# ENCOUNTERING THE INNER FACE OF PRODUCTS: COMPUTER REPAIR PRACTICE AND AMATEUR COMPUTER REPAIRERS

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## ABSTRACT

### ENCOUNTERING THE INNER FACE OF PRODUCTS: COMPUTER REPAIR PRACTICE AND AMATEUR COMPUTER REPAIRERS

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Interacting with the inner face of products leads to knowing more than knowing the product as a user. Repair creates an opportunity for the user to interact with the components of the product. This study investigates amateur computer repairers and the amateur computer repair activities including maintenance, upgrading, modification, replacing part, cleaning, and customization by approaching them with practice theoretical framework. The research aims to describe the user-product interaction that is characteristic of amateur repair practice. For this purpose, I conducted semi-structured interviews with participants who have amateur repair experience on desktop computers or laptops. Further, I made observations of their repair practices using a think-aloud protocol. End of the study, five prominent conclusions are revealed: (1) Amateur repair is a practice that comprises elements as implicit knowledge, explicit knowledge, skills, perspective, value and setting. Therefore, it is meaningful to use the practice theoretical approach to reveal product-user interaction in terms of amateur repair. (2) Amateur repairers are critical actors who sustain and shape the practice. They are considered as users who have particular identity, perspective and skills. (3) Amateur repairers transform the character of the product, independent of how it is designed. (4) The social network and the production network are critical mediums for amateur repair practice in terms of access to the components, tools and the knowledge. (5) Amateur repair practice would contribute to sustainable system design by providing a broader view of repair

Keywords: Amateur Repair, Practice Theory, User-Product Interaction, Design for Sustainability

# ÖZ

## NESNENİN İÇ YÜZÜ: TAMİR PRATİĞİ VE AMATÖR BİLGİSAYAR TAMİRCİLERİNİN DENEYİMİ

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Nesnelerin iç yüzüyle etkileşim, nesneyi kullanıcı olarak bilmenin ötesini bilmeye yol açar. Tamir, kullanıcıya nesnenin altyapısıyla etkileşime geçme fırsatı yaratır. Bu çalışma amatör bilgisayar tamircilerine ve bakım, onarım, iyileştirme, parça değişimi, temizlik ve özelleştirme faaliyetlerini içeren amatör bilgisayar tamirine pratik teorisi çerçevesinden inceler. Araştırmanın amacı amatör tamir pratiğine özgü ürün kullanıcı etkileşimini ortaya çıkarmaktır. Çalışma kapsamında masaüstü veya dizüstü bilgisayarların amatör tamiriyle uğraşan katılımcılarla yarı yapılandırılmış görüşmeler ve tamir esnasında sesli düşünme protokolü kullanılarak gözlemler yapıldı. Araştırma sonunda beş bulgu öne çıktı: (1) Amatör bilgisayar tamiri, içsel bilgi, açık bilgi, kimlik, bakış açısı, değer ve ortam gibi bileşenlerden oluşan bir pratik olarak tanımlandı. Ürün kullanıcı etkileşiminin pratik teorisi açısından incelenebileceği ortaya kondu. (2) Amatör tamir pratiğini sürdüren ve şekillendiren tamirciler, pratiğe özgü bakış açısı, beceri ve kimliğe sahip olan kullanıcılar olarak nitelendirildi. (3) Amatör bilgisayar tamiri sayesinde nesnenin karakterinin, nasıl tasarlandığından bağımsız olarak dönüştüğü tespit edildi. (4) Sosyal ilişki ağları ve üretim ağı, amatör tamir pratiği için önemli aracı ortamlardır. Yedek parça, tamir aletleri ve bilgi bu ağlar sayesinde yayılır. (5) Amatör tamir pratiği geniş bakış açısı sunarak sürdürülebilir sistem tasarımına katkı sağlar.

Anahtar Kelimeler: Amatör Tamir Pratiği, Pratik Teorisi, Ürün Kullanıcı Etkileşimi, Sürdürülebilirlik için Tasarım

*In memory of my mom and dad*

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# CHAPTER 1

# INTRODUCTION

Before explaining the background of the study, I want to elaborate on the title of the thesis. In Turkish version of the title, I used *içyüzü* that have two meaning: the inner face of the something and the realities that lays the background of a phenomenon. Accordingy, I would like to declare that "inner face" word is used in terms of the interiors of the products and the reailities that are behind the cover of the product. Further, I prefer to use "repair" word including fixing, maintanence, upgrading, modification, replacement, cleaning, and customization throughout the thesis. In this part, I describe the background of the study. Then, I state the study's aim and scope. Lastly, I explain the research questions.

## 1.1 Background of the Study

I was curious about the stories of the users and their interactions with the products. I inquire about what the role of the objects is in user-product interaction? Accordingly, I assume the designers should know how the users interact with the product in real life. In line with my curiosity, in the introduction to *How Users and Non-Users Matter*, Oudshoorn and Pinch address essential questions:

> How users are defined by whom? For instance, are users to be conceived of as isolated autonomous consumers, or as self-conscious groups? How do designers think of users? Who speaks for them and how? Are users an important new political group, or a new form of a social movement? In short, what general lessons are to be drawn from a renewed focus on users in today's technologically mediated societies? (Oudshoorn & Pinch 2003, p.2)

As Oudshoorn and Pinch (2003) pointed out, various inquiries are made from different approaches as the social construction of the technology, feminist approaches, semiotic approaches, cultural and media studies to answer the questions

that are related to the users. From the beginning of the field of ergonomics, design studies are interested in the users as a component of the function. Currently, these discussions focus on the users' experiences, which is one of the critical considerations in industrial design studies (Bødker, 2015). In line with the current design considerations, many design researchers focus on the user interface (both digital and material) interaction.

Users, products, and the factors are determined the user- product experience. The understanding the experience of use is a complex issue due to involvement of those actors. While examining the repair in terms of design studies, borrowing from other disciplines' perspectives might be beneficial to capture the interactions among the many actors. One such approach is the practice theoretical approach, which provides a broad view of human and product relationships. Reckwitz (2002, p. 249) describes a practice "as a bodily activities, mental activities and background knowledge of the things and how do they used". A practice consists of the elements that are materials, competences and meaning (Shove et al., 2012). As such, the practice theory might provide an understanding for objects and users' behaviours. I assume that the different aspects of object-user interactions would be evaluated through the practice theory framework.

On the other hand, while a particular part of the product is designed to open to the users, the other parts are not. Furthermore, Ed van Hinte points out (1996, as cited in Verbeek 2005) that while the outer surface of the product is assigned to the user, the interior surface of the product is accessible only to technicians. I investigate the user who engage with the inner face of the product by breaking the boundairies that van Hinte stated. In this thesis, I focus on the user's experience of encountering the inner surface of the product.

To sum up, I believe that practice theory might be a fruitful approach to observe an interaction that has been neglected in design studies. Therefore, this thesis investigates the amateur computer repairers with practice theoretical approach.

## 1.2 Aim and Scope of the Study

This study aims to investigate user-product interaction in the context of amateur repair. The reason is that repair activities create an opportunity to encounter the inner surface of the products, which is otherwise mystified. Furthermore, the repair activity provides a different knowledge than using the product (Houston, 2019). Therefore, interaction with the inner face of the products enables us to diversify user-product interactions.

I focus on the amateur computer repair practice and amateur computer repairers within different contexts. There are already various studies that investigate repair and repairers (Jackson, 2014; Rosner & Ames, 2014; Strebel, Bovet, & Sormani, 2019). In design literature the studies that embrace repair mainly focus the design for sustainability (Ackermann, 2018; Doğan & Walker, 2008; Van Nes, 2010) This study is distinct from other studies on two levels: Firstly, this study investigates both user-product interactions from the practice theoretical perspective. This provides a broad view of the user-product interactions by evaluating the repair practice with its actors. Secondly, repair studies are generally used to inform the designer for ensuring the durability of the products. There is a limited number of studies in design that focuses on repairing as an experience (Terzioğlu, 2017b). However, repair activities can provide insights about users, as well as products as experience, in dialogue with HCI (Houston, 2016) and design for sustainability. In order to fill this gap, this study aims to outline the diverse aspects of the user and product interaction by placing computer repair and the amateur repairer at the center. In order to achieve that, this study is formulated to answer the main research question as follows:

- How is the user-product interaction that is characteristic of amateur repair practice?

Three sub-research questions are presented as follows:

- What are the characteristics of amateur computer repair from the practice theory perspective?
- What are the characteristics of amateur computer repairers, including learning processes, skills, and motivations?
- What types of networks appear around amateur repair practice? How do the networks and the practice shape each other?

In conclusion, this study contributes to the design literature by providing an overview of amateur computer repair practice, discussing the objects and users, and the interactions between them and, lastly, elaborating on the implications of the findings for design for sustainability.

## 1.3 Structure of the Thesis

This thesis consists of five chapters, which are briefly described as follows:

Chapter 1, Introduction, provides a background to the thesis. It argues why it is beneficial to investigate the user-product interaction in the scope of encountering the inner surface of the products, followed by the aim and scope and the research questions of the study.

Chapter 2, Literature Review, investigates the prominent studies of practice theory, repair studies, and the design literature on repair activities in order to review prior studies' results and create a background for the fieldwork.

Chapter 3, Methodology, shows the research approach, and the research design, which adopts the qualitative methods of semi-structured interviews and think-aloud

protocols. Later, sampling and ethics strategies are presented. The chapter continues with the data collection phases of the study. Lastly, the limitations of the methodology are stated.

Chapter 4, Findings, introduces the emerging concepts from the field study. These are divided into three main headings: elements of the repair practice, process of the repair practice, and networks that are organized around the repair practice. By doing that, a broad approach to the amateur computer repair practice is presented.

Chapter 5, Conclusions, elaborates on the findings in relation to the reviewed literature. It starts with a summary and a discussion of the prominent conclusions, which include aspects of the repair practice, users, products, networks, and implications for sustainability studies. Lastly, the limitations of the research and recommendations for further studies are presented.

# CHAPTER 2

# LITERATURE REVIEW

This chapter reviews the related literature on amateur repair practice. Firstly, I employed practice theory as a theoretical framework of this study. In this part I review the key authors and key concepts of the practice theory. Along with, those I provide a background to discuss the amateur repair practice. Then, I summarize the literature on the repair. By doing that, I present the existed studies that focus on the repair activities. Lastly, I elaborated on the studies which focus on the repair activities in the design studies.

## 2.1 Practice Theory Approaches

It is one of the obvious facts that people are surrounded by plenty of appliances, and those appliances achieve most of the responsibilities of the human beings. Thus, it is possible to state that the home appliances, together with their manufacturers and designers, occupy a important place in users' daily lives. Manufacturers and designers have a decision-maker role, which requires them to understand the structure and principles of people's actions. Also, they need to examine the potentials of the object that they had created and its relationship with users. In order to understand people's actions and their relations with objects, practice theory is an approach which explains the artifact and human relationship because the practice theory enlightens how object and user act together and modify each other within the scope of social sciences. By using a practice theoretical framework, product designers can explore the dynamics of human and non-human actors' interaction, thereby understand the roles of artifacts in people's everyday lives.

### 2.1.1 A Brief History of the Practice Theory

In this part, I start by introducing diverse approaches to practice theory through the key authors and concepts. Then, I report on contemporary studies of the practice theory. By following the historical order, I present the former authors and concepts of practice theory firstly, then recent studies that have made critical contributions to the practice theory.

The practice theory is developed by two significant sociologists, Bourdieu (1977) and Giddens (1984). Both of the authors have significant roles in formulating the core concepts of the practice theory. Bourdieu brought into discussion the relation between social dynamics and behaviors of individuals. However, he mainly stressed the "habitus" concept. The "habitus" and the "practice" concepts have similarities in terms of the self-reproducing nature, and unique but repetitive behaviors. Bourdieu (1977) defined "habitus" as follows:

> the durably installed generative principle of regulated improvisations produces practices which tend to reproduce regularities immanent in the objective conditions of the production of their generative principle, while adjusting the demands inscribed as objective potentialities in the situation, as defined by the cognitive and motivating structures making up the habitus. (Bourdieu 1977, p.113)

However, habitus is part of a practice, and it is shaped by the purpose of the practice (Shove, Pantzar &Watson, 2012). It would be reinterpreted that the practice concept embraces the habitus. Shove et al. (2012) stated that habitus concept had influenced the social theoretical debates; however, practice theory, which evolved around Giddens's (1984) studies, reached a particular quality with the contribution of other studies. In the context of practice theory, Giddens's (1984) seminal concept of structuration may be accepted as the starting point of practice theory approach:

> The basic domain of the social sciences, according to the theory of structuration, is neither experiences of the individual actor, nor the existence

> of any form of societal totality, but social practices ordered across space and time. Humans' social activities, like some self-reproducing items in nature, are recursive. That is to say, they are not brought into being by social actors but continually recreated by them via the very means whereby they express themselves as actors. (Giddens 1984, p.2)

Giddens' structuration theory became a basis for further studies and several authors built their theory on his initial concepts (Schatzki, 1996; Reckwitz, 2002; Shove 2007; Shove, 2012; Warde, 2005). Through structuration theory, Giddens (1984) explains the reproduction of the practice and highlights the practices that organize human actions. Secondly, he states that structure functions both as a medium for the reproduction of practices and as a result of the repetitive acts. Thirdly, he states that practices are neither completely conscious nor forced by anyone.

One of the key authors, Schatzki (1996), clarifies the nature of the practice. Schatzki (1996) claims that each action is purposive even if it is not specified systematically. That is to say each action has a certain goal in achieving the practice. His description of the practice, "temporary and spatially dispersed nexus of doing and saying," (p. 89) illuminates the context of practice theory. This idea highlights that practice is a combination of doings and sayings, which are linked to each other. By following this idea, Schatzki (1996) explains in detail the linkage of the elements of the practice (doing and sayings) as follows:

> (1) through understandings, for example, of what to say and do; (2) through explicit rules, principles, precepts and instructions; and (3) through what I will call "teleoaffective" structures embracing ends, projects, tasks, purposes, beliefs, emotions and moods. (Schatzki,1996, p.89)

By reinterpreting Schatzki's quotation, the elements of the practice are first the understanding that refers to knowing how to do and say, and second, the explicit rules that refer to the articulation of the rules and third, "teleoaffective" structures. To better understand Schatzki's concept of "teleoaffectivity," Welch's (2017) interpretation would be useful. Welch (2017) summarizes "teleoaffectivity" as a combination of teleology and affect that enjoins specific goals and purposes with

motivational engagements and emotions. Later on, elements of the practice in Schatzi's definition are recategorized by Warde (2005) as three elements: "understandings, procedures and engagements" (p. 134).

The other key author in practice theory, Reckwitz (2002), describes the notion of the practice comprehensively. His definition of practice embraces first the tacit knowledge, second the articulation, and third, the perception:

> A routinized type of behavior which consists of several elements, interconnected to one other: forms of bodily activities, forms of mental activities, "things" and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge (Reckwitz 2002, p. 249).

