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A Study on Designers' Attitude for Open Innovation in Turkey

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Abstract

In design education, students benefit not only from their project courses' content but also from the information resources they contain. When it comes to the repetition of unique problems and solution-oriented approaches in the design professions, the resources used to research solutions for the problems encountered in design education are also specific to that problem. This situation highlights resource diversity, and especially resource sharing, at various stages and thus opens a view into innovation habits among designers' behaviors. This empirical study explores whether or not designers' behaviors can be related to their practices in design project courses, regarding their open innovation tendencies. Semi-structured interviews with 20 designers are used to form a case study. Interviewees had experience with both in-house designers and freelancers, therefore purposive sampling was used. The results were analyzed thematically and discussed under open innovation practices.

Keywords

Industrial Design, Industrial Design Education, Open Innovation

Background

Design has recently been recognized as a trigger of innovation, as opposed to being considered only one stage of a larger process. Its relevance in managerial processes has been discussed in the literature. As open innovation may be considered both an innovation strategy and a management style, its relationship with design is also discussed in the literature.

Open innovation mainly refers to opening the innovation process to cooperation with others, as opposed to the formerly closed practices where the ideas are solely built within companies (Huizingh, 2011). Open innovation requires interaction and information sharing with others; Enkel et. al. summarize possible information transfers in three groups. Where the outside-in process refers to bringing information from other companies, the inside-out process refers to sharing ideas with others and the coupled process is a combination of both through alliances and cooperation (Enkel et. al, 2009).

Many studies that explore design's assistance with innovation and management focus on its potential to facilitate the abilities needed to solve so-called "wicked problems" and to create a basis for novelty (Cooper et al., 2009; Johansson-Sköldberg et al., 2013; Lockwood, 2009; Verganti, 2009). Design education has the potential to facilitate individuals' managerial capabilities, therefore some have argued that a more holistic understanding of the application of designers' capabilities can be applied to the topic (Boyarski, 1998; Buchanan, 2004; Owen, 1990). Buchanan (2001) stresses that the skills and knowledge bases of designers originate from various disciplines, so that they may act as supporters and implementers of managerial

activities and innovation strategies. Studies that evaluate design as a source of innovation have suggested that design is a factor that should be considered as an element of its own when creating novel ideas, as it is just as effective as technology for facilitating innovation (Norman & Verganti, 2014; Verganti, 2009).

When observing the evolution of innovation processes, Rothwell (1994) argues that innovation becomes increasingly integrated into industrial environments and potential buyers through networks. By developing information technologies, buyers and users become more integrated into the process, addressing innovation strategies that are suggested in design thinking (Brown, 2008). The tendency in innovation practices to be more open through networks and the inclusion of customers in the process may also address the tendency of using design and design-related practices in the same, as discussed in the literature (Acha, 2008; Christiansen et al., 2013).

Education is known to enhance and facilitate professionals' functional capabilities; therefore, an examination of design education provides clues about the main competencies of designers, making it possible to understand their potential value in innovation processes. Ozkan and Dogan (2013) assert that the operation and functioning styles of senior design students are similar to those of design professionals; therefore, the structure of design education can shape design professionals' behaviors. Its investigation may also suggest designers' potential in a business environment.

The projects completed by design students typically include draft and brief professional design practices; students aim to finish a design project within a given timeframe by themselves or while working with a group. The design research that designers conduct through design education plays a major role in their professional design practices (Buchanan, 2001).

Since the behaviors and preferences used in a school design project may shape students' future professional tendencies, an exploration of their design activities and research choices may shed light on their future professional capabilities and propensities. However, the differences between real-world situations and students' assumptions make it important to explore whether a major change happens in the students' research tendencies after graduation.

This study seeks to build upon a prior investigation where a survey was conducted with industrial design students to determine whether a link existed between the habits of students and the open innovation concept. As a possible correlation was found, the study has been extended to explore whether the behavior of design students is reflected in their professional practices (Eroğlu & Ekmekçioğlu, 2018). To gain a more comprehensive understanding of the subject matter and to determine if there have been any changes in preferences, this study aims to compare the tendencies of design students and professional designers concerning information-sharing. To make this comparison, 20 designers were interviewed to determine if their actions in their design project courses are reflected in their current professional practices. To provide a more complete evaluation, designers with both in-house and freelance experiences were chosen for these interviews, to investigate if corporate restrictions affect designers' research preferences. Moreover, their research preferences as freelancers may provide hints concerning the effects of design education and design project courses on their innovation behaviors. Finally, the study evaluates whether design education and design project courses affect designers' potential for open innovation practices.

Open Innovation and Information Sharing

Sharing knowledge is mentioned to be one of the crucial aspects of open innovation (Enkel et. al, 2009; Costa et. al, 2021). In the literature, both "information" and "knowledge" are used to describe intellectual inputs that are shared between co-workers and organizations (Bogers et. al, 2019; Oh & Choi, 2020). In this article "information sharing" term will be used to describe sharing of any kind of data with an intellectual value that may be vital for the development of ideas and projects.

Sharing intellectual property that is developed inside the company is one of the ways of seeking collaboration and commercial potential. Enkel et. al (2009) refer to the "inside-out process" to speed up the process of commercialization of ideas; through sharing intellectual property with other companies, organizations may broaden their market scope through tools such as licensing, joint ventures, etc. While this view focuses on gaining revenues faster than the internal development processes; Chesbrough (2004) stresses the exploring potentials of projects that are no longer continued by firms as they are thought to lack commercial value for the organization. By sharing these intellectual properties, companies can see if there is an interest in the market, which will lead to reconsideration of the intellectual property from different viewpoints (Chesbrough, 2004). Regarding the risks of knowledge sharing, Borgers et. al (2019) mention the necessity of careful management of information transfer among firms to avoid unwanted knowledge leakage.

Singh et. al (2021) address another aspect of knowledge-sharing and open innovation; suggesting that sharing behaviors among co-workers enhance intellectual productivity and pointing out that knowledge-sharing behaviors directly support open innovation. Another study that points out the individuals' role in the success of open innovation suggests that the willingness of team members to share information is an effective element for project success (Oh & Choi, 2020).

Since knowledge sharing between companies and co-workers seems to be an important element of open innovation and the individual behavior of the employees affects overall open innovation success, evaluating industrial designers through their natural knowledge-sharing habits in project courses could hint at their potential for open innovation success.

