Views of Academicians on Design Thinking Skills in Different Disciplines in Higher Education

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Abstract

Design thinking is a human-oriented and creative problem-solving skill that can empathize with the user's emotions. Today, traditional problem-solving approaches are replaced by design thinking practices that include multidimensional thinking skills. The mission of higher education curricula is to enable students to use their design thinking skills effectively in higher education. In this study, the views of academicians on design thinking skills in different disciplines in higher education were consulted. A qualitative research method was used in the study and data were collected by interview technique. The research was carried out in İstanbul in the fall semester of the 2021-2022 academic year, with the participation of academic staff from two state universities (n=15). In this context, a six-question semi-structured interview form developed by the researchers was used as a data collection tool. The data were analyzed with thematic coding and content analysis techniques, which are among the qualitative analysis methods. According to the research findings, academics think that there is a "high, versatile and complementary relationship" between design and thinking skills. They express the concept of design thinking as "people-based, user-need-based, solution-oriented and creativity-based". They express the concept of design thinking as "human-based, user-need-based, solution-oriented and creativity-based". It is stated that design thinking individuals should have characteristics such as "empathy, analysis, openness to innovations, high imagination, attention to details and creative thinking". It is seen that academicians use design thinking in their courses in practices such as "problem solving method, design project, searching real-life problems, developing thinking skills". In addition, the academicians stated that "they do not have knowledge about design thinking skills, some of them have theoretical knowledge, but those who have knowledge have weak practice levels". Finally, it is seen that they make suggestions that "design thinking practices should be added to the course content, applied training should be increased, thinking skills should be developed and innovative thoughts should be included".

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Introduction

Higher education institutions undertake an important mission in gaining skills for the needs of our digitalized age. At the same time, higher education institutions, which should have the ability to keep their education policies flexible in the process of adapting to the change and development of societies, should not ignore the developments in the direction of digitalization and quickly complete their mental transformations. However, does the digitalization of educational processes and environments in universities offer a permanent solution in terms of providing skills training? Do the e-learning environments used in the courses provide a skill training to teachers and learners or is it possible to establish certain quality and standards in this sense? The developments in the direction of digitalization in universities and these questions bring new learning models in the development of learning skills. There are some skills that the student must acquire in order to use skills training effectively in the digital age (İlke Analiz, 2021).

Bates (2016), in his doctoral thesis titled *"teaching in the digital age",* argues that learners in the digital age should be equipped with certain skills while assigning this responsibility to higher education institutions and emphasizing the importance of gaining the following skills to students (Bates, 2016; cited by Taşkıran, 2017).

- "*Communication skills:* Social media skills are required as well as classical communication skills such as reading, writing and speaking
- *Independent learning:* Taking responsibility for one's own learning, autonomy. Individuals should have the ability to decide on their own what information they need and where and how they can access this information.
- *Ethics and responsibility:* Gaining trust, gaining trust in the global business world with a wide variety and number of participants, and being able to choose individuals that one can trust.
- *Teamwork and flexibility:* Collaborating with other employees for new applications and being able to work together in teams, albeit remotely.
- *Thinking skills:* Developing critical thinking skills, developing different perspectives on events and being open to the exchange of information.
- *Digital skills:* To be able to use technology actively and effectively, to learn how to use it professionally.
- *Information management:* The ability to sift accurate and reliable information in a diverse and dynamic flow of information."

Today's higher education institutions are trying to provide their students with multidimensional skill sets in order to keep up with the speed of digital transformation. Design thinking comes to the fore as a multidimensional skill that focuses on human-oriented thinking in parallel with the advancement of innovation and technology. Traditional one-way problem solving ways in teaching and school learning are giving way to the idea of design-oriented thinking, which is interdisciplinary and appeals to understanding human emotion. It becomes a necessity for every brand or institution that needs to empathize with the target audience, explore the target audience's wishes, observe their wishes and reframe them, to benefit from this skill. Leading innovative companies in the world, such as *Apple, Google, General Electric, Samsung Nike, Lego, IBM, Philips, Intuit, Daimler, Deutsche Bank, Accenture, Coca Cola, Uber, Ford, Starbucks, Target, Gamble*, which develop digital and smart technologies, rapidly design it adopts focused thinking method. In addition, universities such as *MIT, Harvard* and *Stanford,* which are the pioneers of progress in our age, are among the institutions that take this model into their programs (Bürotime, 2021).