Shove et al. (2007) clarify that practice theory focuses on what people do under which circumstances. To materialize the theoretical definition of the practice, the examples in everyday life would be valuable. For instance, while Schatzki (1996) gives an example of practices such as cooking or farming, Claycomb and Mulberry's (2007) examples have wide categorization, from a simple practice such as bathing or walking in a crowded street to a complex practice such as buying a house.

In brief, practice theory is evolved around Gidden's (1984) structuration theory. Later on, two important authors had shaped the concept of the practice. Schatzki (1996) defined the practice that includes certain understandings, explicit knowledge and teleoaffective structures. On the other hand, Reckwitz (2002) argued that practice involves bodily activities, mental activities, things and their use and background knowledge. Up to this part, I explained some of the key authors and concepts of practice theory. From now on, I elaborate on the elements and principles of the practice.

### 2.1.2 Elements of the Practice

In this part, firstly, I define the elements of the practice as materials, competences and meanings. Then, I explain the reproduction mechanism of the practice. Lastly, I explain the nexus of the practices. This refers to practices that exist as bundles and complexes.

Reckwitz (2002) stated that practice follows a pattern; therefore, it is a unique action. Accordingly, routines, including a large number of single and unique bodily behaviors, actions and understanding, know-how and desire are the required elements of the practice. On the other hand, Shove et al. (2012) assert two fundamental tenets of the practices. Firstly, the elements of practices are combined when the practices are performed. In the same study, the elements of the practice are categorized as materials, competences, and meanings. By saying "material" they refer to "things, technologies, and tangible physical entities, and the stuff of which objects are made" (Shove et al. 2012, p. 14). They define competences as that "which encompasses skill, know-how and technique" and meaning as "symbolic meanings, ideas, and aspiration" (Shove et al. 2012, p. 14). To sum up, the linkage between the materials, competences and meanings is used to describe a practice, for instance as cleaning, driving or cooking.

The second set of fundamental tenets of a social practice are that the emergence, persistence, and disappearance of a practice depends on the existence of links between elements of the practice (Shove et al., 2012). Shove et al. (2012) explains the role of this linkage with a schema (see figure 2.1).

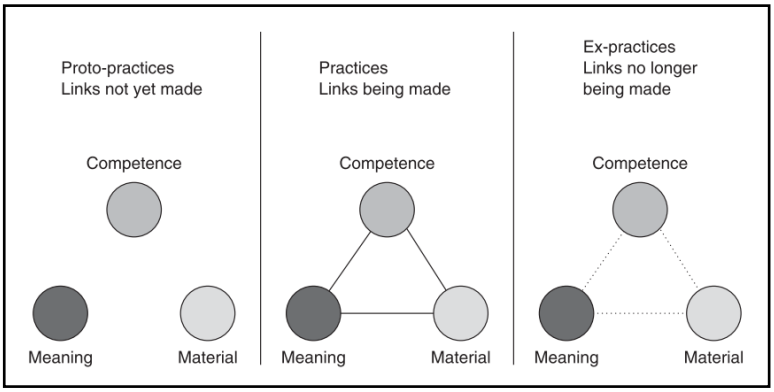


*Figure 2.1.* (1) proto-practice, (2) practice, (3) ex-practice (Show et al., 2012 p.25)

With Figure 2.1, Shove et al. (2012) explains three scenarios that depend on the existence of connections between materials, competences and meaning. (1) Proto-practices means that the elements exist but they are not interconnected. (2) When the elements have connections, it is called a practice. And (3) when the linkage between the elements is no longer sustained, it is called an ex-practice.

Shove et al. (2012) defined the reproduction of the practices by explaining the crossroads of three circuits. The first circuit is elements which are linked to each other when the performance of the practice achieved. The second circuit is the pre-existence and co-existence of the linkages between the elements of practice. The third circuit is feedbacks on the performance because it will influence next or other connected practices. That is to say, the intersection of three circuits lead the regeneration of the practice though reproduction of the linkage.

The practices have a connection between various practices. The practices exist as integrated arrangements in co-dependent or co-existent forms of bundles. The absence or existence of one practice affects the bundles of practices. Westroom (2018) explains how different practices influence each other by giving an example from Japanese bathing practice:

> There exists a bundle between bathing and laundry practices in Japan. In most households I visited, I saw tubes that connected the bath to the washing machine in the adjacent room, as people re-use the bathwater by pumping it into the laundry machine. Bathing shapes the scheduling of laundering since the latter succeeds in the former. As a result, most families I interviewed do laundry daily since they have the water available. However, laundry is not dependent on bathing since one can still launder clothes without using bath water, just less efficiently. (Westroom 2018, p.237)

Shove et al. (2012) described the complexes where the existence of more than one practice that is co-dependent. To state more clearly, "complexes" refer to practices that are perceived as one practice, but it contains several practices. For example, Westroom (2018) mentions the relations between the Japanese identity and Japanese bathing practices as follows:

> Participating in these uniquely Japanese bathing practices allows one to feel Japanese. A Japanese woman told me that "I never considered Japan to have a bath culture until I traveled abroad to the US. It felt unnatural staying in a hotel for a week and not being able to bathe." For some Japanese people, bathing is not solely an act performed to become clean, but one that is somewhat interchangeable with the expression of one's Japanese identity. To choose not to bathe, in a sense, can mute one's expression of Japanese identity. (Westroom 2018, p.237-238)

To sum up, practices are the routinized set of actions that includes doings, sayings and thinking. The actions are debatable in terms of performance. It can be divided into its elements like materials, competences and meanings. However, the existence of the practice depends on the linkage between the elements of the practice. Moreover, the reproduction of the practices has three phases that depend on the linkage of the elements. Later on, I explained the intersection of the practices. Practices exist in the form of bundles and complexes. Bundles of the practices refer to the co-dependency of more than one practice. Complexes mean that when more than one practice is combined, they are acting as a unit.

### 2.1.3 Contents of the Practice

Practices involve various components as the human agents, artifacts, social relations and even the other practices. In this part, I firstly reflect on actors in practice as the agent, and then, artifact, lastly, the social relations.

Agents and their relation with artifacts are the significant subject in scope of the practice theory. According to Schatzki (1996), the performance of the practice includes doings and sayings. Thereby, the practice has two main actors regularly carrying out and reproducing the practice: agents and artifacts. Schatzki (1996) depicts the agent as a reproducer and transformer who carries the practice forward. Besides the role of the carrier and developer of the practice, the agent's other role in the practice is interpreted by Reckwitz (2002). He assumed an agent is a person who "is a bodily and a mental agent," and the carrier has "certain ways of understanding, knowing how and desiring" (Reckwitz 2002, p.250). Furthermore, Warde (2016) advocates that agents are the guardians and enforcers of the practice. It might be interpreted as they are authorities of the practices. This is significant that the guardianship of practice consists of expertise about whether a practice is truly accomplished or not.

On the other hand, artifacts are important actors in the practices. Shove et al. (2007) highlight that non-human factors deserve to be paid equal attention as human factors in everyday life studies. In the *Design of Everyday Life*, they exemplify the centrality of objects through conducting case studies. They focus on the kitchen renewal process, DIY home projects, amateur photography and plastic as a material. Finally, they compiled all findings and argued about the significance of this approach to material culture, consumption, technology, and design.

Reckwitz (2002) distinguishes the practice theories from other cultural theories. According to him, cultural theories are divided into culturalist mentalism, culturalist

textualism, culturalist intersubjective, and these are distinguished from each other according to the placement of the social. The culturalist-mentalism aspect places the social in mind; culturalist-textualism aspect, places the social in discourse and communication; the culturalist-intersubjectivism places the social in interaction. However, “practice theory does not place the social in mental qualities, nor in the discourse, nor interaction” (Reckwitz, p. 249). From the practice theory aspect, the social is situated in the practice.

Shove (2007) asserts that practices are historically situated and presents uniqueness according to the cultures. Therefore, the practice is not controlled by a single actor. On the contrary, the practice includes a social consensus. This claim adds another dimension to the definition of the practice; the practice is more than a combination of its components. Later on, Shove (2012) states the importance of social networks and communities of practice. The practices circulate and are developed in the social networks, and the bond among the members of social networks has a decisive role in the dispersion of the practice (Shove et al., 2012)

In conclusion, the enactment of the practice consists of two essential performers, the agent and the artifact. Agents are carriers, developers, guardians and enforcers of the practice. Furthermore, the practices involve the objects that also have a critical role in the performing of the practice. Then, a practice includes a social consensus that is situated culturally and historically.

### 2.1.4 Studies that Apply Practice Theory Approach

The practice theory approach has become a very fruitful approach for diverse academic research subjects. Specifically, it provides a novel approach and a holistic perspective for product designers. For instance, Shove et al. (2007) explain various aspects of human-artifact relation through practice theory by emphasizing that design studies should take into considerations the practice theoretical frameworks.

They discuss the consumption and transformation of the objects, co-production of ideas and materials. Then they make reflections on the practice theory approach to material culture, consumer technology, and design. Particularly, they insights into product design by elaborating on the products role in everyday life. For instance, the objects actively integrate and configure everyday life. The everyday life is not a result of being scripted by the product that is segregated into different categories. The object and person construct the competencies together. Accordingly, the perspective of the practice-oriented design provides a different approach to the product. Shove et al. (2007) explains the distinction through the value as follows: First, the product-centered design places the value in the object. The user-centred design approach defines the value through the entanglement of the user. However, practice-oriented design, "recognizes the active, cumulative and sometimes generative part things play in the reproduction and transformation of practice" (Shove et al. 2007, p. 147). The distribution of the competences to the user and product provides designers the perspective that the product have the function that normally achieved by the user. They gave an example of an anti-shake feature of the camera that prevents the disruption on the scene that normally depends on the user's skills. Lastly, they recommend the "open scripted" (p. 150) products if it is not possible to make "open-source" product. They support designing a product that does not resist the customization in use, enhance adaptations, appropriation and assembly.

In another study, Taşdizen (2017), in his master thesis, conducted a participatory observation in knitting collectives with the practice theoretical approach in design studies. He investigates skill, pattern, knowledge exchanges in knitting practice (Taşdizen, 2017). He reveals that knitting is a skilled practice that includes cumulative learnings.

In this chapter, I examined practice theory and its key concepts. I revealed that a practice-oriented approach illustrates that humans, together with the product,

actively reconfigure and transform everyday life. In addition to that, the competences, importance and focus dispersed to both product and the human, should be adopted in product design studies.

### 2.1.5 Conclusion

Section 2.1.1 provides a brief history of the generation of the practice theory. The practice theory is developed on the basis of structuration theory. Then the definition of the practice is interpreted by Giddens (1984) and Schatzki (1996). While one of the authors described the practice as understandings, explicit knowledge and teleoaffective structures, the other author stated that practice involves bodily activities, mental activities, background knowledge of things and how they are used.

Section 2.1.2 presents elements of the practice from prominent authors' perspectives. In this part, I highlight that practice comprises of the materials, competences, meanings. The existence and reproduction of the practices have three phases that depend on the linkage of the elements. Further, practices exist in the form of bundles, which refer to co-dependency of more than one practice, and complexes which refer to that when more than one practice is combined, they are acting like one.

Section 2.1.3 introduces that the performance of practice depends on the collaboration of agents and artifacts. At the same time, agents play roles such as carriers, developers, guardians and enforcers of the practice. Moreover, the enactment of the practices is co-dependent to the objects. In this approach, the objects reconfigure the practice; therefore, agents have a critical role in the transformation of the practice. Lastly, practices do not emerge with a single actor; on the contrary, they include a social consensus that is situated culturally and historically.

Lastly, section 2.1.4 introduces comprehensive practice theory studies, particularly in design studies. In this section, I state that the practice-oriented approach provides an understanding that humans, together with products, actively reconfigure and transform everyday life. Design field could benefit from this perspective.

As a conclusion, in order to make a comprehensive study about humans and their actions in the context of repair, I adopt the practice theoretical approach while examining the repair activities. In the further section, I discuss the literature on the repair.

## 2.2 Contemporary Approaches in Repair Studies

This chapter covers the contemporary studies related to repair practice. I will categorize these studies in four groups according to the concepts they focus on. Firstly, I will summarize the research about repair activities by defining main concepts. In the second part, I will review the studies which focus on the role of repairer. Then, I will identify the studies that focus on the the relationship between the repairer and the object. Lastly, I will discuss the studies which focus on networks surrounding repair activities.

### 2.2.1 Repair as a Process

Many studies focus on repairing activities from diverse perspectives, but some of them question the nature of repair activities (Dant, 2019; Jackson, 2014; Rosner & Ames, 2014; Shubert, 2019). I will review these in this section.

Repair activity cannot be fully scripted or planned by producers (Suchman, 1987; Orr, 1996), however, it emerges in everyday practice (Rosner & Ames, 2014). Rosner and Ames (2014) point out that there is a duality about the act of planning the repair activities. They remark that even if the producers plan repair activity, and

make the product open to repair, it may not ensure repair. For example, when lack of a component prevents it. On the other hand, even with a product made for preventing repair activities, a community with expertise and spare parts might overcome the difficulties related to repair (Rosner & Ames, 2014). This brings us to the questions how repair emerges in everyday practice, and how other actors have great importance in repair practice. In the same study, they claim that repair is not a singular and independent phenomenon, repair activities are rather:

> shaped by material, infrastructural, gendered, political, and socioeconomic factors – such as manufacturing limitations, access to repair parts and expertise, and environmental convictions – which designers often did not, and may not have been able to, anticipate" (Rosner & Ames 2014, 319).

The authors introduce the concept of "negotiated endurance" (p. 319) as follows: The first refers to "negotiated identification of breakdown" (p. 328). For instance, even if a problem or malfunction does not affect the performance of the object's operating system, it might still be perceived as a failure by the user. The second is "collaborative definition of the worth" (p. 328). In their field study the authors examine, One Laptop per Child project, where each child gets one laptop that can be easily repairable even by a kid. However, if families have different priorities rather than laptops, repair activities might become unworthy, or if the laptops are seen as toys, they are not worth repairing. The third is "the social relationship between the repairman and the owner of the laptop" (p. 328). This is important, because the circulation of repair knowledge is transferred from the repairman to the user. The fourth finding is "gendered stakes of the repair" (p. 329). A gendered distinction in technology and crafts play a role in repair. (Rosner & Ames 2014)

Schubert's (2019) study examines the situatedness of equipment repairs in medical practice through ethnographic observation in a hospital setting. This study focuses on the essential aspects of inquiry and improvisation in repair activities. The author describes repair as an inquiry which transforms an unclear situation into a clear situation. When an object breaks down, it is an unclear situation until a repairer

solves what caused the malfunction. Therefore, repair activities reveal the problem first, and then provide the cause and effect relationship that results in malfunction. As such, repair is a readjusting activity through particular rules. (Schubert, 2019)

Since repair activity is a situated practice, it includes a social component. Accordingly, many scholars highlight a strong relationship between social networks and repair activity (Rosner & Ames, 2014; Houston et al., 2016). For example, knowledge of how to repair an object is frequently shared by many people. Dant (2019) asserts that DIY videos provide useful information about the structure of objects, and how to repair them simply. Some studies especially focus on the visibility of maintenance and repair in social life (Graham and Thrift, 2007; Jackson, Pompe & Krieshok, 2012). They aim to make subtle repair activities more evident in the technology-enhanced world. Making the repair network visible provides fruitful insights to understand the nature of repair activity. One significant study illustrates a local repair network by mapping the actors through an ethnographic study (Jackson, Pompe & Krieshok, 2012).