Project Courses and Their Relevance to Open Innovation

Project courses are a core element of design education (Wang, 2010), as they are considered the venues in which other relevant design-related knowledge should be implemented (Findeli, 2001; Schön, 1988). When the behaviors of design students working on design projects are evaluated, these evaluations are often somewhat in line with open innovation concepts. In this study, the term "behaviors" is used to describe actions that are more unstructured and instinctual, while the term "practices" is used to describe actions that are structured and outcomes of educational and work environments.

Many scholars have underlined the vagueness of the process. The structures of design education programs, and design projects, are complex (Wang, 2010). The problems tackled are, by nature, ill-defined and they involve real-world problems that are solved at different paces by employing varying sets of knowledge (Easterday et al., 2018). This reflective learning and improvised nature of design education and design projects are found in many designers’

professional practices (Waks, 1999). Along with a trial-and-error structure and the habit of testing ideas by gathering data from outside (Wang, 2010), these qualities may reinforce designers' open-innovation practices.

Another aspect of design education and management to consider is that project courses are collaborations. Students are integrated into a design firm's daily environment during project courses, and they are critiqued along with their fellow students. In the process, students find themselves in other students' worlds (Uluoğlu, 2000). Sometimes, they study in groups, but otherwise, they work on their own to build both a sense of fairness and teamwork (Soliman, 2017). Many studies address the practice of group work and the dynamics of knowledge-sharing (Schön, 1988; Shih et al., 2006). During group discussions, students build their visions and manage data, though they may not always be engaged in interdisciplinary work Research and case studies are also vital for project courses (Soliman, 2017), as they force students to work together to collect data and learn from one another (Kuhn, 2001; Shih et al, 2006). Their research media can vary from basic internet sources to online feedback, former practices of well-known professionals, and social networks (Ham & Schnabel, 2011; Soliman, 2017), all of which somewhat reflect the sources that may be applied in an open innovation environment. During the design phase, students sometimes assume different roles (Schön, 1998) and can then give each other feedback on their projects, a form of peer learning (Kuhn, 2001). They also help each other to solve design problems and come up with solutions, though this undermines the fact that their designs are their intellectual property (Shih et al., 2006).

Even though students are encouraged to act as if intellectual property is not something to be protected, they still act as if they are in a competitive environment and often face the dilemmas between sharing and hiding, or cooperation and competition (Shih et al., 2006). These situations resemble the balancing act of being open and closed in open innovation settings (Odriozola-Fernández et al., 2019).

Open Innovation and Design

Today, design is considered both a source of innovation in general and a supporter of open innovation (Acha, 2008; Verganti, 2009). Although innovation features prominently in the literature, design is often ignored (Hobday et al., 2011). This is mostly due to the perspective in earlier studies that saw innovation because of scientific improvements (Cooper & Press, 1995). The development of innovation was regarded as a transformation process that began with research, led to technology, and then to the emergence of an innovation (Trott, 2005). Recently, new approaches have appeared in innovation studies.

Verganti (2009) studies innovation through the aspects of technology and meaning, where the former refers to novelties that can be related to technical improvements and the latter refers to the changes in a product's meaning created through its design. Both aspects display radical and incremental improvements, as design-driven radical innovations are the result of research into the meaning, and incremental innovations are generally formed by the tenets of human-centered design (Norman & Verganti, 2014).

Designers can support open innovation practices, and user involvement is a critical aspect of them (Gassmann et. al., 2010). Working with users is the core aspect of human-centered design and is frequently used to improve existing products. This is discussed in the concepts of design

thinking (Brown, 2008; Cooper et al., 2009). Designers can include lead users in their design processes to help develop novel ideas (Urban & Von Hippel, 1988).

Another aspect that is stressed in design thinking studies is the ability to cope with uncertainty. Cross (1990, 2001, 2004) underlines these aspects in his work. This ability of designers is also referred to as dealing with "wicked problems," which are, by nature, hard to describe (Buchanan, 1992; Dorst, 2011; Rittel & Weber, 1973). Cross (1990) also draws attention to designers' ability to work with incomplete data and to apply their imaginations in defining and solving uncertain problems in novel ways. These abilities may support companies' open innovation potential, as open innovation may result from the company's design practices, given that design can enforce more open strategies (Acha, 2008). Design is also considered a tool for strategic problem-solving (Hobday et al., 2012), considering that its tendency to openness may affect workers' overall approach to open innovation.

In addition to the above, design enhances innovation activities by supporting knowledge mobility. Researchers who promote radical design-driven innovation bring together designers from various disciplines and other professionals to create a multidisciplinary working environment (Dell'Era & Verganti, 2010). In creative industries, workforce mobility is higher than is common in other fields, as designers are often willing to work in many areas; this may facilitate their knowledge transfer through their mobility and the natural habits of their business practices (Chesbrough, 2012). Designers and design offices can also transfer knowledge, information, and trends among organizations (Verganti, 2003).

Case Study

Research Context: Industrial Design Education in Turkey

Industrial design education in Turkey was first considered through the U.S.-sponsored Marshall Aid Program in the early 1960s; however, the first department in Turkey was not formed until 1971 — at the Istanbul State Academy of Fine Arts (Asatekin, 2006; Küçükerman, 2006). In the early days, industrial design education was not considered necessary (Er, 1993; Özcan, 2009). In the 1960s, architectural and interior design academies mainly supported the formation of these curricula (Celbiş, 2006). Since educational systems that stemmed from other disciplines were adapted, rather than having their language, industrial design education was a derivation of other disciplines and countries' education systems (Bayazıt, 2006; Er & Er, 2006; Er et al., 2003; Flores, 2000; Günal Ertaş, 2011). The early academicians in some industrial design departments were mostly interior architects who held graduate degrees from schools located in Britain, Japan, Germany, Canada, and Italy (Celbiş, 2006). For these reasons, design education in Turkey shares elements with other design disciplines, such as architecture and interior design.

As a result of adaptations, Turkish design education programs historically developed around two main disciplines, the LYS (undergraduate placement examination) and aptitude tests. Through the LYS, students' abilities to solve basic scientific problems related to math and physics are evaluated. In aptitude examinations, students are required to make hand drawings that address the requirements defined by the judging instructors. After 2017, the aptitude tests were abandoned, and today all design departments accept their students based on LYS scores.

