specific way, students have a detailed academic knowledge of the fields of digital product development and UX research. With these course outputs, students gain professional knowledge of a detailed academic research design, experience, and documentation. In addition to the research-based must courses offered at the graduate level, many academics have started to offer project-based elective courses in the fields of digital product and UX. In these elective courses, students construct basic research projects in the light of the technical background knowledge they receive within the scope of must courses and the new knowledge they have acquired in the relevant fields in these elective courses and obtain practical and academic outputs. Participant #16, who conducted a graduate level UX elective course, gave information about the course design and outputs with the following comment.

> [97] "It [the postgraduate UX course] is taken by students with a slightly higher academic level, master's and doctoral students. (...) There, we explain the models. User research can be presented with these models, so basically the output of the course is those models and they explain the models with a poster presentation. (...) Those posters [outputs of the graduate UX course] are studies that can be published in a conference. There were even a few posters that way. In other words, the achievements and goals of the course are in this direction." (P#16)

Similar to participant #12 exemplified in quotation 96, participant #16 explains in their course what kind of models and how they can be used in a practical UX research and expects a poster presentation as an output. Speaking in the context of a technical university with a strong academic orientation, participant #16 also showed that the fact that the course is a graduate level course requires a more extended academic knowledge from the students. Unlike undergraduate level courses, in the light of this extended knowledge, course outputs of the students are academic publications rather than projects, which constitutes the main difference between courses with similar content given at undergraduate and graduate level. According to the semi-structured interviews, it was also observed that certain schools designed courses on digital product development and UX practices in graduate level industrial design education through a market-oriented approach. Participant #35 made the following comment about their course on service design in a completely market-oriented graduate programme.

> [98] "In master's service design, I take a little more advanced service design from undergraduate level. In other words, here are the details of the service concept, service quality, how to manage services in the network... While explaining theories such as franchise services, marketing, and so on… On the other hand, I have a project from the beginning to the end of the

semester, and at the end, students graduate with a project, a prototype as a project... (P#35)

Participant #35, who conducts service design to graduate students from the market on a part-time basis, designed a project in parallel with the market and expected the students to make a project prototype for service design as a course output. The striking point here is that the participant finalised the course with a project prototype without concluding the whole service design process with a finished project. The aspects that participant #35 emphasized in the course were mainly about the process and negotiations, and the design principles remained in the background. This situation, in fact, provided evidence that specialised projects for certain stages of the process could be evaluated in certain order of importance, rather than considering the whole process, which was mentioned in the previous quotations and which the students had just been introduced to in the courses. In addition to department-specific must and elective courses, graduate programmes specialised in UX were found in Turkey. In the semi-structured interviews, many participants indicated that they had a general knowledge of the importance of programmes that are focused entirely on digital product and UX practices. Participant #9 provided information about the content of UX-based graduate programmes in Turkey with the following comment.

[99] "In universities in Turkey, only [name of the university] has a sharp stance on [UX]. They have a master's programme. This master's programme is completely market-oriented. When they first established it, the academics in it were mostly people coming from practice and it was more oriented towards practice... In fact, in my eyes, it is a commercial-oriented programme by partially closing the gap here, and I do not know whether its thesis was opened later or not." (P#9)

The comment of participant #9 provided information that the graduate level UX programme is almost entirely market-oriented, and explained this approach as a study for the institution that the programme is affiliated with to recognise the gap between education and the market. Participant #9 has shown that this UX graduate programme has built its goal of closing the gap in the problem area between education and the market through practices rather than different academics. The fact that starting point of the program is the option of graduation through a project instead of a thesis emphasizes the importance of knowledge and experience from the market in digital product development and UX practices. This situation is actually like the graduate programs mentioned in quotations 94 and 95, which were carried out in the 2000s in usability laboratories in cooperation with large companies in industrial design departments of research-based universities in Europe.

When the participant comments are examined in general, it was seen that graduate industrial design programmes were designed to create solutions to the usability issues of such products and the use of digital products as simple interfaces over physical products. Since the basis of these fields was based on the practices that emerged because of the co-creation and approaches of different disciplines in the market rather than academia, it was seen that graduate courses and programs for these fields were designed as design projects carried out in cooperation with the market. Graduate students related to these fields finalize their academic gains in research methods and UX methodology in various courses by carrying out a project development process in cooperation with different disciplines and have the chance to experience UX professionals in the market in the educational environment.

4.3.2 Evaluation of the Digital Product-Driven Graduation Projects

This doctoral thesis examines the transition between industrial design education and UX professions through the outcomes of the ID402 Graduation Project course at METU Department of Industrial Design. Therefore, the section focuses on the evaluation of the digital product development process and the UX practices within the scope of their graduation projects, and the quotations from the semi-structured interviews refer to the design process as well as the design outcomes. The section discusses this evaluation under three main headings as; (1) expectations, (2) process and jury assessments, and (3) further developments of graduation projects.

4.3.2.1 Expectations from the Graduation Projects

Many of the participants in the semi-structured interviews were involved in the graduation projects as academic or professional jury members. In this way, many participants were able to follow the projects from the concept stage to the final stage in communication with the students at certain points of the digital product development process built in the course context. One of the main questions asked to the participants about the course was regarding their expectations from the students. While some of the participants looked from an academic perspective, another group exemplified the market perspective through student projects. Participants primarily agreed that they would like to see good problem identification from students, regardless of their background or perspective. Following comment of participant #24 exemplified the general expectations of participants on good problem identification.

> [100] "Have they really defined the right problem and the right need? Because sometimes it can be like, without defining a problem or a need, one can come up with a solution directly in one's mind. As people in Turkey, we generally like to produce solutions without linking them to any problem or need. Secondly, did they embrace the problem and solution they found to the end, did they defend it, did they try to convince, or did they take the things they did not realize and continue to develop them again?" (P#24)

In their comment, participant #24 linked problem identification, which is the starting point of the industrial design process, to the digital product development process and emphasized the crucial importance of this point. It is possible to mention that there is a need for a strong problem identification for the fundamental starting point of product development and design processes, whether physical or digital. Participant #24 also mentioned the potential of students to come up with solutions without problem definition. Since the course project includes a design activity, it was emphasised that the students addressed the backbone stages of the process such as problem identification and research from a different perspective. About a strong problem identification, which is at the beginning of the digital product development process, participant #24 expected a certain sense of belonging regarding their ideas from the students. In the design process of any product, product development progresses in certain ways with various ideations and steps are taken for product finalization. Different types of comments, especially from stakeholders, can cause students to get lost in projects or not to stand behind their ideas. Participant #24 emphasized that students who set out with a strong problem identification can achieve a good project development process by owning their projects and ideas.

After problem identification, the user research process constituted an important point among the student expectations of the participants. In the online survey outputs, it was observed that students designed detailed desk research studies and user research. Lack of experience of the students in research methods was a factor that made the process difficult. Students with experience such as student internships stated that this lack of method experience had a negative impact on their projects at the end of the process. In response to this situation, especially UX professionals emphasized that they want a good user research process from students as an expectation. The following comment of participant #17 is an example of the expectations about user research expectations.

> [101] “I want to see really good user research from the students. I mean, not in a sloppy way, but really... In product design, you can quickly ask two or three people about user research and produce something with more or less hypothesis, but in digital products, user research is much more important, as if a little more detail is needed...” (P#17)

Participant #17 emphasized that user research is much more prominent in digital product development than physical product design. Since students undergo a physical product-orientated education until their graduation project process, user research approaches remain in the background compared to its parallel in the market. Although user research methodology is an area that is currently discussed and introduced to students in undergraduate industrial design education, students mostly have an opportunity to experience hands-on research in graduate level programmes (see Section 4.3.1.4). This indicates the need for students to gain additional study or experience in these areas. Even among the students with student internship experience in the digital product development context, it was found that there were difficulties in the facilitation of user research. In addition, the participants provided important insights that interaction with the user in the digital product development process should not be limited to user research at the beginning of the project. Usability testing and user feedback on usage practices after the launch of the product play an important role in the product development process. For this reason, many participants emphasized the expectation that students should start the process with solid user research.

After the emphasis on expectation for problem identification and user research, UI design was another highly emphasized point in the design development process. The students experienced various difficulties because they carried out the project on a strict timetable and their UI experience was very limited. The comments of academicians on UI design within the scope of the development phase were more prominent than those of UX professionals. Most of these comments showed that UI was in the background more than UX in the digital product development process. The fact that the studies on the UI field are left to the end of the process and that the transfer of knowledge about this field is relatively less than UX is seen especially in the expectation of academicians. Regarding this issue, participant #23 made the following comment.

> [102] "Now, in the interface part, if we mean UI design, my expectations from the student are not very high. Because this is not something we teach to the student. In other words, to expect something from students, we need to give them something." (P#23)

In the semi-structured interviews, many participants commented on UI design in line with the comment of participant #23. Academics showed that they have much clearer expectations from the fields of problem identification, research, concept development, ideation, and screening rather than UI design. Since UI design covers all possible screens of a digital product in a project that is ready to be launched and students do not have time for such a comprehensive study within the timetable of the graduation course and at the same time their skills, knowledge, and experience are lacking, the expectation for UI design is much more in the background than the other stages. In addition to this situation, the lack of courses or assignments in which detailed UI design studies could be carried out has also caused academicians to have this approach to their expectations.

It was also observed that the participants had various expectations during the screening and presentation processes following the design development phase. At this point, the expectation that almost all participants, regardless of academics or UX professionals, agreed on was to see readable screens. Minimalism in constructing a user scenario and experience through the screens formed a visible point among the comments. In this regard, participant #6, a UX professional and part-time academic, presented an example with the following comment.

> [103] "Applications already have certain systems and rules, and there is already minimalism. There is no need to get too extreme. I need to make simple, readable screens, designers have already gone to such a place on our side, especially in digital. In other words, you actually need to act more like a curator rather than creating everything you want from scratch." (P#6)

The comment of participant #6 emphasized the expectation that students should present minimal and feasible digital product screens. Previous comments provided insights that students were drowning in details and experiencing various difficulties in process management. At this point, among the expectations from the students were applicable and minimal product presentations for the market. The detailed thinking approach and being a perfectionist aspect, that industrial design education brings along with it, could cause students to get lost in these contemporary fields, especially in project presentations. In addition to this situation, quotation 103 also mentioned the situation of students customising every aspect of their projects. Industrial design students mainly receive formal training to design every aspect of their products. Although this has an important place in the process of designing physical products in terms of the novelty of the resulting product, the expectation and perception of novelty in digital products is different from the participant comments. It was found that the use of ready-made design elements is common especially in UX professional comments. In digital product development, since the design focuses on the experience of users rather than the product itself, many UX professionals stated that they use basic elements such as buttons, layouts, or icons in a ready-made way. Although this situation contradicts with various academic comments, it has an important place among the expectations of UX professionals from students. In this way, UX professionals basically stated that they expect students to be able to curate the digital product they have developed by using some ready-made items instead of designing every fine detail from scratch.

Expectations of participants from students were mainly summarized under the topics of the digital product development process described in the section. In addition to these expectations, it has been shown that especially UX professionals may have additional specialized expectations from students in terms of the fields and firms they work in. These specialized expectations, which were in addition to the common expectations for digital product development regardless of the field of study, were focused on corporate culture and approaches of the firms to the digital products. Participant #21 from advisor firm H, a leading company in the automotive industry, provided an example to the approach with the following comment.

> [104] "Since we are human-machine interface (HMI) department, we wanted to see in-vehicle screens. We gave the brief accordingly from the very beginning. What is important for us is not the phone application, but rather how the human relationship with the screen inside the vehicle is provided. We asked them to work on this, and they did so." (P#21)

Human-machine interface (HMI) is an area of focus for industrial designers working on projects with high interaction with physical products, especially in the automotive and defence sectors. For this reason, students working on project development in these fields are expected to make considerations from the perspective of HMI. The emphasis in the comment of participant #21 on experience design, not specifically on the product, touches on an important point that refers to other participant comments. Regardless of the medium, the importance of the interaction of the product with the user rather than the design has brought to the fore the importance of developing projects for experience design. From this perspective, the approach behind experience design being in front of product in the project outputs of the students working with advisor firm H was seen.

In general, it was observed that academic and UX professional expectations were gathered under various headings for each stage of the digital product development process for graduation projects of the students. Detailed problem identification and research, a less-observed UI design expectation, and a minimal and legible presentation are the expectations that the participants agree on. In addition, it was also observed that there are various requirements and perspectives specific to the fields of work of the advisor firms, and that these create an expectation that the graduation project courses will be customised and become experience-oriented rather than product-oriented.

4.3.2.2 Assessments on the Overall Process

In the semi-structured interviews, assessments of the participants mainly focused on the digital product development process that the students went through during the ID402 course, and its final jury held at the end of the term. Therefore, firstly, the section illustrates appraisals of the participants concentrating on their observations during the semester, and then a narrative is provided through the appraisals presented by these participants based on the final jury held at the end of the semester.

4.3.2.2.1 Appraisals Focusing on the Semester

This section presents insights from the observations and evaluations of participants on the digital product development process in the ID402 Graduation Project course. The insights obtained from the participants mainly focus on how the students approach the digital products and the process and, in addition, how the process works. The first assessment that the participants made by looking at the process was that the students did not have enough knowledge and experience about the process. Lack of knowledge and experience of the students on digital product development shaped their course process to a great extent. Participant #1, who had a lack of knowledge and experience in digital product development, presented an appraisal of the process with the following comment.

> [105] "When I was setting up the system of my project, I had to set up the *flow* and *information architecture*, but I started to create the system without knowing the existence of these. Therefore, I think that we should have been given information about this information architecture and flow in the early stages... I think it could have progressed through these." (P#1)

Participant #1 stated in their comment the points they lacked in digital product development, which is an area they have just experienced in their graduation project. These points are related to the development phase of the product and are not the points that students experience in industrial design education. Therefore, it was observed that these areas that require technical knowledge had a negative effect on shaping the project. Unlike participant #1, participant #2, who gained relative experience in the field by taking a student internship and UX elective course, made the following comment supporting the ideas presented in quotation 105.

> [106] "I did not really receive guidance on it [digital product development], neither in the firm channel nor in the academic channel, none of us received it properly. It was a process that we all discovered on our own, maybe that is the right thing. Maybe this is the main flow of graduation projects, I cannot say anything about that, but the expectations were not in this direction. We took a UX course, but I had a lot of friends who did not. When you analyzed the projects with a knowing eye, it was obvious what their deficiencies were." (P#2)

Participant #2 emphasized in their comment that students define and construct the digital product development process in a way like trial-and-error on their own initiative. The comment of participant #2 that students did not receive clear guidance from academics or advisor firm officials during the graduation project process emphasized another vital point. In traditional industrial design education, students are expected to create their own design processes through trial-and-error. Students internalize the approach during their four-year undergraduate education and make it a part of their professional culture. The participants, who work as UX professionals with industrial design backgrounds, stated in their comments that they do not specifically direct the students in a clear direction, but only transfer information and criticize the ideas presented by the students to make them work. Furthermore, students with hands-on UX and digital product development experience in the field, such as participant #2, interpreted the stages of the graduation project processes according to themselves in the light of the information they gained from the field. Students who lacked experience in these fields went through a heavier and more challenging digital product development process than other students when shaping a graduation project in a relatively new field, as they were used to the process progressing in their own way. Participant #29, who has the role of advisor firm official in graduation projects, appraised the processes of students with knowledge and experience in digital product development with the following comment.

> [107] "They [students with internship experiences] chose their own fields. They chose their own projects; they did not depend on us much. Afterwards, they did not feel the need to meet with us and take critiques. It is interesting." (P#29)

Participant #29 commented on the main difference between students with and without experience in digital product development and UX practices. While process difficulties and guidance needs are at the forefront in the comments of students who lack experience and knowledge in the field, a common feature seen in students with experience is that they have the skills to update the processes according to their own approaches. The fact that students with experience and knowledge did not feel the need for guidance revealed that they were able to internalize the process and embrace the project and processes with their designer approach. Students were able to develop a strong background in digital product development by acquiring the necessary experience, skills, and knowledge through summer practices, student internships, and elective courses in related fields on their own initiative until the semester they took the graduation project course. Students who were able to achieve this development were also able to easily rethink and update the professional approaches and practices they had acquired in formal industrial design education into digital products.

In the comments of the participants, another fundamental point regarding the guidance provided during the graduation projects was seen under the roles of research assistants. In addition to full-time and part-time course coordinators, research assistants also helped students with slightly different contexted guidance during the course period. When the participant comments were analyzed, it was seen that academic critiques and guidances were generally focused on design decisions regardless of course coordinators and research assistants. In addition to this, it was also observed that research assistants provided additional guidance to the students at various points focusing on digital tools and technologies. In this regard, participant #7 made the following comment.

> [108] "I know that the [research] assistants were very helpful. Let me put it this way, since it is a slightly different generation, I think that they have more knowledge than the course coordinators because they are a little younger and actually more familiar with the computers." (P#7)

Although the critiques that the students received from an academic perspective during the process focused on design decisions, the fact that the research assistants were younger as members from a different generation and their technology literacy was higher and more up-to-date brought about the specialization of the academic critiques within the process. Students who learnt digital prototyping programs such as *Figma* from research assistants within the scope of summer practices continued to receive guidance from research assistants in these areas within the scope of their graduation projects. Since the research assistants were more familiar with working in a computer environment and had the opportunity to follow the projects with the students by seeing and experimenting on the computer, they kept themselves up to date with both the tools and the projects. In addition, the fact that the research assistants were closer in age to the students than the full-time and part-time academics indicated that the student-research assistant dialogue during the process was freer and more intense. For this reason, the role of research assistants, especially on technological tools, has gained an important place in the process appraisals of the participants in digital product development.

Among the appraisals of the participants about the digital product development process in their graduation projects, it was also seen that there were evaluations gathered under assignments for certain stages. Comments of the participants on the research phase of the process centred on perception and skills of the students on conducting research. The fact that industrial design students do not have a practical research methods experience has been a point discussed in many semi-structured interviews. Participant #20 made the following comment on the subject.

> [109] "Generally, there are such situations for example, they [students] have met with users. They want to somehow realise everything the users say. But there needs to be a prioritization. Who will eliminate the answers from the user, where there is accumulation, which parts are needed more intensively, after understanding these, they need to create their designs with that prioritization. (...) There, it works if you analyze and synthesize the data after collecting it, not as if I have collected the data. There may be a problem with that process." (P#20)

Many participants, like participant #20, emphasized the lack of experience of the students on research methods. Students approach the detailed research phase in digital product development and UX practices in the same way as in physical product processes. Many students stated that the research questions and analyzes of online surveys were incorrect, rather than the methods they used. Students conducted detailed desk and market research in the process and experienced a productive ideation process. In UX research, they should shape their concept studies by focusing on the problems and needs of users rather than the product. As participant #20 stated in their comment, many students focus on the UX and UI design development phases of digital product development, so they mainly consider the research phase as an assignment. This problem is especially pointed out by the UX professional participants. They stated that students should interact with users more than once during the process, and that the design development process should be based on user interviews. In addition, there are also students who construct the research phase through their immediate environment and collect general information on the themes they have identified instead of focusing on the specific needs of the users. Nevertheless, the fact that research is treated as a check-list item among the students and the data extracted is not prioritized well may cause student projects to remain at the concept stage or not serve their purpose by causing different errors.

In appraisals of the participants on process management, it was observed that a group of comments were specified to cover the research and development stages. Analyzing the outputs of the online surveys and course assignments, it was inferred that the students went through a long research and ideation stages. From the ideation stage, many students moved on to the development and UI design activities with basic hand-drawn wireframes. Despite this, some participants stated that the research stage did not progress in parallel with the market and that the transition to UI design was relatively fast. The following comment of participant #6, a part-time UX design course coordinator, provides a relevant example.

> [110] "They [students] went to the UI side very fast. I mean, they went in a very meaningless place, nothing was clear. I think it needs to be managed better. I think the research phase should be allocated much longer... For example, in my course, I take it to the preliminary jury with wireframes. From the preliminary jury to the final, I switch to UI, but in graduation, I think at the end of a month, the subject went to a place like create a session on the design system. It made me feel that there was no time for those preliminary stages. Research, I think, is like 80% of the work until it comes to UI." (P#6)

Participant #6 emphasized the fundamental place of research in the digital product development process with their comment. Even though the timetable of the course is mostly covered with research and ideation and the development stage including UI design activities is placed at the end of the semester, this appraisal of the process is directed towards the issues of students shaping their own design process. The analysis of the semi-structured interviews has so far, at many points, included implications for the attribution of research methods in industrial design education (see Sections 4.3.1.2 and 4.3.1.3). According to the comments and inferences in these sections, although industrial design students gain knowledge about digital product development, UX practices, and user research methods in their undergraduate education, they lack experience to a great extent. Within the scope of their graduation projects, lack of experience of the students in data collection and data analysis, their lack of familiarity with research methods, and their view of the research stage as a jury requirement due to these problems led them to go through an inefficient research stage. This situation, coupled with the abstract nature of the design process and the perfectionist approach of students and academics, resulted in students who got lost in the preliminary stages of the process and whose projects could not be finalized. Therefore, there were some students who moved quickly from research and ideation to basic wireframing and UI design. The lack of experience and knowledge of the students who updated their process management in line with their own design process approaches based on the course briefs was also included in the appraisals of the participants about the issues related to the course process.

Appraisals of the participants on the graduation project process also referred to the time management issues that occurred during the process. Most of the comments on this situation coincided with responses of the students to the online surveys (see Section 4.1.3.2). Many students stated that they experienced time management issues during the process, especially during the transition to development and finalizing their projects at the end of the semester. Based on these comments about the course process that the students presented from their experiences, the UX professional participants had various appraisals about the course process and timetable. Many UX professionals commented that the digital product development timetable designed within the scope of industrial design education was not parallel to the market. Concentrating on process of the graduation project course, participant #13 provided an example with the following comment.

> [111] "Unfortunately, because they [students] are time-dependent, they have critical time ahead of them. *I will do this for two weeks*, but unfortunately this is not the real world. Sometimes we can make two weeks into 10 weeks, but we finish our last output in two weeks. In total, the process is still completed in 12 weeks, but I think the unreferenced periods of those friends affect them negatively. I wish the whole scope was clearer. Yes, they should know their dates, I accept that, but if the deadlines were given more accurately to digital product development..." (P#13)

The comment of participant #13 became an appraisal of time management issues of the students based on the process organization and management of the graduation projects. Many UX professional participants, who have an active role in the graduation projects, stated that the course setup and timetable are slightly disconnected from the market parallels. Although the digital product development process in the market has a certain flow, the developments that take place during the process can create changes in the processes of the stages themselves. This situation does not progress in parallel due to different concerns and constraints in the educational environment. Within the scope of graduation projects, students can experience practices for digital product development and UX practices, but they have difficulty in fully realizing them for the market. This situation can also negatively affect project development. These comments on process management and time management issues have also been an important issue addressed in the design of elective courses other than graduation projects (see Section 4.3.1.2.2). The comment of participant #26, one of the coordinators of the elective UX design course, in quotation 87 also emphasized the negative effects on students of considering digital product development within the scope of one course in one academic semester.

This section mainly includes appraisal of the participants on the process of the graduation projects. Semi-structured interviews revealed that the lack of knowledge and experience of the students in the fields of digital product development and UX practices largely shape their process. Additionally, academics and advisor firm officials tried not to direct the students by not giving clear answers, thus leaving the process to initiative of the students, just like in traditional industrial design education. In this way, students develop projects through trial-and-error with assignment briefs and basic guidance. In addition to academics and UX professionals, research assistants are close to students in terms of generation and their advanced technology literacy contributes to digital skillset development of the students in the process. Participants, especially UX professionals, provide appraisals on process and time management issues of the students during their graduation projects. Lack of knowledge and experience of the students causes them to see the research phase as an assignment and not to start a structured process. The time limitations arising from the academic semester given within the scope of graduation projects are not in line with the market, which creates an important time management issue and affects digital product development process of the students and therefore their outputs.

4.3.2.2.2 Appraisals Focusing on the Final Jury

In the semi-structured interviews, the participants commented on the process of the graduation projects as well as on the jury evaluation at the end of the semester. These comments on the jury mainly emphasized various points of appraisals in the light of the educational background, professional knowledge, and relevant experiences of the different participants. Appraisals of the participants on the final jury were categorized under three main headings. Firstly, the section discusses appraisals on the presentation approaches of the students in the final jury. Then, based on these presentation approaches, section provides insights into the evaluation criteria of the jury members on the graduation projects. Finally, the section presents appraisals on the communication aspects of the jury in terms of the difference in perspective in the comments received during the final jury.

The first point that stood out in the appraisals for the final jury concentrated on the approach and ability to present digital products of the students. Many participants stated that it has become an issue to see mostly finalized products in the final jury submissions of the students. In the field research part of this PhD study, when the student submissions were examined, it was emphasized that the final jury posters and presentations also included data on specific stages of the digital product development process and that detailed data other than these submissions were seen in the portfolio submissions of the students (see Section 4.2.2). Participant #34 made the following comment regarding this issue.

> [112] "In the posters I saw, there was not much information about user research. There were only the product outputs. (...) How much of its [digital

product] content is fed by data, how much it addresses real user needs, is debatable." (P#34)

Many participants who experienced the final jury process and/or had the opportunity to review the submissions provided information that supported the comment of participant #34. In the digital product development and UX practices processes, digital products, unlike physical products, continue to be constantly updated in the digital environment at the point where they meet the user. The fundamental place of user experience in the process was described by many participants as the focal point of the digital product development process. Additionally, lack of knowledge of the students on proper research methods and the issues related to data collection and data analysis that they experienced during the field research led to the user research being done in a cursory manner, and therefore, presentations of the students remained in the background. Lack of experiences of the students in presenting a digital product also led to the omission of important points in the presentations, causing the students to build their final jury presentations on the approach of presenting a physical product. In this way, problem identification, ideation, insights from the users, and the development process based on them, which have a very important place in digital product development, cannot be followed in the presentations.

Among the final jury appraisals of the participants, another issue like the lack of data on the digital product development process, and especially the UX research phase, in presentations of the students was the incomplete or inaccurate submissions. The insights that lack of expertise, experience, and knowledge about the digital product development process negatively affects process management were discussed in the previous section. This issue of the students also created points in their presentations that did not meet the expectations of the market. Presentation of the UI screens is an example of this issue. The following comment by participant #17, a UX professional with a degree in industrial design, provides a detailed example.

[113] "I am talking about a huge product tree, at least 300 screens. If you are developing an application, there are at least 300 screens. What we see in

students right now is not 300 screens, they show 10 screens. They show five screens, you cannot produce anything with five screens." (P#17)

In the semi-structured interviews, the UX professional participants mostly made appraisals about the user-product relationship and the issues in the screen narratives of the students. Participant #17 emphasized the high number of screens required to realize the product in a real-life digital product development process. In professional life, since a digital product is developed through a cross-functional teamwork, each stage is considered and realized in detail. In the context of graduation projects, this situation is based on the individual efforts and trial-and-error of industrial design students who lack experience and knowledge. In addition to the detailed and numerous requirements of the related fields, the fact that students design all the design features they use in design education from scratch causes them to fall behind in the already strict deadlines. When several requirements and limitations regarding the presentation format are added to this situation, room for maneuver of the students at this stage becomes limited. As a result, screen examples far below the market requirement were included in the final jury presentations of the students. In response to this situation, the students have turned to different ways of describing the user experience through the screens. The video option, which the course coordinators added as optional to the jury checklist, was a point that the students mostly preferred for their presentations. However, narratives of the students through video could create various issues in the evaluations of the jury members due to the relative newness of the field in industrial design education. Participant #23 made the following comment about the construction of digital products through videos in the final jury presentations and the evaluation of the projects through this medium.

[114] "I graduated from [name of a technical university], I think the first graduation project exhibition was held in 2003. For 20 years this department has been doing this work, and has established very good presentations, but the digital products do not meet this. You look at the boards, they are strange, I mean, they do not look like graduation board. They said *let's make a video*, but how will the video be... The process is vital in digital product design. Maybe there is no need to emphasize it so much in the physical product. When we look at it, you can interact with it." (P#23)

Participant #23, who has been following and experiencing the graduation projects and exhibition for a long time, has made some inferences about the presentation and evaluation of graduation projects involving digital products. Physical product design is a field that academics in industrial design departments have experienced for many years. Over the years, the design and presentation requirements of physical products and the evaluation criteria of the products have been fixed based on the experiences. In addition to this, current academics have had the opportunity to experience the process from the student perspective as they have been raised with the same design education approach. Since the process, tools, and presentation techniques of digital product development are market-oriented, the number of professors with experience in these fields is low. Jury members with physical product-oriented education and professional experience also have some doubts when evaluating the differences of digital products. Two-dimensional technical drawings and exploded three-dimensional drawings on physical product presentation boards have been replaced by IA and flow diagrams. The presentation of this change on boards is not parallel to the market.

While the use of video updates the presentations, the fact that students and academics are relatively new to this approach and are currently experiencing it serves as a transition period in the adaptation of digital products to industrial design education. Participant #23 also mentioned the effect of product-user interaction on jury evaluations with their comment. Since user interaction in physical products can be experienced in every aspect instantly, product evaluation and interpretation are more prominent. Participant #8 presented their appraisal of the differences between physical and digital products at the jury stage with the following comment.

> [115] "Our communication/interaction with the physical world is high. Compared to that, our experience with digital products is more limited. Therefore, we may be missing some details when giving feedback or evaluating the user experience of products. There are much more things to criticize in physical products and these can be seen by everyone. Digital products are a bit different. Even if prototypes are tried by everyone, it takes more time to try it in five minutes and give feedback. It is same with

physical products, but since we have a lot of experiments with them, we can give feedback easily, we already use them in our daily lives." (P#8)

Academics could easily analyze and interpret the details and working principles when they look at physical products after many years of experience. The first important point in the comment focused on the self-assessment of the participant. The fact that digital product development is a new field for many academic participants of industrial design departments is seen in the lack of knowledge and experience of some academics as well as students. Even though academics have academic knowledge and experience in the field, there are very few of them who have experienced a real-life digital product development process. In this way, design critiques and evaluations of the academics on digital products are constantly being elaborated and shaped. The second important point in the comment is the explanation of the timespan of the evaluation of digital products. Since a physical product design is finalized with its drawings and model, it can be evaluated with instant experience. The fact that digital products are built on different experiences through different functions creates differences in the duration of the experience. Many participants stated that they needed to experience the functions of a digital product by using it in a hands-on way rather than watching it on video. They emphasized their needs to use the digital product for a time to understand and evaluate. This issue of experiencing also raised questions about the evaluation of digital and physical products within the same jury. The following comment of participant #23 provides an example in this regard.

[116] "We can interact with the physical product and evaluate it. The process is important in digital. The physical is more transparent because it is our expertise. We are not sure how to evaluate digital. (...) When you put a furniture design next to it, it starts to become apples and oranges." (P#23)

Participant #23 summarized in their comment one of the main appraisals of many other participants towards the final jury. Particularly questions of the academic participants on how to evaluate digital product projects increased when these projects took place in the same jury as projects with physical products. Evaluating digital product and physical product projects together in the same final jury emphasized the difference in process and approach between the products. While the stereotypical processes and outputs of the physical products proceeded in a smoother and structured way, the specific processes and requirements of the digital products caused the student presentations to vary within themselves. Evaluating students who make physical and digital products together also brings academics to question their evaluations. The analogy of apples and pears for physical and digital products was made by more than one participant at this point.

In the appraisals for the final jury, the ambiguity and differences in the evaluation criteria were also seen in the approaches and comments of academics and advisor firms. The fact that academic and market interests have different perspectives, experiences, and expectations was a point that attracted the attention of the students in the comments of the final jury. The following comment of participant #2 provides an example of the differences in the perspectives of academic and advisor firms in digital product evaluation criteria.