Jackson et al.'s research (2012) is on how a local network works in a case in Sub-Saharan Africa. They call this mapped network as a "repair world," (pp. 107-115) and they make recommendations. In this study, they point out that building better connections among technology producers and repairers are essential. According to them, if the connections fall apart, firstly, the chance of repair *in situ* disappears. Secondly, if repair skills are not supported and do not grow, the repair activity becomes capitalized. As a result, the politics such as the regulations that control repair activities through the design of the object damages the aim of sustainability. In another study, Jackson (2014) adopts a broader approach to repair and maintenance activities. He describes two different worlds and draws attention to binarities of two worlds as "pain and possibility, creativity and destruction, innovation and the worst excesses of leftover habit and power" (p. 222). Namely, there are forces and realities in two different worlds; one includes continuous

breakdowns and falling apart, while the other is constantly being fixed and reconfigured. He asserts that repair is a “fulcrum” of these two worlds (p. 222). He defines repair as a subtle activity that transforms and regulates complex sociotechnical systems.

Inquiries on repair activity from various perspectives reveal that repair activity is a situated practice. It includes a social component, and it has a larger effect on politics and perception of the world. In the following section, I will elaborate on the role of repairers in repair activity.

### 2.2.2 Roles of Repairers

Various academic studies focus on the role of repairer. In this part, I will review studies that focus on firstly professional repairers, secondly non-professional repairers, and lastly, people who have occupations that partly include repair and maintenance.

The first group of the academic studies focus on expertise in the process of repair; therefore, professional repairers are their main subjects (Bovet and Strebel, 2019; Dant, 2010; Houston, 2019; Rangaswamy & Nair, 2010). Dant (2010) focuses on material interactions and gestures of car repairers. Bovet and Strebel (2019) examine the outcomes of repair activities in a tenant’s everyday life by observing the caretakers in residential houses via video ethnography methods. They provide considerable insights into the results of interventions on social, technical, and material levels by observing local repair activities of broken artifacts. Charter and Keller (2014) demonstrate the volunteer repairers’ works in repair cafes.

These studies show that the repairer has a critical role in shaping the social cycle (Rosner & Ames 2014; Houston, 2019; Rangaswamy & Nair, 2010). These studies focused on professional repairer with their surrounding social cycle. They reveal that

the repairer plays the role of an authority and an agent during the repair process. According to Rangaswamy and Nair (2010), the repairer has serious influence on other people's use of technology. They investigate mobile store owners who sell call credits (Talktime), and also repair, format, and maintain phone hardware. In this study, the mobile store owner is one of the major agents in the technology distribution; therefore, various roles are emerging. Firstly, repairers have the role of a consultant; secondly, the repairers enhance consumer demand by providing new technologies and skills; thirdly, they expand business loops with social relationships. In short, repairers' interventions shape the users' acceptance of technology. (Rangaswamy & Nair, 2010)

The transformative effects of repairers in the use of objects are also remarked in a study by Bovet and Strebel (2019). Their research reveals that the repairer acts as a guide. The tenants need to learn how to live with the repaired objects and reconfigure their interactions as the technician instructs. To state more clearly, the caregiver gains authority on the tenant's daily life by repairing the objects, resulting in differences in the use of the product. Later on, the authors elaborate on problem-solving, which consists of two levels in repair activities, i.e. technical and social. The technical level is not sufficient on its own; at the same time, the tenants must be convinced by the repairer at the social level. Thus, repairer explains the cause and effect relationship that might happen in the future, informs and guides about how to use the object again in a new way. In sum, the informer and guide roles of the repairer in social and technical levels emerge as a part of breakdown. (Bovet & Strebel, 2019)

Houston (2019) discusses the political aspect of the repairer by explaining how the non-authorized mobile phone repairers reach repair knowledge in Kampala, Uganda. She states that authorized workshops have many opportunities for reaching the repair knowledge thorough companies' supports. On the contrary, non-authorized workshops cannot reach an equal amount of knowledge, such as company documentation about products (Houston, 2019; Ahmed, Jackson & Rifat, 2015).

Non-authorized repairers empower themselves by developing ways to reach and distribute information, skills, and experience through online networks. Accordingly, the politics of who can reach the engineering and design knowledge is expanded through non-authorized technicians' online networks, which are built and run by technicians (Houston, 2019). In this case, non-authorized repairers are responsible for both building and distribution of knowledge.

A similar role is seen in Rosner and Ames' (2014) study about coaches (volunteer repairers) and kids (owners of the XO laptops). In this case, the repair knowledge is transferred to the kids by the the coaches. The volunteer repairers in the context of a social project assumes different roles. A repair cafe is mainly a place where people come together and repair their broken products with repairers. Repair cafes aim to make a network of people who has similar perspectives, and overall their practice becomes consumer criticism (Kannengießer, 2018). Furthermore, scholars emphasize that a repair cafe is distinguished as a socialization point (Kannengießer, 2018; Charter & Keller, 2014; 2018; Rosner & Turner, 2015). A survey about repair cafes reveals that repair activity is a mediator for social relations, and the biggest motivation of the volunteer repairer is helping the others (Charter & Keller, 2014). In this sense, the repairer has a social role of helping others by repairing their goods. Kannengießer's (2018) research investigates repair cafes in the context of media studies. This study state that objects owners and repairer have conversations through repair practice. Therefore, the repairer has a crucial role in spreading the ideas, and consumer critics through social relationship. In that sense, the repairer has a mediator and facilitator role in the context of repair cafes.

The second group of studies focuses on non-professional repairers. This group of studies investigates users who carry out repair and maintenance activities. In these cases, users act as repairers; therefore, a new role as a repairer-user emerges. The studies which concentrate on the user's repairer activities provide good insight on being the user and the repairer at the same time (Terzioğlu 2017 b; Lindsay, 2003).

Lindsay (2003) focuses on user representation through how the computer producers are constructing user identity and how these identities are transformed by technology, and vice versa. This study focuses on homebrew user groups, i.e. the users who have technical skills to repair their personal computers. Lindsay (2003) carried out several interviews with TRS-80 (the first personal computer) users in two parts. In the first part, the history of the TRS-80 from late 1970s is examined. Secondly, the study examines the period in 1990s. At the end of the research, it is reported that historical analysis of users and technology makes the author see the linkage across time, that technological products are still developed with the users; even after the production is discontinued (Lindsay, 2003).

Further, these users are still very active. They build their personal computer (TRS-80) and also their own identities. They have various roles as Lindsay (2003, p. 50) describes: "developers, producers, retailers, advertisers, publishers, and technical support staff." Terzioğlu (2017 b) focuses on non-professional repairers in her study. She organized a workshop and asked the participants to fix their goods. In this study, it is emphasized that people used a low-skill level, and repair activities which require low level of knowledge, and they preferred long-lasting solutions; in this sense, user-repairer interaction is constructed. Thus, they widened the life span of their products by repair. In addition, users are actively engaged with their products, and this engagement transforms their relationship with the product, as discussed in the next section (see section 2.3.3).

Furthermore, a recent study discusses the role of the users and, with that, aims to make a taxonomy of active users in design and technology engagement (Kohtala et al., 2020). The study makes a categorization that includes different typologies of the user as "use as-is, active use, user design, user innovation" (p. 34). In their categorization, repair and maintenance are described as "active use," which is explained as when the user makes changes to or personalizes the object, actively adjusting it.

The third group of studies focus on the professionals in various fields, whose occupations partly include repair and maintenance activities (Shubert, 2019; Fürst, 2019). These studies include a repairer role, but in a different sense from all the studies mentioned above. For instance, Schubert (2019) highlights how the medical staff repairs and maintains medical devices, which are critical while operating their work. For those people, repair and readjustment of devices are necessary to carry out their duty in their work routine. In another example, Fürst (2019) focuses on repair by shadowing the librarian's book preservation routines in Australia. In the study, digitization process carried out by librarians is examined from the ANT (Actor-Network Theory) perspective (Fürst, 2019).

All studies include illuminating insights about repairers' role in the repair process, and these studies point out critical effects on social and material levels. By considering all types of studies, I will elaborate on the role of repairers, and on the cases that non-repairers adopt repairers' roles. The first group of these studies reveals that professional repairers have an authority by which they can guide and direct users about how to interact with products, both in material and social levels. Besides, they are responsible for building repair knowledge, and distributing it among repairers. The second group of studies reveal that users are actively engaged with their products during repair activity. Therefore, they adopt a repairer role to stop the decay of their products or to transform their product into other forms. They have a determinant role in the lifespan of objects. The third group focuses on the professionals of various fields whose occupation includes repair. These studies reveal that other professionals are adopting extra roles that include readjusting, repairing and maintenance. In conclusion, the repairer has many diversified roles, and non-repairers adopt the repairer role depending on the context. Next, I will discuss the user-object relationship through repair activities.

### 2.2.3 Repairer-Object Engagement in Repair Process

The most important aspect of this study is the following assumption: Repair is a process that requires engagement between humans and objects, such as materials and tools. Before an inquiry about the engagements in user-product interaction in the process, I will discuss the role of the objects. In this part, I will present the concepts that introduce the openness and transformation of the product.

The engagement between users and objects is underlined in studies that directly focus on repair (Dant, 2010; Dant, 2019; Denis and Pontille, 2015; 2017; Rosner and Ames, 2014, Houston, 2019; Lindsay, 2003; Terzioğlu, 2017). In this part, I will focus on the user-object relationship through repair activity. Therefore, I introduce the concepts mainly derived from STS (Science and Technology Studies) literature. Then, I will present the result of repairer-object engagements as a transformation of objects and a transformation of repairer.

#### 2.2.3.1 The Role of the Object in the Repair Process

In this part, I will review the concepts mainly derived from STS studies. These concepts provide various insights about how users engage with interior surface of products. I introduce the concepts in following order: firstly, territorial segregation, secondly black box, thirdly enactment of the product, and fourthly functional clarity.

The product is generally designed by considering the users' interactions with the surface of the product. However, interaction with the interior of the product is critical for users. Ed van Hinte (1996; as cited in Verbeek 2005), points out two issues that are related to the interaction with the interior of the product.

The first point regards the "territorial segregation" of products, which provides a different perspective on the product's characteristics. According to van Hinte, many

products are designed in two parts: Skin or cover, i.e. the surface of the products, and the interior (which I call "the inner surface" of the product). Based on this territorial segregation, while the outer surface of the product is freely accessible for interaction, the products' inner surface is accessible only for trained technicians. van Hinte gives the following example:

> This segregation into territories is quite peculiar. The person who buys a vacuum cleaner or a walkman does not have the entire purchase at one's disposal. Yes, you can unscrew it and open it up—if you understand how to do this, that is, which might be quite a puzzle—but your attempt will be punished by loss of your guarantee, and in the case of some larger appliances you may even be threatened with death" (van Hinte, 1996, 29; as cited in Verbeek 2005)

The "black box" concept refers to closing the product to any intervention. Latour (1987) explained it as follows:

> The Kodak camera is made of bits and "pieces, of wood, of steel, of coating, of celluloid. The semi- professionals of the time open up their camera and do their own coating and developing, they manufacture their own paper. The object is dismembered each time a new photograph is taken, so that it is not one but rather a bunch of disconnected resources (that others may plunder. Now the new Kodak automatic can not be opened without going wrong. It is made up of many more parts and it is handled by a much more complex commercial network, but it acts as one piece. For the newly convinced user it is one object, no matter how many pieces there are in it and no matter how complex the commercial system of the Eastman Company is. So, it is not simply a question of the number of allies. Numbers unified whole. However, with automatism, a large number of elements is made to act as one, and Eastman benefits from the whole assembly. When many elements are made to act as one, this is at I will now call a black box. (Latour 1987, p. 131)

Jordan and Lynch (1992) describe the black-boxing as when the relations between the input and output are not known or explicitly articulated. They list seven criteria of black box as follows:

> 1. A set of processes, entities, or causal laws that are assumed to operate, and without need for further inquiry
> 2. A reliable—even invariant—set of mechanisms that can be set to

> work and, for all practical purposes forgotten
> 3. A fixed unit containing a complex set of connections: e.g., a printed circuit or silicon chip
> 4. A reified process (ritual), or standardized artifact
> 5. A gloss or simplification which suspends many of the features of a situation in order to focus upon others
> 6. An unknown basis for a palpable outcome
> 7. A historical amnesia about the social process of innovation (Jordan & Lynch 1992, p.105)

They describe white box as the opposite of black box. It refers to knowing the inner working mechanism explicitly.

Denise and Pontille (2017) question the maintenance of objects, technologies, and infrastructures in their study. They use the conceptof maintanence to refer to repairing, mending, fixing, restoring, and more. They aim at identifying particular ways in which maintenance activities are organized under three groups as follows:

> distribution of maintenance practices, the kinds of objects that are enacted through them, and the ecology of the visible and invisible at play in the various way's maintenance work is accomplished and organized (Denise & Pontille 2017, 1).

In other words, Dennise and Pontille (2017) point out that reparability depends on the enactment of objects: Firstly, while some of the objects are designed and produced as easily openable, others are not; and some objects might be open to professional technicians only. Secondly, fragility and mutation of the objects should not be realized by the user. The fragility of the object in the repairer's hand and reliability of the things on the eye of the users are accomplished through maintenance. Thirdly, maintenance activities enact to preserve the authority and functionality of objects. Lastly, they state that maintenance opens a space for the development of the object; it assures the continuity of the object. At this point, it is crucial to remember that some of the objects are made with an open design approach, including their repair, reuse, and upgrading possibilities. Moreover, it is essential to

remember that policies and regulations about maintenance affect the enactment of the objects (Dennise & Pontille 2017; Graham & Thrift, 2007).

Ed Van Hinte's concept of "functional clarity" (1996, as cited in Verbeek 2005, p. 227) offers that the interior of the object should become clearer for the user. That is to say, the user should know (1) what the key components of the product are, (2) what these components do, and (3) how to repair or replace its components. Verbeek (2005) states that inaccessibility to the product causes a lack of user-product attachment. Verbeek explains that transparency works in two ways. First, transparency of the objects allows people to keep up a relationship even the product is broken down. Second, transparency enables the involvement of the product at the material level. He sums this up as follows: "When a product is transparent, it is not only functionally present, but it exhibits how it is functioning. This is true in connection with what the product does for its user" (Verbeek 2005, p. 227)

In sum, the concepts that illuminate the role of the product in repair activity can be listed as follows. The first concept belongs to Ed van Hinte as "territorial segregation" (1996, as cited in Verbeek 2005) refers to separate fields of product. The second concept is "black box" (Jordan & Lynch, 1992) that refers to closing the product to any intervention and the product that has an unknown interior mechanism. The third concept is the "enactment of the product" (Denise & Pontille, 2017), which discusses the performance of the object in terms of openness, fragility, authority and transformation. Lastly, Ed van Hinte's second concept is "the functional clarity" (1996, as cited in Verbeek 2005) refers that transparency of the product provides durable engagement and involvement of the user in material level.