Industrial design education recently found its tone after being shaped through the lenses of architecture and interior design education. Industrial design education, mainly via project-

based courses, aims to reinforce students' own identities, styles, and design ideas (Balcıoğlu, 2009). Today's design students are evaluated in terms of the design process, in which their responses to various aspects are questioned alongside the development stages of their designs, rather than being judged solely on technical and aesthetic elements. Design project courses are regarded as the core element of design education, as these are where knowledge gathered from other courses is applied; this design project-centered view of education is in line with the approaches used in other design disciplines (Wang, 2010).

In the present study, graduates from a variety of disciplines in Turkey are included; all of them are, or hope to be, employed under the title "industrial product designer." This sampling provides a more holistic "designer" profile for our study, as it is common to choose students for programs based on a variety of criteria. At the same time, it should be noted that these selection criteria may also affect students' preferences for conducting research. Different types of problem-solving approaches are defined in the literature (Dorst, 2003), and they may lead to different profiles among designers, based on their educational backgrounds (Resnick, 1999).

Research Design

The empirical study is based on semi-structured interviews with 20 industrial designers to form a case study (McGregor, 2017). 12 designers are undergraduate graduates, 6 of them are graduates and 2 of them are doctoral graduates. All designers' undergraduate degrees are in industrial design and they are all actively working in the industrial design professions. In addition, all participants have 10 to 20 years of professional experience. While selecting the sample of designers, it was considered that they were familiar with both current and past methods and tools of information sharing. The reason for this preference is that while the instruments that are available in design education may differ between the past and present, the instruments used in design processes in today's business world are independent of the designers' graduation years.

The interviewees had experience both as in-house designers and freelancers, therefore purposive sampling was used (Gray, 2004). The designers had experience in the yacht, automotive, furniture, ceramics, wearable products, packaging, household appliances, lighting, and exhibition industries. The research was conducted in the form of open-ended interviews with the participants. The following questions were asked to understand the information sharing of the participants both while working as students, in-house, and freelance:

- What were the sources you used to get information about your design activities when you were a student?
- When you were a student, did you share information in your design activities? What would you pay attention to while sharing?
- What were your sources of information gathering in your design activities while working in the company?
- Would you share information with those outside of the company while you are in the company? (Unfinished, abandoned project, found technologies, etc.) ... What would you pay attention to while sharing?
- What are your research/information sources in your design activities while working as a freelancer?

- As a freelancer, do you/would you share information in your design activities? What would you pay attention to while sharing?
- What do you think a designer should prioritize while exchanging information? Why is that?

Due to the Covid-19 pandemic, interviews were conducted online. Each interview was recorded and transcribed. The transcriptions were read for thematic coding to identify repetitive tendencies within three different practices (Flick, 2018). The results of the thematic analysis for each case are seen in the tables (Appendix A, Appendix B).

Designer Behavior in Education Phase

Sources that Students Use

The interviewees declared that they utilized global and local sources along with expert opinions.

Global sources that can be reached by everyone globally were mainly online sources such as the internet and design blogs. Surely, the utilization of these sources depended on the era and some of the older designers declared that they were not able to reach them at the time of their studentship. However, younger designers mentioned these as their main research media.

> *"... blogs were very popular back then, Blogspot was popular, now that I think of it, it's something else. We made working speaker models with the help of Blogspot while we were doing a speaker project. I remember there were such blogs of people who were very interested in sound systems. I remember finding and reading something there."*

Local sources which were within the physical reach of the students were libraries, printed media, events, sources of other disciplines, and potential users. Some designers declared that they couldn't utilize the Internet at the time, and they were mainly dependent on libraries and bookstores. Arts exhibitions and design events along with industrial exhibitions were also attended by designers while they were students to get inspiration and information. Attendees mentioned that they were used to talking with companies in industrial exhibitions to gather information about certain products and technologies. Also, some of the designers mentioned that they took advantage of being in a campus environment and got information and printed resources from instructors and students of other departments. Finally, gathering information about user tendencies from salespersons and users was also applied to get more information about the design context.

> *"Other than that, we made a lot of observations, especially for user research. We used to record them and analyze them later."*

Instructors and professionals were also present as information sources during design education. The interaction with these people were mostly knowledge transfers, where the refined knowledge from experience was passed to students.

> *"...I decided to do a graduation project without even knowing what sanitaryware means, and there, of course, there are companies with some departments. They directed us to the relevant departments; this is produced like this, that is produced like that..."*

Information and Knowledge Sharing Among Students

Designers declared that when they were students, they shared both information and knowledge and also, and they naturally shared these as a result of the daily networks.

Many of the designers mentioned that they were part of real-life networks with both their classmates and students from other disciplines in faculty buildings or dormitories. Therefore, information was shared in physical spaces like classrooms or working spaces in dormitories. Also, it was easier for them to show their peers how they work with a certain design program or technique. They mentioned that they brought materials and books to their networks to share with their friends in the faculty.

> *"... I think we nurtured each other more as a class. I mean, I hope it's not unfair to my professors when I say I've learned more from my classmates than I've learned from them."*

Regarding information sharing, designers declared that sharing information and not hiding it from peers were common behaviors in university. They also declared that they frequently worked together and brainstormed together. Some designers mentioned that because of the juries, sooner or later they had to share their ideas. They stated that as everyone followed a different path even though they worked on a similar concept, sharing information was not a concern for them in terms of originality.

> *"Because everyone develops their problem and their solutions, the solution that they bring to a problem... I think that the solution that others bring, even if it is the same problem, will be different. Because of this, we didn't hide information from each other, at least it was the tendency around me."*

Designers mentioned that they also shared knowledge through teaching each other and providing criticisms about projects among peers. They declared they taught each other to learn computer programs and more specific knowledge about different courses such as technical drawing. They pointed out that it was usual for them to get criticisms from their peers to improve each other's projects.

> *"When you're telling the person in front of you about your project and when you make a presentation, you present your arguments, so that your friend can provide an answer and the work can get better. We didn't have such a restriction you know, like anything to hide and keep some parts myself, we didn't act like that."*

Although many of the comments reflected an open behavior, some of the designers also defined preferences that can be considered as hesitations, such as closeness and concern about keeping originality.

> *"But I had an idea like this, and if I wanted to keep it, I wouldn't have done it (sharing) until the first presentation, but when I say, "I wouldn't have done it", it's not in the sense of keeping information, you know, I had concerns about copying, etc."*

In-House Designer Behavior

Sources that In-House Designers Use

Attendees specified global sources and local sources as their main tools for research. Designers declared that while working as in-house designers they frequently employed global sources. These are the sources that can be reached globally and are mainly internet sources and expositions. The Internet was mentioned more frequently here as this section is not mainly about past experiences and many of the designers could use the Internet with more efficiency after their graduation. Also, they mentioned dedicated websites and apps such as Pinterest, designer blogs, and design competition websites. Also, as the organizations they worked for provided the opportunities they frequently mentioned expositions and exhibitions among their primary sources. They mentioned they visited both sectoral and non-sectoral expositions.