Design thinking is a methodology based on generating solution-oriented ideas from different perspectives. It is a process that aims to understand individuals, challenge assumptions, re-recognize problems and create innovative solutions. It brings together the desirability of the individual with what is economically possible, where technological possibilities allow (Enstitü, 2021). Design Thinking is the thinking model of the digital age. This model of thinking puts people in the center, is based on uncertainty and makes choices for the future. All functions of the brain teaches to use emotion, logic and intuition together. It also makes individuals adept at empathy, generating ideas, and makes them a leader who can make the right decisions. Design-oriented thinking, which makes it easier for us to get a

general idea about the emotional adventure by learning about the agenda and sensitivities of the other person, makes it easier for us to get a holistic view. It enables us to grasp the target problem more easily and on the spot with different observation methods. It prioritizes thinking skills equipped with the subtleties of creating an observation plan, catching the right clues and meeting in a common mind, making it easier for us to solve existing problems more constructively (Öğretmen Ağı, 2021). While the Stanford School of Design defines design thinking as a problem-solving method, Harvard University Teaching and Learning Laboratory considers it as an approach and mindset. Design thinking is also a method used to discover human needs and produce innovative solutions. According to design firm IDEO, which combines design thinking with the workplace, it is a human-centred innovation approach that uses design tools to combine the needs of people, the possibilities of technology, and the requirements for business success. According to Curedale (2013), design thinking is a way of bringing human-centered solutions to difficult problems, follows collaborative, team-based interdisciplinary processes, uses methods as a tool, and can be used by everyone from an experienced designer to a student (as cited in Soyupak, 2019).

According to (Brown, 2008), design thinking;

• Seeks new ideas and innovative solutions to complex problems.
• It is an innovation approach that helps to cope with uncertainty.
• The process of understanding user needs, exploring solutions and ideas, and iteratively rapid prototyping.
• It is a human-centered methodology (Brown, 2008; Razzouk & Shute, 2012; Girgin, 2020).

There are basically five different stages of the design thinking approach. The process starts with realizing these stages. Empathy, recognizing opportunity and problem areas, developing ideas, prototyping and evaluating by testing enable this process to come to life. Projects and methods used in this process may vary according to needs. The design thinking method is formed by the combination of many different methods. In order to complete this process, each of these methods must be implemented in accordance with the rules. The process, which starts with empathy, ends with testing and evaluation processes, and at the end of the process, what has been learned needs to be reinforced (İstanbul Boğaziçi Enstitü, 2021).

Gibbons (2016, cited by Aydemir, 2019) argued that design thinking consists of 6 basic stages.

These stages can be explained as follows:

1. *Empathy:* It is the stage of understanding and researching what the target audience thinks and feels.
2. *Definition:* It is the stage where the researches done in the empathy stage are combined and the problem is explained.
3. *Idea generation:* This is the stage where creative solutions for the identified problems are put forward and brainstormed.
4. *Prototype:* This is the stage where the ideas obtained are transformed into real and tactile products. The important thing at this stage is that the prototype should represent the ideas in the best way possible.
5. *Test:* This is the stage where the level of meeting human needs of the solution is examined and feedback is received.
6. *Implementation:* This is the stage where the vision is realized.

The concept of design thinking was first defined by Harvard University architecture professor Peter G. Rowe in his book titled "Design Thinking" in 1987. David Kelley, founder of IDEO innovation consulting firm, and Tim Brown, chairman, are among the inventors of Design Thinking and among the people who formalized this approach. Theorists such as Herbert Simon, Nigel Cross, Richard Buchanan, Donald Schön, Tim Brown have played an important role in the conceptualization of concepts and theories for design thinking. In addition, the design thinking approach has been popularized by Stanford University. Big supporters of the design thinking approach include SAP and Apple, which work closely with innovation company IDEO. In this context, SAP's co-founder Hasso Plattner has invested in two project campuses, one in Stanford and the other in Potsdam, to implement the design thinking approach. It started with Simon's basic studies on the nature of design in 1969, and after that, studies on the subject

increased. In addition, it is seen that the number of studies on the subject reached a high point in 2009 (Johansson- Sköldberg et al., 2013; Efeoglu et al., 2013; Aflatoony, 2015; Koh et al., 2015; Cabello Llamas, 2015; Yang, 2018; cited in Ciftci, 2020).

The foundations of the constructivist approach based on the progressivism education philosophy adopted in our country since 2005 are based on experiential learning, collaborative learning and problem-based learning (Girgin, 2020; Kolb & Kolb, 2008; Hmelo-Silver, Duncan, Chinn, 2007; Savery, 2006; Hmelo- Silver, 2004; Bruffee, 1999). With new education systems, where students can be used more and more effectively, it is possible with design thinking to increase their participation in the workforce and knowledge transfer, and to ensure student compatibility towards lifelong learning (Hung, Lim, & Lee, 2014; Chen, 2013; Razzouk & Shute 2012; Herrington & Herrington, 2006) defines design thinking as a thinking structure that has a positive effect among disciplines in 21st century education. It has stated that helping students think like designers can better prepare them to cope with difficult situations and to solve complex problems at school, in their careers and in life in general (as cited in Girgin, 2020).