#### 2.2.3.2 The Results of Interaction with Objects

The result of the interaction affects both the user and the repairer in a transformative way. In this part firstly, I review the related literature that elaborate on transformation of the product, then transformation of the user who can repair the product.

Ahmed, Jackson and Rifat (2015) state that the interior of products prevents repair through glues and non-standard connection elements such as screw heads. However, Rosner and Ames' (2014) view brings a novel approach to the openness and the closeness discussion mentioned as a duality in section 2.2.1. authors state that skilled persons might still repair a closed product. In the same study, the "negotiated endurance" concept is suggested to discuss reparability, and that the life span of objects are affected by many factors (see section 2.2.1).

On the other hand, Dant (2019) states that the repair activities are acts of reconfigurations that are made in order to prevent the existent object from decaying or being damaged or destroyed. Producing objects from scratch is not very common in repair activities. Accordingly, many malfunctions can be fixed by simple replacements, depending on the breakdown. At the end of the practice, the repairer does not create a new object as a craftsman does; repairers aim to make the object same again. Thus, after repairers finish successfully, there is no trace to prove repairers' tasks (Dant, 2010). However, she approach is contrasting. Lindsay (2003) asserts that the user can develop the product through the repair practice. Expertise can go beyond the only fixing and changing the object back to the previous condition. For instance, the case of TRS - 80 (see section 2.2.2) shows that users can still use and develop their computer, even if the technology of the computer is not developed by the original producer anymore (Lindsay, 2003). Accordingly, not limiting repair to only making the object functioning again would lead the repairer to explore and different paths than mainstream technology.

Interacting with the object through repair provides a remarkable aspect to the individuals who deal with repair activity. For example, Houston (2019) states that repair provides a way of knowing an object different from engineering and design. Terzioğlu (2017b) argues that users who repair are informed about the product on the material level; because, while they are solving the breakdown, they have to understand and be aware of the material, form, and structure of the product. She states that through repair, the user has a different type of connection with the product, and gains awareness about the product. Furthermore, Denis and Pontille (2015) claim that the perception of a broken object changes through repair. They argue that if the boundaries between maintainers and users are blurred, everybody takes care of things. They elaborate this idea in another study (Dennis and Pontille, 2017). They state that there is a binary perspective between maintainers and users as follows: Maintainers consider the failure of an object as an ordinary situation while users perceive it as a dramatic problem. The authors invite everyone to share maintenance practice. The distribution of maintenance provides an aspect that deformity is an intermediate stage of the object (Dennis and Pontille, 2017). In this way, objects will not be perceived as broken only.

Dant's (2010) study focuses on the material interaction between car repairers and cars during the practice. He focuses on the body movements, and emphasize that repair requires various embodied skills. He observes that the repairers use their body as an instrument during the repair activity. The repairer does not follow a system or repetition of the movement; on the contrary, repairing is achieved through bodily skills, embodied perception and sensual knowledge. Also, he states that, due to the nature of repair which cannot be planned (Rosner & Ames, 2014; Orr 1996, Suchman, 1987), repairer needs to develop a various set of gestures. That is to say, repairer embodies a different set of skills and the body movement as a result of the interaction with an object in a particular way. (Dant, 2010)

To sum up, the engagement between the product through repair activity provides a way of knowing that differs from engineering or design, enhances the emotional attachment, and creates the perception that is brokenness is a temporary stage. In the following part, the role of the social compound in repair activities is evaluated.

### 2.2.4 Repair Networks

Network is a very crucial component of repair practice. Repair studies have explored two types of systems: repair cafes as an initiative to promote repair activities, and business networks of repair practice in the rural areas. The studies that investigate repair cafes mainly focus on relationships and activities among actors (Charter, 2018; Charter & Keiller, 2016; Kannengießer, 2018; Rosner & Ames 2014; Young & Rosner, 2019; Dewberry et al., 2016). Other studies which focus on repair practices in the third world rural areas analyze the structure of networks and actors in specific areas such as Uganda (Houston, 2019), Bangladesh (Ahmed, Jackson & Rifat,2015), Mumbai (Rangaswamy, Nair, 2010) and Namibia (Jackson, Pompe, Krieshok, 2012). Geographical differences lead to a variety in findings of the studies. For example, the studies which focus on the networks in rural areas have shown that the communities deal with difficulties in resources, organizational routines, skill building (Rangaswamy & Nair, 2010), and inequal access to knowledge (Ahmed, Jackson & Rifat, 2015; Houston 2019).

On the other hand, repair cafe studies focus on social benefits and activist perspectives such as circular economy (Dewberry et al., 2016) and communication studies (Kannengießer, 2018). Nevertheless, they also have implications for repair practices and networks. For instance, the studies reveal that value and endurance of objects are constituted collectively (Houston et al., 2016; Rosner & Ahmed, 2014), or gender problems (Rosner & Young, 2019; Ahmed, Jackson & Rifat, 2015). First, I will identify both types of network structures; then, I will elaborate on the main questions of the related literature: What kinds of collaboration exist in these

networks, how the knowledge is distributed, what the agents of these networks are, and who is excluded.

Charter and Keiller (2016) made a global survey about repair cafes, and shared their findings. Primarily, repair cafes provide spaces for repair activities. People who are in need of repair and those who can repair come and repair objects together (Charter & Keiller, 2016). Charter (2018) states that the prominent motivation of volunteers (repairers) in repair cafes is a social motivation, including engaging with others and being a part of a community, and environmental motivations. The motivation of visitors (object owners) is watching the repairers and learning. Furthermore, there are many advantages of repair cafes; e.g. local economic benefits through repair, and possibility to avoid buying a new product (Charter, 2018). Similarly, Dewberry et al. (2016) examine repair cafes by focusing on the relationships between users and products in repair cafes, and they present the motivation, barriers of repair, and disposal reasons of objects. According to them, repair cafes decrease waste, prolong the life cycle of products, and provide a space for social interaction.

Business networks of repair activities in a rural area are structured by social and economic relationships. For instance, Rangaswamy and Nair's (2010) study demonstrates how mobile phone stores maintain their daily business and communication networks. In this study, they explain that the mobile phone stores are formed of three elements; electricity, hardware and space, and are parts of the hybrid repair network consisting of several business partners such as employees, clients, and mobile phone companies. They indicate the role of the business network under four broad themes:

> (1) Primary business is conducted through local social networking, (2) networks evolve to expand services, (3) outbound networks mostly connect nonformal socioeconomic sectors of the city, and (4) networks integrate local business practices to service a range of needs. (Rangaswamy & Nair 2010, p. 51)

Along with offline networks, online networks are a critical medium for the collaboration and distribution of knowledge. Some studies show the power of online network as a platform to share knowledge among its members. Dant's research (2019) focuses on repair videos in online networks. Houston (2019) comprehensively shows how independent technicians empower themselves through online GSM forums. Although tacit knowledge is not transmitted, the repair knowledge is distributed through textual and visual guidance (Houston, 2019). Accordingly, similar breakdowns and their solutions are accumulated in online forums.

The studies elaborate for a better understanding of the role of networks in repair practice. Rangaswamy and Nair (2010) show that informal business relationships and networking are key factors in dealing with infrastructural difficulty and resources, especially skill-building. For example, Ahmed, Jackson and Rifat's (2015) study identifies that social collaboration plays a critical role in the adaptation of foreign knowledge. The local practitioners adopt international knowledge in Bangladeshi ways, find alternative avenues for lack of material, or adopt the solution according to socioeconomic infrastructures. Thus, the global knowledge is redefined and shared through social collaboration and network (Ahmed et al., 2015). Besides the transmission of skill and knowledge, social practices are transferred through networks. The authors highlight that novice repairers become skilled practitioners through the adoption of social practices and values in the networks. Accordingly, these practices and values create a more extensive repair network by creating occupational identity and broader communities. (Ahmed et al., 2015)

In the same study, it is reported that knowledge flows from developed countries to third-world countries through online sources or the people who have trained abroad. Therefore, global sources have a significant effect on the shape, support, or failure of the repair practice in local areas (Ahmed et al., 2015). The repair networks also have a political role, because repairers produce the trans-local knowledge for other

repairers through networks, thus creating alternative avenues to access engineering and design knowledge, which is the core issue of sharing and reproduction of the repair knowledge. (Houston, 2019). Accordingly, the networks are core elements of sustainability in repair practice and repair-related experience.

Non-authorized repairers in Kampala who had difficulty reaching the company documents (Houston, 2019), is an example that shows who is discarded from networks also matters. Some other examples prove that a selective agency is involved in repair practice. To exemplify, novice repairers have trouble finding a job, some of the repairers cannot reach the repair knowledge because of jealousy, or women are excluded from these networks (Ahmed et al., 2015). Women's exclusion from repair practice is also demonstrated by Young and Rosner's study (2019). They examine the mode of repair activities that constructs, de-constructs, or strengthens both individual and collective gender identities. Secondly, Rosner's (2014) study aims to show the politics of repair on the example of repair cafes as a public repair site. According to the author, the construction of gender roles can be discussed through craft values and technological skills. The repair café cases reveal that although the repair activities are supported and developed by technological opportunities, traditional gender roles are still relevant. The division of crafts and technological competences are always in conflict.

Lastly, some of the studies suggest that building new networks and supporting the existing networks are critical. For instance, Charter (2018, p. 44) suggests for startup repair cafes:

1. Various communication tools should be used to attract visitors and repairers.
2. A friendly community environment should be constructed.
3. The social and economic effects of repair activities should be observed.
4. A good relationship with other possible and vital stakeholders such as the local council and universities should be constructed.

Furthermore, Ahmed et al. (2015) state that the education policies about technology use and consumption should be supported by focusing on repair and its form of tacit and social knowledge. Secondly, raising the value by emphasizing it is a craft-based practice in the community that might help the sustainability and repair network (Ahmed et al. 2015).

In short, the networks are a crucial social component of the repair practices. The roles of the networks are the medium for the collaborations, knowledge, skills, social relations and the business.

### 2.2.5 Conclusion

In this part, repair practice is evaluated in the light of contemporary studies. The main concepts in studies are as follows: Repair as a process, the role of repairers, the repairer and object engagement in the repair process and networks.

Section 2.2.1 provides inquiries about the repair process. Repair practice is an activity that emerges in everyday life. It has social components, including online networks, offline networks, and collaborations. It has an extensive impact on politics and perception of the world. Also, material, infrastructural, gendered, political, and socioeconomic factors are involved in repair practice.

Section 2.2.2 shows that repairers guide and direct the user; therefore, they have a transformative role on the user-object or user-technology interactions. Furthermore, repairers build the knowledge to empower themselves, and distribute this knowledge through online mediums. In this section, I also discuss the user who adopts the repairer role and professional whose occupation includes repair.

Section 2.2.3 focuses on the interaction between the repairer and the object in the context of repair. Firstly, I introduce the concepts that are related to the product-user

interactions. These concepts echo that the interior of the product is designed for specific technicians. The mechanical systems of the product are not transparent for the user. Moreover, the studies point outs that repair reinforces the emotional attachment between product and user. The repairer develops a set of gestures to manage this interaction. Lastly, the repair activity contains the possibility of the transformation of the object.

Section 2.2.4 introduces studies that particularly focus on repair knowledge. Mainly networks in rural areas and repair cafes in developed countries are chosen as a research field. This part shows that the network is a medium for the distribution of knowledge and skills. Also, socialization, business and collaborations are carried through online and offline networks. Next, I will elaborate on repair studies in the design literature.

## 2.3 Design and Repair

In this section, I will introduce the concepts within the frame of repair and maintenance practices in design. Repair and maintenance practices are mainly discussed in sustainability studies and human-computer interaction (HCI). Inspired by Terzioğlu's study (2017a), I will elaborate on design literature on repair in these two main fields. Accordingly, this section contextualizes the repair practices by providing background information on sustainability and HCI literature.

When design studies that focus on repair are reviewed, two main areas become prominent. Most of repair studies in design concentrates on sustainability field, and there are relatively few reviews in human-computer interaction. Recently, the number of HCI studies related to maintenance and repair is increasing. In design literature, a limited number of studies approach repair activity as an experience. In order to fill this gap in sustainability and HCI studies in the design literature, design researchers should explore distinct dimensions of repair experience.

### 2.3.1 Repair in Sustainable Design

In sustainability studies, many researchers intensively focused on prolonging the lifespan of objects. Studies on maintenance and repair of objects provide valuable insights that serve this aim. While some of these researches offer efficient systems for production and consumption (Doğan & Walker, 2008; Ellen MacArthur Foundation, 2012), some others guide designers for reparability and maintenance (Ackermann, 2018; van Nes 2010). Firstly, I will focus on the studies that provide a holistic perspective, in the form of a production or consumption system that revolves around repair activities. Secondly, I will refer to studies that focus on design solutions in the context of repair. Thirdly, I will bring into discussion the prominent aspects of open design in the context of repair.

The first group of studies in sustainability that discuss the repairing activities adopts a holistic approach to production and consumption systems. The circular economy business model is one of them. According to Ellen MacArthur Foundation (2012), the circular economy is a business model that aims to prolong the lifespan of products, based on a circular production and consumption system rather than on linear systems. The circular economy aims at protecting the value of products, prolonging product's life span and getting maximum benefit from it during its lifetime (Ellen MacArthur Foundation, 2012). The circular economy is a consumption and production system based on efficiency, and thus, repair and maintenance have considerable importance in it. Ellen MacArthur Foundation's circular economy graphic (2012) claims that maintenance and repair activities are the first options to achieve maximum efficiency and the highest value of the product. The graphics suggest an order of maintenance, repair and reuse first, and remanufacture and recycle later, rather than direct recycle of an object (Ellen MacArthur Foundation, 2012).

According to Ackermann (2018), product care is a crucial step in the circular economy, and it includes repair and maintenance activities before the object is broken. Product care embraces even brand-new objects (Ackermann, 2018); therefore, in order to keep the highest value of a product, precautions are of vital importance. According to Ellen MacArthur Foundation (2012), instead of producing integrated products and low standardized components, strategies such as design for disassembly and design for sustainability helps in a smooth transition to circular economy. Terzioğlu (2017a) emphasizes the role of repair by defining repair activities as a transition stage from a linear economy to a circular economy. In her study, she presents in a diagram that repair has a role in connecting the product with the user through deep relationships. It also creates awareness and increases product life.