> *"I was working in the furniture sector, and I was attending fairs in the ceramic sector."*

> *"And of course, the WGSN fair is very useful for me as I have access."*

Local sources were mainly printed documents, local networks, and local events. Among printed documents, the archive of the organization was frequently mentioned and design magazines, dedicated industrial magazines, product catalogues, trend books, and exhibition books were mentioned. Local networks included sources from other disciplines and user participation. Sources from other disciplines were suppliers, craftspeople, and other designers such as architects. They mentioned working with lead users during the concept phase and the participation of regular users in the market research and concept testing phases. Finally, events such as lead user briefings, education programs, and seminars organized by the companies were mentioned among the sources.

> *"If there is information to be gained, there may be courses specific to that project, certificate programs of competence, or technical tours. These may be related to the new material or the production method."*

> *"Besides that, we were bringing consultants within the scope of the project, for example, from abroad, the racers, sailing racers for example."*

Information and Knowledge Sharing as In-house Designer

The information-sharing tendencies are evaluated under four sections real-life networks, information sharing, knowledge sharing, and hesitations about openness.

As real-life networks, both networks within and outside of the companies are mentioned. Networks within the firm include both natural interactions during work along with the help provided by colleagues. But designers also mentioned that they share information with the people outside, such as design offices they work with, universities, suppliers, the design community (through research reports and even some of the competitors.

> *"But when our friend working for the competitor asks where you have the packaging for cookware produced, I would share the information of the packaging companies we work with. I mean, why worry if they work with them?"*

Information sharing mostly refers to information sharing among colleagues outside the business context. The main motive is to help the careers of designers.

> *"There was Coroflot and even an advertisement on it like 'send your designs for our book'. The designs were to be published in a book or something. I have sent it to my close designer friends."*

When talking about knowledge sharing, designers stressed sharing their professional experience and personal knowledge. Sharing professional experience means transferring the knowledge gained through career to peers and students, while personal knowledge sharing refers to knowledge that originated from designers' interests or personal capabilities.

> *"We had colleagues who said, 'Those who want to learn Maya, raise your hands!', and they stayed after hours to teach without getting paid for it."*

Again, there were hesitations about openness which could be grouped under closeness and concerns about intellectual property rights. Closeness is more about designers' concerns about a project getting copied (even within the organization), while intellectual property rights concerns were mostly enforced by companies.

> *"When I turned around, I saw him looking at my screen and he stood up and developed my product without asking me. The situation was he was trying to develop and imitate my project visually."*

> *"We already had a contract, and that contract was protecting the client. A general innovation privacy contract."*

Freelance Designer Behavior

Sources that Freelance Designers Use

Designers mainly referred to global and local sources when they talked about their main research tools as freelancers.

They referred to internet and trend reports as global sources. In this section, as there is a lack of organizational financial support, answers are closer to the tendencies of students.

> *"As I said, as a freelancer, I need to research trends more. I also get support from YouTube or Google, or trend reports from large companies while researching trends."*

Local sources that are mentioned are more varied; printed sources, sources from other disciplines, expert opinions, user participation, and events are the sub-themes of this section. Printed sources that were referred to are magazines, libraries, and catalogues that are provided by clients. Sources from other disciplines include people such as architects and animators through personal networks. Expert opinions refer to both professional links with organizations such as suppliers and producers along with experts that are reached with the help of other colleagues. User participation includes surveys and product comments on various websites, while events refer to expositions.

> *"Our friends we work with, those I work with, are industrial design graduates. Because my friends are also involved in different industries, for example, when it is necessary, you know, I get help from them about other areas where I'm not a professional."*

Information and Knowledge Sharing as Freelance Designer

Information sharing as a freelance designer is evaluated in three categories: real-life networks, information transfer, knowledge transfer, and closeness.

Real-life networks are mostly shared data with other designers. Designers share data they got from certain databases, photos, expertise about a certain industry, design ideas, and such.

> *"I try to share all I know in terms of exchanging ideas with those around me. It further enhances the exchange of ideas so there is no such thing as keeping information. That's how I proceed."*

Information transfer is mostly among designers and other professionals or students. Designers share information with others to enhance information networks and pass the information to other generations. They also believe it nourishes the suppliers and improves their work.

> *"It should not be overemphasized, it turns into paranoia at some point, I think knowledge is not that valuable. It is when you do something with it, that it turns into something."*

Sharing knowledge includes sharing work experience and personal acquisition. Sharing work experience is mostly with interns, companies, and sometimes with colleagues. Sharing personal acquisition is sharing networks and information about how to utilize programs and such.

> *"(Sometimes I say to my colleagues) 'Look, I have such products'. You know, maybe there are designs that you can show your customer."*

Closeness is mostly about ethical concerns and forced intellectual property rights. Even without a written contract, some designers find it unethical to share information or designs. When they sign a contract, they are obliged to keep the data closed and they do so.

> *"Again, it's based on personal trust, but as I find it ethically wrong, we have never done this (sharing data) before.*

Designers' Thoughts on Sharing Information

Designers' tendencies about sharing information are evaluated under two sections: openness and closeness.

When it was asked how information sharing among designers should be, designers emphasized that there should be communication between colleagues. It is stated that connections between designers enhance both the business and design itself. Another aspect is turning information into an open source for all designers. Designers declared common knowledge such as trend reports, materials, and such can be reached through open sources, and they appreciated online platforms such as Pinterest. According to interviewees another benefit of openness is avoiding

information pollution; as today there is too much information on the internet, designers may help each other to avoid wasting time in a struggle to find useful information.

> *"I pay attention to… for example, you know now when we receive information from the internet, yes, sometimes we share it, but now there can be information pollution."*

When they talk about keeping information from others, their concerns are mostly commercial. Intellectual property rights are one of the main concerns for designers. They strongly believe that any information that is specific to a company should be kept secret. They also mention commercial concerns; they mention that they don't want to lose their competitive advantage to other designers. Finally, among ethical concerns, they mentioned they find it unethical to share any data about a company with anyone outside the business (not only colleagues) even if there is no written contract.