There are also recent studies of the Ministry of National Education regarding the intertwining of education and design. Although the vision and structure of the science curriculum, published in 2017 and updated in 2018, has similar features with the curriculum used, some additions stand out when the curriculum is examined. Among these additions, it was emphasized that the program should combine science with other disciplines, and that students should transform the knowledge and skills they have learned in theory into practice and products. While the "research inquiry strategy" was taken as the basis in the 2013 science curriculum, the "strategy based on research inquiry and knowledge transfer" was taken as the basis in the programs in 2017-2018 (MEB, 2013a; MEB, 2017; MEB, 2018; MEB, 2019; cited by Atacan, 2020). The main purpose of the MEB 2023 Education Vision is "to raise qualified, moral individuals who are equipped with the skills of the age and the future, who can use this equipment for the good of humanity, who are in love with science, who are curious and sensitive to culture." In addition, it was stated that Design Skills Workshops focused on science, art, culture, sports and life skills will be established (MEB, 2021).

Design thinking (DT) has emerged from the field of design and has become an approach/method used in every field. DT, which was a method that designers used almost intuitively before, was modelled in a way that non-designers could also benefit from, and gained a place in the literature by discussing its principles and components. Today, DT studies are carried out with students in many educational institutions from pre-school to higher education, with employees in many small or large-scale companies and government institutions (Buchanan 1992; Scheer and Noweski 2012; Groeger and Schweitzer, 2014; Brown 2015; Noel and Liub 2017; Akdemir, 2017; Şahin,2019).

Purpose of the Research and Sub-Problems

The purpose of this research is to determine the views of academicians on design thinking skills in different disciplines in higher education. In accordance with the purpose of the research, the following sub-problems were asked to the participants.

1. What themes explain the views of academicians from different disciplines on design thinking skills in higher education?
2. Under which categories explain the created themes according to the views of academicians from different disciplines on design thinking skills in higher education?
3. With which codes explain the categories created according to the views of academicians from different disciplines on design thinking skills in higher education?

Design Thinking Skills in Higher Education

Design thinking has been described as a promising approach to helping students become creative problem solvers and socially competent team workers. The approach was pioneered by fields such as architecture and mechanical engineering. Initially, it was used to develop innovative products or services that would not only benefit companies financially but also help tackle pressing societal problems such as high crime rates or poor health (Brown, 2009; Asquith et al, 2013; von Thienen et al, 2017). The approach soon proved useful far beyond the classical design disciplines. Researchers and practitioners

have become interested in design thinking as a way to build creative trust, creative agency, and creative mastery (Jobst et al., 2012; Kelley & Kelley, 2013; Rauth, Köppen, Jobst, & Meinel, 2010; Royalty, Oishi, & Roth, 2012; von Thienen et al., 2017). Numerous universities have opened design-thinking institutes to help students acquire creative problem-solving and collaboration skills that are hardly encouraged by traditional education. A large number of applications show that students show a significant interest in this type of non-traditional education. The rapid expansion of the Hasso Plattner Institut (HPI) School of Design Thinking at the University of Potsdam in Germany is a good example. It started in 2007 with 40 students from 30 different disciplines. Due to the rapid increase in the number of applications from all over the world, the institute is currently training 120 students from 20 different nationalities and 70 different disciplines in 2015. Students dedicate 2 days a week to design thinking training for either a semester or a year. At the same time, they continue their traditional university education for the remaining 3 days of the week (von Thienen et al., 2017). Universities such as MIT, Harvard, and Stanford are important universities that include design thinking practices in their programs. Important consulting organizations in the field of design such as IDEO and Continuum, educators such as the Design and Rotman schools at the University of Toronto and the Darden school at the University of Virginia have extensively provided explanations on the processes and tools used to implement design thinking (Liedtka, 2015). Design thinking approach has been included in the education programs of Karolinska Institute in Sweden under the name of "Interdisciplinary and User-Oriented Problem Solving with Design Thinking Approach." The content carried out as a course program includes the participation of students studying in fields such as nursing, psychology, physiotherapy, art and journalism (as cited in Aydemir, 2019).

Studies on Design Thinking Skills in Practice

Studies conducted in our country and abroad were examined, and surveys and scale studies on Design Thinking were encountered in studies conducted abroad. Addressing the general target audience abroad, Dosi et al. (2018) and Chesson (2017), a measurement tool developed to determine the DT skills of engineering students (Blizzard et al., 2015), DT attitude scale for system engineers (Greene, Gonzalez & Papalambros, 2019), DT test for primary and secondary school students (Rusmann & Bundsgaard, 2019) are some of them. As Sürmelioğlu and Erdem (2021), as a domestic scale development study, the Design Thinking Scale in Teaching is found in the literature to determine the design thinking structures of teachers in the technology-based instructional design process.