The second study that adopts a holistic approach is Doğan and Walker's (2008). *Integrated Scales of Design and Production for Sustainability* (ISDPS) This model combines small-scale local production with mass production to support crafts and culturally-appropriated products. According to the authors, the concept of ISDPS has three main contributions: Firstly, new possibilities of product aesthetics, and of meaning emerge; second, users and makers (employee or craft maker) go through a transparent production in cooperation with technology; third, new interaction types might be developed between the user and the object through product maintenance. Apparently, ISDPS enables post-use product services such as product caring, maintenance, repair, reuse, and recycling at local level. This production system assigns extensive responsibilities to designers. For instance, designers should anticipate production and post-use process of the objects. Secondly, this system decreases the environmental impacts, and increases the value of the work by suggesting a sustainable productivity model. (Doğan and Walker, 2008)

The second group of studies in sustainability that focus on repairing activities illuminates product design strategies. Unlike the holistic approaches on production

and consumption systems, such as circular design and ISDPS, these studies focus on repair to prolong the life cycle of objects through sustainable product design strategies. Van Nes (2010) categorizes product design strategies for longevity as follows: Firstly, “design for reliability and robustness” refers to high quality performance of a product that does not easily break down. Secondly, “design for repair and maintenance” offers the replacement of broken parts in an easy and fun repair process. The author suggests that the product should detect a malfunction and inform the user about it; and spare parts should be accessible. Thirdly, “design for upgradeability” refers to the possibility to add new functions on the product by replacing upgraded versions of components. For instance, in order to create upgradable products, durable mainframes should be designed; replaceable parts should have the same size; and replaceable covers and cases should be designed. Fourth, “design for product attachment” refers to the enhancement of personal attachment between product and user through personalization of products. Lastly, “design for variability” means that the objects should offer variability and renewable look either by the natural characteristics of materials, or by the intervention of users. (van Nes, 2010)

Personal attachment between the product and the user is one of the main concerns in sustainability studies. Chapman (2005) states that one of the crucial factors for sustainability is emotional durability. Many other studies (Ackermann, 2018; Terzioğlu, 2017a) highlight the importance of emotional durability along with material durability. In fact, Doğan and Walker (2008) states that the new role of designer is to build meaningful relationships between the product and its usage. In order to evaluate the personal attachments and repair correlation, I will discuss the importance of personal attachment in sustainability literature in more detail below.
Terzioğlu (2017b) states that repair creates deeper engagement between products and users. She examines users’ repair experiences in three main phases: discovery, ideation, implementation. During the repair process, users become aware and more informed about the product. Repair activities require the users to define and

understand the problem first, and to create a solution according to the description of the problem. She advocates that design has a role in users' repair behavior; therefore, repair might be reframed as an experience, and several ways can be created through design practice (Terzioğlu, 2017b). Accordingly, Terzioğlu (2017a) suggests enhancing the value of repair in circular economy and product design by reframing repair as an experience.

Designers have a crucial role in creating strong emotional bonds between users and products and in making repairable products and systems. If strong relations are built between the user and the object, the object becomes more durable (Chapman, 2005). Fuad-Luke (2010) supports this idea, and he offers ways to build a durable relationship between users and objects through personalization, co-creation, and co-design. Furthermore, he asserts that the responsibility of creating products has to be transferred from professionals to users (objects manufactured and designed by designers vs. those self-made by users, nonprofessional designers). Manzini (2015) also supports the idea of active users, and attributes a crucial role to community in his definition for bottom-up innovation. Active participation of users is crucial both in personalization of the product and in maintenance of it. Ackermann (2018) claims that personal attachment is not enough to convince users to repair their products; they need other features, such as skill and desire to repair the product. She (2018) also asserts that design guidelines should be proposed to stimulate repair and maintenance through behavioral change, because the motivation of the consumer is main factor while carrying out the repair activity by themselves or others.

The second group of studies that discuss the repairing activities in the context of sustainability is open design studies. Open design is a movement whose origins lie in the open software movement. The main aim of open design is to make the product open to any type of intervention. For instance, Richardson (2015) claims that maker projects are an example of open design, because 3D models can be downloaded and modified, then manufactured by individuals, and that opens a space for endless

hacking of objects. Moreover, open design supports sharing knowledge among community members. Global internet connection enables users to contribute, share, and use design ideas, systems, and ideologies through objects (Tooze et al., 2014). Small-scale production systems adapted in home settings become increasingly widespread. According to Richardson (2015), developments in digital manufacturing techniques provide a real-world agency to users. Thackara (2011) emphasizes that open design is not merely a production process, but it is a culture. Furthermore, it creates a different use and care relationship between objects and users through easy maintenance and local repair. To sum up, open design is an approach that includes collaborative, alternative production systems that enable modification of objects by their users (Bakırlıoğlu, 2017).

Raasch, Herstatt, and Balka (2009) describe the characteristics of objects designed according to open design parameters as follows: They are (1) modular and simple objects, (2) feasible artifacts, or (3) complex but modular objects supported by suppliers. In the same study, they propose a non-industry-specific model of collaborative development based on the circulation of knowledge and ideas among actors. Bonvoisin (2017) investigates the potential of open-source product development. The study reveals that the user comprehends repair-related know-how during manufacturing process. Furthermore, the modularity of the product enhances maintenance by facilitating the replacement of malfunctioning parts. By testing each component, a malfunction can be easily detected (Bonvoisin, 2017). With these specifications, open products allow repair and maintenance.

The critical point for this thesis is that open design and repair are correlated. Bakırlıoğlu (2017) states that open design is promising for sustainability in the scope of local production, increased modularity, and reparability. The innovative process of open design increases the accessibility of components. Therefore, it becomes possible to create different functions through various combinations. Furthermore,

this mobility enables users to reuse, upgrade, and transform the parts, according to need and longevity of the objects (Bakırlıoğlu, 2017).

In brief, sustainability studies provide a valuable perspective for repair studies. The studies have shown that product design, system design and knowledge sharing through communities, local solutions and accessibility of products are critical in enhancing repair activities. Below, I will elaborate on the human-computer interaction studies that focus on repair activities.

### 2.3.2 Repair and Human Computer Interaction

Early human-computer interaction (HCI) studies on repair investigate repair activities in the context of workplace (Orr,1996; Suchman, 1987). These studies are seen as a beginning point of repair studies in the HCI framework (Rosner, 2014; Houston et al. 2016; Terzioğlu, 2017a).

Interaction between human and computer has become a significant field of research since the use of technology became widespread in everyday life. During this process, HCI studies have evolved, and the focus of the HCI studies transformed. Bødker (2015) identifies two waves of HCI prevalent in the past, and explains today's approach of HCI as the third wave. Bødker (2015) describes the evolution of the HCI as follows: From the first wave's perspective, human beings are perceived as subjects; therefore, formal methods and systematic testing were commonly preferred. The second wave focused on settings and group workings, and "action theory, situated actions, and distributed cognition theories" became prominent (Bødker, 2015, p. 24). In the second wave, examination and design processes of HCI systems were clearly described. Lastly, the third wave focuses on concepts such as meaning making and experience, and the context of HCI interaction expanded in such a way that it is not limited in the only workplace anymore (Bødker, 2015; Filimowicz and Tzankova, 2018).

Repair activity and third-wave HCI have a common focus on experience. If the whole repair activity is interpreted as an experience between humans and products, repair activities might become one of the fruitful areas for the HCI studies. An increasing number of repair studies in HCI claims that repair topics will contribute to the HCI perspective (Rosner et al., 2013; Houston, 2016; Jackson, 2014). Furthermore, recent research indicates a gap in the literature; there is no study that focuses on repair phase as experience, and on the barriers of repair (Terzioğlu, 2017b).

Rosner et al. (2013) organized a workshop to bring HCI scholars and other scholars from various fields together to discuss repair practices with mobile phone repair examples. The workshop had four aims: First, to elaborate on how repair and design practices are related; second, to expand the approaches to repair studies in HCI and design practice with the various scholars from fields such as STS, anthropology and art studies; third, to find out how design might be examined from a breakdown perspective; and fourth, to build a cross-national sharing platform through the workshop (Rosner et al., 2013).

Houston et al. (2016) focus on the value of repair in HCI discussions. They have two arguments in their study: First, the value in repair is different from design value and use value, which are popular study topics in HCI. Second, the value in repair is not stabilized and commodified. Their study expands the HCI aspect from a user's interaction with a single artifact to collective social networks. They advocate that the practices of repair and care of technological products should be investigated through communities and collectives, because seeing the big picture of repair activities can introduce several moments of value creation. Another prominent statement of the authors is that considering repair practices as a site of valuation provides a broader point of view. As a consequence of approaching the HCI from a broader perspective, this provides a different issue that "design tools are the beginning of ethical provocations rather than final point" (Houston et al., 2016, p.1412). This perspective

might mean that designed objects can be seen as the beginning of a new ecosystem by changing the research approach.

Another workshop to understand how things decay was organized by Tsaknaki et al. (2016). With this workshop, the authors aimed at developing HCI agenda by approaching instability as an information source to use, design, and maintenance. They discuss impermanence under three themes. The first theme, “temporal and material forms of impermanence” explores the essentials of impermanence in terms of decay and obsolescence. The second theme, “practices of impermanence” explores practices and communities related to impermanence. The third theme, “politics of impermanence” focuses on power relations that have an impact on impermanence. With these themes, they intend to understand the impermanence experience from a broader perspective.

In conclusion, there is a fruitful investigation possibility for both repair studies and human-computer interaction studies in case these two study frames inform each other. However, more research should be carried out to enlarge both the repair experience and HCI studies.

### 2.3.3 Conclusion

In this section, I reviewed some sustainability studies that focus on repair in three groups: Sustainable production and consumption systems, design strategies, and open design movement. The circular economy system gives priority to repair activities in order to prolong the product lifetime through cost-effective methods and low environmental impacts. ISDPS offers an integrated production system through a meaningful relationship between the producer and the product. This approach claims that repair and maintenance of the product should be made at the local level. The second group of studies presents design solutions developed to enhance the lifespan of products. Main product strategies are developed to enhance robustness,

reliability, maintenance, upgradability, variability and product attachment. User and product attachment is discussed. Both the material and emotional durability has great importance to enhance sustainability and to make products repairable. In order to reinforce emotional durability, involving users in various levels of production and consumption is suggested. The third group of studies introduces an open design approach that supports user intervention, collaborative production, and small-scale production. Repair and maintenance activities become widespread through modular and open-source objects, and local knowledge. Therefore, open design approaches enhance repair and maintenance practices.

Compared to sustainability studies, fewer HCI studies are interested in repair. Recent studies have shown that HCI and repair activity would inform each other. Researchers, who studies repair activity advise that instability, maintenance and repair would be used as an information source to HCI and design studies. Workshops are organized to develop the HCI agenda in repair activities.

## 2.4 Conclusion

Related literature is reviewed to reveal main concepts and approaches about repair practices. In this chapter I focused on the studies about repair practices which referred to practice theory, aspects of repair activities, and repair studies in design literature.

Practice theory is the theoretical framework of this thesis, since practice theory pays equal attention to both human and non-human actors, as stated throughout section 2.1. The theory illuminates doing, saying, and thinking behavior and their structures as a part of the practice. Hence, the subtle link between non-human and human interactions can be uncovered. Furthermore, the theory helps to explain how a practice reproduces itself and maintains it. By considering all reasons, the practice

theory is a valuable framework to enlighten repair activities and the link between its components, such as actors, objects, and networks.

Section 2.2 concentrates on understanding repair activity through repair studies that embrace human and non-human actors, such as process, repairers, objects, and networks. Section 2.2.1 questions repair practices by focusing on repair process. Repair is described as a situated practice, and it includes social aspects. Section 2.2.2 focuses on the role of the repairer. It is shown that repairers are both mediators and as facilitators in the use of technology and the use of objects. Besides, repairers produce and distribute knowledge for other repairers. Section 2.2.3 examines the interaction between the repairer and the object. It is seen that users adopt a distinct perspective and skills in terms of repair activities. Lastly, as stated in section 2.2.4, networks of repair are very important for the exchange of knowledge, and for social practices. In this sense, networks perform as a maintainer of repair activities.

Lastly, repair activities in design studies are elaborated in section 2.3. Many authors emphasize the importance of repair activities, but few of them directly put repair activity at the center of their research. Section 2.3.1 reviews the sustainability studies related to the repair practice. It is argued that repair activities have to be integrated both in production and consumption systems. Accordingly, sustainable design solutions have to be a part of these systems. In section 2.3.2, a limited number of studies with HCI approaches in repair activities are reviewed. The advantages of elaborating on repair activities in the light of concepts in the HCI studies are presented. If repair is considered as experience, the factors that have crucial impacts on this experience can be revealed. Communities and collaborative networks can be investigated.

In the light of literature, there is a current gap in research (1) focusing on repair activities by paying equal attention to actors, objects and the networks in the repair practice, (2) studying repair activity as an experience, and (3) investigating the

amateur repair activities and repair networks. This thesis aims to fill the gap by questioning repair activity from an amateur computer repairer's perspective.

In the next chapter, the methodological approach is explained.

# CHAPTER 3

# METHODOLOGY

This study investigates amateurs' computer repair experiences. In order to achieve this, I interviewed people who can repair their computers. In this chapter, I present the research process by explaining the research approach, research design, sampling, ethics and consent, research conduct, data analysis phases, and limitations.

## 3.1 Research Approach

Gray (2014) suggests that the theoretical perspective of research should be considered from the beginning of the study. The philosophy behind the research plays a determinant role in the research process. Whether the researcher believes that there are ways to measure the objective reality or not will affect the research method and research design (Gray, 2014). In this sense, theoretical perspectives have to be considered by the researcher.

Two approaches are the epistemological approach and ontological approach. Grbich (2003) defines epistemology as how we know the knowledge, by aiming to describe the perception of valid knowledge. The ontological approach advocates that there are multiple realities; accordingly, it searches the nature of reality (Creswell, 2014). In sum, the ontological approach focuses on realities, what it means to know is the subject of the epistemological approach (Gray, 2014).

Gray (2014) states that epistemological perspectives divide into constructivism, objectivism, subjectivism. Objectivist epistemology focuses on discovering the facts objectively by excluding the researcher's feelings and values. According to subjectivism, subjects impose the meaning of the objects. Constructivism advocates that meaning is created through interactions of the subjects and the world;

accordingly, each subject constructs their perspectives differently (Gray, 2014). Because I am interested in amateur computer repairers' perspectives and opinions, I believe that participants construct their points of view about their meanings and values. For this reason, I employed a constructivist epistemological approach throughout this research.

Other than the theoretical perspective of the research, the studys aim is decisive through designing the research and analyzing the data. The objective of the study can be either exploratory, descriptive, explanatory, or interpretive. Moisander and Valtonen (2006) explain the interpretive framework as follows:

> It is widely agreed upon among contemporary qualitative researchers that interpretations never simply "emerge" in the process of making sense of the data. It is ratherthe interpretive framework and attendant principles, constructs, techniques, and methods that produce particular interpretations. In this context, the term "interpretive framework" refers to a set of assumptions, ideas and principles that define a particular, theoretically informed perspective and appropriate practices for the process of interpretation, thus opening the data to particular interpretations. (Moisander and Valtonen 2006, p. 101)

According to Gray (2014), interpretivism is linked to the constructivist theoretical approach, and interpretivist studies generally have inductive nature and adopt a qualitative approach in the data collection process. While quantitative approaches deal with quantifiable data in order to compare and generalize, the qualitative approach focuses on the quality. Therefore, the researcher is not concerned with the number of interviews (O'Reilly, 2019). Auerbach and Silverstein (2003) argue that qualitative research aims to discover phenomena by examining and elaborating several data. The authors exemplify qualitative methods as "participant observation, fieldwork, ethnography, unstructured interviews, life histories, textual analysis, discourse analysis, and critical cultural history" (Auerbach & Silverstein 2003, p.4). Miles, Huberman and Saldana (2014) emphasize that researchers can gain a holistic understanding of how systems work with its explicit and implicit rules through qualitative data. For this type of research, in order to be able to comprehend the

participant's context, carrying out the research in the natural setting is significant (Creswell, 2014).