> [117] "When jury members looked at my project, [name of an academic jury member] said, *this is not enough for a graduation project, this is too simple.* They [advisor firm officials] intervened and said, *a completely solved UX project should be simple, this is a project that can be used, we could not understand what complexity you were looking for.* Because the perspective of the market and the perspective of the academy are completely different." (P#2)

The comment of participant #2 refers on the fundamental difference in perspective between academics and industry. In industrial design education, students are expected to design all design features and create comprehensive and detailed projects with a perfectionist approach. In contrast, UX professionals develop experience-oriented digital products by considering market interests at many points and update the design features with design and functional patches after the products are launched and meet with the users by evaluating new trends. For this reason, the advisor firm officials coming from the market to the final jury of graduation projects want to see legible and simple digital products that users can interact with easily and quickly. At this point, the approach and expectations of the academics were able to focus on the fact that the details of the developed product, regardless of whether it was physical or digital, were solved, included certain functions, and were in working condition. This difference in approach between academics and advisor firms in evaluating digital products was also seen in the user research. Participant #13 exemplified the difference in approach to user research with the following comment.

> [118] "In usability testing, there is a world-accepted proven fact that if you go to four to six users, you can find 80% to 90% of their problems. For the rest, you need to go to maybe 190 users so that you can find 99% of the problems. For four to six users, our professors who know the sector said, *what can you find with four or six users?* I wish they could be a little closer to the market, maybe they can more easily understand that these topics they have broken grades are recommended by authorities like NNG and that there is a mathematics behind it." (P#13)

Unlike the appraisal of participant #2 on jury evaluations in quotation 117, participant #13, a UX professional, mentioned the place of user research in jury grading. The academic approach expects students to conduct user research with a larger number of people to increase the diversity and validity of the data collected. The academic expectation for user research is not paralleled in the market. A possible explanation for this main difference is that in the market, digital product development continues after the launch of the product and users can share their experiences with the product in different ways at many stages of the process. Since graduation projects are meant to prepare students for the market and to bring them into contact with the market to a certain extent, this difference between the academy and the market has an important place in the appraisal and grading of the participants in the final jury.

This section was based on the presentation and discussion of the appraisal of the participants on the final jury of the graduation projects. Many participants emphasized the shortcomings and market differences in digital product presentations of the students. In addition to this, a large part of the section was devoted to digital product evaluation criteria. The unique activities, approaches, and methods of physical and digital products within the scope of industrial design education revealed differences in the evaluation criteria. The section also addressed the differences between academic and UX professional perspectives in final jury evaluations and offered insights into final jury guidance and communication.

4.3.2.3 Discussions on the Future of the Graduation Projects

This section presents discussions on how the graduation projects course, which includes digital product development, can evolve in the light of the information obtained from the participants in the semi-structured interviews. Although the participants had many comments about the course, it was seen that these comments generally evolved into outcomes for developments in the formal industrial design curriculum. Participants firstly discuss on how the course design, which includes graduation projects, can be updated. These discussions then turn to the process management within the graduation projects and illustrate the comments on the process stages. Then, in addition to the process stages, the question of how graduation projects can be updated by taking into account the differences in perspectives within the process, taking into account the industrial design education in general, is interpreted.

As with the jury assessment, the first point that the participants mentioned about the development of graduation projects involving digital product development was the evaluation criteria. Many participants responded to questions about how to improve the graduation projects course by pointing out that projects involving digital, hybrid, and physical products should not be evaluated by a jury but in different ways. Participant #17 pointed out an example of this with the following comment.

> [119] "This course needs to be completely separated, and everyone needs to be evaluated as apples-to-apples. For example, in the last collaboration we did, someone actually produced a [physical] product, and you can make more comments there." (P#17)

Participant #17 argued with their comment that products developed in different mediums should be evaluated in different juries. The fact that digital and physical products have different processes and different ranking of importance shapes the evaluation criteria. Additionally, participant #17 stated that physical products can be analyzed and evaluated in more detail (see Section 4.3.2.2.2). A notable point in this comment is that participant #17, like participant #23 in quotation 116, explained digital and physical products using the apple-pear analogy. For this reason, many participants stated that the differentiation of graduation projects in terms of different mediums could be considered in the future constructions of the course.

In terms of the future of graduation projects, the focus and medium of digital products was another option pointed out by the participants. There are students who develop hybrid projects as well as digital and physical products within the scope of their graduation projects. Since these projects included both digital and physical products, the product development process and final presentations brought together knowledge and evaluation criteria from different fields. Many students stated that they experienced many difficulties during the process as they were introduced to digital product development as part of their graduation projects (see Section 4.1.3.2). Since the students who developed hybrid projects developed digital and physical products at the same time, they were exposed to both the deficiencies in the specific skills and knowledge of digital product development and the detailing and heavy workload of physical product development. The different requirements of different product types made the graduation project process more challenging for the students. Participant #12 expressed their views with the following comment.

> [120] "There were hybrid projects. In the projects that tried to bring the two [physical product and digital product] together, I observed that both were not complete. They seemed to have experienced a little bit of difficulty. Maybe, in that sense, it might be a better option to be more focused and to fully experience the digital product process." (P#12)

Students increased the focus of their graduation projects by presenting hybrid projects involving digital and physical products. Since digital product development and physical product design have their own processes and assignments, students developing hybrid projects were working on two different mediums at the same time and thus lagged behind in project elaboration. The fact that both fields have their own processes and knowledge and that the students are new to the digital field put their projects at risk of being more cursory with the addition of the physical product leg of their projects. Since industrial design students are much more familiar with the physical product design process, one group presented projects with the digital part in the background, while the other group concentrated on digital product development, which they had just learned, and presented physical products in the background. This can have a negative impact on the content and quality of the project and, as participant #17 stated in quotation 119, can lead to a questioning of grades and fairness between students with projects from different mediums being evaluated in the same jury. For these reasons, many participants in the semi-structured interviews argued that the focus of graduation projects could be more specific. However, in the semi-structured interviews, there were also instances where this view varied. Some participants stated that the lack of knowledge and experience of the students in digital-only graduation projects leaves the projects at the concept stage and that digital products can be supported by the physical product part in the graduation projects of students with industrial design education. Participant #31 provided an example of this approach with the following comment.

> [121] "But it was made just to make an interface. (...) They were very problematic interfaces, because they were seen as just add-ons. Maybe instead of giving a direct digital interface project, there could be a project about products whose physical side is integrated with technology." (P#31)

Participant #31 mentioned students who approach digital product development stages as a jury requirement. Since many students gained experience with digital products within the scope of their graduation projects, they approached their processes from physical product design approaches (see Section 4.3.2.2.1). Since detailed UX research and UI design were required as parts of the graduation projects, students went through these phases by making more generalized submissions with their limited knowledge and experience. These phases have a fundamental place in UX professions. As seen in the comment of participant #31, experience of the students on UI design as part of their graduation projects resulted in final products that did not work. Based on quotation 121, some participants also suggested that graduation projects could be more grounded by including not only a digital product focus but also a physical product.

In the comments of the participants about the future of the graduation projects, after the comments on product evaluation and medium differences, insights were also obtained about the points where the process setup could be updated. Within the scope of semi-structured interviews, especially UX professional participants stated that the graduation project process is more structured and progressing compared to the market. The fact that the assignments given to the students in this process are not similar to the market has caused students to get lost in this process that they have just experienced. Participant #32 made the following comment on the subject.

> [122] "Especially for the academics, the process is like… It should not be more like a step-by-step process, but should be *like what this process covers, what it can cover, according to which project these processes can be stretched or narrowed.* I think the assignments given to the students can be more grounded." (P#32)

Many participants who are UX professionals made comments similar to the comment of participant #32 regarding the organization of the graduation project process. The time timings and structured course schedule that comes with industrial design education are not in line with the digital product development process in the market. Additionally, the fact that the assignments given to students in projects involving digital products do not have a direct equivalent in the market and that these assignments are adapted to digital product development in a similar way to the physical product design process causes the graduation project process to move away from market experiences and students to get lost in this process that they have just met. Many participants mentioned that project processes in the market can stretch and contract depending on the work areas and requirements. This comment on process management was accompanied by comments on time management. The fact that the graduation projects are experienced by the students under the fiction of a course has created an obligation to comply with the timetable of the academic semester. Moreover, the evaluation of the entire digital product development process within the scope of the project required students to work very strictly. A student who missed a lecture or assignment during the semester could fall behind in an area where they already lacked knowledge and experience. Since this project determined the graduation status of the students, this strict timetable could lead to pressure on the students. Participant #11 made the following comment on this issue.

> [123] "Normally, there is a week schedule planned by the academics. Someone who somehow missed a week in this process had difficulty going back and doing something about it after missing it. When everything has to be extremely organized, they may not be there yet." (P#11)

Participant #11 stated that timetable-related issues in graduation projects could negatively affect the project development process. Many students supported this comment with their responses to online surveys (see Section 4.1.3.2). While students with experience in digital product development and UX practices were able to update their graduation project process as much as the timetable and assignments allowed, students with a lack of experience in these areas had issues in developing projects according to strict timetables. Participant #3 provided an example of their own process and time management issues with the following comment.

> [124] "Actually, UX can continue while continuing the UI part. Now, I think maybe I would take UI together with UX in the background. In other words, after the research phase, I could change my UI decisions a little bit according to the UX." (P#3)

Like many students, participant #3 experienced the digital product development process through their graduation project. In the process, participant #3, who constructed the relevant requirements of the field they had just met through the assignment briefs and timetable given to them, supported the previous quotations with their comment. The fact that the digital product development process is constantly shaped with the product and the user shows that the process can be updated cumulatively through research and experience rather than through assignments.

Participants also commented on the evaluation and process of the graduation projects through themes focusing on communication and collaboration during the process and made inferences about future course design. In the semi-structured interviews, comments on the communication between advisor firm officials and students were significant. Academics and students stated that advisor firms in the context of the graduation projects aim to provide students with a market perspective and to show how the process is different from real life education. During the graduation projects process, many students said that advisor firms facilitated the process by providing guidance by providing a market perspective. However, the dynamics within the advisor firms themselves shaped the involvement of the officials in the graduation projects of the students. Participants commented that the role of advisor firms could be shaped in the future. Regarding this argument, participant #11 provided an example with the following comment.

> [125] "A [UX] designer in a large company spends very little time, but maybe a designer in a start-up spends more time. In that regard, I think that a certain thing needs to be specified to the companies that will be consultants, such as, *frequency of meetings can be held, there can be such a form of communication...*" (P#11)

Participant #11 stated that the internal dynamics of the advisor firms diversify the firm-student communication in the process. The lack of strict requirements or a program for the meetings between the advisor firm and the students may lead to inequality among the students, although it provides a freer communication environment. Based on this argument, the participants suggested that there could be additional guidance for advisor firm-student communication in the future. Argument of participant #11 in quotation 125 was strengtened by participant #32 with the following comment.

> [126] "We were trying to get together, they [students] were a bit more distant so that we could come together and critique. Obviously, there was a difficulty at this point. It would be good if we came together more often and listened to each other more often." (P#32)

Participant #32, who is a UX professional, evaluated the fact that the students did not communicate with the advisor firms on their own initiative during the semester as an issue and made a suggestion for the course design in the future semesters. According to the participant comments, during the graduation project process, some students could not communicate and receive guidance at the rate they wanted due to the intensity of the advisor firm, while some students preferred to continue their own processes without design critiques. Since digital product development and UX practices are built on interdisciplinary cross-functional teams rather than a single discipline, UX professionals who participated in the graduation project process as advisors emphasized that communication and interaction with students should have more place in the process. Comment of participant #32 on increasing student advisor firm communication was supported by participant #31, who is a UX professional, from a different point of view with the following comment.

> [127] "It is important to be in contact with the teams, to constantly shake hands. If the projects are turned into interdisciplinary projects, this process can be more meaningful for students if there are people from other disciplines in the team. Because when you go to the market, if you are not working alone, if you are not working in a job where you individually design... You work with a team, you need to do the planning with teams." (P#31)

Participant #31 emphasized the importance of teamwork in the digital product development process with his comment. Industrial designers who turn to UX professions after their undergraduate education are constantly working in teams in their professional life. In these teams, each member carries out individual studies for their own expertise and experts from different disciplines come together at certain points according to the project development. Comment of participant #31 shows that increasing the number of teamwork-based practices in graduation project design can allow digital product development in industrial design education to proceed more parallel to the market. In this way, students will have the opportunity to experience digital product development and UX practices, which have a lot of scope and necessity, in collaboration and division of labor through a market approach. At many points in the field research of this thesis, the comments of the participants about the process and content of digital product development and UX practices being very detailed were supported by inferences that teamwork could be used more in the functioning of graduation projects.

The specific skill and knowledge requirements of digital product development and UX practices also emphasized the need to support the development of the graduation project course with other courses. Many participants emphasized the need for students to take courses in these areas within industrial design education. User research methods was a point where participants agreed that it would provide support as a prerequisite area that would positively affect the process and outcomes of the graduation project course. Participant #35 made the following comment on this issue.

> [128] "In your four years of education, *if you do not take this [course], you cannot take this [course]...* For example, if there is a research methods course, UX design should not be taken without taking a research methods course before." (P#35)

The fact that research methods is a large area, with its own very specific data collection and data analysis approaches and methodologies, emphasized the need for students to acquire knowledge of such an important area before their graduation projects. UX professionals coming from the design discipline have acquired detailed knowledge and experience in research methods either through experience in the field or by studying for a master's or doctorate degree and designing academic studies. Although this requirement in semi-structured interviews does not directly affect the design of graduation projects, as a comment on industrial design education, it has presented an approach that can positively improve the process and design of graduation projects in the long run. While the increase in the place of research methods in undergraduate industrial design education may change the course of graduation projects, it has been observed that the separation of students who design graduation projects through digital product development from physicals as section and jury has the effect of changing the course fiction.

This section analyzes and discusses the comments of the participants, who had the opportunity to observe and experience the graduation project process and jury, on the future of the course structure and functioning. Many participants emphasized that students who design a digital product as a graduation project should go through a process among themselves and be evaluated by a specific jury. Additionally, hybrid project development was not preferred by some participants because it distracts from the project focus, but it was considered as a procedure that could be applied by some participants due to the industrial design background and lack of experience in UI of the students. Many participants stated that the graduation project process is too structured with a timetable and specific steps, which prevents the parallelism with the market. The digital product development process in the market is more circular rather than linear with much shorter iterations. This approach in the progression of the process allows a vital area such as user research to be included in the project development at certain points and user feedback to be integrated into the digital product in a healthier way. Another point that the participants thought should be addressed in the future of graduation projects was discussed through the themes of collaboration and teamwork in the process. The differences in the internal dynamics of the advisor firms and the individualistic nature of approaches of the students to the design process made the pace of communication in the process uncertain. Moreover, many participants interpreted the need for teamwork to have a more driving force in graduation projects by referring to the cross-functional teams they have been involved in in their professional lives. Lastly, many participants mentioned the benefit of introducing graduation projects to deep and detailed topics such as digital product development and UX practices piecemeal through prerequisite courses, rather than all at once.

4.3.3 Educational Insights on UX Professions

The last section of the semi-structured interviews conducted within the scope of this doctoral thesis focuses on the counterpart of digital product development and UX practices, which are experienced in various ways in industrial design education, in UX professions. Therefore, the section first examines how industrial designers are perceived as UX professionals in the market, then explores how the digital product development process progresses in the market compared to industrial design education, and finally analyzes how UX professionals in the market construct, facilitate, and experience the digital product development process with other stakeholders.

4.3.3.1 Industrial Designers as UX Professionals

This section examines the impact of design background and expertise of industrial design graduates as UX professionals on the current market. Previous sections have discussed the motivations of industrial design students towards digital product development and UX practices (see Section 4.1.1.1), and the place of these fields in industrial design education (see Section 4.3.1.1). In light of these information discussed in the sections, firstly the transition of industrial design graduates to become UX professionals and then the contribution of industrial designers to digital product development and UX practices and their professional roles are illustrated.

In the semi-structured interviews, many UX professional participants who are industrial design graduates described their professional life through their experiences. A group of participants stated that they built their career path on UX practices because they were interested in digital product related fields during their undergraduate education. However, it was observed that there were other factors that contributed to the participants on becoming UX professionals. Participant #29, an industrial design graduate, explained their own process of becoming a UX professional with the following comment.

> [129] "Most of the job openings in the market are on digital fields, so there is a limited space in physical product design. The fields that existed were generally not what I dreamed of when I graduated. There were such [names of white goods companies] you could go to, or there was the defense industry. I did not want defense industry anyway. [Name of white goods company] said, *I'll give you a little less than the minimum wage, let's see for six months, then if everything goes well, if someone leaves...*

> Naturally, there were a lot of job postings here [UX profession], so I started by saying why not?" (P#29)

White goods and defense industries have been the prominent professional fields that many industrial design graduates in Turkey have prefered to work within for many years. The high brand value of the firms in these fields and the fact that they have more favorable working hours and flexible work environments compared to smaller design offices have been a crucial factor that led industrial designers to work in these industries. However, especially in recent years the increasing economic issues in the country, have slowed down the physical production lines in the white goods sector and pushed many firms to downsize or close down. Therefore, fewer industrial designers in these fields have had to do more work for less pay. The defense industry, on the other hand, is a very specialized field and expects confidential projects and industrial designers to have specific requirements and perspectives. Several industrial design graduates do not see it as a priority to work in this field with the argument that they cannot have a flexible field of action in the defense industry. Most importantly, the Covid-19 global pandemic, which broke out in 2019, has increased the digitalization momentum of design fields, which are already evolving with technology, with a high rate. Many recent industrial design students and graduates with high technology literacy have turned to digital product development and UX practices with remote working and freelancing options. Having unlimited workspace options for these fields has started to be seen as a source of income by supporting the creativity of students. Additionally, the fact that many industrial designers can work remotely and freelance abroad from their homes has reduced their daily living expenses within the borders of the country and increased their income by receiving salaries in foreign currency. Participant #29 explained with a real-life example that although they did not have a special interest in digital product development and UX practices, they started working in the digital field in the light of similar concerns and arguments mentioned.

Many participants expressed their preference to become UX professionals after their industrial design education based on specific concerns or, as participant #29 stated, specific arguments. In the semi-structured interviews, regardless of their education, the participants attributed the fact that industrial design graduates are very suitable candidates to become UX professionals to the specific mindset, skills, and knowledge they acquired in their undergradute education. Creativity problem solving activities, which are at the core of the industrial design profession, exist in the perception of industrial designers working in UX-related fields, just like in physical product design, and highlight their qualities as UX professionals. Regarding this issue, participant #33, a UX Professional, made the following comment.

> [130] "I get satisfaction when I produce or create something, and when I see that the user touches it in some way, uses it in their lives… It is a great sense of satisfaction for me. If they [students] thinks they will be satisfied with this, it is a profession they can easily do." (P#33)

The desire and need of industrial designers to offer better living standards and sustainable futures to users through creative problem solving activities has also been seen within the scope of UX professions. The fact that designers design products that will help users and get satisfaction from this brings industrial designers to the forefront in UX professions, unlike other disciplines. Apart from the fact that industrial design education is based on creative problem solving activities, the specific courses it includes also prepare industrial designers to become UX professionals and reveal their differences from other disciplines. The courses on two- and three-imensional product analysis, ergonomics, and digital interaction between the user and the product in industrial design education put industrial designers ahead of graduates from other disciplines in terms of UX professions. Participant #27 made the following comment on the issue.

> [131] "Inevitably, more than half of industrial design graduates are now UXers. This is inevitable because their education is very suitable for this. Three-dimensional thinking, HMI, HCI, which they see in ergonomics, are also very favorable. They learn concepts like design thinking without realizing." (P#27)

Participant #27 emphasized the strong connection of recent industrial design graduates to UX professions. In industrial design education, whether it is a physical or digital product, the user-product interaction has a fundamental place. Industrial designers, who gain the ability to analyze products by knowing this interaction, have more experience and knowledge in the field of experience design in UX professions than many other disciplines. The fact that industrial design education leaves the product process development to the initiative of the student in an abstract structure leads students to experience the profession through trial-and-error. In this case, as participant #27 stated in the comment, it has shown the ability of students to instinctively perform design activities related to a number of experiences. Another striking detail in the comment was the emphasis on design thinking. UX, which is an interdisciplinary profession, is built on the design thinking methodology, taking into account the market requirements. The design thinking expertise of industrial designers is also considered as an important aspect in the context of UX professions. Participant #6 made the following comment about the design thinking methodology in UX professions and the roles of industrial designers based on this methodology.

> [132] "Design thinking methodology has also entered business. In product-idea development in technology companies, our design teams also have a role in teaching this approach to companies. Designers take an active role not only with the screens they draw, but also because they contribute positively to business development processes. They can directly influence the brief and change its direction." (P#6)

Based on their professional experiences, participant #6, part-time academic as UX professional who gives an elective UX course, exemplified the role of industrial designers as UX professionals in the market. Industrial designers start their undergraduate education by learning the design principles on two-dimensional products and carry this knowledge and the skills they acquire in the process to the fields of three-dimensional product design and product analysis. In this way, at the end of their education, industrial designers reach the level of being experts in the interpretation, analysis, and construction of two- and three-dimentional products. The designer perspective and design thinking approach they acquire in the process also allow industrial designers to move in product and process management areas other than design. Since the process stages and the product development itself are as important as the final product in industrial design education, industrial designers, as UX professionals, have the ability to play an active role in briefing and facilitation as mentioned in the comment of participant #6.

Apart from their creative problem solving skills and their expertise of design thinking methodology acquired in their undergraduate education, scenario building skills were another point that made industrial designers stand out within the scope of UX professions. In semi-structured interviews, many participants commented on the ability of industrial designers to think abstractly and build scenarios based on users. Participant #28, who mostly works with engineer developers in the automotive industry, made the following comment on the subject.

> [133] "I think it is easier for industrial designers to think about something in a scenario and predict where it might have an impact than other disciplines. What I see in other systems is that they are trying to create a perfectly engineered product. They want to present all the data they can get to the user, because they can get that data. But when I ask them, *what this data will do for them [users], why do you want him to know this,* they answer, *because I can.*" (P#28)

In the comment of participant #28, difference between perceptions of engineer developers and UX designers on product was noticeable. Engineers, who learn to work with quantitative data and facts in their undergraduate education, continue this approach in their professional lives. This difference in perception manifests itself in the work environment where designers are also active, especially in the UX research phase. The dialog between designer-developer in the comment of participant #28 showed how industrial designers as UX professionals could differentiate from other disciplines, especially in the research analysis context. In the comment, it was pointed out that designers look at the process and experience focus rather than the product focus and, in this way, insight was gained about the added value of industrial designers in UX professions.

In the section, it was mentioned how industrial designers are involved in UX professions with their various professional aspects, expertise, and qualifications and what kind of contributions they make. In addition to these contributions, especially in the concept, research, and ideation stages of the digital product development process, some participants also mentioned the contributions of industrial designers focused on the final product. These contributions were seen as reflections of process fiction and covered the approaches that industrial designers take in their education, especially in relation to production. The following comment of participant #10 is an example of the contribution of industrial designers to finalized digital products.

> [134] "What the industrial designer adds is a very high added value. Because when the person there does the design properly, the production of the product becomes cheaper, the value they earn increases and they can create more value." (P#10)

Participant #10, who works in the digital game design sector, stated that the manufacturing knowledge that industrial designers receive in their education is beneficial in the digital product development process. Industrial designers gain expertise in the management of the product development process by learning to master the stages of the manufacturing process such as material and technical detailing. This professional expertise positively shapes the product development process by adding cost and task effectiveness. The comment of participant #10 illustrated that industrial designers have the ability to shape not only the context, design, and user experience of a digital product, but also the process management and digital manufacturing. When the roles of industrial designers as UX professionals were discussed in the semi-structured interviews, another striking point was the insights on which skills industrial designers use in which roles. Within the scope of UX professions, industrial designers are generally in the roles of UX researcher, UX designer, or UI designer. Today, many digital product companies in Turkey demand industrial designers to fulfill tasks in these three areas. According to the participants, this situation varies according to the scale of the companies and the work they receive. This is due to the fact that these areas are relatively new areas of importance in Turkey and the UX expectations of the customers of the companies are more design-oriented. At this point, we were informed that only companies working with foreign partners or companies with large-scale company clients working in specific areas in Turkey have established teams for UX research. Participant #13 made the following comment about design teams other than research.

> [135] "Since some friends have stronger UI muscles, they are referred to as UX designers, user experience designers. Since other friends have stronger analyzing, information architecture and research muscles, we call them UX researchers." (P#13)

With their comment, participant #13 demonstrated how the expertise of industrial designers in different sub-fields leads to a division of labor under UX professions. Today, even though UX professions in Turkey generally do not include a rigid research and design distinction, industrial designers working in these positions specialize within professions based on their expertise and motivation. It has been observed that industrial designers who are motivated to work with digital tools such as *Figma, Illustrator,* or *Photoshop* in terms of graphic design work in UI-oriented positions in the market, while industrial designers who state that they express themselves better in the field of experience and concept development work in the field of UX in the market. From this comment, the insight that industrial designers contribute to projects by specializing within professions with their research and design competencies was obtained.

Up to this point in the section, the professional aspects of industrial designers that match with UX professions and their contributions to digital product development and UX practices in the market have been exemplified. Within the scope of the semi-structured interviews, it was also mentioned that industrial designers have specific issues within the UX professions. Some participants emphasized that the abstract and creative thinking of industrial designers in their education can lag the market perspective and requirements. Regarding this issue, participant #29 made the following comment.

> [136] "We think very user-oriented, but inevitably, not because it is UX, but I guess because of the firm, there is something that comes with working in the private sector. A process begins where you sometimes put the user in

> the second plan and proceed by thinking about the wishes of firm, how much profit you make and so on.” (P#29)

Participant #29 stated that the commercial concerns of the firms where UX professionals work can put user attributions in digital products on the back burner. Since the digital product development process continues even after the products are launched, they can integrate the features that the firms have ignored or considered in the background related to the user into the products later. In this way, the roles of UX professionals with an industrial design background, who have placed user-oriented project development at the center of their profession, in the market can be examined in different ways at different stages of the process.

This section mainly analyzes how industrial designers become UX professionals after their education and what kind of roles they play in the digital products developed for companies after becoming UX professionals and what kind of contributions they make to the products and processes. In the semi-structured interviews, many UX professional participants stated that they started working in these fields to do creative problem solving based on their special interest in digital fields. In addition, industrial designers are attracted to UX professions by the fact that job openings for physical product design are few and worse than digital products in terms of the conditions they provide. Industrial designers stand out with their ergonomics, HMI, and HCI competencies in the firms where they work as UX professionals. In addition to this, abstract thinking skills of industrial designers and their mastery of design thinking methodology also point out the points where they stand out among UX professionals from other disciplines. Based on these competencies, industrial designers are distinguished among UX professions based on their interests and motivations in UX and UI fields. These competencies of industrial designers can make them highly suitable UX professionals, but market interests in the market may not go in parallel with the perception and roles of industrial designers.

4.3.3.2 Digital Product Development in UX Professions

The previous sections of this chapter have presented insights on how the digital product development process is constructed within industrial design graduation projects (see Section 4.2.1) and how it is experienced and evaluated by industrial design students (see Section 4.1.2). This section mainly provides insights from the semi-structured interview findings on how the digital product development process is constructed and handled within the UX professions. The section first provides information about the functioning and organization of the digital product development process of UX professionals. Then, the differentiation and specialization points of this process, which is constructed and realized in the market, and the way it is experienced in industrial design education are mentioned.

In line with the information obtained from the participants, it was seen that digital product development has a different setup than the path followed in education in UX professions. The time limitations of the academic period and the lack of knowledge of the students in digital product development, which is designed within the scope of elective courses and graduation projects in industrial design education, are not seen in the process followed in the market. On the contrary, it is seen that digital product development is basically specialized in two different branches in the market. The following comment of participant #32 provides an example of the construction of the digital product development process in the market.

> [137] "There are actually two processes. There is the process of developing a product from scratch, and there is the process of improving the existing products, I have been in both. The product improvement process is a bit more about analyzing the existing product, where there are deficiencies, where and why we see deficiencies, and where we base them..." (P#32)

It has been observed that the process constructs for digital product development in industrial design education are completely oriented towards product development from scratch. Participant #32 stated that there are processes to improve existing products as well as developing products from scratch in the market. The fact that the definition of the industrial design profession is not only product design and the focus on developing designs for the improvement of existing products has shown that studies on the improvement of digital products are options that can be used in undergraduate industrial design education. The fact that the digital product development process has two paths within the scope of UX professions also pointed out that the process fiction can be constructed more freely and through more iterations. Additionally, it was found that the process in UX professions is based on cycles rather than a linear shape and differs from the single main process and assignments designed within the scope of education. Many UX professional participants provided common explanations that the routine digital product development process they experience in their work life progresses over short sprints. In this regard, participant #32 gave information about the digital product development process accepted in the market with the following comment.

> [138] "We run two-week sprints. Our process is actually planned every two weeks. These two-week processes usually always have a user interview somewhere. At the point where I say we worked on the UI for five months, it is not that we did not have any user interviews for five months, but we progressed by getting feedback for five months." (P#32)

Participant #32 stated that in their work routine, the digital product development process proceeds in two-week sprints. Although there is a common approach to the stages of the digital product development process in undergraduate industrial design education and UX professions, the difference in the progression of the process emphasized a major difference. UX professionals have a certain expertise in the digital product development process, which facilitates the process setup and progression. On the contrary, industrial design students do not have enough knowledge, experience, and competence about the process, which leads to such differences in the organization of the process. In addition to this, the difference in the perspective of the academia towards digital product development and the necessity of progressing according to an academic calendar have created this difference in the process organization. In the digital product development process designed within the scope of graduation projects, the research and development phases are much more clearly separated from each other. Moreover, the fact that a student develops a final product alone does not allow for the division of labor, thus preventing students from returning to the testing and research phases when they move to the UI phase and preventing them from building their processes in parallel with the market.

Many UX professional participants stated that the sectoral differences of the companies they work for regarding the digital product development processes also reveal the differences in approaches in the same positions. UX professionals who have changed sectors in their professional life emphasized that sectoral requirements shape the process even if their positions are the same. Participant #22 made the following comment on this issue.

> [139] "The things we do on UI are similar, but the fields are different. So now when we say [name of automotive firm], it has a know-how, it has knowledge. There is a system that works very differently, the structure that works with that system is different. [Name of e-commerce firm] has a different user experience, being a designer is different." (P#22)

Participant #22 exemplified sectoral specializations in the digital product development process through different UI approaches in the automotive and e-commerce sectors. The different approaches between sectors according to the stages of the digital product development process were also observed in the graduation projects analyzed (see Section 4.2.3). Information and regulation requirements for dashboards and human factors of the automobile sector are not seen in areas such as e-commerce that offer work through digital service interfaces. This situation shows that the processes of UX professionals working in the same position in different companies are also shaped according to the company and that there is no single correct or linear process. The specialization in the process stages is also shaped according to the disciplines that UX professionals collaborate with. Interdisciplinary teamwork in the market separates the digital product development process in UX professions from the process in industrial design education. Participant #27 mentioned this differentiation with the following comment.

[140] "We have a specific digital product design process. For example, before going to the wireframe stage, we create information architecture based on research outputs. This is something I have not seen in industrial design. We create flow charts like software developers. These are all tasks we take from the software world." (P#27)

UX professional participant #27, who coordinates UX courses in more than one industrial design department, explained the different progression of the digital product development process in the market in industrial design education through interdisciplinarity. In the graduation projects examined within the scope of this thesis and in the responses of students to online surveys and interviews, it was seen that they had difficulties in points such as IAs and flow charts. Within the scope of industrial design education, although digital product development is supported by an advisor firm and part-time academics, it still focuses on the design discipline. In this case, students design tasks from different disciplines with the guidance they receive from designers. In this way, the digital product development process of UX professionals differs from the process experienced by students in industrial design education. The fact that students who lack experience and knowledge in related fields cannot shape the tasks of different disciplines with guidance from that discipline also creates a difference between the process fiction in education and professional life.