Method

Research Design

In this study, qualitative research method was used. To reveal the perceptions and views of academicians about the implementation of design thinking skills in higher education, semi structruted interviews conducted. Interview questions were prepared by the researchers based on the literature. Opinions were asked with 6 open-ended questions.

Study group

The participants of the research consists of 15 academicians working at two different state universities in İstanbul in the fall semester of the 2020-2021 academic year. Typical case sampling, which is one of the purposive sampling methods, has been chosen to determine the participants that make up this study group. The function of qualitative research to gain experience by creating examples and perspectives is clearly revealed in studies using this type of sampling (Yıldırım & Şimşek, 2006). The data on the demographic characteristics of the academicians participating in the research are given in Table 1.

Table 1. Demographic characteristics of academicians participating in the research

Participant	Gender	Year of seniority	Title	Department
P1	Male	25	Prof. Dr.	Mechanical Engineering
P2	Female	22	Assoc. Dr.	Textile
P3	Female	20	Assoc. Dr..	Mechanical
P4	Male	18	Prof. Dr.	Manufacturing
P5	Male	15	Assoc. Dr.	Mechanical
P6	Male	15	Asst.Prof. Dr	Marine
P7	Female	14	Asst.Prof. Dr	Industrial
P8	Female	12	Asst.Prof. Dr	Textile
P9	Male	10	Asst.Prof. Dr	Manufacturing
P10	Male	10	Instructor	Marine
P11	Male	8	Instructor	Mechanical
P12	Female	7	Assoc. Dr.	Industrial
P13	Male	7	Asst. Prof. Dr	Mechanical
P14	Female	7	Instructor	Mechanical
P15	Male	6	Prof. Dr.	Mechanical

When Table 1 is analyzed, the participants consist of a total of 15 academicians, 9 male and 6 female. The seniority of the participants varies between a maximum of 25 and a minimum of 6 years. The titles of the participants are seen as professor, associate professor, asst. prof. dr and instructor. Participants work in Mechanical, Textile, Manufacturing, Industrial, and Marine Engineering departments. Considering this information, it can be said that the participants are experts in their fields and have sufficient experience. Each of the participants was coded by using the abbreviation as participant one (P1), participant two (P2) and so on, according to the order of the interview.

Data Collection Process

In this study, data were collected through a semi-structured interview form prepared by the researchers. After the interview form was prepared, two professors and associate professors working in the field of Educational Sciences were consulted, and the form was corrected and implemented according to the feedback received from them.

Data analysis

Qualitative data obtained from the opinions of academicians on design thinking skill practices in higher education were analyzed by content analysis. Content analysis is a method that enables the collection of similar information within the framework of a certain idea and subject and the understanding of the collected information by the reader (Yıldırım & Şimşek, 2016). In this study, the data were divided into themes and codes and made categorical. Interview records were coded according to these themes and categories. Six themes and categories according to the answers to the research questions are listed in Table 2 as follows.

Table 2. Research themes and categories

Themes	Categories
The relationship between design and thinking skills	• High relationship • Multi-faceted • Complementary • Theory and practice relationship • Purposive • Holistic • Problem-solver • Methodological
Design thinking concept and its importance	• Human-based • User needs-based • Solution-oriented

	• Creative thinking-based • Innovator • Generating original ideas • Concretizing abstract thinking • Evaluating different aspects • Based on empathy • No idea
The characteristics of design thinker individuals	• Empathy skills • Analysis • Open to innovation • High imagination • Paying attention to details • Creative thinking • Observation • Human-based problem solving • Communication skills • Practical thinking • Risk-taking • Open-minded • Compatible with teamwork • Solving complex problems
Design thinking implementations used in courses	• Problem-solving method • Design project • Real-life problems • Developing thinking skills • Discovery learning strategy • Example problems • Researching user experience • Instructional planning phase • Design thinking not implemented
The competence/level of applying design thinking skills of university students	• No design thinking skills • Theoretical level • Poor skill practice • Development level • High level
Suggestions of academicians on the implementation of design thinking skills	• Design thinking should be included in the content of all appropriate courses • Practical training should be increased to provide students with design thinking skills • Workshops and laboratories should be established to practice the skill • Innovative thoughts should be included • Technology should be used effectively in curricula's • Design thinking should be added to curriculum development processes • Design thinking in-service training should be given to academicians • English skills should be developed in order for students to conduct research effectively

Findings

This section conveys the findings obtained from the analysis of the data and comments based on the findings.

Findings of the 1st question of interview "Do you think there is a relationship between design and thinking skills (problem solving, critical thinking, creative thinking, reflective thinking, etc.), if so, what are your thoughts on this subject?"