To be able to reveal individuals' experiences, doing ways, knowledge, and setting of the participants, I gathered qualitative data. Furthermore, this study is counted as an interpretive study that searches for experiences and perspectives of its participants.

## 3.2 Research Design

Establishing trustworthiness is critical for scientific studies. The research findings are evaluated according to their validity, reliability, and generalizability (Robson & McCartan, 2016). Robson and McCartan (2016) explain these concepts as follows:

> Validity is concerned with whether the findings are 'really' about what they appear to be about. Generalizability refers to the extent to which the inquiry findings are more generally applicable outside the specifics of the situation studied. (Robson & McCartan 2016, 78)

Although these notions are mainly discussed in quantitative studies (Robson & McCartan, 2016), these criteria are scientifically valid for qualitative studies; however, the strategies of a qualitative studies to establish trustworthiness can be different from those of quantitative studies. For example, triangulation is a strategy for establishing validity in qualitative research. Triangulation means using multiple ways to ensure the data is valid (Robson & McCartan, 2016). Gray (2014) argues for using multiple methods to overcome the hidden deficiency in each method.

In order to understand individuals' points of view and experience, I adopted a qualitative approach during the data collection process. Furthermore, I made a data triangulation by collecting data from different sources. Accordingly, two complementary research methods are combined to supply diversified data. For gaining a holistic view, I combined two of the most effective qualitative methods in my case. As the main method, semi-structured interviews are conducted to learn

participants' opinions about amateur computer repair, called "sayings" in practice theory (see section 2.1.2). As a complementary method, I organized repair sessions through think-aloud protocols. Through this method, I observed the participants' repair process. I collected the data closely related to applied amateur computer repair, which is discussed as "doings" and "thinkings" in the literature review (see section 2.1.2). The following section provides details of the research design.

### 3.2.1 Interview Design

According to Moisander and Valtonen (2006), researchers who adopt qualitative methods uncover the unseen structures and processes through an individual's perspective. According to Creswell (2014), taking an epistemological perspective in qualitative research studies uses the individuals' views as evidence. More clearly, the knowledge is derived and proved from participants' quotations. Besides the participant, the researcher is the other main actor.

Moisander and Valtonen (2006) describe the interview as a specific type of interaction that depends on both the participant and the researcher's performance and discourses related to the interview subjects. Hannington and Martin (2012) state that interview is a significant method that directly provides data from the person who knows the topic. The interviews can be divided into unstructured, semi-structured, and structured interviews. Although unstructured interviews allow flexibility, they require time allocation (Hannington and Martin, 2012). On the other hand, structured interviews follow the same script for each participant; therefore, the researcher has to avoid improvisations (Hannington and Martin, 2012). However, semi-structured interviews include both flexibility and a particular guideline. Creswell (2014) mentioned that researchers prefer to design their interview questions rather than using strict schemas to conduct qualitative research. Since I aimed to talk about a particular topic related to the repair and captured the precious data about the diversified issues, I preferred to use semi-structured interviews. Accordingly, I

designed a specific question set particular to the study field (Appendix A). New items are added to reach data about new concepts through the interview process. The interviewee is not interrupted by the researcher. Therefore, the order of questions occasionally changed depending on the participant's process.

The question set is designed to move from general to specific questions as it is shown in the Table 3.1 (to see Turkish version in Appendix A). In this set of questions, I aim to understand participants' experiences about computer repairing. The question list contains several questions under five headings. In the first heading, I asked general questions about the participant's background, such as age, occupation, and which objects they repaired until today. These questions aim to learn about the the participants and facilitate the conversation. In the second heading, the development process of the repairing skills is questioned. I asked questions about how long the participant has been repairing, what their first interactions with repair were, and how they learnt repair. With these questions, I aim to understand the participants' learning process about computer repair practice. In the third heading, the repair process is comprehensively discussed. I asked the participants to describe each repair process that the participant experienced step by step; for example, how the participant repaired a most recent computer malfunction, when the participant failed to repair or how they managed to repair. Besides, I asked how they found the spare parts, what tools are essential for them. In the fourth heading, I asked about the repair networks what they think about the computer companies' repair service and how they keep up with the technology. The last heading is designed to learn more about the communities of repair. I asked whether they have a friend who repairs too and what they are sharing. I finished the interview by asking three opinion questions to understand the individual perspective of the participant. These questions asked what an amateur repairer's skills are, why people repair, and what is the contribution of one's repairing their own computer.

Table 3.1. *Interview questions*

| |
|---|
| **Introduction**<br>How old are you?<br>What is your occupation?<br>What did you repair? |
| **Learning process**<br>How much time do you spend on repair activities?<br>When did you start to repair a computer? Could you please tell me your first repair story?<br>How did you learn to repair?<br>Did you ask help from anyone while learning to repair a computer?<br>How do you describe your relationship with the person who helped you in the learning process? |
| **Repair process**<br>When was the last time you repaired a computer?<br>Can you explain to me your typical computer repair process?<br>Which cases were interesting for you?<br>Can you detail the computer repair case that you succeeded? How did you manage to repair that computer?<br>What was the most difficult computer repair case for you?<br>Which computer repair case did you fail in? Why did you fail? (How did that problem affect your computer use) |
| **Settings and Tools**<br>Where do you repair?<br>What are the tools that are used during the repair? Where do you get those tools?<br>Do you plan to buy any new tools these days?<br>If you have an unlimited budget, what repair tool do you want to buy?<br>Did you buy any spare parts? Where? What was your criteria?<br>How do you reach the information that is related to spare parts and repairing?<br>Have you ever had a difficulty in reaching the information? |
| **Network**<br>Who do you speak about repairing activities? Do you have friends that share the information related to the repair activities with you?<br>What do you speak with them? Can you exemplify?<br>What do you think about the computer companies? What do you think about the computer companies' approach to the repair activities?<br>What do you think about the technical services?<br>How do you keep yourself up to date with information about technology and repair the computers? |
| **Conclusion**<br>Why do you like to repair?<br>What is the contribution of repairing to you?<br>What are the skills and characteristics of an amateur repairer? |

Interviews are generally used as a complementary method (Hannington & Martin, 2012). In my case, I combined think-aloud protocols and interviews to collect diversified data since I focus on “doings”, “sayings”, and “thinkings” of the participants.

### 3.2.2 Think-Aloud Protocol

Researchers collect the data in the field, which is the participants’ natural settings, by communicating with the participant directly in qualitative research (Creswell, 2014). As a qualitative method, the think-aloud protocol is used to understand the participants’ “sayings” and “thinkings” during practicing repair activities. The think-aloud protocol method means that the participant asked to talk aloud while solving a problem. This method explains how people solve a problem (van Someren, Barnard and Sandberg, 1994). Therefore, organizing repairing sessions in participants’ settings, the tools, and computer hardware provides comprehensive knowledge that cannot be collected by interviews.

Hannington and Martin (2012) explain two types of think-aloud protocols; retrospective and concurrent think-aloud protocols, which follow different strategies during the data collection process. Though retrospective think-aloud protocol, the participant is asked to complete the task in silence, and the process is recorded on video. After the task is completed, the participant is asked to comment on the process by watching the video record. In a concurrent think-aloud method, the participant asked to verbalize what she or he is doing, thinking, and feeling while completing the task (Hannington & Martin, 2012). In this method, participants explain what is happening by using their language (van Someren, Barnard and Sandberg, 1994). Additionally, the researcher can observe the problem-solving process at the same time. In this method, the researcher reminds the participant to think-aloud if it is necessary. Furthermore, observing participants’ behavior provides extra information about the process (van Someren, Barnard and Sandberg, 1994).

In this research, I conducted a concurrent think-aloud protocol by assigning computer repair tasks to participants. Also, I observed participants practicing the repair activities and asked further questions where I did not understand. Therefore, the reasoning behind the repair activity became clear for me. This method provided valuable information on how participants work on a broken computer, how the participant thinks, how the participant used their body, etc. Thus, I could gather more information related to participants' doings and thinkings. Furthermore, I could confirm the data retrieved from the interviews.

## 3.3 Sampling

Matthew and Ross (2010) state that the snowball sampling strategy is employed to reach particular people without having a list of them. This sampling method was fruitful for reaching diversified participants, particularly the combination of a quota sampling approach that searched for people with specific characteristics (Matthew & Ross, 2010). I firstly clarified the specific characteristics and started to ask this type of people in my own personal surroundings. The study is conducted with people who can repair and maintain their computers. In this research context, I described them as amateur computer repairers. I recruited the sample through my connections and online platforms. The following parts include more details about the sampling criteria and recruitment process.

### 3.3.1 Recruitment of the Participants

I developed a coherent sampling strategy to achieve particular aims during the field research. The first aim of the study investigates the user and object interactions. Thus, I took into consideration the people who can repair their computers. The second important aim was to focus on repair activity that is undertaken without company rules. That is why I chose to conduct research on non-commercial sites

rather than commercial sites such as technical services. For these reasons, I examined amateur repair activities.


*Figure 3.1.* The post on a personal page and in the METU school group

In line with my research aim, my sampling criteria included participants:

- who can repair or maintain their computer,
- who do not earn money from repair activities,
- who did not get professional education on repair activities,

In order to reach the people who are in line with the sampling criteria, I used Facebook groups. I created a post (see Figure 3.1), and then I published on both my timeline and METU students' group (*100. Yıl Evleri*). Many people volunteered to help me. In this stage, majority of the volunteers were male, then I spent special effort finding women participant by considering gender equality. Later, I communicated with the people via Facebook messages or e-mail to ask for more detail about their computer repair activities to recruit more relevant participants. For example, I asked what they repaired or maintained till today. Then, I gave further details about the research.

Table 3.2. *Participants list*

| Pseudonym | Age | Sex | Location | Occupation | Duration | Type | Analyzed (yes/ no/ partial) | Participated in think-aloud protocol |
|---|---|---|---|---|---|---|---|---|
| Kaan | 29 | M | İstanbul | Psychologist | 78 min | online | yes | yes-<br>25 min |
| Melek | 35 | F | Eskişehir | Fashion designer | 41 min | on site | yes | no |
| Berk | 28 | M | Eskişehir | Software developer | 105 min | on site | yes | yes<br>84 min |
| Hasan | 25 | M | İstanbul | Researcher | 68 min | on site | yes | no |
| Melih | 29 | M | Manisa | Software developer | 75 min | on site | yes | no |
| Cem | 25 | M | Eskişehir | Student | 74 min | on site | yes | yes<br>51 min |
| Öykü | 32 | F | Switzerland | Researcher | 81 min | online | yes | no |
| Ülkü | 23 | F | Ankara | Urban Planner | 48 min | online | yes | no |
| Ozan | 23 | M | Ankara | Student | 54 min | online | yes | no |
| Oğuz | 28 | M | Eskişehir | Salesman in a Technology Market | 50 min | on site | yes | no |
| Serkan | 29 | M | Manisa | Graphic designer | 40 min | on site | yes | no |
| İsmet | 30 | M | Manisa | Health technician | 48 min | on site | partial | yes- 85 min |
| Gürkan | 32 | M | İstanbul | Technician | 35 min | on site | partial | no |
| Mustafa | 34 | M | Eskişehir | Software developer | 40min | on site | no | yes- 37 min |
| Ahmet | 29 | M | Manisa | Office Worker | 46 min | on site | no | no |
| Hilal | 26 | F | Ankara | Student | 160 min | online | no | no |
| Eylem | 22 | F | Ankara | Student | 56 min | online | no | no |
| Perihan | 33 | F | Kütahya | Architect | 24 min | online | no | no |
| Işıl | 30 | F | Netherlands | Electrical engineer | 40 min | online | no | no |
| Hüseyin | 30 | M | İstanbul | Software developer | 45 min | online | no | no |

Remote and onsite interviews were conducted. Because of the remote interview opportunities, I was able to reach participants located in different cities. End of the comprehensive data collection process, I completed 20 interviews (see Table 3.2).

However, I found that some of the participants were not matching my criteria. These were not analyzed. An exception was made for two interviews that did not match the sampling criterion of not earning money from repair: Gürkan is working in a computer repair company. İsmet is buying second-hand computers. After repairing them in his home, he sells them. Even though they did not match my criteria, they provided important insights into the company perspective. Therefore, their data was used in a particular section without combining them with the other data.

Furthermore, some of the participants were matching my criteria, but did not provide sufficient data. After I completed all of the interviews, I excluded eight of the interviews (see Table 3.2) based on the quality of the data they provided. These were mostly participants who were not competent in computer repair, some of which were interested in software, gaming parts, mobile phones and circuit design. Two interviews were excluded due to lack of detail. Nevertheless, the excluded interviews provided general insight into repair. In the end, an analysis was made with 11 of the interviews, and the 2 partly-used interviews mentioned above.

After interviews, I organized repair sessions with participants who accepted this. During the sessions, the participants undertook several tasks related to repairing or maintaining the computer such as replacing parts, renewing the thermal compound of processors, fixing a black screen error. While participants worked on these tasks, I observed and probed what they think and do while repairing. In total, five think-aloud sessions were conducted (see Table 3.2).

### 3.3.2 Skill Levels of the Sampling

In my sampling, I considered to include participants from various skills. For this reason, I made a table (see Table 3.2) that explain the background of the participants that are from novice to expert level. The following table provides an approximation of the skill levels of the participants. Rows list the repair practices that came up in the interviews, roughly ordered from easier to more difficult for desktop and laptop computers separately. Marks indicate what each participant has had experience with, based on their claims and my observations in fieldwork.

*Table 3.3. Skills taxonomy for the participants that I analysed*

| | Desktop | | | | Laptop | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 | S11 |
| Kaan | x | x | x | x | x | x | x | x | x | | |
| Melek | | | | | x | | | x | | | |
| Berk | x | x | x | x | x | x | x | x | x | x | x |
| Hasan | x | x | x | x | x | x | x | x | x | | |
| Melih | x | x | x | x | x | x | x | x | x | x | |
| Cem | x | x | x | x | x | x | x | x | x | x | |
| Öykü | x | x | x | x | x | x | | x | | | |
| Ülkü | x | | | | | | | | | | |
| Ozan | x | x | x | x | x | x | x | x | x | | x |
| Oğuz | x | x | x | x | x | x | | | | | |
| Serkan | x | x | x | x | x | x | x | x | x | x | |
| İsmet | x | x | x | x | x | x | x | x | x | x | |
| Gürkan | x | x | x | x | x | x | x | x | x | x | |

For better understanding the participant's skills, I listed the typical engagement of the user through repair and maintanence process in the table 3.3 as follows:
(S1) Opening and cleaning a desktop,
(S2) Replacing the components of a desktop,
(S3) Renewing the thermal compound of a desktop,
(S4) Detecting the malfunctions of a desktop computer,
(S5) Disassembling a laptop,
(S6) Replacing the components of a laptop,
(S7) Renewing the thermal paste of a laptop,
(S8) Soldering cables of a laptop or its battery
(S9) Detecting and repairing the component based malfunction of a laptop
(S10) Replace the screen of a laptop
(S11) Repairing a component of laptop

It is significant to note that this is a just representation of the skills of the participants.