The information obtained from the participants about the stages of the digital product development process in their professional lives showed that the research and development stages in their professional lives have a big difference with their counterparts in education. Within the scope of semi-structured interviews, many participants stated that although there are structured stages of the digital product development process, especially the work on UX research also progresses with the development stage and is an essential part of the process. Participant #19 made the following comment about the fundamental place of research stage and user involvement in the digital product development process in the professional life.

[141] "Design is 80%, research is 20%, but it depends on the project. If it is a very big project, research can even go up to 40% to create a scope at the

beginning. Sometimes product teams come with a request, but they do not have a scope, or they do not have information about the user." (P#19)

Participant #19 commented that the stages of the digital product development process in the market can be flexible depending on the type of product and the team. A vital point in this comment was the research conducted at the beginning of the process. Apart from the product context, uncertainties or inaccuracies in the content or user group for the product to be developed negatively affect the process. This comment was similarly experienced by students developing a graduation project. Many students stated that their preliminary research or field research was incorrect or incomplete as the process progressed, but due to time limitations, they did not have the opportunity to revisit these stages and continued to move their projects in the wrong direction. UX professionals, on the other hand, are able to carefully design a process from the beginning because they have experience and knowledge in such situations, and when they encounter problems, they can make updates and corrections because they can design their own processes.

In the context of UX professions and industrial design education, process differences due to time limitations were seen in the development stage as well as research. Many participants in the market put forward a different perspective from the perspective of academics in industrial design education, especially on design attributions. The fact that the market has different requirements and goals than education and the interdisciplinary structure in the market shape the design activities within the scope of digital product development differently from the process in graduation projects. Participant #6 made the following comment on this issue.

[142] "Reinventing America for every project from scratch is costly and pointless for everyone. For example, we make six different products in the firm, and we do small projects that are not profitable enough to become products. It does not make sense for the user, for me, for the developer to build a radio button experience for each of them from scratch. What we do is, we are moving forward by making some things common so that it will progress more accurately and efficiently, and for the user, if it is not a pioneer app, I should not teach a new experience in an app that the user enters once a month or a year. This is not a good UX design either." (P#6)

Since students learn to be designers at the basis of industrial design education, they are expected to design all design components that they will use in their projects. This is not limited to the design of physical products, but also includes project presentations of the students. The inclusion of digital products in industrial design education did not affect this situation, and students designed the digital products they developed as part of their graduation projects in line with this perspective. Many academic participants asked students to design all the components of the project in the design systems within the scope of their digital products. This was one of the time management issues that students faced while finalizing their projects. This approach is not experienced by UX professionals. Participant #6 stated in quotation 142 that it is a necessity to have certain design features ready to use in digital products and that this is how the process proceeds in the market. This different perspective in industrial design education indicated a significant difference of opinion with the digital product development process within the UX professions.

The differences in the research and design activities of the digital product development process between industrial design education and UX professions were also observed under testing and validation. Within the scope of graduation projects, it was seen that there were students who had to go to the final jury without usability testing. In UX professions, it was found out that digital products largely experience development with usability testing and the additional user research that comes with it. Participant #32 made the following comment on this issue.

> [143] "For example, we conduct more than a hundred usability tests on a project. That is where we actually get feedback about all the flows from the users. (...) In usability tests, we generally prepare prototypes. We expect users to use these prototypes. Step by step, we ask questions according to the answers we want to get." (P#32)

Participant #32 commented that the digital product development process within UX professions proceeds in short iterations with high user involvement. In industrial design education, on the other hand, it was observed that students had difficulties with usability testing during the process (see Section 4.1.3.2). Additionally, it was learned that among the students who were able to conduct usability testing, there were also students who realized that the data they collected at the beginning of the process was incomplete or inaccurate, and they could not update their work due to time constraints. The fact that all stages of the digital product development process within the scope of industrial design education were carried out by a single student within the scope of the graduation project was also among the factors that revealed this problem. In the market, teamwork in the digital product development process is used to prevent this situation. In addition to this situation, the division of UX professionals working among large-scale firms according to their fields of study is another point where the process difference in education emerged. Participant #15, a UX professional in a large-scale firm, provided an example to the case with the following comment.

> [144] "There are other departments that conduct user research. We are not in direct contact with the customer. There is a separate department called customer experience management. They get a lot of data through direct customer contacts, the quality unit, many different surveys, both at dealers and aftersales services, and by conducting various different surveys with different customers. These are also followed globally, and they are passed through a filter and transferred to us, and we use them." (P#15)

According to the semi-structured interviews, firms in Turkey that employ many UX professionals generally consider UX design, research, and UI design within the job description of a UX professional due to the number of jobs they receive, the scale of the firms, and the lack of knowledge of the employer clients about the field. Firms that carry out relatively large-scale international projects categorize the work of UX professionals and distribute them to different teams in line with the large-scale jobs they receive. As seen in the comment of participant #15, specifically the field of UX research can have its own team since it includes activities such as finding users, collecting data from users, and analyzing this data at multiple points. UX professionals in firms working with agencies in the market have the chance to focus on project development based on the finished data analysis they receive. In the process of graduation projects within the scope of industrial design education, the student designs this process for their individual projects on their own.

The biggest difference between the digital product development process followed by UX professionals and its counterpart in industrial design education is the relationship between usability testing and launch. The ease of use of online tools and the ease of public access positively affects usability testing and development iterations. In addition to this, the fact that the focus of digital products is largely on user experiences allows them to be enhanced with feedback received after a certain amount of use. Participant #6 made the following comment regarding the continuation of the development process of digital products after their launch.

> [145] "Digital has this advantage; you can try and give up very fast. You can test simultaneously by drawing something on a piece of paper and guerilla testing it with the user next to you. However, at the same time, to keep the product alive as soon as it is launched, you can measure very directly if the product has errors with new releases every month, every 15 days, you can make a very accurate diagnosis, you can solve it, and you can constantly renew it." (P#6)

The prototypes of digital products prepared through applications such as *Figma* are an example of the convenience of using online tools in the digital product development process. The most important point in the comment of participant #6 was that the development stage of digital products continues after they are launched. Unlike industrial design education, UX professionals bring products together with users in the market and acquire development for some user problems and requests in this direction. In graduation projects within the scope of industrial design education, on the other hand, projects of the students do not meet with the user, so the closest criticism they receive for the user is from the guest members participating in the final jury. Regarding this issue, some academic participants stated that they experienced some evaluation issues while reviewing the digital products in the final jury (see Section 4.3.2.2.2). In the context of graduation projects, students present project concepts with specific flows and only a small number of specific screens, rather than ready-to-launch projects with all functionalities working and ready to be launched, so that the products do not have the opportunity to be updated and developed according to the user perspective. In this way, it has been seen that this great and fundamental feature of the digital product development process within the scope of the UX profession does not have a counterpart in industrial design education.

This section mainly provides information about the digital product development process practiced by UX professionals in the market and discusses the similarities and differences between this process and its counterpart used in industrial design education. According to the information obtained from the semi-structured interviews, there are two main branches of digital product development in the market, developing products from scratch and improving existing products. Although the stages of the process in these branches are like the ones experienced by the students in the training, the process in the market progresses with iteration cycles designed in two-week sprints rather than a linear process. Market requirements, client, and firm perspectives, and the interdisciplinary nature of UX professions bring different approaches to the stages of the process. Unlike in education, the process in the market proceeds simultaneously with research and development and is constantly updated according to the results of user tests. In addition to this, while in the educational process, the student is able to carry out each step of the individual process, the process in the market is carried out by different groups, which is an important difference in terms of project development. The point where the digital product process of UX professions differed the most from the training was the launch of the product. While the digital products in the market are launched after a certain amount of detail and every screen is developed and updated according to the feedback and test results from the users, the limitations brought by the education within the scope of graduation projects emphasized the process difference.

4.3.3.3 Roles and Social Interactions of the Stakeholders

The last section of the semi-structured interview analysis on UX professionals examines the roles of the stakeholders of the digital product development process in the market, and the teamwork and social interaction practices between them. Although industrial design graduate UX professionals work on individual tasks in the market, they come together with other designers and experts from other disciplines, mostly developers from engineering backgrounds, to develop projects. In this project development process, apart from designers and developers, top management of firms, clients, agencies, and users have active roles as stakeholders.

When the participants were asked about the digital product development process in their professional lives, collaboration and teamwork were the first points that all of them emphasized. All the participants stated that unlike the training, they progressed with teamwork in UX practices in the market. Even if designers have individual tasks in their team, the fact that the digital product process is constantly evolving and includes different functions often brings about interdisciplinary interaction and division of work. Participant #32, a UX professional with an industrial design education, emphasized the importance of teamwork in business life with the following comment.

> [146] "It is a different discipline [UX] that we need to work together. We receive a very isolated education in university. We only see each other as industrial designers and we are influenced by each other. At this point, comments from different disciplines..." (P#32)

In undergraduate industrial design education, students spend almost entirely time in their own studios within their own communities. Since the elective courses they take are mostly within the department or faculty, the interaction of industrial design students with other disciplines may remain weak in their education life. In response to this situation, UX professional participant #32, a graduate of industrial design, commented that the interdisciplinary structure of UX practices and the terminology of digital products from fields such as software and marketing revealed the need for

UX professionals to increase their interaction with other disciplines. The interdisciplinary nature of digital product development and UX practices also shapes the progress of the process and teamwork. Many UX professional participants stated that in their professional lives, they have a working order built on fast iterations with teams formed based on Agile methodology. Participant #29 gave information about their routine working pattern as a UX professional with their following comment.

> [147] "In the Agile team, we work by running two-week sprints. We are all in Agile teams of different products and run different projects. We are a team of four. Each of us deals with our own projects alone. We come together on a weekly basis to talk about how our projects are going and get critiques from each other." (P#29)

Participant #29, who works as a UX specialist, gave information about the digital product development process in the market with their comment. The fact that the teamworks in industrial design education are mostly carried out through students from the same discipline differs greatly from the teamwork fiction within the scope of UX professions. The prominent point in this comment was the emphasis on Agile teams within the scope of UX professions. UX professionals form Agile teams in cross-functional groups in the market and every stakeholder contributes to digital product development with their specific expertise and role. The fact that everyone acts on a specific expertise and a task shaped according to this expertise brings about the ability to make quick decisions in digital product development and to adapt quickly to changes that may arise in the process. In the comment of participant #29, the emphasis on teamwork of four people and progress in two-week sprints also provided information about the ability of the goal-oriented Agile process to establish a stronger and faster communication with fewer people.

Agile methodology and cross-functional collaboration within the scope of UX professionals were emphasized by many participants. Cross-functional teamwork was a striking detail in the semi-structured interview analysis. Many participants mentioned Agile teams in the firms where they work as UX professionals, but when the discussions turned to cross-functionality within the scope of these teams, there were variations among the comments. The current socio-economic state of Turkey and the growing recognition of digital product development in the country have influenced the role of UX professionals in the Agile teams they work in. In relation to this issue, it is observed in the literature and in the international market that stakeholders have more defined roles within cross-functional teams. Participant #29 provided information about their role as a designer in the Agile team they works in with their following comment.

> [148] "Unfortunately, now [in the company] there is no separation [of positions] like UI/UX and researcher. From the beginning to the end of the project, the designer assigned to that project does everything." (P#29)

Up to this point in the field research analysis, many participants emphasized the importance of the distinction between research and design and the difference in job descriptions and the importance of this distinction within the scope of UX professions. Participant #29, who advances the digital product development process through sprints with Agile teams, emphasized an important issue in the job description of UX professionals with his comment in quotation 148. Regardless of the scale of the companies and employee satisfaction, many UX professional participants interviewed in the field research mentioned that the lack of distinction between design and research is a problem. Although UX design and UX research have a close relationship, they have very different processes, tools, and activities. In this way, if a single UX professional organizes the research and design of the firms, it may negatively affect the digital product development process and output. Participant #33 made the following comment about the source of this issue in the job description of designers, who are a major stakeholder of the digital product development process.

> [149] "Positioning the research is very difficult for us. When we say, *hello, let's hire a specialized researcher. So we can get rid of the monotony. We can try very different methods. We would work with people who have their own timeline, who have their own agenda,* to people from [Bank name], they say, *how much will it cost me?* It is hard to sell a researcher to a client, it is free for them right now. There is a view that the same person should do research and analyze the results into design." (P#33)

Participant #33 works for a leading digital product consulting firm that collaborates internationally in digital product development and UX practices. As seen in their comment, even in firms with much precise job descriptions and knowledge, research is perceived as an additional cost for clients. The fact that UX professionals with an industrial design background have knowledge in research causes design and research roles to be handled together. In this way, in cross-functional Agile teams, research, which is not included in the expertise areas, is added to the role of designers. Just like participant #33, many participants made statements about the role of the clients as a stakeholder in the digital product development process.

In Agile teams, which are built as a result of the evaluation of the wants and needs of clients, developers with an engineer background constitute another fundamental stakeholder in addition to UX professionals with a designer role. The fact that software engineering is the basis of digital product development and Agile methodology leads many engineers to take part in the team as stakeholders. In addition to their different perspectives, UX professionals and developers who develop digital projects in collaboration in the process have different working routines. Participant #11 provided an example of the specific routines of different stakeholders who collaborate intensively in digital product development with the following comment.

> [150] "Developers have a slightly different sysyem; they keep certain routine reports on a weekly basis, they set targets, they work on them. As designers, we come together on Mondays and Fridays for idea meetings, to determine creative processes... *What are this week's tasks, who can do them...* We usually try to make joint decisions." (P#11)

The different perceptions, approaches, processes, and activities on project development of design-oriented and engineering-oriented stakeholders reveal different perspectives on the evaluation of digital products. According to many participants, this difference in perspectives between the stakeholders has the power to improve the process of developing digital products in the direction of the dominant perspective. In the semi-structured interviews, the UX professional participants stated that their interactions and communication with the developers shaped the process to a great extent. The fact that developers offer more result-oriented solutions than the designers they work with with engineer perspectives was one of the main points mentioned by UX professionals through their communication. UX professionals, who did not have the experience of developing projects in collaboration with engineers during their industrial design education, say that they realize this deficiency in their professional lives. The lack of communication between engineers and designers, combined with the essential role of developers in digital product development, shapes the contributions of designers. Related to this topic, participant #17 made the following comment.

> [151] "In the sector, the designer does not trigger the process very much. Because IT says, *I cannot.* You know how they used to teach us in product design, when the mechanical engineer said, *I cannot,* they would say, *you can force the mechanical engineer with your knowledge.* But right now we cannot force IT." (P#17)

Participant #17 stated that the digital product development process in the market is mostly carried out through IT teams. This comment emphasized the negotiation between IT teams and UX professionals. Many participants emphasized that UX professionals should have certain negotiation skills in the digital product development process (see Section 4.3.3.1). Participant #17 emphasized the importance of the knowledge of UX professions on technical terminology and jargon of digital product development from software engineering. As mechanical knowledge guides the process in the production phase of physical product design, the knowledge of UX professionals on the technical language and jargon of software development in digital product development has the potential to emphasize their role as stakeholders and increase their competence in the facilitation and decision-making phases of the process.

According to the semi-structured interviews, agencies are another stakeholder that UX professionals collaborate with in the digital product development process. In this process, agencies are not as prominent as designers and developers, but are mostly involved in the process as an external stakeholder within the scope of UX research. Participant #18 made the following comment about the place of agencies as external stakeholders in the digital product development process.

> [152] "We conduct tests based on the interviews, prototypes, or wireframes. We usually outsource these to agencies because we do not have the sufficient resources or time." (P#18)

Within the semi-structured interviews, there were participants who indicated that agencies were involved in the digital product development process in user recruitment and data collection in some cases. As seen in the comment of participant #18, process and time management concerns constructed the involvement of agencies as external stakeholders in the digital product development process. Especially the detailed data analysis requirements of the UX research stage are not sufficient in cases where UX professionals are involved in digital product design on the one hand. In addition, the need for a systematic user sampling process in order for the developed digital products to reach diverse user groups leads firms to outsource user-related areas within their budgets. UX professionals who are in contact with agencies at the points of user sampling, UX research, and data collection share the criteria and concerns they have determined about the user with agencies. In this way, agencies working in user-related areas share the data they collect with UX professionals and can take part as an effective stakeholder in the process.

The last stakeholder of the digital product development process mentioned by the participants within the scope of UX professions was users. The fact that digital products are built on the basis of user experiences, and that the updates and developments of these products are shaped by the comments given by users based on their experiences emphasizes the importance of users as stakeholders and provides information about their role. Participant #13 made the following comment about the role of users as stakeholders in the digital product development process within UX professions.

[153] "If we think that this [digital product development] is a living process. For example, we prepared a prototype, validated it with usability testing, and then we went live. We did usability testing in the broadcast, the user is present in the whole process. The product was finished, we tried to get information with the questionnaires we sent out. We tested with shadow customers from independent organizations. I can say that the user, including us, is everywhere in the product in 360˚." (P#13)

Participant #13 explained the role of users as stakeholders in the digital product development process in terms of the fact that digital products are products that can be evaluated live. Since digital products are shaped according to the experiences of users, their role as stakeholders is updated through their usage practices even after the launch of the products. For this reason, user involvement and the development stage in digital products continue in certain patterns after the products meet the users (see Section 4.3.3.2). In some firms, even though the teams stated that they do not interact with the users one-on-one, they can become users themselves by experiencing the developed product first-hand. As a result, when product development teams focus on the users in the creation, development, and experience of a digital product and live the process with the user from start to finish, they may see themselves as users. Therefore, users constitute the largest stakeholder group of the digital product development process within the scope of UX professions.

This section of the semi-structured interview analysis mainly revealed the stakeholders within the UX professions, the roles of the stakeholders, and their social interactions with each other in the process. Industrial design graduate UX professionals who mostly work on design tasks within UX professions work with Agile teams over two-week sprints. Many UX teams in the market are designed as cross-functional teams. Interests, perceptions, and requests of the clients shape the approach of UX teams in the setup of UX teams. Concerns of the clients about budget are also effective in team building. For this reason, in many firms in Turkey, a single UX professional deals with research as well as UX and UI design. The group that UX professionals collaborate intensively in the process is developers consisting of software engineers. The development of digital products is centered on developers.

In order for UX professionals to make their role in the process more effective and to negotiate with developers for decision-making, they need to be familiar with the relevant jargon and terminology. UX professionals also interact with external stakeholders such as agencies, especially in the areas of user sampling, field research, and data analysis, which have specific requirements and processes. Agencies involvement reduces the process and time management issues of digital product development. Users constitute the largest stakeholder group in the digital product development process. In some firms, even if UX professionals do not interact directly with users, many UX professionals consider themselves as users. The fact that digital products undergo development after they are launched according to user experiences makes users an active stakeholder at every stage of the process.

4.3.4 Summary of Semi-Structured Interviews

This section of the thesis is based on the analysis of 35 semi-structured interviews with three industrial design students, 14 academics, and 18 UX professionals. As the previous two data collection phases of the research were mainly based on data collected from industrial design students, in the last phase, the focus shifted to the academic and UX professional perspectives. The involvement of the students in the semi-structured interviews is considered in a secondary role to strengthen the ideas with examples. Participants were asked about the relationship between digital product development, UX practices, and industrial design education. In addition to questions about how these areas are implemented within the scope of industrial design education, there were also questions about the graduation projects examined within the scope of the thesis. In addition to the questions about digital product development and UX practices in industrial design education, the participants were also asked about the professional life implications of these fields. Participants answered the questions based on their own experiences and shared their insights and observations about the areas they had experienced. The data collected in the semi-structured interviews are grouped under three main themes that refer to the research questions of the thesis; (1) the place of digital products and UX practices in industrial design education, (2) the evaluation of graduation projects involving digital products, and (3) the reflections of the implementation of these fields in education within the scope of UX professions. The framework of the semi-structured interview analysis was constructed as a flow from industrial design education to UX professions. It investigated how students positioned and contextualized the knowledge and skills they acquired in their undergraduate education toward physical product design with digital products and UX practices. Digital product-oriented graduation projects served as a bridge through which students experienced the market process. The final point explored in the semi-structured interviews was how the educational process was reflected in the market as UX professionals. The findings in this section contributed to the study by providing diverse data on the content, process, and market response of digital product development and UX practices in industrial design education. In light of this information, the analysis of the semi-structured interviews presents the following insights:

- There are multiple discussions on how digital product development and UX practices should be included in industrial design education. Many participants stated that these areas should be part of industrial design education. The reasons given by the participants were that these areas should be practiced through the design thinking methodology and that digital products should be included within the scope of industrial design.
- The different écoles of the universities shape the approach to these areas in the context of industrial design education. Many departments implement these areas at the undergraduate level through a variety of must, elective, summer practice, and extracurricular activities. Within the scope of the must courses, students gain knowledge about GUI with Basic Design courses and are introduced to cognitive ergonomics and usability with ergonomics courses. They also mainly experience product development projects in the third- and fourth-year studios. In elective courses, part-time UX professionals from the market offer students specialized courses on UX practice focusing

on the process or different stages of digital products. Apart from these courses during the academic semester, students gain first-hand knowledge and experience in these areas through summer practices, student internships, and freelance and part-time work on their initiative.

- The lack of research methods in undergraduate industrial design education negatively affects works of the students on digital product development and UX practices. In addition, the unique process and regulations of digital product development and practices create difficulties in addressing them from start to finish in a project period.
- It has been observed that the courses and studies on digital product development and UX practices within the scope of graduate programs are research-based. In these research-based studies, participants are expected to have a certain level of knowledge. Unlike undergraduate-level courses, the outputs of graduate-level courses are expected to be academic publications and presentations.
- When the graduation projects involving digital product development were analyzed, it was learned that academics and UX professionals wanted to see good problem identification, detailed UX research, and straightforward presentations of the outputs from the students.
- Graduation project evaluations were divided into process-oriented and final jury oriented. The knowledge and experience of the students in digital product development and UX practices shaped their processes. Academics and advisor firms refrained from giving direct answers to the students in this process as in the physical product design process and mainly provided guidance. It was observed that the process management designed within the scope of graduation projects differed from that seen in the market. This situation caused time management problems, especially for students who needed more knowledge and experience. In the final jury, since the presentations of the students were designed in line with the structure of physical product design, they still needed to meet the presentation needs

required in the market. Even if the video presentation shows the process, it creates difficulty in experiencing the product. This situation confuses academics, specifically from an industrial design background, in evaluating digital products.

- It was emphasized that the process and assignments in graduation projects should align with the market. In addition, comments were received that digital products could be handled as a separate section and jury to make the project evaluations healthier. It was informed that handling the process from start to finish in a semester project leads to the cursory passing of specific tasks. The need for additional courses before the graduation project course to prepare students with background knowledge and skills and the idea of re-evaluating the course process towards managing digital product development projects emerged.
- After studying industrial design, many new graduates are drawn to the digital field due to their particular interest, the fact that digital product-related fields offer a more flexible working environment than physical products, higher salaries, and a higher number of national and international job openings. Knowledge and skills of industrial designers in GUI, cognitive ergonomics, experience in UX process through various courses, and familiarity with design thinking approach make them suitable and desirable candidates as UX professionals. They also learn to act according to market interests by experiencing them in the firms they work for.
- In the market, UX professionals approach the digital product development process in two ways; developing and improving existing products from scratch. These processes progress as cycles of two-week sprints differently than in education. Research and development stages are intertwined in the processes designed according to market interests. The most significant difference from its counterpart in education is the research and development phases carried out with the user after the launch of digital products in the

market. Post-launch usability tests continue to be conducted for product updates.

- UX professionals work in cross-functional teams based on Agile methodology in the market. UX professionals in the design role have individual tasks, meet with the team in weekly meetings, and go through a decision-making process with brainstorming and discussion. The setup of UX teams is based on the perception, interests, concerns, and budgetary limitations of the clients. It has been observed that the stakeholders that UX professionals collaborate with the most in the process are developers. Since the process proceeds through the dominant discipline of developers and the production of products passes through developers, it has been learned that UX professionals need to master their jargon and terminology. Strong communication between the UX professional and the developer and the negotiation skills of the UX professional a critical part of the design pillar in digital product development. UX professionals work with agencies as external stakeholders, especially when firms outsource user sampling, field research, and data analysis stages. This collaboration reduces the process and time management issues of UX professionals. Users, who can interact with stakeholders at every stage of the process and shape the product, constitute the stakeholder group with the most significant number of members, sometimes including UX professionals.

CHAPTER 5

CONCLUSION

As revealed in the first chapter of this thesis, this thesis is designed as an exploratory research to understand the process of industrial designers becoming UX professionals. Although industrial design education includes many knowledge and skills for UX professionals, the fact that it is shaped according to market experiences at many points emphasizes the knowledge that students cannot experience during industrial design education. Based on this problem background at the starting point of the research, the research questions of this thesis were determined first. Then, a research framework was developed through a detailed literature review, a research methodology was constructed based on this framework, and answers to the research questions of the thesis were formed by analyzing the data collected in the field research with this research methodology (see Figure 5.1).

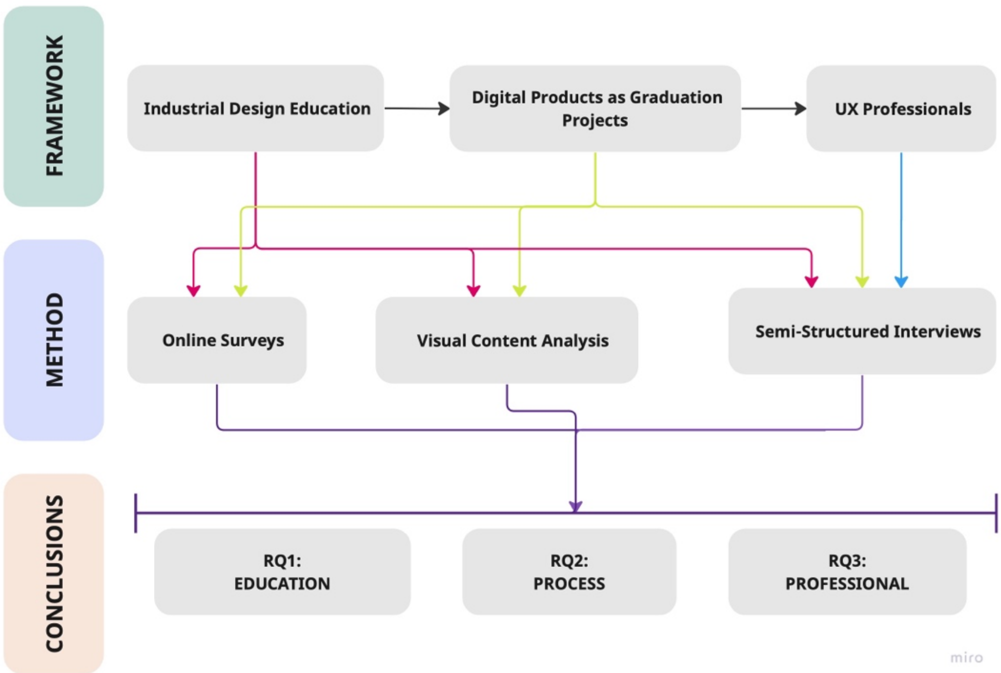

Figure 5.1: Process of the Thesis

The research, whose problem area, aim, and research questions are based on the literature review, basically constructed the transition process from industrial design education to UX professions with a framework under three headings. The three main headings of the framework focus on (1) industrial design education and its digital product development and UX practices, (2) graduation projects in industrial design education in which students see the market parallels of these fields, and (3) the process and practices of becoming a UX professional in the market with the knowledge and experience gained from their education. In the framework where these three topics are constructed as stages, graduation projects serve as a bridge between the topics of education and professional life when evaluated in terms of content and process. This framework was designed with a qualitative approach by using three different data collection methods (online survey, visual content analysis, and semi-structured interview) to collect data from industrial design students, academics, and UX professionals in field research. As a result of the data analysis, the answers to the research questions at the beginning of the thesis are evaluated and explained by dividing them into the themes of education, process, and professional, respectively.

This concluding chapter of the doctoral thesis illustrates its main findings and insights with the relevant literature to reach its aim and respond to its research questions. The chapter, firstly, revisits the research questions and presents their answers. Later, the meta discussion and research implications are stated. Then, the contributions of the thesis are revealed. The chapter declares the limitations of the research, and lastly, concludes by presenting possible directions for future research.

5.1 Revisiting the Research Questions

As mentioned in Section 1.3, this doctoral thesis incorporates a research conducted to better understand the gap between industrial design education and UX professions and to build a bridge between them. In order to achieve this aim, firstly, the literature review examined the evolving and digitalized contexts of the industrial design profession and education over the years and the UX practice methodology followed in the market. Through the field research conducted within the scope of the thesis, insights have been gained into the positioning of digital product development and UX practices in industrial design education, the digital product development process experienced through university-industry collaboration within the scope of graduation projects, and various key drivers in the professional lives of UX professionals in the market. In this thesis, where graduation projects are considered as a bridge in the transition from industrial design education to UX professions, research questions are designed to refer to three main themes in total, focusing on *education, process,* and *professional,* respectively. In light of all this information obtained from literature review and field research, this section provides answers to the three research questions presented in Section 1.4.

5.1.1 Directions for Digital Product Development and UX Practices in Industrial Design Education

RQ1: *How does digital product development, and the UX practices it embodies, currently take part in industrial design education, and in which directions can it be further developed?*

Since the organization of the research questions of the thesis, just like the organization of the literature review and finding of the thesis, is structured as basic industrial design education, graduation projects focusing on the digital product development process, and their equivalents in UX professions in the market, the first research question is designed to evaluate digital product development and UX practices in industrial design education. This research question discusses both the position of these fields in current industrial design education and possible future scenarios.

The second chapter of this thesis explains in detail how industrial design education has expanded from traditional product design to contemporary fields by expanding its context and digitalization over the years (Oygür Ilhan & Karapars, 2019). Section

2.2.3.3 mainly shows how digital product development has been included in industrial design education and provides information about its implications that have diversified in the process. Especially in recent years, with the impact of the Covid-19 pandemic, industrial design education has had to undergo a great deal of digitalization, and the inclusion of digital product development in undergraduate education has gained great momentum in the online education process (Desai, Stahl, & Chamorro-Koc, 2021). In addition to this, the interdisciplinary nature of digital product development (Hartson & Pyla, 2018), and UX practices and their market-oriented rather than academia-oriented nature emphasize the importance of university-industry collaboration in the inclusion of these fields in industrial design education (Getto et al., 2013; Yargın, Süner, & Günay, 2018). In this way, students see and experience the market approach to digital product development in courses and extracurricular activities (Gray et al., 2020; Meyer & Norman, 2020).

In light of this information obtained from the literature review and field research, the following conclusions have been reached regarding the future scenarios of digital product development and UX practices in industrial design education:

- First of all, the current industrial design education curriculum should be reconsidered based on academic research together with market requirements, taking into account developments in the contemporary design fields.
- Undergraduate level industrial design education requires students to take courses on research methods before developing projects for digital product development. In these courses, students should experience the data collection and analysis processes of qualitative and quantitative UX research.
- Since UX research, UI design, service, interaction, and UX design have their own processes, methods, and tools, the specialization of courses in these areas should be diversified and the numbers increased. When these subjects are taught in a single course, students are not provided with the necessary information about the process stages.

- Since UX professionals in the market develop digital products as part of cross-functional teams, industrial design education should also be considered through courses opened to and feeding from different disciplines.
- While industrial design education is based on well-established academic sources, practical knowledge on digital products is formed through experience in the market. Especially online courses and certificate programs for UX professions provide practical knowledge and skills for the stages of the digital product development process and the tools used. Such specific online programs should be considered, though with caution, while updating courses in these areas, in reference to academic research, in undergraduate industrial design education.