Theme 1. The relationship between design and thinking skills

Table 3. Codes and frequency distributions of the answers to the first theme

Codes	Frequency (n)
High	4
Multi-faceted	3
Complementary	3
Theory and practice relationship	1
Purposive	1
Holistic	1
Problem-solver	1
Methodological	1

According to Table 3, the question about whether there is a relationship between the design and thinking skills of the academicians is "high relationship" (n=4), "multi-faceted relationship" (n=3), "complementary relationship" (n=3), "theory and practice relationship" (n=1), "purposeful relationship" (n=1), "holistic relationship" (n=1), "problem-solving relationship" (n=1) and "methodological relationship" (n=1). According to the answers given, it is stated that there is a high relationship at most and a methodological relationship at least. Some of the answers to the question are given below.

P12. "There are strong links between design and thinking skills. When designing, imagination is required. In addition to this imagination, questions arise that need to be answered. While searching for answers to these questions, a critical perspective provides easier and clearer answers to these questions (High)"

P3. "In my opinion, in order to be able to design something in one's head, one must be able to think multi-dimensionally, that is, creative, critical and reflective thinking skills must be used well in this person, and he must know how to use the knowledge he has acquired while designing on a subject, in relation to these abilities (Multi-faced)."

P7. "The design is made for a specific purpose. Design is intertwined with the phenomenon of thinking. Whether identifying a problem, thinking about its solution or reaching a solution, mental processes always take place. Complementary and purposive relationship)"

P1. "The first step of design is imagination. Imagination, on the other hand, is a practice of thinking about a concept that has not yet embodied. Therefore, it is not possible to dream without thinking and to design without imagination (Theory- practice and complemantary)."

P9. "Design is the method used to solve a problem or increase the efficiency of a problem, accordingly, it is aimed to realize the problem solving (design) by prioritizing problem solving skills and critical thinking, which are indispensable for design (Problem solver)."

Findings of the 2nd question of interview "Do you have any information about the design thinking skill, if any, what are your thoughts on the importance of the design thinking skill?"

Theme 2. Design thinking concept and its importance

Table 4. Codes and frequency distributions of the answers to the second theme

Codes	Frequency (n)
Human-based	3
User needs-based	2
Solution-oriented	2
Creative thinking-based	2
Innovator	1
Generating original ideas	1
Concretizing abstract thinking	1
Evaluating different aspects	1
Based on empathy	1
No idea	1

When Table 4 is examined, the concept of design thinking and its importance are perceived as follows, according to the views of the academicians. "Human-based" (n=3), "user needs-based" (n=2), "solution-oriented" (n=2), "creative thinking-based" (n =2), "innovator" (n=1), "generating original ideas" (n=1), "concretizing abstract thinking" (n=1), "evaluating different aspects" (n =1), "based on

empathy" (n=1), "no idea" (n=1). According to the findings, it is seen that the concept of design thinking is mostly human-based (n=3), then it is perceived as user needs-based, solution-oriented and based on creativity. Some comments on the concept of design thinking and its importance are given below.

P5. *"It is a people-oriented systematic problem-solving technique. If a sustainable solution, product or even life is in question, we must perceive our surroundings correctly, identify our needs and advantages, and act in line with the method we put forward with the least cost. Design thinking skill has emerged to perform this process efficiently (Human-based)."*

P9. *"Unfortunately, it is not meaningful to think without serving a purpose. What we think about needs to serve a space or topic and user needs in a meaningful way. Considering the design part while proposing-developing a product or process is very important at this point (User needs-based)."*

P2. *"I use the design-oriented thinking processes effectively in the "mechanical design" course. We have to think human-centered for every work we do in the field of engineering. Ergonomics, reducing the use of harmful materials and increasing efficiency are aimed at the best possible solution in all studies, and I believe that especially those who deal with engineering should learn / apply (Human and solution based)."*

P10. *"It is a design-oriented approach to finding solutions to complex problems depending on the imagination of people. People who think design-oriented are highly creative. They define problems better and approach them solution-oriented. They can predict the problems that may occur (Solution-based)."*

P11. *"I can define it as a constant search for self-renewal and iteratively reconsidering designs a few times while doing so. Those who think design-oriented have a strong sensitivity to their environment. They care about expectations and believe that there are/could be solutions out of the ordinary. They are flexible and change/change is a habit for them. These features are the personality characters (Innovator) that should be for innovative design."*

Findings of the 3rd question of interview "What do you think are the characteristics of design thinker individuals?''