## 3.4 Ethics and Consent

Creswell (2014) explains the ethical issues while conducting the research as respecting the participants and collecting data without creating power imbalances. The ethics approval both certifies that the research is conducted according to ethical rules and enhances the researcher's awareness due to planning the research in detail (Matthew and Ross, 2010).

Prior to conducting the study, I got ethic approval from the METU UEAM. While recruiting the participants, I sent the informed consent form to provide more detail (see Appendix B). Informed consent is a form that discloses the purpose of the study and proves that the participant voluntarily gets involved in the study (Creswell, 2014). Before starting the interview, I explained the research aims and process one more time for the participants. I asked them to sign the hard copy of the consent

form. Some of the participants gave verbal consent for the data recording. As in the data collection process, ethical considerations are critical during the data analysis. Data should be analyzed by respecting privacy and protecting participant anonymity (Creswell, 2014). Therefore, I used pseudonyms throughout this study. In the next part, I explain the data collection process.

## 3.5 Data Collection

The data collection process consists of two phases. In the first phase, preliminary studies were used to determine the field study, sampling, and research methods. In the second phase, the data was collected through semi-structured interviews and think-aloud protocols. Firstly, I present preliminary studies. Then, I elaborate on the semi-structured interview data collection process. Lastly, I clarify the progress of think-aloud protocols.

### 3.5.1 Preliminary Studies

In this part, I present my preliminary studies in order to clarify the reasons behind particular research design decisions. In order to observe repair activities, and in this manner, specify the type of repair activities and sampling I will research, I made preliminary studies as follows:

Firstly, I searched for repair courses. Luckily, I came across two repair courses in Eskişehir, where I live. It was organized in one of the course centers of Eskişehir Municipality, called ESMEK. Both courses were organized for women; one of the courses was focused on car repair activities; the second one was focused on repair courses. However, these courses were not offered in 2018.

Because of time concerns, I decided to speak with repairers who work in technical services, individual repairers, and amateur repairers. When I spoke with the owner

of a technical service where electronic goods and white goods are repaired, I learned that technical services mainly follow the manufacturer companies' rules and procedures. Accordingly, they mainly replaced the broken part with the new part because of the guarantee specifications of the companies. Then I spoke with individual repairers in my neighborhood who generally repair small domestic appliances. One informal interview took two and a half hours; however main topics were politics, individual careers of the technician, importance of the reputation, and spare part dealers. The first repairer was not willing to speak about the details of repair. He stated that knowledge is a trade secret based on technical skills; therefore, it was inappropriate to share them with anyone. The second informal interview took about 30 minutes. In that conversation, the learning process of the repairer, again reputation and the repairer's trade associations were discussed. More importantly, the repairer did not answer my questions about the object repair process in detail. I understood that they do not use the objects; they are trade the objects. Then, I decided to contact the users of the object who repair their own objects.


*Figure 3.2.* The Facebook post for preliminary studies

As shown in Figure 3.2, I made a Facebook post to contact people who deal with repairing the small appliances. I found that two of my friends had experienced the

repair of their goods. One informal interview took 13 minutes; the other tooks 20 minutes. Both interviewees mainly emphasized that they did not have user and object attachment. I could not learn what I was wondering about.

After the desired data is not received from the small house repairer, I decided to focus the computer repairers. In order to observe the user-product interaction, I speak to people who can repair their computers instead of the professional computer repairer. I conducted one informal semi-structured interview with one of my friends, who is keen on computers. It took almost 45 minutes. The prominent concepts were the development of technical skills, history of the computer interest, online forums, repair of the hardware, computer companies, guarantee conditions, limitation of the technical services, and so forth. Accordingly, I decided to interview people who repair and maintain their computers. At that time, I had no specific knowledge about the components of the computers. The first time in my life, I had seen the components at that time. The participant showed me both components of the desktop and the laptop by explaining their functions. In the next part, I explain how I conducted semi-structured interviews with the people who agreed to get involved in this research.

### 3.5.2 Conducting Interviews

During two and a half months, I conducted face-to-face or online meetings with participants from different cities. In total, 11 face-to-face and 9 online meetings were conducted. I held 5 of the face-to-face meetings in Eskişehir, where I am currently residing in. 2 of the face-to-face meetings were conducted in Istanbul, and 4 of the face-to-face meetings took place in Manisa, where my family lives in. The online meetings were conducted with participants in Ankara, Istanbul, Kütahya, Netherlands, and Switzerland (see Table 3.2). Skype and Facebook call were used, depending on the participant's choice. Before I started the interviews, I asked the participants' consent by giving them a copy of the form in face-to-face meetings. For

online meetings, I asked whether they agreed or not to voice recording. The interviews were recorded with my mobile phone and computer voice recorder.

Interviews started with the background of the participant including age, occupation, and how many years they have been performing repair. Then, I passed to the question about their learning process. In this part, the flexible structure of the interview helped me, because when I asked about their first repair, they answered that they were keen on mechanical toy repairs when they were children. Most participants emphasized that their interest in repairing activities started from their childhood and lasted until today. It was surprising for me to hear their linkage between repair of toys in childhood and computer repair. At this point, I could retrospectively probe and reach many interesting stories with the advantage of the semi-structured interview. Then I moved into the third topic, which includes questions related to repair process. In this part, participants explained the repair process retrospectively. Therefore, I could hear about diverse cases that participants dealt with in the past. Fourth heading was related to the networks; and the fifth was about the repair community. In this part, the role of the online communities was emphasized by many participants. Besides these set of questions, I could ask additional questions to better understand the case. Sometimes I took note as the participant drew schemas to explain the subject in more detail. All in all, interviews took 22 hours and 46 minutes in total.

### 3.5.3 Think-aloud Protocols

After interviews, I set up think-aloud protocol sessions with participants who accepted. Sometimes participants stated that they might use their own computer. Sometimes a third person's computer is used with the confirmation of the repairer and the object owner. When I could not find any other options, I used my computer as a sample. However, I declared that the result of the computer repair was not important. The process is more important than the result. During the process, the participants used their own tools and materials. Two of the observations were

conducted in the participants' home, which provided information about their routine repair settings. Two of them were conducted in my house; it was the participants' choice. One computer belonged to my house-mate; in the other case it was mine.

Before starting the think-aloud protocol, I asked the participant to express their ideas and behavior loudly. When they did not use verbal expressions, I asked them why they were doing that or what they were thinking. As a researcher, facilitating the expression was my important role in the process. Next, I will briefly introduce each think-aloud session.

In the first session, I provided two old but functioning laptops to participants. After Cem worked on laptops, he decided to combine the two of them and made one proper computer. By saying that, he disassembled the computers, replaced the components. The session lasted almost 51 minutes.

The second session was conducted online. Kaan was planning to renew his computer's thermal compound. I asked if I could observe it. Because he worked on desktop computers, the disassemble phase was very short, as it took about 25 minutes. He cleaned the dried thermal paste from the surface of the processors; then he put the new one.

The third session was conducted with Mustafa on-site. I provided my laptop, which had a non-functioning touchpad problem. Contrary to the other think-aloud processes, in this case, we conducted the think-aloud session, then I could ask some of the interview questions because of his time limitations. The combination of the think-aloud session and the interview lasted 77 minutes. Besides, the participant was hurried; therefore, he was behaving more quickly and harshly to the computer, contrary to other participants.

The fourth session was also conducted with İsmet on-site. One of my friends in Manisa both introduced me to the participant and provided the broken-down laptop. The laptop had a wi-fi connection problem and damage to the connection mechanism. The participant detected that the wi-fi cable was split into two pieces; therefore, the connection was lost. Then he fixed the broken hinge by mounting a screw. The whole session lasted almost 85 minutes.

The fifth session was also conducted with Berk onsite. One of my friends had a black screen problem on her computer. The participant agreed to fix that computer. He firstly disassembled the computer by checking each part whether a problem occurred or not. Finally, he found that the cable was detached, that is why the screen lost its power. The session lasted 84 minutes.

Throughout the think-aloud protocol, I gathered information about what the participant thinks in the progress of the repair. With the observation of their movements, I understood how they interacted with materials and components. That is why think-aloud sessions illustrated what participants were thinking and doing. At the end of the data collection process, I have gathered elements of the repair practice as the participants "doings", "sayings", and "thinking" (see section 2.2.1 on combining interview and think-aloud protocol).

## 3.6 Data Analysis

During the analysis, interpretation of the data requires an iterative process. According to Moisander and Valtonen (2006), the researcher has to become acquainted with the data by reading it many times. Also, it is significant that the interpretation of the data is comprised of improvisation and creative aspects (Moisander & Valtonen, 2006). Another factor is whether the researchers' attitude is inductive or deductive (Gray 2014). In qualitative studies, researchers use inductive and deductive coding while reasoning the data to be able to build themes (Creswell,

2014). In this research, I adopted the inductive approach, which reveals tentative theories from the data, contrary to deductive approaches, which use the theory to set out criteria to prove the hypothesis (Matthews and Ross, 2010). Researchers claim prior assumptions, theories and hypotheses while doing deductive analysis. Inductive analysis is an approach that mainly uses the raw data to reveal concepts, themes (Thomas, 2006). In this study, I mainly adopt an inductive coding approach and I used the transcriptions of the interviews to derive codes and concepts. Thomas (2006) explains the inductive coding process as follows:

1. Preparation of raw data files
2. A close reading of the text
3. Creation of categories
4. Overlapping coding and uncoded text
5. Continuing revision and refinement of category system (Thomas, 2006, p.241)

After collecting the data, I move into the analysis section. Firstly, I transcribed some of the interviews and some of the think-aloud protocols according to particular criteria. Next, I will detail how I transcribed the data and the analysis of the interview.

### 3.6.1 Transcribing the Interview Data

I voice-recorded the semi-structured interviews and think-aloud protocols. I used a voice recorder app on my phone during the face-to-face meetings. For an online meeting, I used my voice recorder program on my computer. At the end of the process, I recorded around 22 hours of meetings.

After I collected voice records, I transcribed the data by using the Express Scribe program. This program was very efficient to transcribe audio data. I transcribed 11

interviews and partially transcribed 2 interviews. Think-aloud sessions were partially transcribed for efficient use of time.

### 3.6.2 Analysis of Interviews

After I finished the transcriptions, I moved onto the analysis of these data. This process has two cycles. The first cycle constitutes an initial analysis of the transcribed data. At the beginning of the process, I printed two of the interviews which belong to Melih and Berk. Then I reviewed and coded the interviews on paper. Based on the initial coding session, I made a preliminary code tree using Post-Its, including descriptive and theoretical codes. After this process, I printed the rest of the interviews and I analyzed the data manually. End of this process, I made a draft code tree.

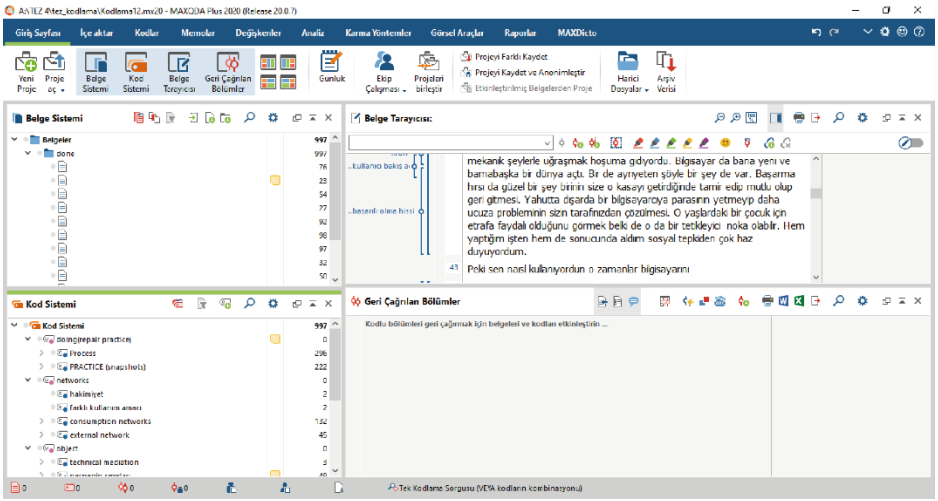


*Figure 3.3.* Second cycle coding in MAXQDA

After completing the first cycle, I moved onto the second cycle of the analysis. I did the second cycle of the analysis in software for qualitative data analysis. I used the MAXQDA program (see Figure 3.3), provided by METU. Descriptive and theoretical codes I developed in second cycle can be found in Figures 3.4 and Figures 3.5.

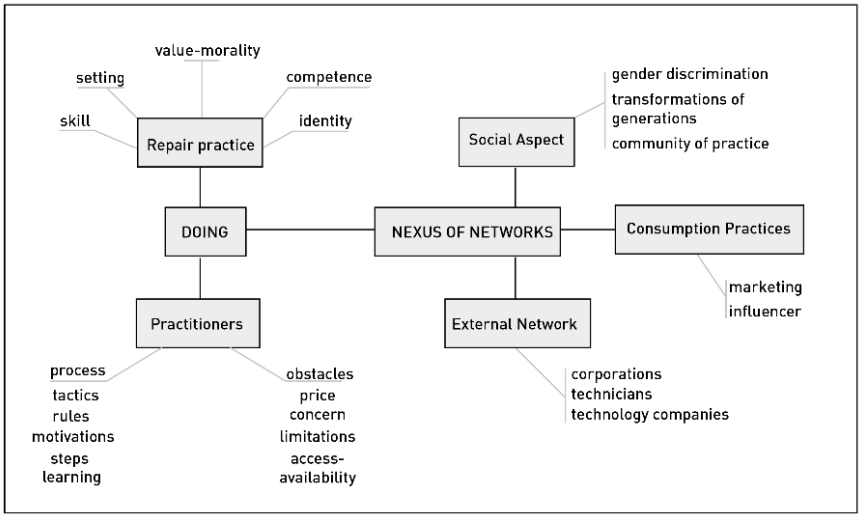


*Figure 3.4* Descriptive codes

I completed the second cycle by analyzing eleven interviews. In addition to the analysis of the ten interviews, I used some of the quotations from Kaan's think-aloud protocol (see section 4.1.1), Gürkan's interview (4.3.1) and İsmet's think-aloud protocol (see section 4.1.5). At the end of this process, I had three upper level codes: "repair practice", "repairer", and "networks", which constituted my descriptive codes (see Figure 3.4). These codes are presented in the findings section (see chapter 4) and discussed in the conclusion section (see Chapter 5). Theoretical codes are discussed in the conclusion section (see Figure 3.5).