5.1.2 Transformation of Digital Product Development from Industrial Design Education to UX Professions

RQ2: *How does digital product development process evolve from industrial design education into the UX professions, and what are its key drivers?*

The second research question of this thesis focuses on the digital product development process as applied in industrial design education. The second chapter of the thesis provides information about the content and stages of the digital product development process in the market (see Section 2.1.4). The characteristics and stages of this process are elaborated and specialized according to the sector of the firms and the resulting product. Despite these differentiations, most academic and professional studies and resources agree that digital product development is structured mainly through the ideation, research, prototyping, design detailing, validation and testing, development, and launch stages and their steps (Canziba, 2018; Kerim, 2020; Savarit, 2020; Illés & Funtek, 2021; Singh, 2022; uizard, 2022; Matviyuk, 2022). Although there is a similar design process in industrial design education, the academic calendar has certain constraints and industrial design students do not have as much knowledge, skills, and experience in these areas as UX professionals, which causes the digital product development process to differentiate between education and professional life. Although there are implementations for digital product development and UX practices within the scope of industrial design education (see Section 2.2.3.3), the fact that the rules, aim, and goal brought about by the educational environment have a different focus than in the market causes the process that industrial design students experience in their education to have different key drivers. Besides, industrial design students experience different project development processes for physical product design in seven semesters in their undergraduate process until they take the graduation project course, but their experience on digital product development offers an experience that will cover two academic semesters under the own initiative of the students. This situation creates a difference in the experiences of the students within the scope of industrial design education and shows the effects of the physical product design approach in the processes of their graduation projects.

In light of the information obtained from the literature review and field research, the following conclusions have been reached regarding the transformation of digital product development and UX practices from industrial design education to UX professions:

- The digital product development process applied in industrial design education, and the UX practices within it, are not parallel to what UX professionals experience in the market. Therefore, as mentioned in the first research question, the process needs to be re-evaluated within the scope of the graduation projects course.
- The digital product development process is a field that is shaped according to the experiences of the users, that proceeds through iterations in short sprints of two weeks, and whose timetable can constantly change according to the projects. For this reason, in an important course such as a graduation project, this process should be shaped according to the type of projects and the timetable should be flexed instead of a single linear flow.

- Digital product development process in the market has two branches; developing products from scratch by UX professionals and improving existing products. In courses with strict timetable requirements, digital product development projects can be designed to improve existing cases and help students with process and time management. With this approach, students will be able to use a set of ready-made templates and ready-to-make design features as in the market, which will positively affect the course process.
- Within an academic semester, a single student, to the extent of their knowledge and experience, has difficulty in creating a digital product as a graduation project. On the other hand, it is seen that UX professionals in the market continue similar processes with Agile teams. Based on the involvement of agencies as external stakeholders in the process, especially in the fields of data collection and data analysis from users, the application of teamwork in certain stages of a digital product development process in industrial design education will positively affect the course process and outcomes.
- Within the scope of the digital product development process, the development and UX research stages continue after the products are launched. For this reason, launching and experiencing the prototypes developed by the students within the scope of the graduation projects course before the final jury will both positively affect the product development and create an opportunity to experience the products that the jury members will evaluate before the final jury.
- The fact that physical product design and digital product development processes have different stages, tools, and activities necessitates the differentiation of students working on graduation projects through different mediums. For this reason, students should be grouped according to the medium (e.g., physical, hybrid, or digital) of the product group they are working on and assignments and processes should be specialized. In this way,

graduation projects can be evaluated under an umbrella term such as *experience-driven design*, independent of the field of study. This separation and reorganization would creates an option that would guide the process of the students as well as the jury members who will evaluate the student projects.

5.1.3 Qualifications for Industrial Designers on Becoming UX Professionals

RQ3: *How do industrial design students transform into UX professionals, and what knowledge, skills, and competences do they need during this process?*

The last research question of this thesis focuses on the process of industrial design graduates becoming UX professionals, the qualifications that the market expects from an industrial design UX professional, and the experience of UX professionals in the market. The second chapter of the thesis details who the contemporary industrial designer is and how their roles and fields of work have evolved over the years (see Section 2.1.2.1). Many sources have shown that over the years, the industrial design profession has become digitalized in the light of technological developments, and this has also shaped the skills and knowledge expected of industrial designers (King & Chang, 2016; Oygür Ilhan & Karapars, 2019). This digitalization in product and medium contexts has democratized the sole creator role of industrial designers in the design process and increased the intensity of collaboration with various disciplines. In this way, contemporary design fields within the industrial design profession have added new stakeholders to the product development process (see Section 2.1.2.2). In light of this information, the field research findings of this thesis examined how industrial design students are introduced to digital product development and UX practices in their educational life and how they are prepared to become UX professionals in the market through their graduation projects.

Based on the field research findings and literature review, this research question provides answers about how and how industrial designers enter the market, what knowledge and skills from their education make them suitable UX Professionals, what qualifications the market demands from them apart from this knowledge and skills, and with whom and how they work in their professional environment:

- Industrial design graduates present their design and research portfolios to companies while getting jobs as UX professionals. These portfolios should cover the entire digital product development process rather than the final product focus, and UX professional candidates should include sketches and research outputs for the stages of the process.
- Many knowledge and skills that industrial designers acquire during their undergraduate education, consciously or unconsciously, such as the designerly way of thinking or design thinking methodology, meet the requirements to become UX professionals in the market.
- In addition to the designerly way of thinking and design thinking methodology, the two-dimensional design elements that industrial designers learn, especially in Basic Design courses, indicate that they have detailed knowledge about GUI in the context of digital products. With this knowledge, they have the knowledge and skills to design posters and presentations and promote their designs during their four-year undergraduate education, making them suitable and desirable UX professionals.
- Apart from the general, suitable structure of industrial design students towards UX professions, some of their qualifications also show that they are specialized in UX professions. Students with strong ideation and research skills tend to do UX research, while those with high design skills and competencies tend to design UI. In addition, the progression of digital product development and UX practices in short and fast iterations creates a dynamic product development process. It offers a suitable job field for impatient and active industrial designers.

- Communication skills have a significant place in UX professions. In the digital product development process in the market, which progresses with cooperation and teamwork with cross-functional teams consisting of professionals from different disciplines, UX professionals need to master the jargon and terminology, especially for software development. Since the production phase of digital products progresses with developers, just as industrial designers need to negotiate with mechanical engineers in the physical product development process, UX professionals are expected to be active in negotiating and directing the digital product development process by mastering jargon and terminology.
- The strong communication skills expected of UX professionals in the market include interaction with users and shaping the process with professionals from other disciplines, such as developers. Throughout their undergraduate education, industrial design graduates learn how to design products that meet the needs of diverse user groups and deliver sustainable futures for users, as stated in their job descriptions. This professional approach they acquire in their undergraduate education also has an essential place within the scope of UX professions. UX professionals aim to be the voice of users by empathizing with users within the scope of the products they develop and providing social inclusion through digital channels.

5.2 Discussion and Implications

This doctoral thesis examines the relationship between industrial design education and UX professions and evaluates the digital product development projects experienced within the scope of graduation projects as a bridge between industrial design education and UX professions. The findings from online surveys, visual content analysis, and semi-structured interviews conducted for data collection within the scope of the field research revealed the three main themes of the thesis as; (1)

industrial design education, (2) digital product development in graduation projects, and (3) UX professions.

As discussed in detail (see Chapter 4), nowadays, in the digitalized world, digital product development has a prominent role in the contemporary design fields. It focuses on the design of digital products, systems, and services that are frequently used in everyday life, resulting in a flexible, iterative, collaborative, and user-centered design process (Canziba, 2018). The use of various tools and methods in the digital product development process by following the latest technological trends is essential to achieve user-friendly outputs (Gerschütz et al., 2021). Although digital product development, a collaborative process, is shaped according to the disciplines of the stakeholders involved, it basically defines a process for the stages between ideation and launch of a digital product and beyond (Guérineau et al., 2018; Gerschütz et al., 2021). Multiple studies agreed that, the digital product development process and their activities mainly includes; (1) research, (2) ideation, (3) design, (4) development, and (5) launch and beyond stages (Kerim, 2020; Illés & Funtek, 2021; Matviyuk, 2022; Singh, 2022; uizard, 2022). Industrial designers are mostly involved in the UX and UI research and design stages and activities of the digital product development process, especially with their expertise in user-centered design.

In the formal education of industrial designers, digital product development is addressed and transferred to students in different ways at multiple points. Digital product development and UX practices are especially introduced to students in undergraduate industrial design education through various must and elective courses (Aldoy & Evans, 2011; Getto & Beecher, 2016; Yargın, Günay, & Süner-Pla-Cerdà, 2019; Morris, 2021; Temor, Husain, & Coppin, 2022). Several courses on basic design, ergonomics, and especially UX design (Bačíková, 2015; Getto & Beecher, 2016; Süner-Pla-Cerdà et al., 2021) focus on specific stages of the digital product development process and are mostly taught by part-time academics with market experience. In addition to this, the specific knowledge and skill requirements of the research field in particular are provided to industrial designers through graduate level courses. Furthermore, internships, summer practices, and freelance working experiences of industrial designers in the market provide the market equivalent of digital product development.

The point where digital product development is addressed from the beginning to the end in industrial design education, at METU Department of Industrial Design, is the ID402 Graduation Project course, which is also a part of the field research of this thesis. As a finding from the interviews, it was observed that this situation was similar in other institutions. Within the scope of such main industrial design project courses, industrial design students create industry collaborative projects for the product, service, and system designs they are interested in (Qian, Visser, & Chen, 2011; Yargın, Süner, & Günay, 2018; Börekçi, Hasdoğan, & Korkut, 2021). Within the scope of this thesis, the projects of students who developed digital products, systems, and services with an advisor firm in the course were evaluated. In this process, students had the chance to experience the digital product development process followed in the market within an academic semester. The course, by adhering to the educational context, shaped and updated the digital product development process in the market and presented it to the students. In this process, various implimentations for digital product development, especially for ideation and research, were included. Industrial design students, who are familiar with these stages from their physical product design education, have advanced these stages according to the digital product development process with the help of advisor firm officials and academics. Afterwards, short studies were carried out on the context and visual design of the projects for the UX and UI design stages. Ultimately, the graduation projects were presented in the final jury and evaluated by both UX professionals from the market and industrial design academics, and the students graduated with the experience of creating designs and following design processes that they can put in their portfolios in order to become UX professionals.

Industrial designers who gain digital product development experience within the scope of graduation projects work in many different positions covering UX professions in the market. Industrial design, digital product development and UX practices are interconnected (Ruiz, Serral, & Snoeck, 2021). Design thinking competencies and user-centered expertise of industrial designers, as well as their knowledge and skills in cognitive ergonomics and visual design within the scope of their industrial design education, make them suitable UX professionals in the market and make them preferred by many companies. Additionally, there is a lack of market-related knowledge and skills in digital product development among industrial designers. Industrial designers are also expected to have cross-functional teamwork experiences, and strong communication and negotiation skills in the market.

As a result of the literature review and the field research of the thesis, it is seen that the knowledge and experience in digital product development and UX practices acquired by industrial designers in their education differ from their market counterparts at various points. The author of this thesis having an educator position in addition to their researcher position helps the findings and insights to suggest possible implications for education. Based on the field research findings and insights, the digital product development process followed in industrial design education should follow a unique model. Some time and process management limitations brought about by the academic calendar constitute important elements that negatively affect the design processes of students (see Section 4.1.3.2). Agile, short and iterative cycles, and sprints in the digital product development process are suitable to be used in graduation projects with their flexible nature. In this way, rethinking the timetable and allowing students, especially experienced ones, to design their own processes to a certain extent is in line with the trial-and-error system and short iterations of digital product development and UX practices.

In addition, it is suggested to integrate a post-launch stage to the course structure. Conducting studies focusing on post-launch stages of the digital product development process in the market, in accordance with the possible timetable revisions, will both increase the similarity of the process with the market and create a model that will contribute to the experience and development of the products evaluated in the final juries. Integrating cross-functional teamwork within the process, which has an important place in digital product development, can contribute to the course operation and process management. Especially wireframing, prototyping and usability testing stages are the points where the lack of knowledge and experience in digital product development of the industrial design students is evident. Since cross-functional teamwork in the market can cover this area with the cooperation of designers and developers, teamwork in activities for these stages in education will positively affect the process and product outputs. In addition, course assignments and when possible specific courses on the use of qualitative research methods such as user interviews may be made compulsory before the graduation project course as it will improve knowledge and skills of the students in data collection and data analysis.

5.3 Contributions of the Thesis

This doctoral thesis makes the following contributions to the literature within the scope of industrial design education. First, it presents the state of digital product development and UX practice within current industrial design education. The field research findings provide detailed information on how industrial design students and academics perceive them. Therefore, the strengths, weaknesses, opportunities, and threats of current UX approaches in industrial design education are revealed. Secondly, the thesis provides insights from UX professionals on how UX implementation works in a professional environment. Perception of the UX professionals illustrates the motivations, expectations, requirements, and challenges of UX professionals. This thesis can be helpful for industrial design students to choose their career paths, for industrial design academics to further develop their course contents by showing student and professional perspectives, and for UX professionals to better understand the background and qualifications of the designers they are working with. Furthermore, since the context of this research is relatively new, practice-based, and highly interdisciplinary, many of the current sources are based on online blogs, videos, or certification-based online courses, this doctoral thesis provides an academic perspective to a practice-based professional field.

5.4 Limitations of the Research

Several challenges and limitations were encountered during the research process of this thesis. These challenges and limitations were mainly focused on; (1) participant recruitment, (2) differences of UX professions in Turkey from their foreign and literature counterparts, (3) observational obstacles for ID402 course, and (4) accessibility related issues for digital prototypes within the scope of graduation projects.

Reaching the participants within the scope of field research was the biggest limitation encountered during the process. Especially the online surveys distributed to industrial design students had problems in obtaining responses. Although 24 students who were contacted for the online survey signed the consent form, some of them preferred not to respond to the surveys even though reminder e-mails were sent. Participation in Online Survey A, which was distributed to students at the beginning of the semester, was higher than Online Survey B, which was distributed at the end of the semester. Fifteen out of 24 students responded to Online Survey A and nine out of 24 students responded to Online Survey B. Nevertheless, the fact that the data provided by the students participating in the online surveys included detailed and clear answers shaped the process positively. A similar challenge was also experienced during the semi-structured interview process. Many students did not participate in the semi-structured interviews, due to having completed the course and the semester. At this stage, the number of participants was obtained through snowball sampling thanks to the communication network among the students who did participate. During the sampling process of the semi-structured interviews, the fastest and most positive feedback was provided by the academics. In addition, it was observed that UX professionals, especially those working in Istanbul, provided participation through common contacts.

Another limitation of UX professionals is revealed by the job descriptions of these experts. Digital product development and UX practices are relatively new fields in Turkey where industrial designers work. In addition to this, socio-economic issues in Turkey, differences in job descriptions in UX professionals from their counterparts abroad and in the literature, and differences in the industrial sectors where UX professionals work led to unstructured interviews, in some cases reducing the contributions of interviewees.

Another limitation encountered during the thesis process was the lack of observation for the ID402 course. In the course setup during the semester, the frequency and routines of the students taking critiques varied, and the fact that the class hours coincided with the work hours of researcher prevented the establishment of a routine observation order. The potential of participating in a routine desk critiques process could have provided an observation component to the field research of the thesis and provided data on the unstructured and unwritten stages and problem solutions in the process. In addition to this, the content, size, and number of students of the ID402 course introduced constraints to the research. The strict regulations imposed by the course focus of the projects reduced the flexibility of the research.

The last limitation of the research was based on the digital prototypes of the graduation projects. At the end of the semester, although all assignment and project process portfolios submitted by the students during their graduation projects were accessed, the digital prototypes of the students could not be accessed. This situation led to the prototypes not being experienced first-hand. Having access to all assignments in the process and the comments received from the students played an important role in the analysis. The lack of experiencing the digital prototypes prevented the findings and insights that were made within the scope of the thesis from being explained with additional examples.

5.5 Further Research Directions

This thesis has shown how digital product development and UX practices are positioned and practiced in current industrial design education in Turkey and has provided information about the counterpart of these practices in UX professions.

Based on this research, it is possible to construct comparative research on the same fields. Semi-structured interviews also revealed that these fields are positioned and practiced differently in industrial design education, especially abroad. Therefore, a similar field research to the one in this thesis can be carried out within the scope of the schools abroad and evaluated with its counterpart in Turkey and evolve into a comparative research project.

Based on this thesis, another further research can be based on the graduation projects in the ID402 course. According to the findings and conclusions of the thesis, a different course schedule and assignment structure can be created and tried. In this way, the data obtained from this thesis will also be validated. In addition, since the UX research pillar of the digital product development process is more prominent in this thesis, a similar study can be designed and re-evaluated according to the planning of the UX/UI design process of the course.

Another further research could be designed towards a more in-depth and industry-specific study with fewer cases by making the firm or sector more specific among the graduation projects. In such a study, observation and a more specific interview protocol could potentially provide insights into how the digital product development process and UX practices differ across industries.

As another further research, similar to this research, a research setup like this research can be tried in a course on digital product development and UX practices other than the graduation projects course within the scope of industrial design education, focusing on the use of certain tools or on certain stages of the process. In this way, data will be collected for the validation of certain digital tools used by UX professionals within the scope of industrial design education.

Finally, based on the findings and conclusions of this thesis, a decision-making workshop on the stages of digital product development in an industrial design education environment can be conducted. In this study, the expectations and evaluation criteria on the stages can be ranked in order of importance. This ranking can create a tool that will facilitate the evaluation of graduation projects involving digital products in the final jury.

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APPENDICES

A. Informed Consent Form (Distributed in Turkish)

Araştırmacı

Doğan Can Hatunoğlu
Doktora, Endüstriyel Tasarım Ana Bilim Dalı
Orta Doğu Teknik Üniversitesi

Tez Konusu

Endüstriyel Tasarım Eğitimi Yoluyla Dijital Ürün Geliştirmede Anahtar Bir Sürücü Olarak Kullanıcı Deneyimi Araştırmasını Keşfetmek

Çalışmanın Amacı

Bu çalışmanın amacı; etkileşimli ürün geliştirme sürecini incelemek, bu süreçte kullanıcıların istek ve ihtiyaçlarını sürece daha etkin katabilmek için Kalite Fonksiyon Açınımı (QFD) aracının süreçte kullanımı incelemek ve geliştirmektir. Çalışma ilk olarak endüstriyel tasarımda etkileşimli ürün geliştirme sürecini araştırmak ile başlayacaktır. Daha sonra çalışma, kullanıcı ihtiyaçlarının süreçte tasarımcılar tarafından nasıl algılandığını ve projeye nasıl entegre edildiğini araştırmayı hedeflemektedir. Bu aşamada QFD yöntemi uzun yıllardır geleneksel ürün geliştirme sürecinde etkin olarak kullanıldığı için, ürün geliştirmeyle olan ilişkisi göz önünde bulundurularak, araştırmanın saha çalışmasında QFD bir araç olarak kullanılıp etkileşimli ürün geliştirme sürecinde kullanıcı ile ilişkisi incelenecektir.

Bu çalışma, tasarım öğrencileri ve akademisyenler için dijital ürün geliştirme bağlamında daha yeterli bir kullanıcı deneyimi (UX) araştırmasının nasıl yürütüleceği konusunda bir rehber ve araç sunmayı amaçlamaktadır. Bu amaca ulaşmak için araştırma iki bölümden oluşmaktadır; (1) keşif ve (2) uygulama. Araştırmanın keşif bölümünde, endüstriyel tasarım eğitiminde dijital ürün geliştirme süreci, özellikle kullanıcı araştırma aşaması, endüstriyel tasarım bitirme projeleri örnekleri üzerinden incelenmiştir. Bu kapsamda veri toplama yöntemleri olarak çevrimiçi anketler, doğal gözlem, öğrencilerin veri teslimlerinin sistematik olarak incelenmesi ve endüstriyel tasarım öğrencileri, akademisyenler ve profesyonellerle yarı yapılandırılmış görüşmeler kullanılmaktadır. Araştırmanın keşif bölümünün bulguları literatür taraması ile birleştirilerek çıktılar kurgulanacak ve araştırmanın ikinci bölümü olan uygulamanın temelini oluşturacaktır. Araştırmanın uygulama kısmında endüstriyel tasarım öğrencileri ile yarı deneysel bir atölye çalışması gerçekleştirilecektir.

Araştırma Yöntemi

Araştırmada veri toplamak amacıyla, çevrimiçi anketler, doğal gözlem ve yarı yapılandırılmış görüşmeler yapılacaktır. Araştırmacı, (1) Orta Doğu Teknik Üniversitesi Endüstriyel Tasarım bölümünde bitirme projesi olarak dijital ürün geliştirmek üzerine çalışan gönüllü öğrenciler ve (2) dijital ürün geliştirme ile ilişkili derslerin yürütücülüğü yapmış gönüllü akademisyenler ile çalışacaktır.

Araştırmanın ilk veri toplama yöntemini çevrimiçi anketler oluşturmaktadır. Bu anketlerden ilki dönemin başında öğrencilerin dijital ürün tasarım sürecine dair bilgilerini ve kullanıcı seçimi tercihleri hakkında veri toplamaya yöneliktir. Dönem sonunda, dönem içi sürece yönelik ikinci bir anket öğrenciler tarafından doldurulacaktır. Buradaki amaç, öğrencilerin dijital ürün tasarım sürecinde deneyimlediklerini, yaşadıkları problemleri, fikirlerini ve önerilerini toplamaktır. İkinci bir yöntem olarak araştırmacı dönem boyunca belirlenecek aralıklarla stüdyoda doğal gözlem yapacaktır. Burada, araştırmacı öğrencilerin tasarım sürecini dışarıdan bir göz olarak izleyecek, yazılı olmayan kuralları ve çalışma dinamiklerini gözlemleyecektir. Bu kapsamda araştırmacı dönem sonunda yapılacak olan final jüriye de gözlemci olarak katılacaktır. Araştırmacı süreçte çekeceği video, fotoğraflar ve ders için yapılan teslimler ile sürece yönelik bir dokümantasyon oluşturacaktır. Son olarak, araştırmacı dönem sonunda anket ve gözlem çıktılarına göre seçilecek öğrencilerle ve dijital ürün geliştirme ile ilişkili derslerin yürütücülüğü yapmış gönüllü akademisyenler ile yarı yapılandırılmış görüşmeler yapacaktır. Görüşmeler sırasında konuşulanları daha sonra hatırlayabilmek için ses kaydı alınacaktır. Görüşmelerin yeri ve zamanı katılımcı ve araştırmacı tarafından, katılımcıların uygun olduğu gün ve saatler göz önünde bulundurularak belirlenecektir. Görüşmelerin uzunluğu katılımcının ayırabileceği zamana göre ayarlanacaktır.

Veri toplama sürecindeki tüm yazılı kayıtlar, öğrenci teslimleri, video, fotoğraflar ve ses kayıtları içerik olarak analiz edilerek bulgular anonimleştirildikten sonra yalnızca bu doktora tezinde ve akademik amaçlı yayınlarda kullanılacaktır. Bunların dışında başka amaçlarla kullanılmayacak olup, araştırmacı dışında kişilerle paylaşılmayacaktır. Elde edilen bilgiler kullanılırken katılımcıların kimlikleri ve verdikleri bilgiler (kurum, firma, isim vb.) gizli tutulacak, kişilerin verdikleri bilgilerle kimliklerinin eşleştirilmemesine özen gösterilecektir.

Bu çalışmaya katılmak tamamen gönüllülük esasına dayanmaktadır. Bu formu okuyup onaylamanız, araştırmaya katılmayı kabul ettiğiniz anlamına gelir. Ancak, çalışmaya katılmama veya katıldıktan sonra herhangi bir anda vazgeçme hakkına sahipsiniz. Çalışmaya katılmayı kabul ettiğiniz takdirde izin formunu karşılıklı olarak imzalayacağız ve birer kopyasını saklayacağız. Bu araştırma, Orta Doğu Teknik Üniversitesi Endüstriyel Tasarım Bölümünde yürütülmekte olan bir doktora tezi kapsamındadır. Araştırma süresince herhangi bir şikâyetiniz olursa, bu çalışmanın danışmanı olan Doç. Dr. Naz A.G.Z. Börekçi ile iletişime geçebilirsiniz. İletişim bilgilerini aşağıda bulabilirsiniz.

Zaman ayırdığınız için teşekkür ederim.

Araştırmacı: Doğan Can Hatunoğlu (Doktora Adayı)
[redacted]

Tez Danışmanı: Doç. Dr. Naz A.G.Z. Börekçi
[redacted]

Yukarıda yer alan ve araştırmadan önce verilmesi gereken bilgileri okudum ve çalışmanın kapsamını ve amacını, gönüllü olarak üzerime düşen sorumlulukları anladım. Çalışma hakkında yazılı ve sözlü açıklama aşağıda adı belirtilen araştırmacı tarafından yapıldı. Alınan yazılı, görsel ve ses kayıtları ancak anonimleştirildikten sonra ve yalnızca bu doktora tezinde ve akademik amaçlı yayınlarda kullanılacak. Bunların dışında, katılımcının yazılı izni olmadan başka hiç bir amaç için kullanılmayacak ve araştırmacı ve tarafım dışında kimsenin orijinal kayıtlara erişimi olmayacak. Kimliğim ve verdiğim tüm bilgiler gizli tutulacak ve belirli anonimleştirme süreçleri doğrultusunda tarafımla eşleştirilemez ve ilişkilendirilemez hale getirilecek. Bu koşullarda söz konusu araştırmaya kendi isteğimle katılmayı kabul ediyorum.

Ad Soyad (Katılımcı)	Tarih	İmza (Katılımcı)
	__ /__ / __	
Ad Soyad (Araştırmacı)	Tarih	İmza (Araştırmacı)
	__ /__ / __	

B. Informed Consent Form (Translated into English)

Researcher

Doğan Can Hatunoğlu, MSc
Doctoral Candidate, Industrial Design
Middle East Technical University

Title of the Thesis

Exploring User Experience (UX) Research as a Key Driver in Digital Product Development within Industrial Design Education

Aim of the Thesis

This study aims to present a guide and a tool for design students and academics on how to execute more adequate user experience (UX) research in the context of digital product development. To achieve its aim, research is constructed in two parts; (1) exploration and (2) implementation. In the exploration part of the research, digital product development process in industrial design education, and particularly its user research phase, is explored in the case of industrial design graduation projects. In that context, online surveys, naturalistic observation, systematic review of students' submissions, and semi-structured interviews with industrial design students, academics, and professionals are carried out as data collection methods. Findings of the exploration part of the research will be combined with literature review, and their outputs will form the basis of the second part of the research, that is implementation. In the implementation part of the research, a quasi-experimental workshop will be facilitated with industrial design students.

Research Method

To collect data in the research, online surveys, naturalistic observation, systematic review of students' submissions, and semi-structured interviews are conducted. Researcher will conduct the research with (1) volunteer senior students (from METU Department of Industrial Design) who focus on digital product development in their graduation projects, and (2) volunteer academics who have been instructing students in digital product development related courses, (3) industrial design graduates who have professional experience and professionals from firms that have collaborated with the department in graduation projects.

The first data collection method of the research is online surveys. The first survey is given to collect data on students' knowledge of the digital product development process and their perceptions on user research at the beginning of the semester. At the end of the semester, the second survey focusing on the overall design process was filled out by students. The aim is to gather information on students' experiences, problems, ideas, and suggestions during the digital product development process in industrial design education. As a second method, the researcher made naturalistic observations in the studio throughout the semester during interim and final evaluations. In this context, the researcher also participated to the graduation jury and exhibition, which was held at the end of the semester, as an observer. The researcher created a process-oriented documentation with photographs and submissions made for the course. Lastly, the researcher conducted semi-structured interviews with the students who were selected according to the survey and observation outputs, and is currently conducting semi-structured interviews with volunteer academics who have conducted courses related to digital product development. Interviews with professionals are currently being planned. Voice recording is used to be able to remember what was spoken during the interviews. The place and time of the interviews are determined by the participant and the researcher, taking into account the days and hours available to the participants. The length of the interviews is adjusted according to the time the participant can spare.

All written records, student submissions, photographs and audio recordings in the data collection process will be used only in this doctoral thesis and academic publications after the findings are anonymized by analyzing them. Apart from these, it will not be used for other purposes and will not be shared with third parties. While using the information obtained, the identities of the participants and the information they provide (e.g. institutions, companies, names) will be kept confidential, and care will be taken not to match the information provided by the individuals with their identities.

Participation in this study is voluntary. By reading and approving this form, you agree to participate in the study. However, you have the right not to participate in the study, or to opt out at any time after participating. If you agree to participate in the study, we will mutually sign the consent form and keep a copy each. This research is within the scope of a doctoral thesis being conducted in METU Department of Industrial Design. If you have any complaints during the research, you can contact Assoc. Prof. Dr. Naz A.G.Z. Börekçi. You can find contact information below.

Thank you for your time.

Researcher: Doğan Can Hatunoğlu, MSc (Doctoral Candidate)
[redacted]

Supervisor: Assoc. Prof. Dr. Naz A.G.Z. Börekçi
[redacted]

I have read the information above and I understand the scope and purpose of the study and my responsibilities as a volunteer. Written and verbal explanation about the study was made by the researcher whose name is mentioned. Written, visual and audio recordings received will only be used in this doctoral thesis and academic publications after they have been anonymized. Apart from these, they will not be used for any other purpose without the written consent of the participant, and no one other than the researcher and myself will have access to the original records. My identity and all the information I provide will be kept confidential and will not be matched or associated with me in line with certain anonymization processes. In these circumstances, I agree to participate in this research voluntarily.