Theme 3. The characteristics of design thinker individuals

Table 5. Codes and frequency distributions of the answers to the third theme

Codes	Frequency (n)
Empathy skills	2
Analysis	1
Openness to innovation	1
High imagination	1
Paying attention to details	1
Creative thinking	1
Observation	1
Human-based problem solving	1
Communication skills	1
Practical thinking	1
Risk-taking	1
Open-minded	1
Compatible with teamwork	1
Solving complex problems	1

According to Table 5 the frequency distributions of academicians' views on the characteristics of design individuals are listed as follows, from the most to the least. "Empathy skills" (n=2), "Analysis"(n=1), "Open to innovation"(n=1), "High imagination" (n=1), " Paying attention to details' (n=1), "Creative thinking" (n=1), "Observation" (n=1), "Human-based problem solving" (n=1), "Communication skills" (n=1), "Practical thinking" (n=1), "Risk-taking" (n=1), "Open-minded" (n=1), "Compatible with teamwork" (n=1), "Solving complex problems" (n=1). According to the comments, it is stated that design thinker individuals should have features such as empathy skills, analysis, being open to innovation, high imagination, attention to details and creative thinking.

P6. "They are people who like to think, observe, think analytically, take risks, empathize, have broad imaginations and knowledge about different fields (Empathy, Observation, Risk-taking, High imagination, Analytical thinking)."

P5. "They are productive individuals who can identify the problems and difficulties they encounter, produce ideas for resolution, and think creatively, reflectively and critically (Creative thinking, Open to innovation, Solving complex problems)."

P8. "They analyze the design issue in detail. They consider it necessary to do preliminary research/observation/interview before starting the design. They are determined and willing to learn new design tools when necessary. They are sensitive about details (Analysis, Paying attention to details)."

P7. "He/she should empathize with the problem situation in order to understand the problem in detail.

Communication skills should be developed,

Being prone to teamwork

Respecting differences,

Being aware of their own way of thinking and potential,

Developed the ability to focus,

Having a holistic and detailed perspective (Empathy, Communication, Compatible with teamwork)."

Findings of the 4th question of interview "Do you use design thinking implements in your courses? If yes, what kind of implements do you make?''

Theme 4. Design thinking implementations used in courses

Table 6. Codes and frequency distributions of the answers to the fourth theme

Codes	Frequency (n)
Problem-solving method	4
Design project	2
Real-life problems	2
Developing thinking skills	2
Discovery learning strategy	1
Example problems	1
Researching user experience	1
Instructional planning phase	1
Design thinking not implemented	1

When Table 6 is examined, the comments given to the question whether I use design thinking practices in the lecturers' classes are listed as follows. "Problem-solving method" (n=4), "Design Project" (n=2), "Real-life problems" (n=2), "Developing thinking skills" (n= 2), "Discovery learning strategy" (n=1), "Example problems" (n=1), "Researching user experience" (n=1), "Instructional planning phase" (n=1), "Design thinking not implemented" (n=1). According to the findings, it is seen that academicians use design thinking in their lessons, in practices such as problem solving method, design project, researching real life problems, and developing thinking skills. Some of his teaching comments are as follows.

P3. "In my machine design course, we have a work called a design project. In this study, we divide our students into groups of 5 and give a problem text. This is all about defining the problems we encounter in our daily lives within certain limits. We expect our students to have a study in which they will report all processes from idea to design in 1 semester, taking into account engineering and human factors (Design Project)."

P9. "I'm trying to use it in my solid modeling and entrepreneurship classes, especially on computers. In an ergonomic goods design, logo design, intellectual and industrial rights unit, in project studies for the solution of current problems (disinfectant machine, discoveries for the unhindered

circulation of the disabled at school-ramp-bridge-elevator, etc., mask production process and similar (Real-life problems)"

P2. "Since the courses taught in our faculty are taught within the framework of ABET, I especially care that my students approach design-oriented subjects in all my courses. In all the courses I teach, I make sure that term papers are design-oriented. In addition, while preparing the exam questions, I try to prepare questions in a way that the questions should be answered by using the thinking skills of the students, not memorization (Developing thinking skills)."

P4. "In other words, we do speaking and writing activities on the problems encountered in daily life. Like a kind of brainstorming, everyone shares their free opinion on that subject and we try to generate ideas using the problem-solving method (Problem-solving method, Real-life problems)."

P5. "I try to use an invention-based learning strategy for situations they may encounter in daily life and have activities to develop their problem-solving skills (Problem-solving method, Discovery learning strategy, Real-life problems)."

P8. "While explaining the subject of the lesson, I give examples from real life/applications. By discussing the reasons behind the features of the designs around us, I invite students to think critically and questioningly. While explaining the lesson topics, I increase the verbal explanations for a deep understanding of each concept. I'm trying to create surprise by giving something to the other side with its opposite. In exam questions, I choose real-life physical events that every student will find close to himself in homework questions. Sometimes I also want monetary cost calculations to be done to intensify students' attention. I definitely include the design element in homework questions (Real life problems)."