> *"I think the ethical part should be prioritized. If you made something original and you go and use it somewhere else, it doesn't seem very ethical to me."*

Discussion

General Description of Practices

The interviews indicated that designers understood open innovation, both during their time as students and in their professional practices as in-house and freelance designers.

As students, the education environment enforced the sharing of ideas, even at the concept stage, which led to the inevitable exchange of ideas. As students, the designers learned that a single design problem can be resolved by a variety of solutions. They also reported their tendency to share information about techniques and materials, as they were more focused on the differentiation of their final solutions. They also noted that they tended to keep their final solutions to themselves until a certain point. Also, due to the nature of the education environment, most of their information sources were open ones, and they were used to interacting with their peers to get information.

As in-house designers, naturally, the designers reported some closed resources, such as archives, that only the employees of a company may access. However, the open sources they used during their education are still in frequent use. When sharing information, professional designers are more careful since their works are directly related to the intellectual property rights of an organization. Nonetheless, they continue to share information both within and outside their companies. Sometimes, they mentioned keeping a distance from their colleagues, as if there is a competitive environment within the company, but generally, they are eager to teach skills and knowledge to other designers within the company. Outside of their company settings, they share information with others for educational purposes, they inform their networks about beneficial information, and they even tend to bend company restrictions to enhance others' capabilities.

As freelancers, designers seem to have more control over their design ideas, and they share them more freely with their friends. They also share knowledge and information with younger designers and peers. However, they are still bound to agreements they make with their clients, and some designers tend to keep their intellectual property to themselves, to preserve their competitive edge. Their information sources are the same as the sources they used throughout

their education, though supplemented with the addition of clients, suppliers, and their more advanced personal networks.

When designers talk about their thoughts on sharing information, they refer to the natural processes of design actions and typically separate information and certain knowledge from seeking a competitive edge. They are in favor of sharing and open-source use, as they believe data itself does not solely create intellectual property, whereas the unique synthesis and interpretation of the data, which leads to a design, does. Although they are often restricted by contracts and agreements, they tend to share information but are certainly hesitant when it comes to sharing material that creates a competitive edge.

Comparison of Practices

It can be understood that within each different practice, designers gather and share informatively. However, not surprisingly, there are differences between actions, as practices occur in various environments and under differing restrictions.

While gathering information, ease of reach is an important factor for preference of the source (Table 1). Internet and design events are equally preferred among the three different practices as they are open for designers from all levels. However, some of the sources are accessible for certain practices; libraries and academic staff are more accessible for students while exhibitions are financed by companies and therefore are more accessible for in-house designers. Freelancers are not backed up by corporate structures such as universities or companies, therefore they rely more on their network and highly depend on experts and share information with colleagues. Printed sources are accessible to students and in-house designers, as they are financed by organizations such as firms and universities. Sources from different disciplines are easy to reach on campus and in office environments and therefore are mostly used by students and in-house designers.

Trend reports are more utile for freelancers as they provide intense insight that freelance designers cannot obtain on their own. User participation is valuable at every stage; however, the type of participation may change from snowball sampling at the student level to organized focus groups at the corporate level. Event participation may be seen at each level but can be more frequent if backed up by a corporation.

Table 1. Information gathering motivations according to the designer's stages

Information Gathering		Designer's Stage		
Codes	Motivations	Student	In-House	Freelance
Global Sources	Internet	+	+	+
	Design Blogs	+		
	Sources From Different Disciplines	+	+	+
	Exhibitions		+	
	Trend Reports			+
Local Sources	Libraries	+		
	Printed Sources	+	+	+
	Events	+	+	+
	User Participation	+	+	+
	Instructors	+		
	Experts	+		+

Regarding information sharing, it is defined by abilities and restrictions (Table 2). Most freelancers sign binding contracts so they are careful not to share any business-related context with those outside of the company. This tendency is only seen in in-house designers, probably because they have a better understanding of the limits they are required to obey. However, as freelancers, designers support openness more. This may be related to the perception that as in-house employees; designers feel that their expertise should serve the company that they work for. While they as in-house they share knowledge, and they frequently mention cooperation practices, such as the projects they conduct with universities. They also do not share information with colleagues, while as freelancers and students, they frequently do. Designers refer to openness more when talking about their practices as freelancers and students, as they mostly depend on open sources. They mention closeness within every practice in a sense to protect intellectual property that they expect to benefit from. Also, naturally, intellectual property concern on a legal basis is mentioned while working with companies and students do not mention this aspect.

Table 2. Information sharing motivations according to the designer's stages

Information Sharing		Designer's Stage		
Codes	Motivations	Student	In-House	Freelance
Real-Life Network	Sharing in Physical Space	+		
	Working Together	+		
Information Sharing	Personal Information Sharing		+	
	Sharing Information Among Students /Colleagues	+		+
	Inhouse Information Sharing		+	
	Information Sharing With Outside the Firm		+	
Knowledge Sharing	Openness	+		+
	Closeness	+	+	+
	Experince Sharing		+	+
	Personal Knowledge Sharing	+	+	+
	Intellectual Property Concern		+	+

To summarize, it can be said that designers have an understanding of open innovation as students, in-house designers, and freelancers based on our field study in Turkey. However, they feel obliged to be more sensitive about information sharing when they work with companies and they tend to keep the knowledge and intellectual property that differentiates them from others at every level. This tendency is also in line with the basics of open innovation, it may hamper innovation capability through being more restricted than required.

Conclusion

The results of the study suggest that industrial design students' information-sharing tendencies reflect their professional practices; as individuals' willingness to share information enhances project success in open innovation (Oh & Choi, 2022), industrial designers may be valuable assets for companies that depend on open innovation for product development.

Industrial design education enables design students to adapt their design methodology and problem-solving skills to different problem-solving areas, instead of teaching them in-depth knowledge in a particular field. This situation reveals the need to create a new information framework for every project encountered, both in a designer's school and professional life. Designers also try to use every available resource effectively for every new project. This trend, which begins during student life and is predominantly open source, is also reflected in designers' professional lives. The generally open environment of design education programs can also be related to the discipline's need for up-to-date information on various subjects and the responsibility placed on students to provide necessary information for every design

problem. Therefore, industrial designers may act as sources for various information in design practice, as they tend to scan and apply information that comes from various sources.