Name Surname (Participant)	Date	Signature (Participant)
	__ /__ / __	
Name Surname (Researcher)	Date	Signature (Researcher)
	__ /__ / __	

C. METU IAEK Approval Form (in Turkish)

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

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14 NİSAN 2022

Konu : Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi : İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Doç. Dr. Naz A.G.Z. BÖREKÇİ

Danışmanlığını yürüttüğünüz Doğan Can Hatunoğlu'nun "Etkileşimli Ürün Geliştirmede Kullanıcı Etkileşimini Artırmak Amacıyla Bir Yöntem Olarak Kalite Fonksiyon Açınımı (QFD) Aracının Kullanılması" başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **0197-ODTUİAEK-2022** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

[redacted]

IAEK Başkan

D. Protocol of Online Survey A (Prepared and Distributed in Turkish)

Etkileşimli Tasarım İçeren Mezuniyet Projeleri İçin Süreç Başı Anketi

1. Daha önce herhangi bir etkileşimli ürün tasarımı, UX veya UI üzerine çalışma deneyiminiz oldu mu? *

- ◯ Evet
- ◯ Hayır

2. Deneyiminizi nerede edindiniz? *

- ☐ Birinci sınıf
- ☐ İkinci sınıf
- ☐ Üçüncü sınıf
- ☐ Dördüncü sınıf
- ☐ Mezuniyet projesi
- ☐ Seçmeli ders kapsamında proje
- ☐ İkinci sınıf yaz stajı
- ☐ Üçüncü sınıf yaz stajı
- ☐ Öğrenci stajyerlik sırasında
- ☐ Özel iş olarak
- ☐ Deneyimim olmadı
- ☐ Diğer: ______________________

3. Varsa bu konuda olumlu veya olumsuz ne gibi deneyimler yaşadınız? *

4. Sizi mezuniyet projesi olarak bu alana çeken etkenler nelerdir? *

- [ ] Özel ilgi sebebiyle
- [ ] Yeni teknolojilerle çalışma isteği nedeniyle
- [ ] Profesyonel hayatta bu alanda çalışmak istemek / İş olanaklarının fazla olması
- [ ] Piyasa değerinin yüksek olması
- [ ] Yurtdışı fırsatlarının fazla olması
- [ ] Uzaktan ve yarı zamanlı çalışabilme olanaklarının fazla olması
- [ ] Diğer: ______________________

5. Sizi projenizle ilgili en çok heyecanlandıran noktalar nelerdir? *

____

____

____

____

6. Süreçte en çok keyif alacağınızı düşündüğünüz aşama hangisidir? *

- [ ] Literatür / Teknik araştırması
- [ ] Kullanıcı araştırması
- [ ] Fikir geliştirme
- [ ] Prototipleme
- [ ] Test etme
- [ ] Diğer: ______________________

7. Neden bu aşamanın size en çok keyif verecek aşama olduğunu düşünüyorsunuz? *

____

____

____

____

8. Etkileşimli ürün tasarımı süreci ile ilgili araştırma yaparken hangi kaynaklardan yararlanıyorsunuz? *

- [ ] Kitaplar
- [ ] Web siteleri veya çevrimiçi bloglar
- [ ] Akademik yayınlar
- [ ] Video veya podcast'ler
- [ ] Kullanıcılar
- [ ] Diğer: ____________

9. Size bu konuda en çok yardımı dokunan kaynaklardan örnekler verebilir misiniz? *

____

10. İş birliği halinde olduğunuz firmanın size sağlamış olduğu bir kullanıcı araştırması oldu mu? Olduysa içeriğine dair kısaca bilgi verebilir misiniz? *

____

11. Projede şu ana kadar kullanıcı araştırması sürecinde aşağıdaki hangi yöntemlerden yararlandınız? *

- [ ] Saha araştırması
- [ ] Kullanıcı mülakatları
- [ ] Kullanıcıya dair literatür araştırması
- [ ] Kullanıcı gözlemleri
- [ ] Kullanıcılarla yapılan anketler (Yüzyüze veya çevrimiçi)
- [ ] Kullanıcılara ürün denettirme
- [ ] Kişisel ürün denemeleri
- [ ] İkinci el kaynaklardan videolar (Youtube vb.)
- [ ] Çevrimiçi blog ve forumlar
- [ ] Akran görüşmeleri (Peer discussions)
- [ ] Odak grubu
- [ ] Diğer: ____________

12. Yaklaşık kaç kullanıcı ile araştırma gerçekleştirdiniz veya gerçekleştirmeyi düşünüyorsunuz? *

- 1-10
- 11-20
- 21-30
- 31-40
- 41 ve üzeri

13. Belirlediğiniz kadarıyla kullanıcı profilinizden kısaca bahsedebilir misiniz? *

14. Kısaca kullanıcılarınızın tasarım projenize dair saptadığınız problemlerinden bahsedebilir misiniz? *

15. Projenizde ele almak üzere, kullanıcılarınıza dair belirlediğiniz ihtiyaçlardan bahsedebilir misiniz? *

16. Yaptığınız kullanıcı araştırması sonucu tasarım projeniz için ne gibi fırsatlar oluştuğunu düşünüyorsunuz? *

17. Bundan sonraki süreç aşamalarında kullanıcıların sürece nasıl dahil olacağını düşünüyorsunuz? *

E. Protocol of Online Survey B (Prepared and Distributed in Turkish)

Etkileşimli Tasarım İçeren Mezuniyet Projeleri İçin Süreç Sonu Anketi

1. Mezuniyet projenizden memnun kaldınız mı? *

Yalnızca bir şıkkı işaretleyin.

Çok memnun kaldım

1 ◯
2 ◯
3 ◯
4 ◯
5 ◯

Hiç memnun kalmadım

2. Mezuniyet projenizden memnuniyet durumunuzun sebepleri nelerdir? (Olumlu ve olumsuz yanları ne oldu?) *

3. Proje geliştirme sürecinizde sizi en çok şaşırtan veri ne oldu? *

4. Şu an sürece başından başlasanız değiştirmek isteyeceğiniz nokta veya noktalar neler olabilir? *

Uygun olanların tümünü işaretleyin.

- [ ] Tasarım süreci ve aşamalandırma
- [ ] Teknik araştırma süreci
- [ ] Kullanıcı araştırması
- [ ] Pazar araştırması
- [ ] Fikir geliştirme süreci
- [ ] Danışman firma ile etkileşim
- [ ] Öğretim elemanları ile etkileşim
- [ ] Tasarım detaylandırma ve sonlandırma
- [ ] Prototipleme
- [ ] Sunum teknikleri
- [ ] Alınan geri bildirim yöntemi ve niteliği
- [ ] Kullanıcı ile ürün denemeleri
- [ ] Zaman kullanımı
- [ ] Yok
- [ ] Diğer: ____________________

5. Yukarıdaki seçimlerinizden en önemlileri hakkında bilgi verebilir misiniz? *

____

____

____

____

____

6. Süreç içerisinde öğretim elemanlarından aldığınız yönlendirmeler ve geri bildirimler hakkında bilgi verebilir misiniz? *

____

____

____

____

____

7. Süreçte işbirliği içerisinde olduğunuz danışman firmadan aldığınız yönlendirmeler ve geri bildirimler hakkında bilgi verebilir misiniz? *

8. Süreçte en çok hangi aşamada zorluk yaşadınız? *

Uygun olanların tümünü işaretleyin.

- [ ] Literatür / Teknik araştırması
- [ ] Kullanıcı araştırması
- [ ] Pazar araştırması
- [ ] Fikir geliştirme
- [ ] Prototipleme
- [ ] Test etme
- [ ] Final sunum hazırlama
- [ ] Dönem içi teslimlere hazırlanma
- [ ] Zorluk yaşamadım
- [ ] Diğer: ______________

9. Kullanıcı araştırmalarınızı hangi aşamalarda sürece dahil ettiniz? *

Uygun olanların tümünü işaretleyin.

- [ ] Literatür / Teknik araştırması
- [ ] Pazar araştırması
- [ ] Ön fikir geliştirme (Initial Ideas)
- [ ] İki farklı fikir geliştirme (Preliminary Jury)
- [ ] Tek fikre düşürüp tasarımı geliştirme
- [ ] Prototipleme
- [ ] Test etme
- [ ] Diğer: ______________

10. Bu aşamalarda kullanıcıları ne şekilde sürece dahil ettiniz? (Örn. nasıl bir strateji kurguladınız? veya nasıl yöntemler kullandınız?) *

11. Kullandığınız kullanıcı araştırması yöntemlerinden en etkili olanlar hangisiydi? *

Uygun olanların tümünü işaretleyin.

- [ ] Saha araştırması
- [ ] Kullanıcı mülakatları
- [ ] Kullanıcıya dair literatür araştırması
- [ ] Kullanıcı gözlemleri
- [ ] Kullanıcılarla yapılan anketler (Yüzyüze veya çevrimiçi)
- [ ] Kullanıcılara ürün denettirme
- [ ] Kişisel ürün denemeleri
- [ ] İkinci el kaynaklardan videolar (Youtube vb.)
- [ ] Çevrimiçi blog ve forumlar
- [ ] Akran görüşmeleri (Peer discussions)
- [ ] Odak grubu
- [ ] Diğer:

12. Kullanıcı profilinize özel belirlediğiniz nitelikler nelerdir? (Örn. Yaş aralığı, özel ihtiyaçlar gibi) *

13. Süreçte en çok faydalandığınız kaynaklar neydi? *

Uygun olanların tümünü işaretleyin.

- [ ] Kitap ve benzeri basılı kaynaklar
- [ ] Web siteleri veya çevrimiçi bloglar
- [ ] Akademik yayınlar
- [ ] Video veya podcast'ler
- [ ] Sosyal medya
- [ ] Kullanıcılar
- [ ] Danışman firma
- [ ] Eğitim ortamı
- [ ] Diğer benzer ürünler
- [ ] Diğer: ______________________

14. Bu kaynakları seçmenizin sebebi nedir? *

15. Profesyonel yaşamda bu alana yönelmeyi düşünüyor musunuz? Neden? *

F. Brief of the Workshop I: Project Elaboration I

METU Faculty of Architecture Department of Industrial Design
Spring 2021-22 | ID 402 Graduation Project | Section B
[redacted]

WORKSHOP 1: PROJECT ELABORATION 1

MONDAY 14 MARCH 2022
FORMAT: A3 sheets, hand-generated or hybrid on Miro.

PART 1: PROJECT SCOPE & STATEMENT

(90 minutes)

The purpose of a **project statement** is to describe as accurately as possible the 'design area' in which you will be working, e.g.,

"Outdoor play environment for the physical exercising needs of visually impaired children aged 7-14."

To decide on this design area, it is first necessary to consider what problems, opportunities or user needs you are intending to address in your project.

- What is the product/service sector?
- Why is a new product/service needed?
- Where does the motivation come from (e.g., what are the benefits for users and the external Advisor)?
- Is there a 'market pull' or a 'technology push' you want to explore?
- Who is your intended user group?
- What is the context/environment of use?
- Are there any essential requirements that your product proposal **should** fulfil (e.g., what will it do? what will it be?).

Think about these issues and prepare an A3 **mind-map** to explore the scope of your project. Then, on a separate A3 sheet, prepare a **single-sentence project statement** (15-25 words) taking into account what you have considered in your mind-map. At this stage, make sure your project statement does not lead you to preconceived solutions (e.g. a 'bicycle' is a specific solution, whereas 'human-powered transportation' is broad and open to wide interpretation).

The project statement must imply a project within the knowledge, skillset and scope of final-year industrial design undergraduate education, focused on physical product design (which may be accompanied by digital and physical services) and/or service design (which may include physical components).

You will discuss your mind-map and project statement with instructors, so please be ready to explain it, the reasons for your interest in the design area, and whether your statement has benefitted from discussion with your external Advisor.

PART 2: STATEMENT KEYWORDS/PHRASES

(90 minutes)

On a new A3 sheet, write down your project statement from PART 1. Then, underline all the keywords or phrases that can be expanded upon. For example:

"[Outdoor play environment] for the [physical exercising needs] of[visually impaired children] [aged 7-14]."

For each keyword/phrase, make a list of related concepts, ideas or alternative keywords/phrases that can improve your understanding of the design task in front of you. Consider how items on the list might affect the project emphasis, the research you will need to undertake, and the possible design directions you may explore.

Collate your Part 1 and Part 2 submissions to the 'Workshop 1 Project Elaboration 1' board on Miro by 17:30, at https://miro.com/app/board/uXjVOFyn6lA=/?invite_link_id=401652331293

PART 3: PRODUCT ANALYSIS

(Take-Home Assignment)

Make research on products related to your project statement and select six products that you find especially relevant, inspiring, and notable. Prepare an A3 analysis sheet for each product (i.e. six A3 sheets in total), including: product image(s), and annotated strong/weak points (e.g. concerning functionality, usability, aesthetics, target users, usage scenario, interactions, user experience, materials, cost, and any other points you find worth mentioning).

Collate your six A3 product analysis sheets on the 'Workshop 1 Project Elaboration 1' board on Miro, for the studio session on Thursday 22 March before class, at same link above.

SUBMISSION

Convert your 'Workshop 1' A3 sheets to PDF and submit them to ODTUClass by Thursday 17 March, 13:00.

Also include the outcomes of this workshop in your project process portfolio.

G. Brief of the Workshop II: Project Elaboration II

METU Faculty of Architecture Department of Industrial Design
Spring 2021-22 | ID 402 Graduation Project | Section B
[redacted]

WORKSHOP 2: PROJECT ELABORATION 2

THURSDAY 17 MARCH 2022

FORMAT: Group discussion on Miro boards; A3 sheets and post-it notes.
Include the process and outcomes of this workshop in your project process portfolio.

SUBMISSION: Compile your workshop outcomes as a single PDF file ("Name_Surname_Workshop 2.pdf") and submit to ODTUClass by 20 March 2022 Sunday, 23:59.

The aim of today's workshop is to gather important insights to support your initial idea generation. There are four parts: group discussion on project statement; group discussion on product analysis; presentation and reflection on the "Creative Crossovers" theme; and research planning.

PART 1: GROUP DISCUSSION ON PROJECT STATEMENT

(**90 minutes**)

For this session you will work as a mixed group of 3 or 4 students, all with different project advisors. Please refer to the end of this document for the distribution of groups. You should have your A3 sheet containing your latest project statement ready, with underlined keywords/phrases, prepared during Project Elaboration 1 workshop. Taking turns (approx. 15 minutes per student), show your project statement to group members. Explain to them how you arrived at your statement and what you intend to achieve with your project. Ask group members for their feedback and suggestions.

Compile and reflect on these suggestions, and make revisions to your project statement, keywords, and possible research topics and directions.

PART 2: GROUP DISCUSSION ON PRODUCT ANALYSIS

(**90 minutes**)

Continue working in the same group. Have your six product analysis A3 sheets ready on Miro. Taking turns (approx. 15 minutes per student), share the results of your product analysis with group members. Explain to them why you chose the 6 example products and their relevance to your graduation project. Using your observed strong/weak points, initiate a discussion about **what can be learned from the 6 products** and how they might inform what you do in your graduation project. Compile and reflect on the group members' comments, and develop your insights.

PART 3: RESEARCH PLANNING (Home Assignment)

FORMAT: A3 sheets

By now you will be very familiar with your project statement and the aims of your graduation project. You will also have identified areas of personal knowledge that need boosting through research; these areas may relate to, for example, technologies, materials, market trends, lifestyle trends, user needs, user habits, etc.

1

[redacted]

Step A: What and Where to Find Out?

On an A3 sheet, write-down and complete **no fewer than ten short sentences that each begin with the words "For my graduation project, I do not know enough about .... [something]".**

Then, decide and write-down as precisely as possible where you can get the best answers to your information needs (e.g. secondary sources including Internet, videos, articles, academic papers and books). To best understand your users, you will need to conduct user research yourself (unless your external advisor shares sufficient research results with you).

Step B: User Research Plans

Who are your users? What do they do? What is their need for your design? These are questions that you should continually ask yourself throughout your graduation project. You should use the answers to evaluate and iterate your ongoing design proposals. You will undoubtedly have presumptions regarding your intended users' goals, behaviours, lifestyles, age, activities, etc. The role of user research is to replace presumptions with evidence from the field.

We expect you to **conduct user research as soon as possible**, ideally during the early phases of the graduation project so that we can evaluate your initial ideas against the findings of your user research. Certainly, you should be **planning your user research** immediately. Use the remainder of the studio session to make initial plans and gather feedback from instructors.

- **Which research methods do you think will lead to useful user insights for your project** (e.g. interviews, surveys, observations, cultural probes, etc.)?
- If you choose interviewing, prepare a list of questions to ask your participants. Where will you find your interviewees?
- If you choose an online survey, write down the questions of the survey. How will you create a survey (e.g. online, paper) and how will you share it with participants?
- For interviewing and surveys, consider how the questions may be asked to generate a particular kind of answer (e.g. yes/no, fixed choice answers, free text, scaled rating, etc.).
- If you choose to make observations, prepare questions to yourself that can help direct those observations.
- If you choose to use cultural probes, become familiar with the various types and the different insights they can provide.

As your project progresses, you will inevitably need to update your knowledge and acquire new knowledge. Therefore, the carrying out of research is expected throughout the entirety of your graduation project, not just during the early phases.

Bring evidence of your research planning (including user research planning) –and some initial findings– to the studio session on Monday 21 March.

Also think on the theme "Creative Crossovers". On the following studio session we will carry out discussions on this theme and start our idea generation process.

DISTRIBUTION OF GROUPS	
GROUP 1	GROUP 2
[redacted]	[redacted]
GROUP 3	GROUP 4
[redacted]	[redacted]
GROUP 5	GROUP 6
[redacted]	[redacted]
GROUP 7	GROUP 8
[redacted]	[redacted]
GROUP 9	GROUP 10
[redacted]	[redacted]

H. Brief of the Workshop III: Idea Generation

METU Faculty of Architecture Department of Industrial Design
Spring 2021-22 | ID 402 Graduation Project | Section B
[redacted]

WORKSHOP 3: IDEA GENERATION

MONDAY 21 MARCH 2022

FORMAT: A3 sheets, hand-generated sketches.

Include the outcomes of this in-class exercise in your project process portfolio.

SUBMISSION: Compile your workshop outcomes as a single PDF file ("Name_Surname_Workshop 3.pdf") and submit to ODTUClass by 24 March 2022 Thursday, 13:00.

PART 1: DESIGN FOR CREATIVE CROSSOVERS (90 minutes)

In the first session of this workshop, you will work as a group of 3-4. You may set up your own groups.

As a group, discuss the various ways in which the theme "creative crossovers" can be interpreted, and how "design for creative crossovers" could affect (add value to) your graduation projects. Taking turns (approx. 15 minutes per student), explain the meaning of this theme for you and for your approach to your project, and ask the group members for their feedback and suggestions. Following the discussions, **individually** prepare an A3 **mind-map** that visualizes your thoughts.

PART 2: IMMEDIATE IDEAS (90 minutes)

Visualise the ideas that come into your mind at this stage of your project. Refer to all the previous work you have done in setting the background to your project, to help with your ideation. In other words, make use of what you have learned from the project elaboration workshops, your current project statement, the product analysis exercise and your initial user research findings. Your ideas may vary between those at a systems level to partial solutions. You may look at the design problem from different perspectives, addressing various issues relevant to your graduation project. You may also find it helpful to deconstruct your project and ideate for each component.

Use scenario building and empathy modelling to help generate and express your ideas.

At this stage, we expect you to generate many ideas. The ideas should be **diverse** (i.e. represent different ways/approaches to responding to your project statement), rather than variations on a basically similar theme. **Quantity and diversity are important.**

PART 3: RADICAL AND ADVENTUROUS IDEAS (90 minutes)

For the third part of the workshop, we ask you to focus your idea generation on creating radical, innovative and adventurous ideas. In other words, considering the needs of your users and potential design solutions, aim to generate ideas that 'push boundaries' and are 'away from the conventional' regarding your problem area.

Thinking in this way can stimulate you towards diversity in your idea generation as well as open avenues for novel design contributions.

Your ideas can include new ideas or variations on already sketched ideas from Part 2.

Remember that your ideas at this stage do not have to be combined into a coherent design solution – it is fine for them to relate to separate functions, features, components, etc.

PART 4: CONTINUE IDEA GENERATION (Home assignment)

For the remaining studio time, revise your ideas, support them with research if necessary, and continue generating more. Allow your ideas to flow freely at this stage. Refer to your project statement from time to time, and make refinements or adjustments if necessary.

As your home assignment, review your ideas, compile them into design solution alternatives, and add further ideas making new sketches. Please note that your ideas may still be partial at this stage, meaning they do not represent overall complete design solutions.

Please note that idea generation is a continuous process and requires an open mindset. This will require 2D design exploration that also feeds your understanding of the problem area. Support your design exploration with research and 3D mockups also.

For Thursday's online studio session, we will discuss your ideas through critiques.

I. Brief of the Initial Ideas Jury

METU Faculty of Architecture Department of Industrial Design
Spring 2021-22 | ID 402 Graduation Project | Section B
[redacted]

26 March 2022

INITIAL IDEAS JURY

The Initial Ideas Jury is the first formal evaluation of your graduation project ideas, constituting **10%** of the ID402 grade. The overall aim is for you to demonstrate progress in setting the foundation of your project, as well as success in generating a range of promising initial ideas. A jury timetable is arranged, showing which students will present at which session; please find it at the end of this document.

SESSION 1: MONDAY 4 April (08:40-12:30)
SESSION 2: MONDAY 4 April (13:40-17:30)
SESSION 3: THURSDAY 7 April (13:40-17:30)

REQUIREMENTS

You are required to prepare a presentation within Miro (using Miro's frames and presentation mode) comprising **12** individual frames (sheets), as described below. Use 'A3 landscape' sized frames. At the jury, you will share your Miro screen in the studio and if necessary over Zoom.

1. One frame containing **YOUR NAME,** the name of your **EXTERNAL ADVISOR** and your current **PROJECT STATEMENT**.
2. One frame containing 4 insightful **IMAGES OF YOUR TARGET USER GROUP** and a list of **KEYWORDS** describing users' attributes most relevant to the project.
3. Two frames containing **INFOGRAPHICS / SHORT SENTENCES** that communicate important **CONCLUSIONS** from research (including user studies) that you have carried out so far.
4. Eight frames containing **HAND-GENERATED SKETCHES OF YOUR EIGHT STRONGEST / MOST FAVOURED DESIGN IDEAS**.

Each student will be allocated a jury slot lasting approximately 15 minutes. Therefore, use no more than **HALF** this time for your oral presentation, leaving the other half for questions and answers. Focus your presentation on your **EIGHT IDEAS** and the main decisions that led to the creation of those ideas. **Please rehearse to make sure you communicate your key messages and do not overrun.**

SUBMISSION

Your Miro presentation frames should be exported as a PDF and uploaded to ODTUClass no later than 08:00 on **Monday 4 April** (**Session 1 and Session 2 students**) or 08:00 on **Thursday 7 April** (**Session 3 students**).

ASSESSMENT (10%)

Assessment will be made against the following criteria.

- Quality of **project grounding** with regard to explaining the underlying need, the target user group, and research conclusions.
- **Diversity** and **quality** of **design ideas** (including obvious connections between project statement, research and initial ideas)
- Quality of **communication** (sketches, visuals, infographics, oral presentation, timekeeping, and discussion)

METU Faculty of Architecture Department of Industrial Design
Spring 2021-22 | ID 402 Graduation Project | Section B
[redacted]

METU ID402 GRADUATION PROJECT SECTION B // SPRING 2021-2022 // JURY TIMETABLE

SESSION 1: MONDAY (09:00-12:45)	
9:00	[redacted]
9:15	
9:30	
9:45	
10:00	
10:15	
10:30	
10:45	
11:00	
11:15	
11:30	
11:45	
12:00	
12:15	
12:30	

SESSION 2: MONDAY (13:45-17:30)	
13:45	[redacted]
14:00	
14:15	
14:30	
14:45	
15:00	
15:15	
15:30	
15:45	
16:00	
16:15	
16:30	
16:45	
17:00	
17:15	

SESSION 3: THURSDAY (13:45-17:30)	
13:45	[redacted]
14:00	
14:15	
14:30	
14:45	
15:00	
15:15	
15:30	
15:45	
16:00	
16:15	
16:30	
16:45	
17:00	
17:15	

J. Brief of the Workshop IV: Constraints, Objectives & Directions (CODs)

METU Faculty of Architecture Department of Industrial Design
Spring 2021-22 | ID 402 Graduation Project | Section B
[redacted]

11 April 2022

Distribution of Workshop Brief: 11 April 2022, Monday
WORKSHOP 4: 18 April 2022, Monday

WORKSHOP 4: CONSTRAINTS, OBJECTIVES & DIRECTIVES (CODs)

FORMAT: A3 sheets.

Include the outcomes of this workshop in your project process portfolio.

SUBMISSION: Compile your workshop outcomes as a single PDF file ("Name_Surname_Workshop 4.pdf") and submit to ODTUClass by **18 April 2022 Monday,** 23:59.

The specifications for a new product can range from those that are fixed (non-negotiable), to those that are optional (fully negotiable). This workshop uses a technique of prioritization to determine the more important and less important design considerations in your project. You will identify **constraints, objectives** and **directives** (CODs) that will lead you towards an effective exploration of the design solution space.

CODs can relate to many different factors, for example: a spotted problem, technological developments, physical limitations of the user, a need that is unfulfilled, demands or wishes of potential users, manufacturing resources, work practices or product portfolio of the external advisor, material supplies, etc. Overall, CODs help to define the **specification** of the product and service that you are designing. On completion of the workshop, the number of CODs generated should be plenty enough so as to form a basis for concept development.

CONSTRAINTS ...are obligatory requirements. The word 'must' is used to emphasize the strength of the statement. Constraints often come from manufacturing resources, essential user requirements, principle functionality, legislation, official standards, and conventions.

*"The product **must** be sterile prior to its application in the field."*

OBJECTIVES ...are less forceful requirements than constraints. These are expressed as statements that the designer strives to achieve as much as possible.
Objectives often come from marketplace trends, aspirations of users, and strategies for product differentiation.

*"The display of the product **should** be legible at a distance of 2 metres."*

DIRECTIVES ...are goals that are desirable, but not urgently important. In other words, they can contribute to a more successful product, but success can also be achieved without them.
Directives often come from lower priority user requirements, trendsetting decisions, add-ons, and the personal values and style of the designer.

*"A programmable timer **could** be added to the user interface."*

1

WORKSHOP 4 PREPARATIONS (Week of 11-18 April 2022)

Compile and develop **two diverse ideas** based on the comments and feedback from instructors and advisors, from your Initial Ideas Jury. We expect these two ideas to go beyond rough and sketchy drawings; please make sure you have **explored them to a level through sketches, 3D mockups and/or interface prototypes** that communicate your ideas.

WORKSHOP 4: CODs (18 April 2022 Monday, 09:00)

PART 1: IDENTIFICATION OF CODs (60 minutes)

1. Work individually.
2. On top of an A3 sheet, write down your latest project statement.
3. Divide the space left below the statement into three columns with the headings Constraints, Objectives and Directives.
4. Based on your understanding of your Graduation Project, think carefully about relevant Constraints, Objectives and Directives. On the A3 sheet, write down at least **eight** constraints, **six** objectives and **four** directives. Make your statements as project specific as possible. Do not use generic statements such as "must be ergonomic" or "should be pleasing to look at" – these are standard industrial design criteria that do not need to be mentioned within the CODs list.

PART 2: COD-BASED EVALUATION OF TWO INITIAL IDEAS (120 minutes)

Organize yourselves into groups of 3 students with diverse advisors. Taking turns, amongst your group briefly discuss your project statement, CODs and **2 ideas you compiled and further developed** after last week. Then, ask group members to evaluate and discuss your ideas considering:

- whether these ideas address your CODs;
- whether additional (or rephrased) CODs are needed.

Note down their comments on your A3 sheet, by adding new CODs to the lists or changing the wording of existing CODs. It can be helpful to use different colour pens for the comments of different group members.

PART 3: RE-EVALUATION OF CODs (90 minutes)

Return to working *individually*.

Review all your current CODs: original statements, modified statements and new statements. It is often the case that useful statements have been generated, but they are currently residing in the 'wrong' category. Therefore, evaluate the position of each statement based on your understanding of your project. Move statements between COD categories if you believe they are currently within the wrong category. Discard CODs that you feel are not relevant to your project. Prepare a new tidied A3 sheet with your re-organized CODs ready for discussion with instructors during critique sessions (complete within the studio hours).

After completing your re-evaluation, continue with your concept development and/or research activities in order to prepare for the preliminary jury.

Do not forget to upload your PDF file to ODTUClass by 23:59 today (18 April 2022, Monday).

K. Brief of the Preliminary Jury

METU Faculty of Architecture Department of Industrial Design
Spring 2021-22 | ID 402 Graduation Project | Section B
[redacted]

18 April 2022

PRELIMINARY JURY

The Preliminary Jury is the second formal evaluation of your Graduation Project, constituting 20% of the ID402 grade. At this point, you are expected to demonstrate progress in developing **TWO coherent design concepts**. The term **'coherent'** refers to a **'unified whole'**, emphasizing the need to synthesize (bring together) a wide range of design considerations into a single concept, such as: responding to prioritized user needs, usage scenarios, product form, product features, UI/UX, anthropometrics, technologies, materials, etc. On the other hand, an incoherent concept would be lacking such synthesis: it would appear as a collection of ideas that are disconnected without integration into a single product/solution.

The jury timetable has been announced earlier in the semester, showing which students will present at which session. External advisors are invited to attend the Preliminary Jury. Students are required to attend the jury in person, face to face.

SESSION 1: MONDAY 25 APRIL (Morning)
SESSION 2: MONDAY 25 APRIL (Afternoon)
SESSION 3: THURSDAY 28 APRIL (Afternoon)

REQUIREMENTS

You are required to prepare a presentation within Miro (using Miro's frames and presentation mode), explaining TWO coherent design concepts (**Concept A, Concept B**).

These concepts should be sufficiently different to provoke a wide range of critique and evaluation. You will decide after the jury which is the overall stronger concept – or in some cases – which elements of each concept might be combined to create a new and preferable hybrid Concept A+B.

There is no limit on the total number of frames (sheets) you may present. However, since each student will be allocated a jury slot lasting only 15 minutes, your presentation should last no longer than 6-7 minutes, leaving the remaining 8-9 minutes for questions and answers. **Please rehearse to make sure you communicate your key messages and do not overrun.**

At the jury, you will share your Miro screen over Zoom. Use 'A3 landscape' sized frames and the following presentation structure.

1. One frame containing **YOUR NAME**, the name of your **EXTERNAL ADVISOR**, your most up-to-date **PROJECT STATEMENT**, and your **PRODUCT/SERVICE NAME**.
2. Maximum two frames containing essential information on your **TARGET USER GROUP**. You are free to decide what that information will be and how it will be communicated. Make sure the information is highly relevant to your project.
3. A set of frames that explain **CONCEPT A.** Storyboards may be helpful to explain the usage scenario. Exploded views and sections may be useful to indicate internal components and highlight technological or working principles. Section drawings must be drawn to scale.

   Please include human figures, hands, etc., in your visualizations, drawn to scale, to illustrate size, interaction, ergonomic constraints, etc. On-product graphical user interfaces (GUIs) and mobile app concepts must be visualized to scale.

   Where appropriate, justify your approach, design rationale, individual design features, etc., by making reference to your research findings.

Use sketching, CAD modeling, renderings, vector graphics programs, mock-ups etc., to visualize your concept.

We expect 3D explorations for the concept; bring your mock-ups to the jury.

In your presentation please include your interpretation of the 2022 Graduation Projects Section B theme "creative crossovers".

4. The same as (3) but for **CONCEPT B.**

For Graphical User Interface (GUI) or App-only Projects

Students with GUI/app-only projects will provide specific content such as customer journey map, concept and design system in their draft form. Instead of technical drawings, the presentation for app-only projects will also include draft information architecture, flow diagram(s) and low-fidelity mockups prepared for user trials.

Students are expected to get familiar with the relevant software (InVision Studio, Figma or Adobe XD file).

Customer Journey Map (CJM)
CJM includes the following content items:

- Persona: A brief description of the persona including age, sex, occupation, digital literacy level, lifestyle, marital status, education level, etc.
- Scenario: A scenario integrated into the customer journey map. The scenario should address user actions and goals. The scenario may be described as a timeline consisting of pre-service, service and post-service phases.
- Touchpoints: Description of physical, digital and human elements that are in touch with the target user at different phases.
- Feelings and emotions explained with annotations: Description of feelings and emotions that users face at different phases and why they feel that way.
- Benefits: The benefits and opportunities that the solution provides the users with at different phases of the journey.

Information architecture is a visual representation of the structure of the app, organizing the features and displaying the hierarchy among them.

Flow diagram highlights all the critical tasks designed for the app, using conventional flow chart notation and symbols.

Concept and Design System
An introduction of the app, its design system (color palette, typeface, icons, buttons, notifications, visualizations, etc.), main features, target users, social, technological and cultural context. The name and logo of the app, its objective and major benefits. Critical snapshots to describe the visual identity of the app, and the main operational features of the user interface and the flow.

Please also refer to the examples we provided from previous year's projects.
(https://drive.google.com/drive/folders/1sXN99mcNooJIY0GxXJWgRaLw2036-AZP?usp=sharing)

SUBMISSION

Your Miro presentation frames should be exported as a PDF and uploaded to ODTUClass **no later than 08:00 on Monday 25 April** (Sessions 1 and 2 students) or **08:00 on Thursday 28 April** (Session 3 students).

ASSESSMENT (20%)

Assessment will be made against the following criteria.

- Quality of conceptual thinking, regarding **usage scenarios, sensitivity to user needs** and overall **design contribution / innovation.**
- Strength of **connections** between project statement, supportive research, user requirements and design concepts.
- Evidence of **prioritized features** amongst the concepts (i.e. main/headline points versus supportive/additional points).
- Quality of **communication** (visuals, renderings, infographics, mock-ups, oral presentation, timekeeping, and discussion).

L. Brief of the Final Screenings

METU Faculty of Architecture Department of Industrial Design
Spring 2021-22 | ID 402 Graduation Project | Section B

[redacted]

17 May 2022

FINAL SCREENING (10%)

All final screening sessions will be conducted face-to-face in the studio, including Thursdays.