Findings of the 5th question of interview "Do your students know about design thinking skills? If so, what are your opinions on your students' ability to use/practice design thinking skills?"

Theme 5. The competence/level of applying design thinking skills of university students

Table 7. Codes and frequency distributions of the answers to the fifth theme

Codes	Frequency (n)
No design thinking skills	7
Theoretical level	3
Poor skill practice	2
Development level	2
High level	1

According to Table 7, the answers given by the academicians to the questions related to the theme of the competency of applying design thinking skills are listed as follows, from the most to the least. "No design thinking skills" (n=7), "Theoretical level" (n=3), "Poor skill practice (n=2), "Development level" (n=2), "High level" (n=1). According to the findings, it is seen that the students do not have information about the design thinking skills or they have theoretical knowledge and their level of application of the skill is poor.

P12. "I don't think my students know much. Since it is an area where I am just trying to improve myself, I think we are at the very beginning (No design thinking skills)."

P3. "Yes, my students have limited and theoretical knowledge on this subject. Pragmatic approaches contribute to their development. It supports the right decision making processes. It mostly supports their motivation to the lesson/subject (Theoretical level)."

P8. "I don't think they have direct information. Creative problem-solving skills, which are an important part of design-oriented thinking, are covered in the Creativity Only course. Methods such as six hats and SCAMPER are experienced in the classroom environment. No design thinking skills)."

P4. "Throughout the semester, I try to instill a design thinking in students in our follow-up courses. However, I see that the vast majority, except for a small number of students, prefer to stay away from this approach. I think I can list the reasons as laziness in thought, proneness to easy, inability to come to difficulty. At this point, I observe that in our society, approaching innovations often without seriousness, belittlement of new ideas, the desire to reach economic prosperity in a short way, erode their intelligence in their earlier ages and consume their energies in useless areas. Another observation

of mine is that while students are preparing for high school and university exams, they cannot easily get away from their long-term preparation habits for test exams until the last years of university (Skill practice is poor)."

P7. "Since the courses taught in our faculty are taught within the framework of ABET, all of our students are theoretically aware of this subject. I emphasize the importance of this especially in the courses I teach. While my students contribute more meaningfully to the design process in applied courses, they show sufficient competence in classical courses. Also, I think that the 2nd year students are not involved in the design process by doing enough research (Theoretical level, Development level)."

Findings of the 6th question of interview "Do you think that design thinking is used effectively in higher education implementations in the era of digitalization? What kind of arrangements should be made in higher education, taking into account student needs in practice? What are your suggestions?"

Theme 6. Suggestions of academicians on the implementation of design thinking skills

Table 8. Codes and frequency distributions of the answers to the sixth theme

Codes	Frequency (n)
Design thinking should be included in the content of all appropriate courses	5
Practical training should be increased to provide students with design thinking skills	2
Workshops and laboratories should be established to practice the skill	2
Innovative thoughts should be included	2
Technology should be used effectively in curricula's	1
Design thinking should be added to curriculum development processes	1
Design thinking in-service training should be given to academicians	1
English skills should be developed in order for students to do research effectively	1

When Table 8 is examined, the suggestions for the implementation of the design thinking skills of the academicians in higher education are listed as follows. "Design thinking should be included in the content of all appropriate courses" (n=5), "Practical education should be increased to provide students with design thinking skills" (n=2), "Workshops and laboratories should be established to apply the skill" (n=2), "Innovative thoughts should be included" (n=2), "Technology should be used effectively in programs" (n=2), "Design thinking should be added to curriculum development processes" (n=1) , "Design thinking in-service training should be given to academicians" (n=1), "English skills should be developed for students to conduct research effectively" (n=1). According to the findings, it can be said that academicians made suggestions such as adding design thinking practices to the course content, increasing applied training, improving my skills and including innovative thoughts. Below are some suggestions made.

P1. "I am in favor of higher education to include innovative ideas, but also to meet basic engineering needs. I am not in favor of destroying basic needs when introducing a new concept."

"P12. Practical training aimed at gaining design thinking skills in higher education should be increased. Problem-based and learner-centered modules can be created by developing special scenarios. I believe that teacher candidates will increase their classroom management skills. Alternative authentic course evaluation methods can be implemented in practice."