Due to the nature of design courses, knowledge sharing among students is quite common, and design can often be considered a case of open innovation, in terms of using design and design-related practices from a design education perspective. This study has observed that open innovation habits formed during one's design education continue in professional work, both as in-house and freelance designers. This approach may enhance information networks between designers in professional practices, which may lead to formal and/or informal networks between designers and companies to enhance open innovation practices.

The interviews with designers reveal that they have an in-built understanding of open innovation as they favor nourishing their peers while keeping their original solutions and points of view for design. One of the most striking points uncovered in this study is that designers generally want to share information mutually. The student's belief in the variety of possible solutions that can arise from the same data set encourages them to share information, and this is later reflected in real-world situations of working with mutual sources to come up with different solutions. The idea is one of the core strengths of open innovation, as it is thought that sharing information may favor companies on the way to bringing better solutions for innovation tasks along with keeping the core competitive advantage to itself. The generation of differentiated solutions through novel combinations also favors radical innovations, which is vital for the development of any industry. Therefore, design practice may also lead to radical innovations by favoring open innovation with industrial designers' information behaviors, without hampering companies' competitive advantage.

While practicing open innovation in project courses comes naturally to designers, they seem to feel restricted in corporate environments. This is an important issue because their natural habits can enhance a company's innovation capabilities in the modern industrial environment. Furthermore, designers' interpretations of open information sources and their definitions of sharing vary based on the generation in which they were educated. This study observed that the means of accessing resources, both in education and professional design life, the prevalence of digitalization in education, and changes in communication opportunities facilitated by technology can affect the quality of resources and the culture of sharing. Encouraging interactions among designers can help design practice nurture open innovation further.

To summarize, it can be said that an awareness of designers' natural habits regarding project research behavior and an understanding of their information-sharing habits may benefit companies in establishing better open innovation capabilities. As designers have a core understanding of what to share and what to keep, they may have more freedom to develop networks and manage information flow to build an effective and agile innovation practice.

The limitations of this study mainly arise from the variety of interviewees that were included. Designers from various age groups were added to the study to understand if their tendencies regarding information sharing arise from actual popular information sources or design practices. As a result of this choice, this study does not provide an up-to-date picture of current design students. The results were derived from Turkish design education, which is briefly explained and may differ from other countries with different educational practices. Finally,

while designers with experience in various industrial areas were included, the results may be industry-dependent in some cases. To obtain a more holistic understanding of a single industry, an exclusive study may be necessary.

In future studies, researchers can identify the factors that nurture designers' open innovation tendencies and evaluate design education using the latest communication and information media. This can lead to the development of more supportive design education programs.

Ethics Declarations

Data availability statement

The datasets generated during and/or analysed during the current study are not publicly available due to the fact that the data of the study was collected through interviews and there was interview confidentiality but are available from the corresponding author on reasonable request.

Conflict of interest

The authors declare that they have no conflict of interest.

References

Acha, V. (2008). Open by Design: The Role of Design in Open Innovation. *Academy of Management 2008 Annual Meeting: The Questions We Ask*, AOM 2008.

Asatekin, M. (2006). ODTÜ Mimarlık Fakültesi Endüstri Ürünleri Tasarımı Bölümü "Başlangıç Notları". *Tasarım+ Kuram Dergisi*, *3*(5), 28-33. http://www.tasarimkuram.msgsu.edu.tr/index.php/tasarimkuram/article/download/24/26

Balcıoğlu, T. (2009). *İçimizdeki Bauhaus: İzmir Ekonomi Üniversitesi Güzel Sanatlar ve Tasarım Fakültesi Eğitim Programları. Bauhaus: Modernleşmenin Tasarımı Türkiye'de Mimarlık, Sanat, Tasarım Eğitimi Ve Bauhaus*. İletişim Yayınları, İstanbul.

Bayazıt, N. (2006). İTÜ'de Endüstri Ürünleri Tasarımı Bölümü "DENEYİ'mim". *Tasarım+ Kuram Dergisi*, *3*(5), 41-53. http://tasarimkuram.msgsu.edu.tr/index.php/tasarimkuram/article/viewFile/26/28

Bogers, M., Chesbrough, H., Heaton, S., & Teece, D. J. (2019). Strategic management of open innovation: A dynamic capabilities perspective. *California Management Review*, *62*(1), 77-94.

Boyarski, D. (1998). Designing Design Education. *ACM SIGCHI Bulletin*, 30(3): 7-10.

Brown, T. (2008). Design Thinking. *Harvard Business Review*. June: 1-11.

Buchanan, R. (1992). Wicked Problems in Design Thinking. *Design Issues*, 8(2): 5-21.

Buchanan, R. (2001). Design Research and the New Learning. *Design Issues*, 17(4): 3-23.

Buchanan, R. (2004). Human-Centered Design: Changing Perspectives On Design Education in the East and West. *Design Issues*, 20(1): 30-39.

Celbiş, Ü. (2006). Marmara Üniversitesi, Güzel Sanatlar Fakültesi, Endüstri Ürünleri Tasarımı Bölümü. *Tasarım+ Kuram Dergisi*, 3(5), 34-40. http://tasarimkuram.msgsu.edu.tr/index.php/tasarimkuram/article/viewFile/25/27

Chesbrough, H. (2004). Managing open innovation. *Research-technology management*, *47*(1), 23-26.

Chesbrough, H. (2012). Open Innovation: Where We've Been and Where We're Going. *Research-Technology Management*, *55*(4), 20-27.

Christiansen, J. K., Gasparin, M., & Varnes, C. J. (2013). Improving Design with Open Innovation: a Flexible Management Technology. *Research-Technology Management*, 56(2): 36-44.

Cooper, R., Junginger, S., Lockwood, T. (2009). Design Thinking and Design Management: A Research and Practice Perspective. *Design Management Review*. 20(2): 45-55.

Cooper, R., & Press, M. (1995). The design agenda: a guide to successful design management. John Wiley and Sons.

Costa, J., Neves, A. R., & Reis, J. (2021). Two sides of the same coin. university-industry collaboration and open innovation as enhancers of firm performance. *Sustainability*, *13*(7), 3866.

Cross, N. (1990). The Nature and Nurture of Design Ability. *Design Studies*, 11(3): 127-140.

Cross, N. (2001). Designerly Ways of Knowing: Design Discipline Versus Design Science. *Design Issues*, 17(3): 49-55.

Cross, N. (2004). Expertise in Design: An Overview. *Design Studies*, 25(5): 427-441.