Final Screening is a very important process during which instructors and students discuss how best to finalize and present the graduation project. Final Screening comprises three separate stages:

- Project Statement & Summary (23 & 26 May 2022)
- Final Screening for Design Details (5%) (23 & 26 May 2022)
- Final Screening for Presentation (5%) (30 May & 2 June 2022)

Permission to exhibit your project is given ONLY if you satisfy the requirements of ALL THREE final screening stages.

1. PROJECT STATEMENT & SUMMARY

You are required to provide a finalized project statement, product/proposal name, as well as a maximum 80-word summary of the major points of your design proposal, to take place in the **2022 Graduation Projects Catalogue.** The statement and the summary must be prepared both **in English and Turkish.**

Please pay special attention to making sure that the text is **well written in both languages**. The English and Turkish versions **must also be synchronized**: In other words, they should be a translation of each other and "say the same thing." The synchronization and quality of the text, as well as spell checking, is **your responsibility.** Instructors will make only minor checks and edits.

You will be informed when the checking/editing process is completed, so that you can use the final versions for your graduation project posters, final jury presentation, video, etc. The final version will also be used in the Graduation Projects Catalogue.

SUBMISSION (Google Spreadsheet)

09:00 MONDAY, 23 MAY 2022 (SESSIONS 1&2)
09:00 THURSDAY, 26 MAY 2022 (SESSION 3)

Please provide the requested information using the Google spreadsheet link below. You are also requested to provide a professional email address and mobile telephone number, to be included in the catalogue.

https://docs.google.com/spreadsheets/d/1oRYvRiuXnNsDmZH0MBwJA8a9ZgKtZbbO/edit?usp=sharing&ouid=108314951854785940700&rtpof=true&sd=true

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2. FINAL SCREENING FOR DESIGN DETAILS

SUBMISSION (ODTUclass)

09:00 ON MONDAY, 23 MAY 2022 (SESSIONS 1 & 2)
09:00 ON THURSDAY, 26 MAY 2022 (SESSION 3)
File naming format: Surname_Name_Final Screening_Design Details

This stage of final screening takes place as a scheduled critique with instructors. The objective is to have a discussion over **the details of your product / service / application**. By details, what is referred to is, for example, refined usage scenarios and storylines of use; translating product surfaces into manufacturable components; making final choices of colours, materials, finishes and manufacturing processes; methods for assembling components; product controls and feedback; and GUI (graphical user interface) designs.

Final screening for design details is carried out very much like a regular critique but is graded, based on how well details have been resolved. **It constitutes 5% of the ID402 grade**.

SCREENING SCHEDULE
The announced semester jury timetable will be used for the screening.
SESSION 1: MONDAY, 23 MAY (Morning)
SESSION 2: MONDAY, 23 MAY (Afternoon)
SESSION 3: THURSDAY, 26 MAY (Afternoon)

Format: 90 x 110 cm, landscape, **black & white printout.** Use the template provided on ODTUclass.

We recommend you also **have the following items ready to show on your laptop during the session.**

ITEM		FURTHER INFORMATION
1.	3D CAD Models	Have your CAD modelling program open. Instructors may want to see how you have modelled the product, what the separate components are, and how they are assembled.
2.	Product Renderings	Place several renderings of your design proposal in Miro, taken from good camera positions, so that your design can be quickly understood.
3.	Graphical User Interfaces (GUIs), Apps, Games	If your product uses a GUI, or especially if you are working on mobile apps or games, you can open your specialist applications such as InVision Studio, Figma, Sketch, Adobe XD, etc. This way you can interactively talk through the intended interactions. You may also/alternatively prepare a series of screenshots in Miro to show how the GUI/app/game will look and work.

3. FINAL SCREENING FOR PRESENTATION

SUBMISSION (ODTUclass)

09:00 ON MONDAY, 30 MAY 2022 (SESSIONS 1 & 2)
09:00 ON THURSDAY, 02 JUNE 2022 (SESSION 3)
File naming format: Surname_Name_Final Screening_Presentation Boards

The purpose of final screening for presentation is to give feedback to students on how to effectively communicate their final design proposal. **The design proposal itself will not be critiqued. This stage of final screening constitutes 5% of the ID402 grade.**

Feedback and grading will be provided in relation to **completeness, messages, layout, graphics, English (and Turkish),** and **general communication quality.** Presentation boards that are relatively complete at final screening will receive more detailed feedback and higher grades.

SCREENING SCHEDULE

The announced semester jury timetable will be used for the screening.

SESSION 1: MONDAY, 30 MAY (Morning)
SESSION 2: MONDAY, 30 MAY (Afternoon)
SESSION 3: THURSDAY, 2 JUNE (Afternoon)

Format: 90 x 110 cm, landscape, **black & white printouts.** Use the template provided on ODTUclass.

SPECIFICATIONS FOR PRESENTATION BOARDS

An example board from a previous graduation project is given below.

The boards must be prepared using the template provided on ODTUclass and exported as a high-quality PDF for submission. Full specifications for the board are given in the following table.

[redacted]

GENERAL	
Submission File Format:	JPG (high quality)
Colour Space:	RGB (not CMYK)
Physical Size:	110 cm x 90 cm
Resolution:	200 DPI
Digital Size:	8661 x 7087 pixels
Language:	English (optional addition: Turkish)
HEADER (DO NOT EDIT)	
Background:	White
Left Align:	METU emblem, followed by text "METU DEPARTMENT OF INDUSTRIAL DESIGN"
Right Align:	Text "ID402 GRADUATION PROJECT SPRING 2021-22"
Divider:	Thin edge-to-edge grey horizontal line
CENTRAL AREA	
General:	This is the area in which you will present your project.
Margins:	20 mm left and right margins (except for non-critical images/graphics, which may continue to the edges)
FOOTER (EDIT ONLY YOUR NAME AND YOUR EXTERNAL ADVISOR'S LOGO/EMBLEM)	
Divider:	Thin edge-to-edge grey horizontal line
Background:	White
Left Align:	Text [Student Name]
Right Align:	Text "Project Advisor:" and then logo/emblem of the external advisor

[redacted]

CONTENT & LAYOUT OF PRESENTATION BOARDS

Start by sketching ideas for layout and content of the 'central area' of the presentation board. Use a grid system as the basis for your board layout. Ensure that elements align to the grid. Choose fonts that are contemporary and readable. Do not use METU corporate font. All images should be high resolution. Do not use copyrighted or 'stock' images (e.g., Flickr, iStockphoto) unless you have permission from the copyright holder or have paid for reproduction rights. We strongly encourage students to develop their own graphic art, especially for visual material characterising the app, GUI or game, rather than using (copyright-free) material from digital platforms.

The content of your board will differ, depending on whether you have worked on a product design project or a GUI/app-only/game design project. Please follow the advice below.

Product Design Projects

We expect the following content to be shown on the presentation boards.

Board 1 (Concept Board)

- Name (logotype) of your design proposal and finalized project statement
- Main rendering showing your design proposal in its intended environment / in use
- Brief explanation of who your target users are, and key research findings (to justify your project area)
- Usage scenario(s) / interaction storyline
- Renderings that highlight user-product interaction and product features
- Description of any technologies that are essential to the product functionality

Board 2 (Technical Board)

- Contains product name / logo
- Exploded view(s) of product assembly with component names, materials, manufacturing processes and joining methods.
- Interface details
- Mechanical details
- Technical drawings

In addition, please take the following advice into consideration.

- **Mechanical or Internal Details.** It can be helpful to use ghosted or cutaway renderings. If you have Graphical User Interfaces (GUIs) on your product, or you have developed an app as part of your final design, show screenshots for key points of interaction.
- **Communication of Product Space.** If your product proposal will be placed in a specific space (e.g., furniture in a lounge, sanitary ware in a bathroom, coffee maker in a bar, kitchen in a studio flat, equipment in a playground), make sure that you properly communicate the relation between your design proposal and that space. In other words, communicate the layout, size, position, circulation, interaction, etc., shared between your design proposal and its intended surroundings. This might be in orthographic plan view, as well as in perspective visualizations.
- **Human Figures.** Make sure that you include human figures, or close-ups of user-product interaction with hands, etc., in your visuals. Without these, product proposals appear isolated and not user-centred. Properly proportioned human figures placed within side views can assist ergonomics evaluation such as size, position, reach, etc.

GUI/App-only/Game Design Projects

Students carrying out **GUI/app-only/game design projects** need to integrate the following components into their presentation boards.

- **Name (logotype) of your design proposal** and finalized project statement.

- **Customer Journey Map (except for game design projects).** CJM should include the following content items:

Persona: Provide a brief description of your persona including age, sex, occupation, digital literacy level, lifestyle, marital status, education level, etc.

Scenario: Integrate your scenario into the customer journey map. Your scenario should address user actions and goals. Preferably you may describe your scenario as a timeline consisting of pre-service, service and post-service phases.

Touch points: Indicate physical, digital and human elements that are in touch with the target user at different phases.

Feelings and emotions explained with annotations: Describe the feelings and emotions that users face at different phases and why they feel that way.

Benefits: Indicate the benefits and opportunities that your solution provides the users with at different phases of the journey.

- **Game design** project presentations must include storyboards and snapshots describing the game structure, actions, game objectives, gamer experience, and graphics such as landscape, objects, characters, dashboard, pop-ups, weather, etc.

- **Concept and Design System**. Introduce your app, its design system (color palette, typeface, icons, buttons, notifications, visualizations, etc.), main features, target users, social, technological and cultural context. Make sure that your presentation includes the name and logo of your app, its objective and major benefits. Use critical snapshots to describe the visual identity of your app and communicate the main operational features of the user interface and the flow.

- **Information Architecture, Flow Diagram and other details** should be included in the technical board.

M. Brief of the Final Jury

METU Faculty of Architecture Department of Industrial Design
Spring 2021-22 | ID 402 Graduation Project | Section B
[redacted]

30 May 2022

FINAL JURY SUBMISSION REQUIREMENTS

After a two-year break because of COVID-19 restrictions, this year we will return to a physical (face-to-face) Graduation Projects Exhibition and Final Jury. The final jury requirements are listed in the table below. All students are required to prepare two presentation boards (concept, technical). Additionally, students are required to prepare a minimum of one of the listed 'other' items. Students should choose which 'other' item(s) to create, according to the needs of their project, available resources, skills, interest, etc. See the next page for the submission schedule.

COMPULSORY	
Concept Presentation Board	90 x 110 cm board (Adobe Illustrator template and fonts were provided through ODTUclass.) Language: English (optional addition: Turkish) Resolution: 200 DPI (i.e. pixel dimensions: 7087 x 8661) Colour: RGB File format: JPG (high quality)
Technical Presentation Board	90 x 110 cm board (Adobe Illustrator template and fonts were provided through ODTUclass.) Language: English (optional addition: Turkish) Resolution: 200 DPI (i.e. pixel dimensions: 7087 x 8661) Colour: RGB File format: JPG (high quality)
OTHERS (CHOOSE AT LEAST ONE)	
Physical Model or Physical Prototype	Full-size (1:1) or scaled. You should have a 'Plan B', in case 'Plan A' goes wrong.
Interactive App/GUI/Game Design Prototype	Full-size (1:1) to allow interactive evaluation by jury members. Language: English (or Turkish) You must prepare the prototype file with assets embedded and segue animations included, using e.g., InVision Studio, Figma, Adobe XD. You must provide a web address to the prototype published on the application website (e.g., invisionapp.com, figma.com, xd.adobe.com). The studio team will create a QR code for access.
Product/App/GUI/Game Design Animation or Video	Duration between 1 and 3 minutes. Language: English (preferably with Turkish subtitles) Minimum 1280 x 720 pixels, ideally Full HD 1920 x 1080. File format: MP4, M4V, MOV, or MPG You must provide the video file itself. The studio team will create a QR code for access.

[redacted]

CATALOGUE MATERIALS

Submission to ODTUClass: 6 June 2022, Monday, 23:59.

Project Visual: Submit a project visual to be used in the Graduation Projects Catalogue. Your visual should communicate your project concept clearly. It should not contain any logo or text as the following page will contain your project description. Make sure you use high-resolution images. Do not place critical elements close to the edges. Do not frame your visual, use the full image area.

You may check the examples from the previous years' catalogues at the following address: <https://id.metu.edu.tr/en/project-catalogs/>

Specifications: 14.5 x 19.5 cm (1713 x 2303 pixels), landscape orientation, 300 dpi, JPG format.

File naming format: Surname_Name_Project Visual_Catalogue

SUBMISSION OF CONCEPT AND TECHNICAL PRESENTATION BOARDS

Digital submission to ODTUClass: 6-9 June 2022, Monday to Thursday.
Digital submissions end on 9 June 2022, Thursday, 23:59. After the deadline, the course late policy will apply. No more digital submissions will be allowed after 13 June 2022, Monday, 08:40.

File naming format: Surname_Name_Final Jury_Presentation Boards

Print-out submission: Room 429, 6-9 June 2022, Monday to Thursday, 09:00-17:00.
Starting from 10th of June, Friday, the course late policy will apply. No print-out submissions will be received over the weekend. No more print-out submissions will be accepted after 13 June 2022, Monday, 08:40.

For GUI/App-only projects

As explained in the final screening handout, the students with GUI/app-only projects will provide specific content such as **customer journey map, concept and design system**. Instead of technical drawings, the presentation for app-only projects will also include **information architecture, flow diagram**(s) and the **prototype file** with assets embedded and segue animations included (InVision Studio, Figma or Adobe XD file) together with the **link** to the prototype published at the application's website (e.g. invisionapp.com, figma.com, xd.adobe.com).

Customer Journey Map. CJM should include the following content items:
Persona: Provide a brief description of your persona including age, sex, occupation, digital literacy level, lifestyle, marital status, education level, etc.

Scenario: Integrate your scenario into the customer journey map. Your scenario should address user actions and goals. Preferably you may describe your scenario as a timeline consisting of pre-service, service and post-service phases.
Touchpoints: Indicate physical, digital and human elements that are in touch with the target user at different phases.
Feelings and emotions explained with annotations: Describe the feelings and emotions that users face at different phases and why they feel that way.
Benefits: Indicate the benefits and opportunities that your solution provides the users with at different phases of the journey.

Concept and Design System. Introduce your app, its design system (color palette, typeface, icons, buttons, notifications, visualizations, etc.), main features, target users, social, technological and cultural context. Make sure that your presentation includes the name and logo of your app, its objective and major benefits. Use critical snapshots to describe the visual identity of your app and communicate the main operational features of the user interface and the flow.

Information Architecture. Highlight the elements of your own contribution and separate them from the elements belonging to other apps.

Flow Diagram. Highlight all the critical tasks you designed for the app, using conventional flow chart notation and symbols. Please also refer to the examples we provided from previous year's projects.

Game Design Projects

Game design project presentations must include storyboards and snapshots describing the game structure, actions, game objectives, gamer experience, and graphics such as landscape, objects, characters, dashboard, pop-ups, weather, etc. Game design project presentations do not have to include customer journey map or information architecture. If relevant, game design project presentations may include flow diagrams.

SUBMISSION OF OTHER MATERIAL

Submission of Physical Models

Submission of physical models: 20 June 2022, Monday, 11:00, at METU Culture and Convention Center.

Photos of the physical models or prototypes will be submitted to ODTUClass as a separate file.

Digital submission of photos of physical models to ODTUClass: 24 June 2022, Friday, 23:59.
File naming format: Surname_Name_Final Jury_Physical Model

Submission of Interactive Prototypes and Videos

Submission of digital prototype links to the excel folder shared on ODTUClass: 20 June 2022 Monday, 9:00.

Submission of videos and/or animations to ODTUClass: 20 June 2022, Monday, 09:00.
File naming format: Surname_Name_Final Jury_Video

The course late policy will apply to all late submissions.

File Format: Max. 3-minute MP4, MOV, MPG etc. (min. 1280 x 720 pixels, ideally Full HD 1920 x 1080)

Video size can be optimized via Adobe Media Encoder, HandBrake, VLC or similar encoding applications.

You are free to use any graphical and video-creation techniques you like. Where appropriate, use subtitles/captions to explain the visuals. You must obtain permission to use copyrighted material (e.g. images, soundtracks that are not your own). The overall aim is to clearly tell what your product/service is and give a 'tour' of its main functions/features. Your video must be structured into four parts:

Part 1: Introduction. Include: "METU Department of Industrial Design ID402 2021-2022 Graduation Project", student name, external Advisor, product/app/game name, project statement, background/outline of need, conclusion from research, profile of target users.

Part 2: Design process. Give a visual summary of some of the activities you carried out during your project, e.g. photos/videos from field studies, making or testing mock-ups, important sketches, other anecdotes or 'outtakes' that can be fun or insightful.

Part 3: Outline of product/app/game design (description and features). Include: (i) 'walk around' of product CAD model, as if viewing a physical model at an exhibition; (ii) animation of dynamic aspects of final design (e.g. moving parts, connections, illumination, sound, interfaces); (iii) product-user interaction (how is it used?). Depending on your preference, Part 3 may be created from a series of still images or a specially prepared CAD-based animation.

For GUI/app-only/game design projects, show the main features and provide a walk-through of main tasks; you may do this with the support of acting out of a scenario. Please note that you are also expected to use the video for walking us through the highlights of your design process.

Part 4: Acknowledgements. Give credit to the individual people/organizations who have helped you in your project.

SUBMISSION OF PROJECT PROCESS PORTFOLIO

Submission to ODTUClass: 04 July 2022, Monday, 17:00.
File naming format: Surname_Name_Process Portfolio.PDF

Submit your project process portfolio, as explained in the "ID402_2021-22_Course Syllabus and Graduation Projects Introduction" file uploaded to ODTUClass at the beginning of the semester.

N. ID402 Graduation Project Course Calendar

MIDDLE EAST TECHNICAL UNIVERSITY
DEPARTMENT OF INDUSTRIAL DESIGN

2021-2022 SPRING SEMESTER / SECTION B

ID402 GRADUATION PROJECT COURSE CALENDAR

Week	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SAT	SUN
1	7 MARCH SUBMISSION > Poster (Draft) Poster Critique	8	9	10 COURSE HANDOUTS Introduction to Graduation Projects Process	11	12	13
2	14 ¤ FINALIZED POSTER SUBMISSION > Poster (Finalized) * WORKSHOP 1	15	16	17 ¤ WORKSHOP 2	18	19	20
3	21 ¤ WORKSHOP 3	22	23	24 ¤ Voting for Poster	25	26	27
4	28 INITIAL IDEAS JURY *	29	30	31 INITIAL IDEAS JURY *	1 APRIL	2	3
5	4 ¤ WORKSHOP 4	5	6	7 ¤	8	9	10
6	11 ¤ ADVISOR CRITIQUE WEEK	12	13	14 ¤ ADVISOR CRITIQUE WEEK	15	16	17
7	18 ¤	19	20	21 ¤	22	23 National Holiday	24
8	25 PRELIMINARY JURY *	26	27	28 PRELIMINARY JURY *	29	30	1 MAY National Holiday

Items marked '*' are graded. ¤ = Critiques with studio instructors. ‡ = Students are expected to work on their final submission.

MIDDLE EAST TECHNICAL UNIVERSITY DEPARTMENT OF INDUSTRIAL DESIGN
2021-2022 SPRING SEMESTER / SECTION B / ID402 GRADUATION PROJECT COURSE CALENDAR

Week	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SAT	SUN
9	2 Religious Holiday	3 Religious Holiday	4 Religious Holiday	5 ¤	6	7	8
10	9 ¤	10	11	12 ¤	13	14	15
11	16 ¤	17	18	19 National Holiday	20	21	22
12	23 SUBMISSION > Project Statement & Summary EN & TR FINAL SCREENING (DESIGN DETAILS) ∗	24	25	26 SUBMISSION > Project Statement & Summary EN & TR FINAL SCREENING (DESIGN DETAILS) ∗	27	28	29
13	30 SUBMISSION > Images for Exhibition Catalogue FINAL SCREENING (PRESENTATION) ∗	31	1 JUNE	2 FINAL SCREENING (PRESENTATION) ∗	3	4	5
14	6 ‡ ¤ SUBMISSION > Finalised Presentation Poster Information for Exhibition	7 ‡	8 ‡	9 ‡ ¤	10 ‡	11	12
15	13 ‡ ¤	14 ‡	15 ‡	16 ‡ ¤	17 ‡ *Last day of classes*	18	19
16	20 *Graduation Exhibition* *SET-UP*	21 *Graduation Exhibition* FINAL JURY ∗	22 *Graduation Exhibition* FINAL JURY ∗	23 *Graduation Exhibition* FINAL JURY ∗	24 *Graduation Exhibition* FINAL JURY ∗	25	26
17	27	28	29	30	1 JULY	2	3
18	4 SUBMISSION > Project Process Portfolio ∗ Completion Form ∗	5	6	7	8	9 Religious Holiday	10 Religious Holiday

N.B. Tuesday, 12 July 2022 - Deadline for submission of final grades

Items marked '∗' are graded. ¤ = Critiques with studio instructors. ‡ = Students are expected to work on their final submission.

O. Semi-Structured Interview Guide for Students (Conducted in Turkish)

Endüstriyel Tasarım Eğitimi Hakkında Sorular

- Sizce ODTÜ'deki endüstriyel tasarım eğitimde bu alana yaklaşım ne yönde? Yeterli mi? Geliştirilmesi gerekiyorsa ne şekilde ve yönde?
- Başka okullarda bu konunun nasıl ele alındığı hakkında varsa bilgilerinizi paylaşır mısınız?

Dijital Ürün Geliştirme Hakkında Sorular

- Bitirme projenizin oluşma süreci hakkında bilgi verebilir misiniz? Tasarım konunuzu nasıl belirlediniz? (Konuyu vurgulayan kullanıcı profili / ana temayı / hedefi nasıl belirlediniz?)
- Dijital ürün tasarladığınız bu sürecin farklı aşamalarındaki deneyimlerinizden ve yeni birikimlerinizden bahsedebilir misiniz?
- Bu süreçte neler öğrendiniz? Bu sürecin olumlu ve olumsuz yönlerinden bahsedebilir misiniz?
- Bilgi mimarisi / akış şeması / kullanıcı arayüzü / dijital şablon / dijital prototipleme aşamalarınızdan bahsedebilir misiniz?

Kullanıcı Araştırması Hakkında Sorular

- Bu süreçte kullanıcıları nasıl belirlediniz? Profili nasıl tanımladınız?
- Kullanıcılardan bahsettiniz, bu kişilerin proje üzerinden hareketle ihtiyaçları hakkında neler söyleyebilirsiniz?
- Kullanıcıların ihtiyaçları hakkında ne tür araştırmalar yürüttünüz?
- Kullanıcıların ihtiyaçlarını projeye nasıl dâhil ettiniz?

Kapanış Soruları

- Sizin gibi ileride bu alanda bitirme projesi yapacak kişilere önerileriniz nelerdir?
- Etkileşimli ürün tasarlamaya başladığınızdan beri alana dair düşüncelerinizde bir değişiklik oldu mu?
- Benim sorularım bu kadar. Sizin çalışmayla ilgili eklemek istedikleriniz veya herhangi bir öneriniz var mı?

P. Semi-Structured Interview Guide for Students (Translated into English)

Questions Regarding Industrial Design Education

- What do you think about the METU Department of Industrial Design's approach to digital product development in industrial design education? Is it enough? In what way and direction if it needs to be improved?
- Do you have any information on how this issue is handled in other departments at other universities? If so, can you share them?

Questions Regarding Digital Product Development

- Can you give information about the starting point of your graduation project? How did you choose the design topic? (How did you determine the user profile / main theme / target that highlights the topic?)
- Can you tell me about your new experiences at different stages of this process where you are designing a digital product?
- What did you learn in this process? Can you talk about the positive and negative aspects of this process?
- Can you talk about your information architecture / flow diagram / UI / wireframing / digital prototyping phases within your graduation project?

Questions Regarding User Research

- How did you identify the users in this process? How did you define the profile group?
- You mentioned the users, what can you say about their needs based on the project?
- What kind of research have you conducted about users' needs? What methods / tools did you use?
- How did you include your user group's needs in your graduation project?

To Wrap-Up…

- What are your suggestions to students who will do a graduation project in this field in the future like yourself?
- Have your thoughts on the digital product development changed since you started designing digital products?
- That is all for my questions. Do you have anything to add or any suggestions about the study?

Q. Semi-Structured Interview Guide for Academics (in Turkish)

Endüstriyel Tasarım Eğitimi Hakkında Sorular

- Sizce dijital ürün geliştirmenin endüstriyel tasarım eğitiminde yeri nedir?
- Bölümünüz tasarım eğitiminde dijital ürün geliştirmeye nasıl yaklaşıyor?
- Diğer okullar nasıl yaklaşıyor?
- Eğitimde dijital ürün geliştirme sürecini yürütürken neler yapılmalı veya neler yapılmamalı?
- Geçtiğimiz mezuniyet projeleri dönemini nasıl değerlendiriyorsunuz?
- Öğrenciler dijital ürün geliştirme sürecine ne derece hâkimdiler? Bu durum projelerini nasıl etkiledi?

Dijital Ürün Geliştirme Hakkında Sorular

- Sizce dijital ürün geliştirme süreci yürüten öğrenciler fiziksel ürün tasarımı içeren bir proje üzerinde çalışan öğrencilerden hangi noktalarda farklılıklar gösterdiler?
- Sizce fiziksel ürün tasarımı ile dijital ürün tasarımı süreçleri birbirlerinden ne şekilde farklı?
- Dönemi kurgularken nasıl bir yöntem izlediniz?
- Öğrencilerinizi süreci yönetirken nasıl yönlendiriyorsunuz?
- Öğrencileri değerlendirme kriterleriniz nedir?
- Süreç içinde ne gibi sıkıntılar ortaya çıktı ve bunları nasıl ele aldınız?

Kullanıcı Araştırması Hakkında Sorular

- Kullanıcı araştırması dijital ürün içeren proje sürecinde nasıl işleniyor?
- Öğrenciler kullanıcı araştırmalarında ne gibi yöntemler izlediler?
- Kullanıcıları hangi aşamalarda ve ne şekilde tasarım süreçlerine dâhil ettiler?

Kapanış Soruları

- İleride bu alanda mezuniyet projesi yapacak öğrencilere önerileriniz nelerdir?
- İleride bu alanda mezuniyet projesi yürütecek öğretim elemanları için önerileriniz nelerdir?
- Benim sorularım bu kadar. Sizin çalışmayla ilgili eklemek istedikleriniz veya herhangi bir öneriniz var mı?

R. Semi-Structured Interview Guide for Academics (in English)

Questions Regarding Industrial Design Education

- What do you think on the place of digital product development in industrial design education?
- How does METU department of ID approaches digital product development?
- Do you know any other departments' approaches on the subject?
- What should or should not be done while carrying out the digital product development process in industrial design education?
- What do you think about, and how do you evaluate the last semester's graduation projects?
- To what extent did the students master the digital product development process? How did this affect their graduation projects?

Questions Regarding Digital Product Development

- In what ways do you think the students working on the digital product design differed from the students working on physical product design?
- How do you think physical product design and digital product design processes differ from each other?
- How did you construct the semester? Alternatively, how did you plan the process?
- How do you guide your students in the process?
- What are your criteria for evaluating students?
- What difficulties appeared during the process and how did you handle them?

Questions Regarding User Research

- How user research is handled in the graduation projects?
- What methods did the students use in their user research?
- At what stages and in what way did they involve users in the design process?

To Wrap-Up...

- What are your suggestions to students who will chose to do a digital product related graduation project in the future?
- What are your suggestions for the instructors who will carry out a graduation project in this field in the future?
- That is all my questions. Do you have anything to add or any suggestions about the study?

S. Semi-Structured Interview Guide for Professionals (in Turkish)

- Kendinizden ve eğitim geçmişinizden bahsedebilir misiniz? Hangi lisans programında ve/veya hangi yüksek lisans programında kaç yılında mezun oldunuz?

İş Hayatı Deneyimleri Hakkında Sorular

- Endüstriyel Tasarım eğitimi aldıktan sonra bu alanda çalışmaya sizi teşvik eden sebepler nelerdi? Bu alanda çalışmaya nasıl başladınız?
- Aldığınız eğitimden sonra bu alanda çalışmaya başladığınızda sizi şaşırtan etkenler oldu mu? Neler yaşadınız?
- İşiniz hakkında bilgi verebilir misiniz? Hangi pozisyonda, ne gibi projeler üzerinde çalışıyorsunuz?
- Çalışma ortamında tasarımcılar dışında kimler var? Nasıl bir iş bölümü yapıyorsunuz?
- Bu alanda yürüttüğünüz herhangi bir projenizi nasıl kurguladığınızı ve süreci nasıl yürüttüğünüzü anlatabilir misiniz?
- Bahsettiğiniz süreçten hareketle, eğitimde aldığınız proje geliştirme sürecinden farklı neler saptadınız?

Endüstriyel Tasarım Eğitimi Hakkında Sorular

- Sizce dijital ürün geliştirmenin endüstriyel tasarım eğitiminde yeri nedir?
- Okuduğunuz bölüm tasarım eğitiminde dijital ürün geliştirmeye nasıl yaklaşıyordu?
- Eğitimde dijital ürün geliştirme sürecini yürütürken neler yapılmalı veya neler yapılmamalı?
- Eğitim ortamında yürüttüğünüz dönem ve mezuniyet projelerinde beklentileriniz neler oldu?
- Bu sürecin olumlu ve olumsuz yönlerinden bahsedebilir misiniz? Örnek verebilir misiniz?
- Bu süreçler nasıl geliştirilebilir?

Kullanıcı Araştırması Hakkında Sorular

- Kullanıcı araştırması iş yaşantınızda nasıl bir yere sahip?
- Proje sürecinde kullanıcı araştırması için ne gibi yöntemler izliyorsunuz?
- Kullanıcılar hangi aşamalarda ne şekilde sürece dâhil ediyorsunuz?
- Üzerinde çalışmış olduğunuz bir proje üzerinden kullanıcı araştırmasının yeri için örnek verebilir misiniz?

Kapanış Soruları

- İleride bu alanda çalışmak isteyen öğrencilere önerileriniz nelerdir?
- Bu alanda eğitim verecek öğretim elemanları için önerileriniz nelerdir?
- Benim sorularım bu kadar. Sizin çalışmayla ilgili eklemek istedikleriniz veya herhangi bir öneriniz var mı?

T. Semi-Structured Interview Guide for Professionals (in English)

- Can you tell me about yourself and your educational background? When and which undergraduate program and/or which master's program did you graduate in?

Questions Regarding Professional Experiences

- What were the reasons that encouraged you to work in this field after studying (industrial) design (or your major field)? How did you start working in this field?
- Were there any factors that surprised you when you started working in this field after your education? What did you experience?
- Can you give information about your job? In which position do you work in? What kind of projects are you working on?
- Who is in your work environment other than designers? How do you manage the division of work with these people?
- Can you tell me how you set up any of your projects at work, and how you carried out the development process of the project?
- Based on the process you mentioned, what did you determine that was different from the project development process you received in (design) education?

Questions Regarding Industrial Design Education

- In your opinion, what is the place and role of digital product development in industrial design education?
- How did your undergraduate department approach digital product development in design education?
- What should or should not be done while carrying out the digital product development process in education?
- What were your expectations in the semester and graduation projects that you took part as a consultant in the education environment?
- Can you talk about the positive and negative aspects of this process? Can you give an example?
- How can this process be improved?

Questions Regarding User Research

- What place does user research have in your professional life?
- What types of methods do you follow for user research during the project development process?
- At what stages, and how do you include users in the product development process?

- Can you give an example of the user research phase on a project you have worked on?

To Wrap-Up…

- What are your suggestions to students who want to work in this field in the future?
- What are your suggestions for the academics or instructors who will teach in this field?
- That is all for my questions. Do you have anything to add or any suggestions about the study?