P5. "Design thinking should be included in all courses whose content is appropriate. Not every individual who enters a university has to graduate. Students who do not/cannot meet the success conditions required by our age and adopted by the university/who have insufficient skills should be directed to the fields suitable for them (which can be done at the secondary school level as in Germany) and should not be graduated. In this respect, a discipline is necessary for all Turkish universities in which successful students can graduate. Otherwise, it results in organizing education by taking the lowest level students as a reference, as is the case now. However, successful students should be rewarded and education in a class should be about carrying the most successful students to a higher level, and other students should push themselves according to that higher level. Course passing success can be adjusted by setting a reasonable limit. What I want to say here is that universities take the point of serving lazy students and work as institutions that prioritize hardworking students and are interested in ways to be more useful to them. From the same point of view, academicians revise their courses when

necessary at the point of design-oriented thinking and give students projects on project subjects close to their expertise in design project courses. Project design courses can be organized in a way that the student and the lecturer work together at certain hours per week. In these courses, the lecturer can transfer the design software tools, design thinking and design methodology he knows to the students. Universities should allocate a budget and design projects should be implemented. The student who sees that he has succeeded in his projects will gain self-confidence, and perhaps he will have a desire and desire to pursue an idea of work, design, and innovation that will never fade throughout his life."

P9. "A system in which student workshops are kept open permanently and these workshops are supplied with sufficient number of technicians and materials should be implemented as soon as possible. On the other hand, a purely design-oriented approach would also be problematic, I also believe that the theoretical foundations of design thinking should not be left incomplete."

Discussion, Conclusion and Suggestions

In this study, the views of academicians on design thinking skills in different disciplines in higher education were examined. In our education system, where skill education has become a vision, the organization of higher education programs in accordance with the requirements of the digital age in order to gain the desired quality can only be achieved by gaining thinking skills. Design thinking, which is a problem-solving skill, is a skill that meets the skills of the digital age and is essential to be applied in higher education. When we look at the literature compiled and analyzed in this study, it is seen that design thinking has entered the curricula of important universities abroad, but the studies on this subject in our country are limited to master's theses, doctoral dissertations and research articles, and it has not yet been put into practice from the theoretical dimension. In this respect, it is important to get the opinions of academicians about design thinking practices in higher education. As a result of the interviews, the following findings were reached.

Academicians state that there is a high, multifaceted and complementary relationship to the question of whether there is a relationship between design and thinking skills. Multidimensional skills such as creative, problem solving, critical and reflective thinking are used in the design process. The design process starts with thinking and a product emerges according to the emotions and needs of the users.

According to the findings, it is seen that the concept of design thinking is mostly perceived as human-based, user needs-based, solution-oriented and creativity-based. "Design thinking is a methodology based on solution-oriented thinking within the framework of different perspectives" (İşbank, 2021). Design thinking has a human-centered core. It encourages organizations to focus on the people they're creating for, which leads to better products, services, and internal processes (IDEOU, 2021). Research findings support this definitions.

According to the views of academicians, it is stated that individuals who think design-oriented should have features such as empathy skills, analysis, being open to innovation, high imagination, attention to details and creative thinking. In her doctoral dissertation in 2017, Chesson defines the characteristics of design thinkers as follows. A design thinker has a dynamic mindset, is empathetic, human centered, visual, comfortable with ambiguity, collaborative, reflective, open to taking risks, embracing of failure, optimistic, and is able to engage in prototyping (Chesson, 2017). Educators who apply design thinking in education have stated that design thinking contributes positively to students' problem solving, creative thinking and working in collaboration (Anderson, 2012; Arcan, 2019; Scheer & Plattner 2011; Skaggs, Fry & Howell 2009; Watson, 2015; quoted by Girgin, 2020). As a result, it is revealed that design thinker individuals should have multidimensional thinking skills.

It is seen that academicians use design thinking in their courses, in practices such as problem solving method, design project, researching real life problems, and developing thinking skills. Academicians stated that students do not have knowledge about design thinking skills, some of them have theoretical knowledge, and those who have knowledge have a weak application level of the skill. According to the findings, it is seen that academicians make suggestions such as adding design thinking practices to the course content, increasing applied training, improving thinking skills and including innovative ideas.

In the light of the data of this study, the following recommendations could be made.

1. Applied design thinking laboratories and institutes should be established in higher education.
2. It is seen that the studies carried out abroad on design thinking skills are done as an achievement test, skill measurement tool and attitude scale, but there is a study called "Design Thinking Scale in Teaching" for teachers as a scale study in Turkey. Considering the limitations in the design thinking literature and the findings revealed by the opinions of the academicians, it is necessary to conduct scale development studies that evaluate the skills of university students.
3. Design thinking studies should be supported by academic studies and practice-oriented studies should be carried out.
4. Workshops and seminars on design thinking skills, which include the skill sets of the digital age, should be given.
5. When the subject literature is examined, it has been observed that there are more studies focused on design departments and science. It is recommended that educational science researchers conduct applied studies on design thinking.
6. It is suggested that design thinking practices, which is the interdisciplinary approach of our age, should be included in the planning, preparation and development stages of higher education curricula.
7. Considering the data of this research, it is seen as a need to conduct a program evaluation study in order to check the effectiveness of design thinking in higher education curricula.
8. Design thinking practices should be added to all course content.

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