Dell'Era, C., and Verganti, R. (2010), "Collaborative Strategies in Design-Intensive Industries: Knowledge Diversity and Innovation", *Long Range Planning*, Vol. 43, No. 1, pp. 123-141.

Dorst, K. (2003). The Problem of Design Problems. *Expertise in Design*, 135-147.

Dorst, K. (2011). The Core of Design Thinking and It's Application. *Design Studies*, 32(6): 521-532.

Easterday, M. W., Gerber, E. M., & Rees Lewis, D. G. (2018). Social innovation networks: A new approach to social design education and impact. *Design Issues*, *34*(2), 64-76.

Enkel, E., Gassmann, O., & Chesbrough, H. (2009). Open R&D and open innovation: exploring the phenomenon. *R&d Management*, *39*(4), 311-316.

Er, H. A. (1993). The State of Design: Towards an Assessment of the Development of Industrial Design In Turkey, *METU Journal of Faculty of Architecture*, Vol 13(1-2).

Er, Alpay, and Er, Özlem (2006). "Design research in the periphery: A review of the foundations and development characteristics of industrial design research in Turkey", *A/Z ITU Journal of the Faculty of Architecture*, 3(1-2), 85-97.

Er, H.A., Korkut, F. & Er, Ö.(2003). US Involvement in the Development of Design in the Periphery: The Case History of Industrial Design Education in Turkey, 1950s–1970s. *Design Issues*, 19(2), 17-34. DOI: https://doi.org/10.1162/074793603765201389

Eroglu, I., & Ekmekçioglu, D. (2018). Exploring the Relation between Students' Research Behaviours in Project Courses and Open Innovation. *Design and Technology Education*, *23*(3), 46-61.

Findeli, A. (2001). Rethinking design education for the 21st century: Theoretical, methodological, and ethical discussion. *Design issues*, *17*(1), 5-17.

Flick, U. (2018). An introduction to qualitative research. Sage.

Flores, O. S. (2000) "Research and Design in Mexico", Design Research: Proceedings of the Politecnico di Milano Conference, Milano 18- 20 May 2000, pp. 490-494.

Gassmann, O., Enkel, E., & Chesbrough, H. (2010). The Future of Open Innovation. *R&D Management*, 40(3): 213-221.

Gray, D. E. (2004). Doing research in the real world. Sage, London.

Günal Ertaş, D. (2011). İTÜ Endüstri Ürünleri Tasarımı Bölümünün Kuruluş Çalışmaları, *Endüstride Tasarımda Eğitimde 40 Yıl Sempozyumu*, 7-9 Aralık 2011, MSGSÜ, İstanbul.

Ham, J. J., & Schnabel, M. A. (2011). Web 2.0 virtual design studio: social networking as facilitator of design education. *Architectural Science Review*, 54(2), 108-116.

Hobday, M., Boddington, A., & Grantham, A. (2011). An Innovation Perspective on Design: Part 1. *Design Issues*, 27(4): 5-15.

Hobday, M., Boddington, A. & Grantham, A. (2012). An Innovation Perspective on Design: Part 2. *Design Issues*. 28(1): 18-29.

Huizingh, E. K. (2011). Open innovation: State of the art and future perspectives. *Technovation*, *31*(1), 2-9.

Johansson-Sköldberg, U., Woodilla, J., & Çetinkaya, M. (2013). Design Thinking: Past, Present and Possible Futures. *Creativity and Innovation Management*, 22(2): 121-146.

Kuhn, S. (2001). Learning from the architecture studio: Implications for project-based pedagogy. *International Journal of Engineering Education,* 17(4/5), 349-352.

Küçükerman, Ö. (2006). 1971 Yılında Türkiye'de ilk Kez Güzel Sanatlar Akademisi ile Başlatılan Endüstri Tasarımı Eğitiminin 37 Yıllık "SEYiR DEFTERi". Tasarım+ Kuram, 3(5), 1-27.

McGregor, S. L. (2017). Understanding and evaluating research: A critical guide. Sage Publications.

Norman, D. A., & Verganti, R. (2014). Incremental and Radical Innovation: Design Research vs. Technology and Meaning Change. *Design Issues*, 30(1): 78-96.

Lockwood, T. (2009). Transition: How to become a more design- minded organization. *Design Management Review*, 20(3): 28-37.

Odriozola-Fernández, I., Berbegal-Mirabent, J., & Merigó-Lindahl, J. M. (2019). Open innovation in small and medium enterprises: a bibliometric analysis. *Journal of Organizational Change Management*.

Oh, M., & Choi, S. (2020). The competence of project team members and success factors with open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *6*(3), 51.

Owen, C. L. (1990). Design Education in the Information Age. *Design Studies*, 11(4): 202-206.

Özcan, A. C. (2009). An Overview of The Early Foundations and Development of Contemporary Industrial Design in Turkey. *The Design Journal*, *12*(3), 267-287. http://www.tandfonline.com/doi/pdf/10.2752/146069209X12530928086289

Ozkan, O., & Dogan, F. (2013). Cognitive Strategies of Analogical Reasoning in Design: Differences Between Expert and Novice Designers. *Design Studies*, 34(2): 161-192.

Resnick, L. B. (1999). Making America Smarter. *Education Week Century Series*, 18(40), 38-40.

Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a General Theory of Planning. *Policy Sciences*, 4(2): 155-169.

Rothwell, R. (1994). Towards the Fifth-Generation Innovation Process. *International Marketing Review*, 11(1): 7-31.

Schön, D. A. (1988). Toward a marriage of artistry & applied science in the architectural design studio. *Journal of Architectural Education*, *41*(4), 4-10.

Shih, S. G., Hu, T. P., & Chen, C. N. (2006). A game theory-based approach to the analysis of cooperative learning in design studios. *Design Studies*, *27*(6), 711-722.

Singh, S. K., Gupta, S., Busso, D., & Kamboj, S. (2021). Top management knowledge value, knowledge sharing practices, open innovation and organizational performance. *Journal of Business Research*, *128*, 788-798.

Soliman, A. M. (2017). Appropriate teaching and learning strategies for the architectural design process in pedagogic design studios. *Frontiers of architectural research*, *6*(2), 204-217.

Trott, P. (2005). *Innovation Management and New Product Development*, Pearson Education, Essex.

Uluoğlu, B. (2000). Design knowledge communicated in studio critiques. Design Studies, 21(1), 33-58.

Urban, G. L., & Von Hippel, E. (1988). Lead user analyses for the development of new industrial products. *Management Science*, *34*(5), 569-582.