U. Complete Code Table for Online Surveys in MaxQDA

MAXQDA 2022

Code System

Code System	**992**
User Friendly	7
Academic Comments (Critiques)	3
Satisfaction / Motivation	5
User Profile (Updated)	9
Real Time Examples	3
Motivation & Need	2
Surprised	4
Dissatisfaction	7
Educating User Group	2
Impact of Summer Internships/Practices	1
Lack of Interaction (Integration)	1
Lack of Products	1
User Centered Design	1
Attraction	1
Wayfinding	1
Simplification	1
Financial Wellbeing	4
Industry Collaboration	3
Shared Knowledge	1
Experiences Differ	1
Communication Problems	3
Mental (& Physical) Wellbeing	1
First Hand Experience	2
User Needs	21
User Profile	21
Community Building ?	3
Interaction	9
Exciting	13
Novelty	2
Socialization	12
Community	7
Remote Working	1
Working Abroad	1
Repetition	1
User Problems	15
(High) Technology Literacy	10
Ergonomics	1
Usability	5

MAXQDA 2022

Code System

Open Source	3
Importance of Social Media	3
Problem	2
Empathy	2
Time Management	12
Company Perspective	9
Financial Problems	7
Visualization	6
UX/UI	6
Accessible	6
Gamification	4
Design for Children	5
Design for Society	1
Creativity	3
Ideation	6
Sustainability	7
Unfamiliarity - Lack of Knowledge	7
Wireframes and Usability Tests	3
Lack of Knowledge	10
Social Inclusion - Empowerment	7
System Design	1
Teamwork	4
UI	8
Importance of Design Process	9
Further Career	3
Advantage	4
Disadvantage	14
Design Tools/Softwares	4
Possible Project Opportunities	19
Social Awareness	3
Different perspectives	3
Customization	2
Collaboration in Design	3
Developing Habits	9
Sense of Belonging	3
Financial Visibility	2
Service Design	1
Lack of Representation - Empowerment I...	2
Economic Issues	2

V. Graduation Project Submission Analysis Board on Miro

W. Quotations and Conversations (in Turkish)

Quotations from the Online Surveys

[1] “Aynı konuyla ilgili başka bir ürünün olmaması, çocuklara yönelik olduğu için eğlenceli içerik içermesi, fiziksel ve dijital çözümleri bir araya getirmesi, bu zamana kadar yaptığım projelerden tamamen farklı olması.” (S#20)

[2] “Teknoloji sayesinde kullanıcı ile anlık geribildirimlerle iletişim kurabilmek.” (S#14)

[3] “Üniversite hayatım boyunca kendi yaşadığım problemlere çözüm bulabilme potansiyelim heyecanlandırıyor.” (S#12)

[4] “Türkiye’nin finans sektöründeki lider firmalarından birinde birçok senior ile birlikte çalışmak.” (S#4)

[5] “Okuldaki service design dersi, seçmeli UX dersi ve [şirket adı] içerisinde yaptığım stajın olumlu etkileri oldu.” (S#4)

[6] “Bölümümüzde genel olarak UX/UI eğitimine ağırlık verildiğini düşünmüyorum. Son bir senedir bu alanda seçmeli dersler açıldı ve projeler bu alana yönelmeye başladı. O nedenle ilk projemizde biraz kaybolmuştuk, ne yapmamız lazım nasıl ilerlemeliyiz gibi. Arayüz alanında en küçük detayın bile ne kadar önemli olduğu, insan davranışlarının önemi.” (S#10)

[7] “3. sınıfta yaptığım ilk projede süreç grup çalışması olarak ilerledi. Hakkında bilgi sahibi olmadığım için grup çalışmasıyla birlikte tanıdığım UX alanında proje sürecinde görev dağılımı yapmakta ve süreci planlamakta çok zorlandım. Kendimi bu alanda geliştirdikçe, ilk proje öncesinde ve proje sürecinde bizlerin süreç hakkında yeteri kadar bilgilendirilmediğimizi fark ettim.” (S#1)

[8] “Özel iş deneyimlerimde müşteri ve yazılımcılar ile aynı dili konuşmakta çok problem yaşadım. Gerçek hayat ile okulda aldığım eğitimin, tecrübe ettiğim deneyimin çok farklı düştüğü noktalar var.” (S#12)

[9] “Özgür bir şekilde ortaya fikir atılması beynimi dinç tutuyor ve hayal kurabildiğim için keyif alıyorum.” (S#20)

[10] “Tasarım yapacağım konu hakkındaki perspektifimi genişletmesi ve fikir aşamasında bana yardımcı olması. Kullanıcı hakkında bilmediğim şeyleri öğrenerek fikir geliştirmeme olanak sağlaması.” (S#1)

[11] “Test etme kısmında ortaya çıkardığım projenin deneyimlenmesi beni tatmin ediyor. Kağıt üzerinde fark edilemeyenler bu süreçte fark ediliyor, renk seçimi, butonların yeri…” (S#10)

[12] “Oluşan fikirler prototipe geçtiğinde oldukça değişebiliyor. Başka fikirler veya sorunlar ortaya çıkarabiliyor. Bu yüzden prototipe başlamak ilk başta zor gibi görünüyor ama içine girdikçe sorunları çözmenin veya yeni potansiyelleri fark etmenin keyifli olduğunu düşünüyorum.” (S#17)

[13] “Literatür araştırması yaparken daha önce deneyimlemediğim ve kullanmadığım kaynakları inceleme fırsatım oldu. (…) Bu çıktılar üzerine

yeni fikirler oluşturup onları çözümlemek projenin ilerleyişinde beni ileri aşamaya taşıdı.” (S#9)

[14] “İnsanların en çok şikâyetlerini belirttikleri sosyal medya platformları çok işime yaradı. Hem güncel hem yıllar içindeki sorunlara bakabildim. Hatta öğrencilerin yarattıkları çözümleri de. Kitlesel bir zihni gözlemleme fırsatı bulduğum için bu kaynaklar yardımcı oldu.” (S#11)

[15] “Kargo alanında çok fazla bilgi kargo şirketleri tarafından dışarı verilmediği için. çok fazla yazılı kaynak bulamadım. O yüzden direkt olarak kullanıcı, danışma ve hocalar ile görüştüm.” (S#22)

[16] “18 yaş üzeri Z jenerasyonu, birden fazla banka kullanan, paraya dolaylı ya da direkt sahip olan (burs, aile desteği veya çalışan), sosyal, çok arkadaş sahibi ya da arkadaşlarla gerçekleştirilen etkinliklere katılım gösteren.” (S#2)

[17] “Bir galeri tarafından temsil edilen ya da galeri temsiliyeti olmayan amatör dijital okuryazarlık düzeyi yüksek ve yeni gelişmelere sıcak bakan, güncel ve ilgili sanatçılar.” (S#9)

[18] “[gözlem metodu ile] çocukların öğrenme süreçlerini gözlemlediğim için kurgulayacağım oyun/ürün için içerik oluşturma ve nasıl kullanılabileceğine dair fikrim oldu.” (S#14)

[19] “Direkt olarak etkileşimi hissedebiliyor ve yaptığım araştırmaların somut karşılığını görebiliyorum.” (S#2)

[20] “Her aşamada araştırma çıktılarımı tekrar kontrol ederek iterasyonlar kurgularken araştırmamla çelişen veya kullanıcı kitlemle ters düşen yönleri belirlemeye çalıştım.” (S#1)

[21] “Bir kargo dağıtıcısıyla bir iş günü geçirdim. Shadowing ve interview yaptım.” (S#22)

[22] “Önce interview ile ilerleyen süreç, saha araştırması ve iletişimde kalarak kullanıcılarla ara ara mini görüşmeler yapmamla sonuçlandı. Bütünsel bir test olmasa da parça parça akışlarımı kullanıcılara prototip ile test ettirip alternatiflerden neye yakın hissettiklerini öğrenmeye çalıştım.” (S#2)

[23] “NFT sektöründe sanatçıların koleksiyonerlerle Twitter üzerinden iletişim kurduğunu ve sanatçının kendisini promote etmesinin zor olabileceği.” (S9)

[24] “[Bireylerin] Gönüllülük koşullarını ve nasıl fayda sağlayabileceklerini bilmemek [STK’lardan].” (S#10)

[25] “Dengesiz ekonomide para biriktirememe, yatırım yapacakları şeyler hakkında detaylı bilgi bulamama.” (S#4)

[26] “Finansal sıkıntı. Üretim için gerekli malzemelere ulaşımda sıkıntı. Maaşlı çalışan gibi aylık fatura ödeme. Kredi çekmekte ödeyememe endişesi. Hasat sonrası ürün pazarlama konusu.” (S#3)

[27] “Etkinliklerin ve öğrenci topluluklarının çeşitliliği, öğrencilerin kendileri için hangisinin uygun olduğunu bilememeleri. Öğrencilerin ortak ilgi alanlarına sahip insanlarla tanışamaması. Doğru kaynaklara veya yetkili kişilere ulaşamamak.” (S#13)

[28] “Projem evdeki enerji kaynaklarının verimli kullanımını teşvik edecek bir platform ortaya çıkarmak. Kullanıcı gurubumdaki çocuklar da genelde bu konuda bilinçli olmuyor veya bu konuyu önemsemiyor.” (S#17)

[29] “Carsharing app’lerinin araç ekranlarına entegre olmaması.” (S#23)

[30] “Piyasadaki ürünler fazla düşünülmemiş ve merkezine kullanıcıyı koyup tasarlanmamış ürünler; bu yüzden bu özelliklerin kullanılıp tercih edilebilirliği yüksek bir tasarım olacağını düşünüyorum. Aynı zamanda konum olan biyoloji, bilim müzelerinde yer verilmeyen bir konu; çocukların ilgisini çektiğini gördüm ve tercih edileceğini düşünüyorum.” (S#20)

[31] “[Çocukların] Basitleştirilmiş içeriklere ve açıklamalara ihtiyaçları var, oyunu fazla tercih edip öğrenmeyi arka plana atıyorlar. [Piyasada] kullanımı kolay ve anlaşılır ürünlere ihtiyaçları var.” (S#20)

[32] “Sistemde eski ve yeni bilgilerin birbirine karışması, birbiriyle bağlantılı bilgilerin kullanışlı bir şekilde organize olmaması, bilgilerin kullanıcıyla iletişiminin zayıf olması (mixed media’dan yararlanılmaması).” (S#11)

[33] “(…) Sanatçıların görünürlüklerinin artırılacağı ve işlerinin ön plana çıkarılacağı bir sistem geliştirilmeli. (…) Sanatçılar platform tarafından promote edilebilir. (…) Sanatçı özgürlüğü ve gizliliği gözetilmeli. (…) Kullanıcıların sanata ve esere erişilebilirliği artırılabilir. Kullanıcıların sanatçılarla iletişim kurabilecekleri, sanatçıların diğer sanatçılarla tanışıp kolektif işler üretebilecekleri bir platform geliştirilebilir.” (S#9)

[34] “STK’lar yönünden ise daha fazla kullanıcıya ulaşmaya çalışma, reklam ve sosyal medya çalışmaları. Daha fazla bağış ve gelir sağlama (…) STK’ların ürün satışları, gelir ve bağış kazanımları. Maddi ve manevi destek için gönüllülere ulaşma.” (S#10)

[35] “Yatırım yapacakları hisseler/projeler hakkında detaylı bilgiye erişebilme, birikim alışkanlığı oluşturma [GenZ için].” (S#4)

[36] “Yatırım sürecinde, yatırım kararı verme aşamasında kişinin kendini yalnız hissetmesi. Bundan dolayı mantıklı bir analiz süreci yürütememesi.” (S#1)

[37] “Farklı departmanlardan yeni insanlarla tanışmak. Sosyalleşmek, yeni deneyimler kazanmak ve keyifli vakit geçirmek. Fiziksel ve zihinsel sağlığın korunmasına yardımcı olur. Bir arkadaşla birlikte olmak, devamlılık için bir motivasyon ve teşvik kaynağı olabilir.” (S#13)

[38] “Sürecin sosyal hale getirilmesi. Z jenerasyonu birbirinden esinlenerek süreçleri yönetmeye ve birbirinden öğrenmeye yatkın olduğu için ürünümü süreci sosyalleştirecek şekilde kurguladım.” (S#1)

[39] “Kullanıcının kolaylıkla aradığı bilgiye ulaşması, sistemle bilgi alışverişinde bulunabilmesi, ders seçimi anının stresini azaltma, kendi ilgisine göre seçmeli dersleri bulabilmesi.” (S#11)

[40] “Kullanıcı grubumun bir aile olması sebebiyle, hem çocuklar hem de yetişkinler için anlaşılabilir, kullanılabilir ve tatmin edici bir deneyim yaşatmak en büyük ihtiyacım. Ergonomi olarak da aynı şey geçerli, çocuklar ve yetişkinler aynı ölçütte bir deneyim yaşayabilmeli.” (S#19)

[41] “Kullanıcı [deneyimi] araştırması ve fikir geliştirme oldukça önemli iki aşamaydı. Süreç içinde de birbirleriyle etkileşim içinde olduklarından projenin kümülatif bir şekilde ilerlemesine sebep oldular.” (S#9)

[42] “(…) Onlar [ders yürütücüleri] olmasa süreç içerisinde kaybolmak ve bu aşama bitti diyebilmek zor olurdu benim için. Ayrıca tasarım kararlarında

ölçülü bir şekilde hem çalışmayan yerleri benimle aynı takımdalar gibi söylemeleri hem de cesaretlendirici sözleri motivasyonum konusunda veya tasarımımı geliştirmemde yararlı oldu.” (S#11)

[43] “Danışman firma çok yönlendirmede bulunmamaya, gerçekçilik ve uygulanabilirlik sorgulamaya aynı zamanda kendilerinin sektörde karşılaştığı örneklere yer vermeye çalıştı.” (S#2)

[44] “Tamamen özgürce ve konsept olarak düşünme kısmı beni çok heyecanlandırıyor.” (S#19)

[45] “Fikir geliştirme sürecinde çok zaman kaybettiğimi düşünüyorum. Aldığım feedback’lerden sonra sürekli yeni fikir arayışına girdim ve her yeni fikrim için tekrar benchmark pazar araştırması gibi süreçleri tekrarladım.” (S#5)

[46] “Oluşan fikirler prototipe geçtiğinde oldukça değişebiliyor. Başka fikirler veya sorunlar ortaya çıkarabiliyor. Bu yüzden prototipe başlamak ilk başta zor gibi görünüyor ama içine girdikçe sorunları çözmenin veya yeni potansiyelleri fark etmenin keyifli olduğunu düşünüyorum.” (S#17)

[47] “Fikirlerimin ilerleyişinde deneyimi iyileştirme yönünde yol gösterecek (prototip ile) ayrıca geliştirebileceğim, gözümden kaçan veya fırsat yaratabilecek alanlarda iç görü oluşturacaklar.” (S#2)

[48] “Test aşamasında kullanıcının ihtiyaçlarına yanıt verip vermediğimi çok daha iyi anlıyorum. Bu yüzden en faydalı ve keyif verecek aşama olduğunu düşünüyorum.” (S#13)

[49] “Nihai aşamada bütünsel bir test olmasa da parça parça akışlarımı kullanıcılara prototip ile test ettirip alternatiflerden neye yakın hissettiklerini öğrenmeye çalıştım.” (S#10)

[50] “Kullanıcı araştırması yapmak oldukça kolaydı. Figma aracılığıyla yaptığımız prototipleri kolaylıkla test edebiliyorduk. Fakat süreç olarak, edindiğim deneyimlerde, çok benzer şeyleri tekrar tekrar yaptığımı fark ettim. Bu sebeple yeterince tatmin ve heyecan hissetmedim.” (S#19)

[51] “[Aynı sürece tekrar başlamak durumunda] Detaylandırma kısmına çok daha fazla zaman ayırırdım çünkü benim projemde wireframe’ler detaylanmaya başlayınca ürün şekillenmeye başladı ve kullanıcı testlerinde yeni deneyebileceğim imkânlar ortaya çıktı fakat bu projenin sonlarına doğru olmaya başladığı için istediğim ölçüde denetme şansım olmadı ürünümü. Ve detaylarla uğraşma aşamasından da keyif aldığımı fark ettim ama işte zaman daralmıştı.” (S#11)

[52] “Sunumlarımda ise [ürünümü] kullandığım ekranların üzerinden anlatmayı tercih ettim, fakat bu ekranların yanlarına özelliklerini de yazmam gerekirdi. Sunum sırasında [jüri üyelerinin] kaçırdıkları okumaları için bir açıklama iyi olurdu.” (S#5)

[53] “[Ders yürütücülerinden] Sunduğum deneyim ve konsept fikirlerimin üzerinden değil daha çok görsel anlamda değerlendirmeler alabildim.” (S#3)

[54] “Çok şey öğrendim, ana sebebi bu. Çalışmaktan keyif aldığım bir konu seçtim ve içinde bulunduğum bir user group olduğu için ve ürünün hizmet edeceği kurumu da sevdiğim için, süreçten memnunum.” (S#11)

[55] “Oldukça pozitif ve yapıcı geri bildirimler aldım. Zaten firmanın aynı zamanda çalışanı olduğum için alışma sürecim de olmadı.” (S#4)

[56] “Benim için oldukça olumlu olan bu deneyimler fiziksel ürün tasarımı ile özdeşleşen endüstriyel tasarım algımda hem deneyim hem de dijital ürünlerle ilgili yeni sorgulamalar oluşturdu. Projelere yalnızca bir çıktıdan öte bir süreç olarak bakma algımı, nihai sonuç diye bir durum olmadığını öğretti.” (S#2)

[57] “Ülkemizin tarımla ve üretimle alakalı problemlerini çözebileceğine inandığım ve çiftçimize bu süreçte destek olabilecek bir konsept tasarladığımı düşünüyorum ve mu beni mutlu ediyor.” (S#3)

[58] “Araştırma süreci çok uzun tutuldu ama tasarım için yeterince zaman bırakılmadığını düşünüyorum.” (S#10)

[59] “Zaman açısından biraz sıkıntı çektim ve ürünümü kullanıcılarla test etme fırsatım olmadı.” (S#3)

[60] “Süreç yönetimi konusunda ilerleyiş UX projesi için gereken adımlarda eksik kalabildi. Burada daha çok zaman görsel tasarıma ayrılmıştı ve bu da hem benim hem de projem ile ilgilenen kişilerin bir deneyim yorumlamasından öte görsel dengeyi eleştirmesine sebep oldu. Bu yüzden projem deneyim açısından beklediğimden zayıf kaldı ve ben gelişmemiş bir kısım olan görsel tasarım üzerinde çabalarken kendimi buldum.” (S#2)

[61] “Sürecin tüm ilerleyişinde başta diverge eden fikirlerde bir sayı ve çeşitlilik sınırlandırması vardı. Çok uzun bir süre divergede kaldık. Bu converge aşamasında nitelikli bir fikrin daha detaylı ve başarılı çalışılmasına ayrılacak süreyi kısalttı. Geri bildirimler kişi sayısından öte her hafta farklı hocadan alındığı için bir istenilenle diğeri birbirlerine zıt şeyler olabiliyor oldu. Araştırmada süre ve ilerleyiş dengesini yeniden düzenlerdim.” (S#2)

[62] “Fırma projeme neden dahil olucak, nasıl bır kazancı olucak gibi konularda beni çıkmaza soktu açıkcası. Projenin başlarnda firmam sürdürülebilirlikte öncü olmanın ve z kuşağının bağlılını sağlamanın maddi kazançtan çok daha önemli olduğunu savunurken, sonlara doğru sermaye kaygılarından bahsetmeye başladılar. Hem onların isteği olsun hem de projemi çöp etmemek adına ara yolu bulmaya çalıştığım ve beni demoralize eden bir süreç oldu.” (S#5)

[63] “Daha önce hiç kullanılmayan terimler; örneğin "customer journey map, ınformatıon architecture" gibi UI’ın teknik tarafını oluşturan konularda bir çalışma yapılmaması, öğrenme ve geliştirme sürecini kötü etkilediğini düşünüyorum.” (S#5)

[64] “Evet. Bir senedir bu alanda bilfiil çalışıyorum. Bu alanda devam etmeyi hedefliyorum çünkü Türkiye’de sanayi gelişmemiş olduğu için giriş seviyesindeki endüstriyel tasarımcılar genellikle *copycat* olarak çalışıyor ve garanti işler yaparak fazla inovatif olamıyorlar. Dijital kanalda ise maliyet çok daha düşük olduğu için yükselmenin ve potansiyeli kullanmanın daha olası olduğunu düşünüyorum.” (S#4)

[65] “Evet. Kullanıcı deneyimi ve arayüz tasarımı kednimi geliştirmeyi ve devam etmeyi düşündüğüm bir alan. Uzaktan çalışma olanağı var, görece daha rahat bir çalışma ortamı var ve genel olarak maaş durumu daha yüksek.” (S#10)

[66] “Evet, o yüzden bu projeyi seçtim. Ben UX'in insanlara bir ses verdiğini düşünüyorum. İnsanların anlaşılması ve duyulmasını istediğim için UX üzerine çalışmak istiyorum. Ayrıca çağımızda problem çözümleri artık sanala kaydığı için de daha çok insanın hayatını kolaylaştırıp onların zamanlarını daha kaliteli harcayabilmeleri adına bu alanda çalışmak istiyorum.” (S#11)

Quotations from the Semi-Structured Interviews

[67] “Kullanıcısına fonksiyonel veya hedonik bağlamda yaşam kalitesini iyileştirecek her ürün endüstriyel tasarımın konusu kapsamına girer. Dolayısıyla biz de bunu eğitime katmak durumundayız. Hala akademisyenler arasında endüstri 4.0’ı göz ardı ederek bunu eleştirenler bulunmakla birlikte bizim tam zamanlı akademik kadromuz eğitimin bu tarafa doğru gitmesi gerektiğine. Makine üretim yöntemleri ve malzeme kadar dijital ürünün üretimi ve tasarım sürecine de önem verilmesi gerektiğine inanıyoruz.” (P#5)

[68] “Fiziksel ürünler de dahil olmak üzere hepsi [ürünlerin], birer arayüz, biraz öyle yaklaşmak gerek. Kullanıcı araştırması sadece dijital ürünlerde uygulanan bir süreç değil. Aslında herhangi bir ürünün geliştirme sürecine entegre edilmesi gereken bir şey. (…) User experience gibi dersler belki de gerçekten curriculum’un şeyin programın must dersleri olmalı gibi, öyle bir ihtiyaç var gibi geliyor. Bunun öğrenci isterse ilgilensin gibi bir seçeneğinin olduğunu düşünmüyorum artık. Yani hiçbir zaman yoktu bence. Biz böyle her şey fiziksel da kalsaydı dahi bence bir şekilde eğitime daha iyi entegre edilebilir diye düşünüyorum.” (P#12)

[69] “Şimdi uygulamayı endüstriyel tasarımcılar tasarlamıyorlar zaten. Yani burada bence bir kavram karmaşası var. Çünkü bir endüstriyel tasarımcı bir uygulama tasarlayamaz zaten. (…) Endüstriyel tasarımcının tek yapabildiği şey mesela bir kiosk varsa mobilyasını tasarlamak…. Anlatabiliyor muyum?” (P#14)

[70] “Aslında bence geleneksel bir yaklaşım [digital product development bizim alanımız değildir]. Hani endüstriyel tasarım dediğin sadece fiziksel ürün tasarımını kapsar gibi biraz da tutucu bulduğum bir düşünce şekli.” (P#4)

[71] “Belki yurtdışında bir ülkede olsaydık [üniversite adı]’nun eğitimi hala iyi olabilirdi. Mesela Almanya'da yaşasaydık ama Türkiye'deki ekonomik durumdan dolayı üretim çok maliyetli. Kimse bir şey üretmek istemiyor ve fiziksel bir şey üretilmediği sürece benim zaten yerim yok. Fiziksel ürün tasarımcısı olduğun bir Dünya’da… Haliyle buna bakıldığında sadece öğrencilerin şu anki dünyaya adapte olması için bile bu eğitimin lisansta verilmesi çok değerli ve ne yazık ki şuan en temel problem bence lisanslı öğrencilerin bununla son senelerinde tanışıyor olmaları.” (P#29)

[72] “Bizim okulu baz alırsak aslında bizim için endüstriyel tasarım aslında fiziksel ürün tasarımı yönünde ağır basıyor. Bizim okulda da zaten genel olarak geleneksel yapının dışına çıkmama gibi bir eğilim var, o yüzden

aslında dijital ürün tasarımının bizde çok fazla yer olduğunu düşünmüyorum." (P#7)

[73] "[Üniversite adı]'nda dijital bir proje ile yapalım mı diye gittiklerinde, *Biz ürün tasarımcısıyız* dediklerini biliyorum ki bunun aynısı mevcut bizim diğer şubede de oluyor. Bir ürünle bağlı bir dijital ürün yapmak lazımmış gibi… İşte bizde de zaten bu algıyı değiştirmek lazım. Deneyim tasarımı dediğin şey dijital ya da fiziksel değildir. Herkesin yaşadığı bir deneyim var." (P#2)

[74] "Aslında bizde her zaman [teknik üniversite adı] olarak fonksiyon estetikle birlikte gider. (…) [Güzel sanatlar odaklı üniversite adı] mesela tamamen *oraya koydum ve oldu* gözüyle bakıyor. Yani orada şey estetik kaygının dışında gerçekten butonu niye buraya koydum?" (P#17)

[75] "UX ekipleri %90 endüstriyel tasarım. Bu arada çok enteresan güzel sanatlarda, [güzel sanatlar odaklı üniversite adı] da böyle bir bölüm var. O özel yetenekli alıyor. Ama oradan ben şu ana kadar sektörde çalışan hiç görmedim. [Teknik üniversite adı] ve daha çok [Teknik üniversite adı] da var." (P#18)

[76] "Fiziksel ergonomiyle başlıyor [ergonomic dersi]. Fiziksel ilişkiler üzerinden başlıyor. Sonra bilişsel ergonomi üzerine odaklanıyoruz, burada biraz daha dijital arayüzler ile etkileşime yönelik belli altyapı bilgileri ediniyorlar, kullanılabilirlik ve kullanılabilirliğini ürüne yansıması, ürün-kullanıcı deneyimi gibi konular hakkında altyapı bilgileri ediniyorlar. Kullanıcı araştırması kısmında da bu etkileşimi inceleyebilecekleri yöntemlere ilişkin bilgiler ediniyorlar ve uygulama yapıyorlar." (P#16)

[77] "Ilk dijital ürün geliştirme sürecine biz üçüncü sınıfta başlamıştık, [akademisyen adı] Hocaların stüdyosunda. Çocuklar için ürettiğimiz ve sanat ya da spor alanındaki bir arayüzdü. Şu an baktığımda çok yeterli gelmiyor ama research kısmına oldukça yoğun yer vermişlerdi. O aşamayı bayağı iyi oturtmuştuk. Bitirme projesinde de özellikle son iki yıl UX/UI alanına hocalar tarafından da bir geçiş olduğunu söyleyebilirim." (P#1)

[78] "Sadece dördüncü sınıfta bitirme projesi olarak veriliyor [dijital ürünler]. Ama çocuklarda bu çok havada kalıyor, çok ciddi bir bilgi eksikliği var. Çünkü çocukları fiziksel ürün tasarımı yönünde bilgilendiriyoruz, ama dijital ürün tasarımının çok farklı gereklilikler var. O farklı gereklilikleri yerine getirebilecek, arkaplanı oluşturabilecek derslerimiz çok az." (P#7)

[79] "Bir ekrana baktığınızda o ekranın iyi mi kötü mü olduğunu sadece grafik açıdan değerlendirirsiniz. O da nedir? Basic design eğitiminde aldığımız eğitimlerdir. Yani bunun hiyerarşisi doğru mu? Alignment'ı doğru mu? Contrast vesaire vesaire." (P#6)

[80] "Birinci sınıfta design research diye bir ders var, ben veriyorum. Bunun birinci sınıfta olmasının amacı… Birinci sınıfta olduğu için en iyi şekilde öğretemiyorsun ama buradaki yaklaşım tasarımcı bir sanatçı değildir ya da piyasadaki adıyla egocentric tasarımcı değildir. Kullanıcıyı iyi anlar ve onun işine yarayacak şeyler öğrenir. Dolayısıyla eline daha kağıda koymadan senin önce user'ı anlaman lazım her yönüyle. Onun için birinci sınıfta bunu aşılayan bir ders var. Ondan sonra normal ergonomi dersi var." (P#25)

[81] “Mesela [üniversite adı]’nden iki arkadaş vardı. Onlar ikinci veya üçüncü sınıftan sonra tamamen ayrılarak eğitimlerine devam ediyordu. Digital interactive tarafından ya da servis design tarafından, ve fiziksel ürünü tarafından gibi… Bence temel tasarım eğitimi verildikten üzerine bir şeyler koyulduktan sonra böyle bir ayrışım bana çok mantıklı geldi. Çünkü ben son iki senemi otobüs yapmaya çalışarak harcamasaydım. Bunun yerine dijital tasarım eğitimi alsaydım şu an iki sene daha önde olurdum.” (P#30)

[82] “Öğrenciler İskandinavya’daki gibi prototipleme dersleri alıyorlar. Kodlama dersi alıyorlar. Biraz html öğreniyorlar. Biraz java öğreniyorlar. Ondan sonra UX dersleri, etkileşim tasarımı dersleri var. Mekânsal etkileşim var.” (P#25)

[83] “Ben tasarım yönetimi/pazarlama dersinde bu konulara [dijital ürün geliştirme] girmeye çalışıyorum. (…) Üretim yöntemleri gerekirse elektronik ve dijital üretim yöntemleri katılarak işlenmeli.” (P#5)

[84] “Benim amacım piyasaya da çalışacak başarılı UX’ciler oluşturmak. (…) UX’cilerin işyerindeki başarılarını fark ettiren şey çizdikleri ekrandan çok organizasyon içinde aldıkları şekil, diğer insanları ve projeyi yönetme biçimi. Ne yapacaklarını, ne gibi negotiation’lara gireceklerini bilmeleri, nelerden ne zaman vazgeçip, neleri zorlamaları gerektiğini bilmeleri, buralar aslında işin %50, %60’ı.” (P#6)

[85] “Bir tane customer experience (CX) dersi açtık mesela seçmeli. Orada piyasada büyük kurumsal firmalarda bu işin başındaki birisi geliyor, anlatıyor. Introduction to UX’de de yine böyle etnografik araştırma ya da belki başka türlü alan araştırması yapıp büyük şirketlere strateji ile karışık servislerini düzeltmek üzere danışmanlık veren ajansların bir tane kurucusu geliyor.” (P#25)

[86] “Dersin içeriğini ise aslında design thinking metodolojisini hafta hafta uygulattım. (…) Arkadaşlar *14 hafta şunu yapacağız şuraya kadar. Buralarda kalacağız. Şu anda bunun metodolojisinin şu adımındayız. Dolayısıyla şuralardan düşünün ilerisini düşünmeyin,* ilerleyen öğrencilerin direkt durdurdum. Şu anda bu adımdayız derken aslında onlar her hafta projeyi geliştirdiklerinde dönemin sonunda bir baktılar ki profesyonel bir iş çıkmış bile.” (P#6)

[87] “Biz bütün süreci koyarak birazcık hata yaptık. Çıktılar çok güzel olsa da öğrenciler çok yoruldu. Hatırlıyorum kaç öğrenci stüdyodan daha çok bu derse çalışıyoruz diye… Bütün süreci baştan sona yapmaktansa daha spesifik bir kaç adıma odaklanmak daha iyi olur gibi geliyor. Ürün bitti piyasaya sürüldü değil. O tasarım hiç bitmiyor aslında circular bir süreçte. Belki de yarım cycle’ına odaklanmak lazım.” (P#26)