Verganti, R. (2003). Design as brokering of languages: Innovation strategies in Italian firms. *Design management journal*, *14*(3), 34-42.

Verganti, R. (2009). *Design Driven Innovation: Changing the Rules of Competition by Radically Innovating What Things Mean*. Harvard Business Press, Boston.

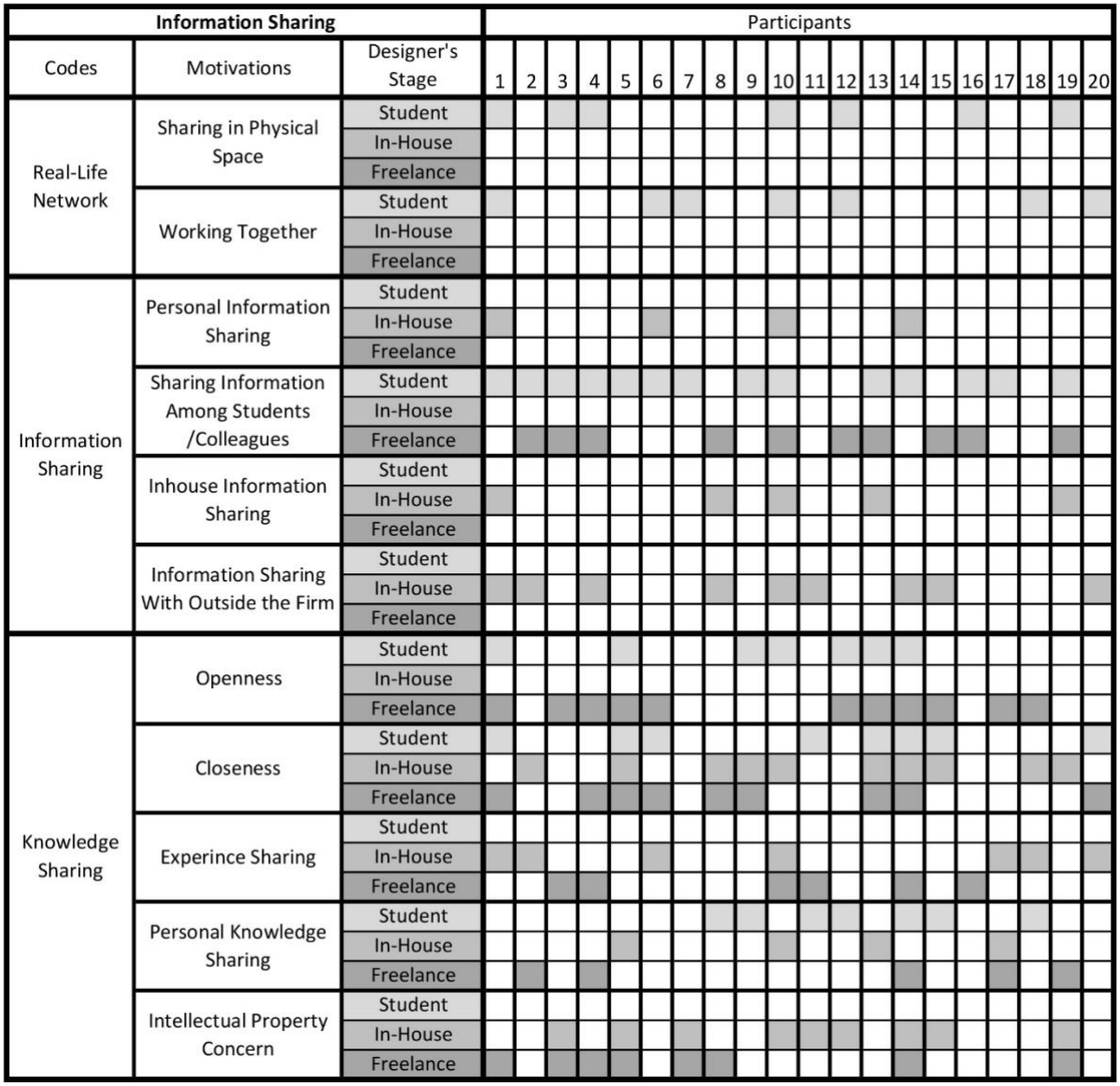
Waks, L. J. (1999). Reflective Practice in The Design Studio and Teacher Education. *Journal of Curriculum Studies*, *31*(3), 303-316.

Wang, T. (2010). A new paradigm for design studio education. *International Journal of Art & Design Education*, *29*(2), 173-183.

Appendix A. Designer's Information Gathering Codes and Motivations

Information Gathering			Participants																			
Codes	Motivations	Designer's Stage	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Global Sources	Internet	Student																				
		In-House																				
		Freelance																				
	Design Blogs	Student																				
		In-House																				
		Freelance																				
	Sources From Different Disciplines	Student																				
		In-House																				
		Freelance																				
	Exhibitions	Student																				
		In-House																				
		Freelance																				
	Trend Reports	Student																				
		In-House																				
		Freelance																				
Local Sources	Libraries	Student																				
		In-House																				
		Freelance																				
	Printed Sources	Student																				
		In-House																				
		Freelance																				
	Events	Student																				
		In-House																				
		Freelance																				
	User Participation	Student																				
		In-House																				
		Freelance																				
	Instructors	Student																				
		In-House																				
		Freelance																				
	Experts	Student																				
		In-House																				
		Freelance																				

Appendix B. Designer's Information Sharing Codes and Motivations



Information Sharing			Participants																			
Codes	Motivations	Designer's Stage	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Real-Life Network	Sharing in Physical Space	Student																				
		In-House																				
		Freelance																				
	Working Together	Student																				
		In-House																				
		Freelance																				
Information Sharing	Personal Information Sharing	Student																				
		In-House																				
		Freelance																				
	Sharing Information Among Students /Colleagues	Student																				
		In-House																				
		Freelance																				
	Inhouse Information Sharing	Student																				
		In-House																				
		Freelance																				
	Information Sharing With Outside the Firm	Student																				
		In-House																				
		Freelance																				
Knowledge Sharing	Openness	Student																				
		In-House																				
		Freelance																				
	Closeness	Student																				
		In-House																				
		Freelance																				
	Experince Sharing	Student																				
		In-House																				
		Freelance																				
	Personal Knowledge Sharing	Student																				
		In-House																				
		Freelance																				
	Intellectual Property Concern	Student																				
		In-House																				
		Freelance																				