[88] “Bu alanda da [UX/UI araçları] şu an mesela bilgisayar stajında ikinci sınıflara *Figma* eğitimi veriliyor. Çünkü akademisyenlerin bunları eğitime daha çok entegre etmek istediklerini gördüm.” (P#1)

[89] “Arayüz tasarımı alanında da mesela ofis stajı yapabilirler. Buna dikkat ediyoruz, karşı çıkmıyoruz. Dolayısıyla bu konuda ilgisi olan öğrencileri mutlaka onu yapmalarını söylüyoruz.” (P#23)

[90] “Mesela çoğu öğrenci zaten stajyer olarak bir yerlerde çalışıyor oluyor. Öyle ya da böyle öğreniyor oluyorlar yani pişerek diyeyim.” (P#7)

[91] “Öğrenciler de artık bu artan yoğun yaşam tarzında UX sertifikası, staj, işte bir sürü şey yapmadan sanki kariyerinde bu noktada ilerleyemeyecek gibi düşündükleri için bu yerlerden de bilgi alıyor.” (P#34)

[92] “Bazı firmalar mezuniyet projesinde öğrencileri aynı zamanda stajyer gibi işe aldılar. Onlar açısından sanıyorum süreçler çok daha iyi gitti. Yani bu tür daha önce benzer projeler yapmayanlar, ya da işte part-time çalışmayanlar ya da deneyimi olmayanlar daha zorlanmışlardır diye düşünüyorum.” (P#8)

[93] “Çocuklar çok iyilerdi. Çünkü pandemide hepsi freelance çalışmış, uzakta oldukları için de çoğu UX ile alakalı freelance işler bulmuş ve çok donanımlılardı. Zaten çoğu mezun olduktan sonra iş buldular.” (P#29)

[94] “Ürünün dijitalleşmesi, klasik endüstriyel tasarım ürünlerinin dijitalleşmesi sonucu çıkan etkileşim problemine usability adı altında endüstriyel tasarımcılar başladı. Sanırım ilk defa [Hollanda’daki bir üniversitenin adı]’te usability lab’lar falan kurmuşlardı. O zamanlar [İngiltere’de bir üniversitenin adı]’nin, [Hollanda’daki bir üniversitenin adı]’in usability labları vardı. (…) Ben o dönem [2008] Finlandiya’daydım. Şöyle bir ders almıştım, interaktif prototyping. O zaman bütün ülkede [telekominikasyon şirketi adı] çok büyük ve üniversitelerle çalışarak akıllı telefon tasarlıyordu. Yani endüstriyel tasarım bölümünde master derslerinde tasarımı yapıp böyle hakikaten kodunu yazarak prototipleyerek. Bir de onu yazılarla bir şekilde test ettiğin bir proje dersinde çalıştım mesela.” (P#25)

[95] “Önce graduate’den başladı, yani zaten öyle olurmuş ya. Graduate’de o konuda çalışan insanlar böyle dersler oluşturmaya başlayıp… Hatta [akademisyen adları] çok güzel bir ders açtılar 2004’te veya 2005’te. Ben de aldım, 500 kodlu böyle dijital tasarım, onun araştırma yöntemleri, user research yöntemleri, belki test yöntemleri falan gibi makale okuyup proje yaptığımız… Kimisi tasarım projesi yaptı. Kimisi benim gibi var olan ürünleri araştırdı. Onun üstüne böyle usability raporunu yazdı. Öyle bir dersleri açtılar.” (P#25)

[96] “Araştırma metotları alıyoruz yüksek lisansta. Bunlar çok kullanıcı odaklı şeyler değil. Yani nicel ve nitel arasındaki farka odaklanan, daha genel olarak araştırma metodlarının incelendiği, daha genel bilginin verildiği ve literatür araştırmasının nasıl yürütüleceği gibi bilgilerin verildiği bir şey.” (P#12)

[97] “Onu [lisansüstü UX dersi] biraz daha akademik seviye yüksek, yüksek lisans ve doktora öğrencileri alıyor. (…) Orada işte modelleri anlatıyoruz. Bakın kullanıcı araştırması şu modellerle sunulabilir, yani temelde aslında dersin çıktısı o modeller oluyor ve bir poster sunumuyla modelleri anlatıyorlar. (…) O posterler [lisansüstü UX dersi çıktıları] bir konferansta yayınlanabilecek nitelikte çalışmalar oluyor. Hatta birkaç tane de poster çıktı o şekilde. Yani dersin kazanımları ve hedefleri bu yönde.” (P#16)

[98] “Master’da servis tasarımında ise biraz daha lisanstan ileri seviye servis tasarımı konusunu ele alıp. Yani işte hizmet kavramının detayları, hizmet kalitesi, network’te hizmetler nasıl yönetilir… İşte franchise hizmetler,

pazarlama vs gibi teorileri anlatırken bir yandan da dönemin başından sonuna kadar bir proje yaptırıyorum ve sonunda öğrenciler proje ile mezun oluyorlar, proje olarak bir prototip…" (P#35)

[99] "Türkiye'deki okullarda bir tek [üniversite adı]'nin bu konuda [UX] keskin bir tutumu var. Onlarda bir yüksek lisans programı var. Bu yüksek lisans programı da aslında tamamen piyasaya yönelik. İlk başta kurduklarında içerisindeki akademisyenlerin daha çok pratikten gelen insanların olduğu ve daha çok pratiğe yönelik… Aslında kısmi olarak da buradaki açıklığı kapatarak bir yandan da ticariye yönelik bir program benim gözümde daha sonra onun tezlisi açıldı mı, açılmadı mı bilmiyorum." (P#9)

[100] "Gerçekten doğru problemi ve doğru ihtiyacı tanımladılar mı? Çünkü bazen şöyle olabiliyor, bir problem ya da ihtiyacı tanımlamadan doğrudan kafalarda bir çözümle gelinebiliyor. Türkiye'de insanlar olarak genelde çözüm üretmeyi seviyoruz, herhangi bir problem ya da ihtiyaca bağlamadan. Ikincisi de, bulduğu problemi ve çözümü sonuna kadar sahiplendi mi, savundu mu, ikna etmeye çalıştı mı, ya da fark etmediği şeyleri alıp üzerine tekrar geliştirmeye devam etti mi?" (P#24)

[101] "Ben öğrencilerden gerçekten iyi bir kullanıcı araştırması görmek istiyorum. Bunu hani yalapşap değil de gerçekten... Ürün tasarımında birazcık böyle kullanıcı araştırmasını hızlıca 2-3 kişiye sorup, az çok hipotez ile bir şeyler üretebiliyorsun Ama dijital ürünlerde birazcık daha böyle sanki detaya ihtiyaç var gibi kullanıcı araştırması çok daha önemli..." (P#17)

[102] "Şimdi arayüz kısmında yani UI design'ı kastediyorsak eğer, benim öğrenciden beklentim çok yüksek değil. Çünkü bu bizim öğrenciye öğrettiğimiz bir şey değil. Yani öğrencilerden bir şeyi bekleyebilmek için onlara bir şeyi veriyor olmamız lazım." (P#23)

[103] "Uygulamaların zaten sistemleri belirli kuralları belli zaten şu anda minimalizm var. Çok uçuklaşmaya da gerek yok. Sade, okunur ekranlar yapmam gerekiyor zaten şu anda tasarımcılar bizim tarafta özellikle dijitalde de biraz öyle bir yere gitti. Yani sıfırdan her bir istenenleri senin yaratmantan ziyade daha, kuratör gibi davranman gerekiyor aslında." (P#6)

[104] "HMI bölümü olduğumuz için araç içi ekranlar görmek istedik. En başından brief'i ona göre verdik. Yani bizim için önemli olan telefon uygulaması değil, daha çok aracın içindeki ekranla insan ilişkisinin nasıl sağlandığı. Bu konuda çalışmalarını rica ettik, öyle de yaptılar." (P#21)

[105] "Projemin sistemini kurarken aslında flow'u ve information architecture'ü oluşturarak kurmam gerekiyordu, ama ben bunların daha varlığını bilmeden sistemi oluşturmaya başladım. Ondan dolayı daha ilk aşamalarda bize bu information architecture ve flow un bilgisinin verilip… Bunlar üzerinden ilerleyebilirdi bence." (P#1)

[106] "Ne şirket kanalında ne akademik kanalda gerçekten buna [dijital ürün geliştirme] karşı guidance almadım, hiçbirimiz almadık doğru düzgün. Hepimizin kendi keşfettiği bir süreçti, belki doğrusu da budur. Belki bitirme projelerinin ana akışı da budur, ona bir şey diyemem ama beklentiler bu yönde değildi. Biz UX dersi almıştık ama almayan bir sürü arkadaşım vardı.

Onların zaten projeleri bilen bir gözle incelediğinde eksikliklerinin ne olduğu çok bariz görünüyordu." (P#2)

[107] "Onlar [stajyer öğrenci olarak deneyimi olan öğrenciler] kendi alanlarını seçtiler. Kendi projelerini seçtiler, çok bize bağlı kalmadılar. Sonrasında bizimle görüşmek ve çok böyle kritik alma ihtiyacı duymadılar. Gerçekten çok ilginç şekilde." (P#29)

[108] "Asistanlardan çok yardımcı olanlar oldu diye biliyorum. Şöyle söyleyeyim biraz daha farklı bir nesil olduğu için hocalardan, biraz daha genç olduğu için ve aslında bilgisayarla daha çok haşır neşir olduğu için daha çok bilgi sahibi olduğunu düşünüyorum." (P#7)

[109] "Genelde şöyle durumlar oluyor, mesela kullanıcılarla görüşmüş oluyorlar. Kullanıcıların her söylediğini bir şekilde hayata geçirmek istiyorlar. Fakat orada bir önceliklendirme yapmak lazım. Kullanıcıdan gelecek cevapları kim eleyecek, nerede birikme var, hangi kısımlara daha yoğun ihtiyaç var, bunları anladıktan sonra o önceliklendirme ile birlikte tasarımlarını oluşturmaları gerekiyor. (…) Orada ben dataları topladım bitti gibi değil de topladıktan sonra analizini sentezini yaparsanız iş görüyor. O süreçle ilgili bir sıkıntı olabilir." (P#20)

[110] "UI tarafına çok hızlı geçtiler. Yani çok anlamsız yerde geçtiler, hiçbir şey belli değildi. Onun daha iyi yönetilmesi gerektiğini düşünüyorum. Research aşamasına çok daha uzun süre ayrılıp… Mesela ben dersimde ön ön jüriye wireframe ile çıkartıyorum. Ön jüriden finale kadar UI'a geçiyorum ama mezuniyette sanırım hemen bir ay sonunda işte design sisteme oturum oluşturun gibi bir yere gitmiş konu. O ön aşamalara vakit ayrılmadığını hissettirdi bana. Research bence işin %80'i falan UI'a gelene kadarki aşamaya." (P#6)

[111] "Maalesef arkadaşlar [öğrenciler] süre bağımlı çalıştığı için önlerinde kritik süreler var. *İki hafta boyunca bunu yapacağım*, ama gerçek dünya böyle değil maalesef. Biz bazen iki haftayı 10 hafta yapabiliyoruz, ama en son çıktımızı iki haftada bitiriyoruz. Toplamda yine 12 haftada bitiriliyor süreç, ama o arkadaşların referanssız süreleri bence onları negatif etkiliyor. Keşke bütün kapsam net olsa. Evet, tarihini bilmeli, bunu kabul ediyorum, ama süreler dijital ürün geliştirmeye daha doğru verilse…" (P#13)

[112] "Gördüğüm posterlerde kullanıcı araştırmasına yönelik çok fazla bilgi yoktu. Sadece ürün çıktısı vardı. (…) Onun [digital ürünün] içeriği ne kadar data'dan beslenmiş, ne kadar gerçek kullanıcı ihtiyacına hitap ediyor, tartışılır bu." (P#34)

[113] "Kocaman bir ürün ağacından bahsediyorum, aslında en az 300 ekranın olduğu. Gerçekten bir uygulama geliştiriyorsanız en az 300 ekran çıkar. Bizim şu anda öğrencilerde gördüğümüz şey, 300 ekran değil, 10 tane ekran gösteriyor. Beş tane ekran gösteriyor ve beş tane ekranla hiçbir şey üretemezsin." (P#17)

[114] "[Teknik üniversite adı] mezunuyum, 2003'te sanıyorum ilk mezuniyet projesi sergisi yapılmış açık olarak. 20 yıldır bu işi yapıyor bu bölüm ve çok güzel sunum gibi şeyleri oturtmuş, ama digital ürünler bunu karşılamıyor.

Paftalara bakıyorsun bir garip, yani mezuniyet paftası gibi değil. *Video yapalım* denmiş, ama video nasıl olacak… Süreç çünkü digital ürün tasarımında çok önemli. Belki fiziksel üründe o kadar vurgulamaya gerek yok. Onunla baktığımız zaman etkileşim kurabiliyorsunuz." (P#23)

[115] "Fiziksel dünya iletişimimiz ve etkileşimiz çok yüksek bizim. Yani onunla kıyasladığınızda dijital ürünlerle deneyimimiz diğerine göre daha kısıtlı. Dolayısıyla ürünlerin kullanım deneyimi konusunda belki geri bildirim verirken ya da değerlendirirken bazı ayrıntıları atlıyor olabiliriz. Fiziksel ürünlerde çok daha fazla eleştirilecek şey çıkıyor ve bunlar herkes tarafından görülebiliyor. Dijital ürünler biraz daha farklı. Prototipler herkes tarafından denense bile, onu beş dakikada denemek ve geri bildirim vermek daha zamana yayılıyor. Fiziksel ürünlerde de öyle ama onlarda benzer deneylerimiz çok olduğu için, onları zaten günlük hayatımızda kullandığımız için daha kolay geri bildirim verebiliyoruz." (P#8)

[116] "Fiziksel ürünle etkileşim kurabiliyor, değerlendiriyoruz. Dijitalde süreç önemli. Fiziksel bizim alanımız olduğu için daha transparan. Dijitali nasıl değerlendireceğimizden emin olamıyoruz. (…) Onun yanına bir mobilya tasarımı koyduğunda elma ile armut haline gelmeye başlıyor." (P#23)

[117] "Projeme baktıkları zaman jüride [akademisyen adı], *bir bitirme projesi için yeterli gelmedi bu bana, bu çok sade,* dedi. Oradan araya girip dediler ki, *tamamıyla çözülmüş bir UX projesinin basit olması lazım, bu kullanılabilecek bir proje, aradığınız komplekslik ne anlayamadık.* Çünkü sektörün bakış açısıyla akademinin bakış açısı bambaşka." (P#2)

[118] "Kullanabilirlik testinde dünyaca kabul görmüş, kanıtlanmış bir konu var, siz dört ila altı kullanıcıya giderseniz problemlerinin %80 ile % 90'ı bulabilirsiniz. Kalanı için belki 190 kullanıcıya gitmeniz gerekiyor ki %99'unu bulabilin. Dört altı kullanıcı için sektörü bilen hocalarımız şey diye yorum yapmıştı. *Dört ne bulabilir ki, altı ne bulabilir ki,* demişlerdi. Keşke onlar da sektöre biraz daha yakın oluyor olabilseler, belki puan kırdıkları bu konuların *NNG* gibi otoriteler tarafından önerildiğini ve arkasında bir matematik olduğunu daha rahat anlayabilirler." (P#13)

[119] "Tamamen bu dersin ayrıştırılması ve herkesin elma-elma şeklinde değerlendirilmesi gerekiyor. Mesela en son yaptığımız işbirliğinde birisi gerçekten ürün çıkarmış orada daha fazla yorum yapabiliyorsun." (P#17)

[120] "Hibrid çalışmalar vardı. Orada ikisini [fiziksel ürün ve dijital ürün] bir araya getirmeye çalışan projelerde ikisinin de tam olamama durumunu gözlemledim. Biraz onun zorluğunu yaşamışlar gibiydi. Belki de hakikaten o anlamda bakıldığında daha odaklı ve dijital ürün sürecini tam olarak yaşamak daha iyi bir seçenek olabilir." (P#12)

[121] "Sırf bir arayüz yapılmış için yapılmış ama. (…) Çok sorunlu arayüzler oluyorlar, çünkü sadece bir eklenti gibi görülüyor. Belki direkt bir dijital arayüz projesi vermektense fiziksel yanı teknoloji ile entegre olmuş ürünlerle ilgili bir proje olabilir." (P#31)

[122] "Özellikle hocalar için süreç şöyle… Yani daha çok adım adım bir süreç gibi değil de bu süreç neleri kapsıyor, neleri kapsayabilir, hangi projeye göre bu

süreçler esneyebilir ya da daralabilir. (…) Bence öğrencilere verilen assignment'lar daha ayakları yere basan bir yerden verilebilir gibi düşünüyorum." (P#32)

[123] "Normalde hocaların planladığı bir hafta çizelgesi var. Bu süreçte bir haftayı bir şekilde kaçıran biri kaçırdıktan sonra geriye dönüp onunla ilgili bir şey yaparken zorluk çekiyordu. Her şeyin aşırı düzenli olması gerektiğinde henüz tam oraya gelememiş olabiliyorlar." (P#11)

[124] "Aslında UI kısmına devam ederken de UX devam edebiliyormuş. Şimdi olsa belki arka planda UI'ı UX ile birlikte götürürdüm diye düşünüyorum. Yani research aşamasından sonra UI kararlarımı da UX'lere göre belki birazcık değiştirebilirdim." (P#3)

[125] "Çok büyük firmadaki tasarımcı çok az vakit ayırıyor ama işte belki bir start-up'taki tasarımcı daha çok vakit ayırıyor. O konuda bence danışman olacak firmalara belli bir şeyin belirtilmesi gerekiyor, *şu sıklıkta toplantı yapılabilir, şöyle bir iletişim şekli olabilir...*" (P#11)

[126] "Biz bir araya gelmek için uğraşıyorduk. Bir araya gelelim, kritikler olsun diye biraz daha mesafeli yaklaşıyorlardı. Açıkçası bu noktada bir zorlanma söz konusuydu. Daha sık bir araya gelsek ve daha sık birbirimizi dinlesek iyi olurdu." (P#32)

[127] "Ekipler ile iletişim halinde olmak, sürekli el sıkışarak gitmek önemli. (…) Belki projeler interdisciplıner projeler haline çevrilirse takım içerisinde başka disiplinlerden insanlar da olursa bu süreç daha anlamlı olabilir öğrenciler için. Çünkü piyasaya çıktığınızda tek başınıza çalışmıyorsanız, sadece tasarım yapıp verdiğiniz bir işte çalışmıyorsanız, öyle bir durum yok. Bir ekiple çalışıyorsun, planlamayı ekiplerle yapman lazım." (P#31)

[128] "Dört senelik eğitim hayatında *bunu almazsan bunu alamazsın* gibi... Örneğin, araştırma teknikleri dersi varsa araştırma teknikleri dersi almadan UX design'ın alınamaz olması lazım." (P#35)

[129] "Piyasadaki ilanların çok büyük bir kısmı dijitalde yani fiziksel ürün tasarımında daha kısıtlı alan var. Var olan alanlar genelde benim mezun olurken hayalimde olan şeyler değildi. Gidebileceğin böyle [beyaz eşya firma adları] var ya da savunma sanayi vardı. Savunma sanayi zaten istemiyordum. [Beyaz eşya firması adı] şey demişti, *ben sana asgari ücretten bir tık az para vereceğim, altı ay bakalım sonra her şey iyi giderse, birisi ayrılırsa…* Haliyle burada [UX mesleği] çok fazla iş ilanı vardı, neden olmasın diyerek başladım." (P#29)

[130] "Şeyden tatmin oluyorum mesela, bir şey üretiyorum, yaratıyorum ve onu kullanıcının bir şekilde dokunduğunu, kullandığını, hayatında bir şeyler paylaştığını gördüğümde benim için müthiş bir tatmin duygusu. Bundan tatmin olacağını düşünüyorsa rahatlıkla yapabileceği bir meslek." (P#33)

[131] "Kaçınılmaz olarak endüstriyel tasarım bölümü mezunlarının yarısından çoğu artık UX'ci oluyor. Bu da aslında kaçınılmaz, çünkü eğitimleri buna çok uygun. Üç boyutlu düşünme, ergonomide gördükleri insan-makine etkileşimi, insan-bilgisayar etkileşimi konuları da çok yatkın. Design thinking vb. gibi konuları öğrenerek çıkıyorlar da farkında değiller." (P#27)

[132] “Design thinking metodolojisi business’a da girdi. Teknoloji şirketlerindeki ürün-fikir geliştirmede tasarım ekiplerimizin şirketlere bu yaklaşımı öğretme rolleri de var. Tasarımcı sadece çizdiği ekranlarla değil, aslında insanların iş geliştirme süreçlerine olumlu katkı sağladığı için orada aktif rol alıyor. Direkt brief’e etki edebiliyor ve yönünü değiştirebiliyor.” (P#6)

[133] “Endüstriyel tasarımcılar için bir şeyi senaryo dahilinde düşünmek ve bunun nerelerde etkileri olabileceğini öngörmek, diğer disiplinlere göre sanıyorum daha kolay. Diğer sistemlerde şunu görüyorum, mükemmel bir mühendislik ürünü ortaya çıkarmaya çalışıyorlar. Alabildiği tüm dataları kullanıcıya sunabilmek istiyor. Çünkü o dataları alabiliyor ama ben *bu data onun ne işine yarayacak, neden bunu bilmesini istiyorsun,* dediğim zaman *çünkü alabiliyorum* diye cevap veriyor.” (P#28)

[134] “Endüstriyel tasarımcının kattığı şey çok yüksek bir katma değer. Çünkü orada kişi tasarımı düzgün yaptığı zaman ürün imalatı ucuzluyor, kazandığı değer artıyor ve daha çok değer yaratabiliyor.” (P#10)

[135] “Bazı arkadaşların UI kasları daha güçlü olduğu için UX designer olarak geçiyorlar, kullanıcı deneyimi tasarımcısı. Diğer arkadaşların analiz etme, bilgi mimarisi kurma, araştırma kasları daha güçlü olduğu için onlara da UX researcher diyoruz.” (P#13)

[136] “Biz çok kullanıcı odaklı düşünüyoruz ama ister istemez UX olmasından dolayı değil galiba firmadan dolayı, özel sektörde çalışmanın getirdiği bir şey var. Kullanıcıyı bazen ikinci plana atıp firmanın isteklerini, ne kadar kâr ettiğini vesaireyi düşünerek ilerlediğin bir süreç başlıyor.” (P#29)

[137] “Aslında iki tane süreç var. Sıfırdan ürün geliştirme süreci bir de var olan ürünü iyileştirme süreci, ikisinde de bulundum. İkisi birbirinden farklı ilerliyor. Ürün iyileştirme süreci biraz daha mevcuttaki ürünü analiz edip nerelerde eksikler var, nerede ve neden eksik görüyoruz, bunları nereye dayandırıyoruz…” (P#32)

[138] “Biz iki haftalık sprint’ler koşuyoruz. Sürecimiz iki haftada bir aslında planlamaya alınıyor. Yaptıklarımız bu iki haftalık süreçlerin genellikle bir yerinde hep kullanıcı görüşmesi var. Beş ay boyunca UI’a çalıştık dediğim noktada beş ay boyunca hiç kullanıcı ile görüşme yapmadık değil de beş ay boyunca hep geri bildirimler alarak ilerledik.” (P#32)

[139] “UI üzerine yaptığımız şeyler birbirine benziyor ama tabi ki de alanlar farklı. Yani şimdi [otomotiv firmasının adı] dediğimiz zaman bir know-how’ı var, bilgi birikimi var. Çok farklı işleyen bir sistem var, o sistemle çalışan yapı farklı. [E-ticaret firmasının adı] kullanıcı deneyimi, tasarımcısı olmak farklı bizimkisi daha farklı.” (P#22)

[140] “Bizim bir dijital ürün tasarlama sürecimiz var. Mesela, wireframe aşamasına geçmeden önce, research çıktılarına göre bilgi mimarisi oluştururuz. Bu endüstriyel tasarımda görmediğim bir şey. Yazılımcı gibi flow chart’lar oluştururuz. Bunlar hep yazılım dünyasından aldığımız task’lar.” (P#27)

[141] “Tasarım %80, research de %20, ama projesine göre değişebilir. Çok büyük kapsamlı proje yapılacaksa orada %40’lara bile çıkabiliyor araştırma,

başlangıçta kapsam oluşturmak için. Çünkü bazen ürün ekipleri bir taleple geliyor, ama kapsam oluşmamış ya da kullanıcı ile ilgili bilgileri yok.” (P#19)

[142] “Sıfırdan her projede Amerika'yı tekrar keşfetmek herkes açısından maliyetli ve anlamsız. Örneğin, şirkette altı farklı ürün yapıyoruz ve ürünleşecek kadar karlı olmayan küçük projeler yapıyoruz. Her birine sıfırdan radio button deneyimi yapmam kullanıcı için de, benim için de, yazılımcı için de anlamsız. Ne yapıyoruz? Bazı şeyleri ortaklaştırarak ilerliyoruz ki daha doğru verimli ilerlesin kullanıcı için de zaten ben pioneer bir app değilse, yeni bir deneyime kullanıcının ayda yılda bir girdiği bir app’te benim ona öğretmemem gerekiyor. Bu iyi bir UX tasarımı da olmaz.” (P#6)

[143] “Mesela bir proje üzerinde yüzden fazla kullanılabilirlik testi yaptığımız oluyor. Bütün akışlar ile ilgili geri bildirimleri aslında oralarda alıyoruz kullanıcılardan. (…) Kullanılabilirlik testlerinde genel olarak prototip hazırlıyoruz. Kullanıcıların bu prototipleri kullanmasını bekliyoruz. Adım adım almak istediğimiz cevaplara göre sorular soruyoruz.” (P#32)

[144] “Kullanıcı araştırması yapan başka birimler var. Biz direkt müşteri ile temasla değiliz. Müşteri deneyimi yöneticiliği diye ayrı bir yöneticilik var. Onlar direkt müşteri ile temaslar, kalite birimi, birçok farklı anketlerle hem bayilerde hem servislerde hem de farklı müşterilerle çeşitli farklı anketler uygulayarak birçok veriler alıyorlar. Globalde de takip ediliyor bunlar ve bir süzgeçten geçip bize aktarılıyor ve biz de bunları kullanıyoruz.” (P#15)

[145] “Dijitalin şöyle bir artısı var; çok hızlı deneyip vazgeçebiliyorsun. Bir kağıda bile bir şey çizip yanındaki kullanıcıya guerilla test yaparak aslında eş zamanlı test edebiliyorsun. Fakat, aynı zamanda ürün çıktığı anda da sürekli canlı tutmak için ayda bir, 15 günde bir yeni release’lerle ürünün hataları varsa çok direkt ölçebiliyorsun, çok doğru teşhisi koyabiliyorsun, çözebiliyorsun, ve bunu sürekli yenileyebiliyorsun.” (P#6)

[146] “Birlikte hareket etmemiz gereken farklı bir disiplin [UX]. Okulda çok izole bir eğitim alıyoruz. Sadece endüstriyel tasarımcılar olarak hep birbirimizi görüyoruz ve birbirimizden etkileniyoruz. Bu noktada farklı disiplinlerden gelen yorumlar...” (P#32)

[147] “Biz Agile ekipte iki haftalık sprint’ler koşarak çalışıyoruz. Hepimiz farklı ürünlerin Agile ekiplerinde yer alıp farklı projeler yürütüyoruz. Dört kişilik bir ekibiz. Her birimiz kendi projelerimizle tek başımıza ilgileniyoruz. Haftalık olarak bir araya gelip kendi projelerimizin ne noktaya gittiğini anlatıp birbirimizden kritik alıyoruz.” (P#29)

[148] “Ne yazık ki şu an [şirkette] UI/UX ve researcher gibi [pozisyonlar] ayrılmıyor. Projenin en başından sonuna kadar o proje ile alakalı görevlendirilmiş tasarımcı her şeyi yapıyor.” (P#29)

[149] “Bizde research konumlandırması çok zor. [Banka adı]’na, *merhaba artık işlerimizi uzman bir researcher’la halledelim. Böylece tekdüzelikten kurtulalım. Çok daha farklı metodlar deneyebiliriz. Kendi timeline'a olan, kendi gündemi olan bir insanla çalışırız,* dediğimizde, *kaça mal olacak bana,* diyorlar. Müşteriye researcher satmak zor, bu şu anda onlar için ücretsiz. *Aynı kişi araştırma da yapsın sonuçları da tasarıma çevirsin,* görüşü var.” (P#33)

[150] “Yazılımcıların düzenleri biraz daha farklı; haftalık belli rutin raporlar tutuyorlar, hedefler belirliyorlar, onlar üzerine gidiyorlar. Tasarımcılar biraz daha şey... Pazartesi ve Cuma’ları bir araya gelip fikir toplantıları, kreatif süreçleri belirleme… *Bu haftanın işleri neler, kimler yapabilir,* diye… Genelde ortak karar almaya çalışıyoruz.” (P#11)

[151] “Sektörde tasarımcı süreci tetiklemiyor çok fazla. Çünkü IT, *yapamam,* diyor. Hani bize ürün tasarımında öğretirlerdi ya makineci, *yapamam,* dediğinde *sen makineciyi bilginle zorlayabilirsin,* diyorlardı. Ama şu anda IT’yi zorlayamıyoruz.” (P#17)

[152] “Interview’lar ve prototipler veya wireframe’ler üzerinden testler gerçekleştiriyoruz. Bunları genelde ajanslara outsource ediyoruz, çünkü kaynak veya vaktimiz yetmiyor.” (P#18)

[153] “Bunun [dijital ürün geliştirme] yaşayan bir süreç olduğunu düşünecek olursak. Örneğin bir prototip hazırladık, usability testing ile valide ettik sonra yayına çıktık. Yayında usability test yaptık, kullanıcı sürecin hepsinde var. Ürün bitti, gönderdiğimiz anketlerle bilgi almaya çalıştık. Bağımsız kuruluşlardan gölge müşteri ile test yaptık. Bizim de dahil olduğumuz kullanıcı 360˚ ürünün her yerinde var diyebilirim.” (P#13)

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EDUCATION

Degree	Institution	Year of Graduation
MS	METU - Industrial Design	2019
BFA	Bilkent University - Interior Architecture and Environmental Design	2013
High School	Lycée de Tevfik Fikret d'Ankara	2009

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Native Turkish, Professional French, Fluent English

PUBLICATIONS

1. Hatunoğlu, D. C., & Kaygan, P. "Formation of Industrial Design Culture from Educational to Professional Life", Article is submitted to the *A|Z ITU Journal of the Faculty of Architecture* in February 2023.

2. Hatunoğlu, D. C. "A Study on Understanding the Influence of Different Design Approaches to Design Democratization", *Gazi University Journal of Science Part B: Art Humanities Design and Planning, 10*(4), 399-413 (2022).

3. Demirci, H. M., & Hatunoğlu, D. C. "Impact of Augmented Reality (AR) Tool Usage in Learning Engagement of Product Design Education", In Ilhan, B. S. (Ed.), *Academic Research and Reviews in Architecture, Planning, and Design Sciences, Duvar Publishing*, 93-111 (2021).

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2. Hatunoglu, D. C. & Kaygan, P. "The Relation between the Professional Culture of Industrial Designers and their Experiences in Professional Life". Fourteenth International Conference of Design Principles & Practices. Pratt Institute, New York, USA. November 11-13, 2020.

AWARDS

1. A' Design Awards 2021 - Bronze in Office Furniture Design. Available at https://competition.adesignaward.com/design.php?ID=120108

2. IDA (International Design Awards) 2021 - Bronze in Office Equipment-Furnitures /Modules. Available at https://www.idesignawards.com/winners/zoom.php?eid=9-40037-21

CERTIFICATES

1. Agile Methods for UX Design – IxDF (Ongoing)

2. Human-Computer Interaction: The Foundations of UX Design – IxDF (Ongoing)

3. Interior Design for Hotels – Nuova Accademia di Belle Arti, Milan, Italy (2015)