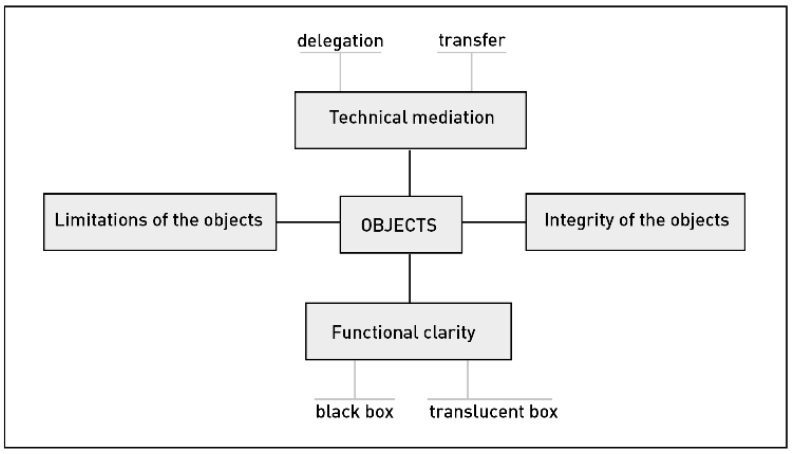


*Figure 3.5*. Theoretical codes

## 3.7 Limitations of the Data Collection Process

The research emerges through the process instead of being strictly determined from the beginning. Research design might transform during qualitative research (Creswell, 2014). As I explain in the sampling strategies, I conducted interviews. Starting from the preliminary study, I had some limitations. The first limitation occurred in finding women being engaged in amateur repair in my surroundings. Accordingly, I posted a text which emphasizes that particularly women participants were searched. The second problem was finding broken down laptops to work on in the think-aloud sessions. The third problem was the location and time problems of the participant. Therefore, some of the interviews were conducted in an online format. On the other hand, some of the participants were gaining money for amateur repair; some were not interested in computer repair. I present these problems in detail in section 3.3.1.

## 3.8 Summary

This chapter presented research approach, research design, sampling methods, ethics and consent, data collection process, the analysis of the data and limitation of the studies. During the research, epistemological constructivist perspective was adopted. During the data collection process qualitative methods were used. In the analysis of the study, inductive coding strategy was applied. Preliminary studies were carried out to test the field before the main research. In the main research semi-structured interviews and concurrent think-aloud protocol sessions were conducted. In total, the research was completed with 21 amateur repairers. However, 11 of interviews were analyzed and 2 of the interviews were partly used. After coding in two cycles, themes emerged. The codes were divided into two: descriptive codes and theoretical codes. In the next chapter, the findings of the analysis are elaborated.

# CHAPTER 4

# FINDINGS

The previous chapter illustrates the applied research methods and research samples. This chapter presents the data which was collected during the semi-structured interviews and observation sessions under three sections. Section 4.1 is about the character of amateur repair practice as "nexus" and discusses the "elements" of repair as practice. Section 4.2 is about the performance, the doings of amateur repair practice. It relies more on descriptions of what the repairers do in a hands-on process. The third section 4.3 introduces the larger networks which surround the repair practice.

## 4.1 Amateur Repair Practice

This section helps to define the amateur repair practice. As with any practice, the amateur repair practice consists of particular elements. In order to understand the amateur repair practice, the elements of the practice should be elaborated. Shove (2012) asserts that practice is described by its snapshots of competences, meanings, materials and skills. Inspired by Shove's (2012) categorization (see section 2.1.2), I divided the data into five sections to define the amateur repair practice. These sections are skill and abilities, perspective, identity, value and moralities, and the setting. Before discussing the elements of the repair practice, I present the rules of the amateur repair practice, which is divided into as implicit and explicit. The explicit rules are more descriptive explanations, as Schatzki (1996, p. 89) described: "principles, precepts and instructions" (see section 2.1.1). Implicit rules are the tacit knowledge that is not verbally transferred: stated that "understandings, for example, of what to say and do" by Schatzki (1996, p. 89) in section 2.1.1. It is possible to write an amateur repair manual with explicit rules and implicit rules. First, I illustrate the explicit rules, then implicit rules.

### 4.1.1 Explicit Rules in the Repair Practice

While working on an electronic product, the behaviors of the practitioner can lead to accidents or injuries. Following the safety precautions protect the amateur repairers from potential damages. The learning process of the amateur repairers is not structured as much as formal training process and is based on self-learning (see 4.2.3). For this reason, safety precautions might not draw their attention before they start to repair. The practitioners should be careful in order not to harm themselves or the goods in the house. Ozan stated that as follows:

> When I started doing this job, the most important thing for me was working with electricity. Of course, I have that humanly feeling deep inside: Would the electricity strike me? I mean, we work with electricity and everybody has this fear. There are some safety measures, such as working with soldering iron. How should you put it on a surface so that it doesn't burn the carpet or wooden surfaces? I was paying attention to the safety measures not to do something wrong for the first time. [Ozan]

The first explicit rule is following safety precautions. Amateur repairers have to consider safety precautions more than professional repairers, because they are working in a home setting which is not mainly designed as a workshop. Not to harm anything or anybody, they need to act carefully.

Most people watch repair videos to solve specific malfunctions. In this context, following the explanation that the repairer on the video points out is critical. For example, Kaan explained how he follows the instructions: "There are some rules. I do not ruin [my laptop] by playing by ear". Further, reading the manual might prevent unpleasant mistakes. Ozan stated the importance of double-checking the manuals:

> I read [the instruction] carefully, two times. All the procedures. If you say "Yes, I got it" and act in a hurry without double-checking the further steps, you might damage the laptop. Maybe it says [in the instruction] "you should slowly remove the solder" however you only focus the "remove the soldered part," it

> might lead you to irreversible damage, when the repairer says that there is a clip which will make a sound like a click when you touch. [Ozan]

In this explanation, Ozan explained how he tries to move delicately. He focuses on repairers, both the verbal descriptions and the sounds of the material in the video. Most of the explicit rules are written in the forums or instructed on the videos. In this sense, while following the instructions, warnings and steps carefully, the repair procedure is significant. To be more specific, the second explicit rule is mimicking the repairer correctly and focusing on their movements while they interact with the materials.

Opening a complex object such as a laptop or desktop in the correct order is significant. Since each computer has a different assembly style, it causes a diversity of disassembling processes. However, the following law is the essential rule as most of the participant highlighted:

> Actually, it is layer by layer. You know, first, you are removing the back cover, there are screws of the processor under the cover and there are screws of the fan. There are some computers in which it is impossible to open the case; removing the bottom case is a nightmare. So, you are dealing with it for hours, you know. For example, this is what I hate the most. In computers, when you remove the hard disk, for example, there is a small cover on the hard disk. You've got to remove the hard disk. You can get the hard disk directly or maybe there is another cover on the RAM. In fact, there is a big cover at the back. When you disassemble it, you see the fan is there, the RAMs are here, the hard disk is here. But sometimes you need to remove the bottom case completely so that you can reach the hard disk. I get nervous about them. I even think like this: "I wouldn't fix it". I think they want it. But in some computers, it opens very easily. [Berk]

The third explicit rule is following the reverse of the assemble order of the computer while disassembling. That means dismantling the computer layer by layer. More clearly, starting to remove from outside to inside is recommended by the participant. Further, as this quote illustrates, computers have different infrastructures. While some of the laptop models have an accessible infrastructure, some of them have a very complex disassembling process. That depends on the manufacturing strategy of

the company that is related to “black boxing” the product (see section 2.1.1). In addition, organizing the screws according to the layers might be a good solution not to disarrange them. Otherwise, little mistakes like forgetting to place the screws might happen.

Having a clean repair setting during the disassembly stage is critical. The components are very sensitive to dust, sunlight or shaking. Even touching them might cause malfunctions. Ozan emphasized having a dust-free repair setting not to harm the delicate components.

> When you disassemble the solder, dust mustn’t get into [hard disk]. Some hard disks are resistant to dust. Or, some hard disks shouldn’t be exposed to sunlight and shouldn’t be shaken. Once you damage its magnetic mechanism, you can’t rely on it, even if you open it up and try or manage to fix it. What if it breaks down one day again? It can cause a loss of data because of your previous false move. [Ozan]

The last explicit rule is, as this quote highlighted, the specific components have specific handling requirements: the warnings such as protecting from sunlight or dust, etc., written explicitly in manuals. However, any mistake that is not recognized at the moment of the repair can cause more critical problems in the future. Therefore, the amateur repairer has to minimize risk by learning how to interact with the component or they would prefer to replace the components with the new one instead of repairing it.

This section explained the explicit rules in the amateur repair practice. The first rule is following specific precautions that are especially significant for amateur repairer because they do not repair in a specific place that is organized for repairing activities. The second rule is mimicking the instructions of the other repairers in order to be aware of the small details of complex products. Third rule is following the correct order in the disassembly and assembly process, since laptops are mainly produced and mounted layer by layer. The fourth rule is knowing the specific requirements for

handling each of the components. Next, I illustrate the implicit rules of amateur repair practice.

### 4.1.2 Implicit Rules in the Repair Practice

Implicit rules of repair practice signify tacit knowledge of amateur computer repairer. Contrary to explicit rules, implicit rules cannot be instructed verbally. In that sense, identifying the implicit rules are challenging. Instead of describing the tacit knowledge that amateur computer repairers have, firstly, I will indicate how amateur repairers describe their body movement. Secondly, I will demonstrate how amateur repairers learn how to act.

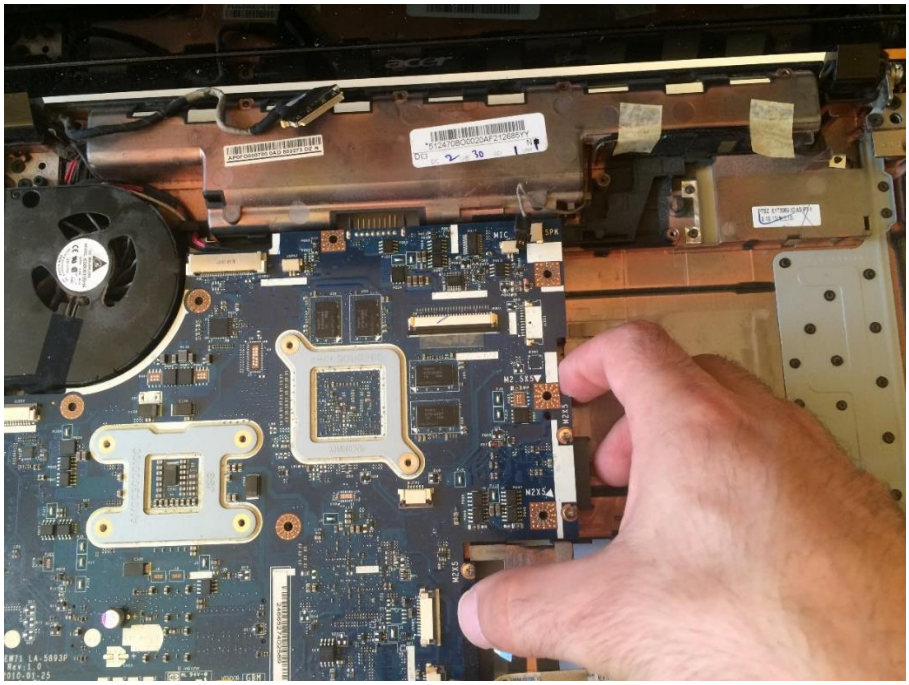

*Figure 4.1.* Showing that the amateur repairer touches to the motherboard

During the interview session, participants pointed out that computer repair practice requires sensitive and slow movements while interacting with computer cases and hardware since certain parts of computers are quite delicate (see Figure 4.1). Ozan

compared the sensitivity and precision of his hands when he was fixing wires of hardware with doing a surgical operation.

> There are pins in the CPU (central processing unit) socket and some of them were crooked. Because of that, my friend who placed the CPU burned the processor. It caused a short-circuit. Also, in the motherboard area, in the socket that the CPU is placed, some of the pins were crooked but those pins are… how can I say? They are thinner than a millimeter and as thin as the tip of a needle. In the CPU socket, some pins are so thin that you have to look at them with a magnifier glass. Since it's so hard to see them with naked eyes and some of them were crooked, he brought it to me to ask if we could fix it and as far as I had known, there were no solutions but, after searching a little, we found something. It was written that with a credit card or any kind of ID card, it could be fixed. For nearly two or two and a half hours, I tried to fix those little pins as if I was performing surgery with the lights on and the zoom of my phone's camera while holding a needle in one hand and a credit card in the other. [Ozan]

As seen in this quote, Ozan dealt with quite a detailed task. He emphasizes that achieving the task was similar to doing surgical operations in the sense of delicacy and critical. Only one wrong movement could ruin the component. In addition to that, the computer might become useless. This example reveals that amateur repairers should act carefully and calmly. At the same time, they have to achieve sensitivity and precision in their movement. In this context, tools that help to achieve that precision are very critical. The participant achieved this sensitive task that requires a large amount of effort and cares with a card that is not designed for this job.

In addition to the achieve sensitivity and precision, the amateur repairer has to control their body movement's speed. Kaan stated that:

> Disassembling the laptop is not equivalent to disassembling a desktop, so if you act by impulse, you will break [the laptop]. You might harm the motherboard or the cables. So, you need to be calm and catch a certain rhythm, so it is not a task where you can act rapidly. [Kaan]

As seen in this example, Kaan emphasized that repairing computers requires bodily control and rhythm in order not to cause damage to the computer. More importantly, it is critical to comprehend what to do next and how to act. Instead of going by heart or performing with the impulse, repairers have to act in a way that has been planned well and thought about carefully. Ülkü's example proved this assertion. She stated, "I broke the tip of the cords when I was trying to plug in the cables to the computer with panic." In brief, amateur repairers know how to control their bodies, how to act thoughtfully and calmly.

Learning implicit rules is demanding because implicit rules are mostly related to interaction with the material. Understanding how to engage with the material bodily is one of the significant implicit rules. In order to comprehend implicit rules, participants used two fundamental strategies; mimicking the other repairers and practicing the repair task by oneself. As I stated in section 2.1.1, mimicking the other repairers and following their instructions are required to comprehend bodily knowledge. Ozan's explanation is an example of how the amateur repairers capture the clues, sounds on the videos in order to act in line with the repairer's bodily movements.

The first strategy to comprehend implicit rules is practicing the repair task by oneself. Most participants use the trial and error method while practicing. Ozan continues to explain why he was not successful in the first intervention. This statement points out his heuristic approach:

> I searched how to change the things on the SATA port, I saw that a few people comment on it like 'Push the pin on the sides, pull it back, it becomes a bit stiff, but it can be opened.' Then, I took the screwdriver, while I was struggling, I broke it. In short, I couldn't open it… When I broke [SATA port], I check out on the internet [how to open it]. I understood the exact point. Also, this time I slowly tried and without forcing [the material], with the tip of the screwdriver. I opened it in the second try. I noticed where I made a mistake for the first time. The second one was very successful. [Ozan]

As this account illustrates, after he failed in his first intervention, he learned exactly how to interact with the material in a proper way. His first mistakes show that bodily experimenting involves learning how to behave implicitly. He developed the bodily knowledge of repair practice through training with the practice.

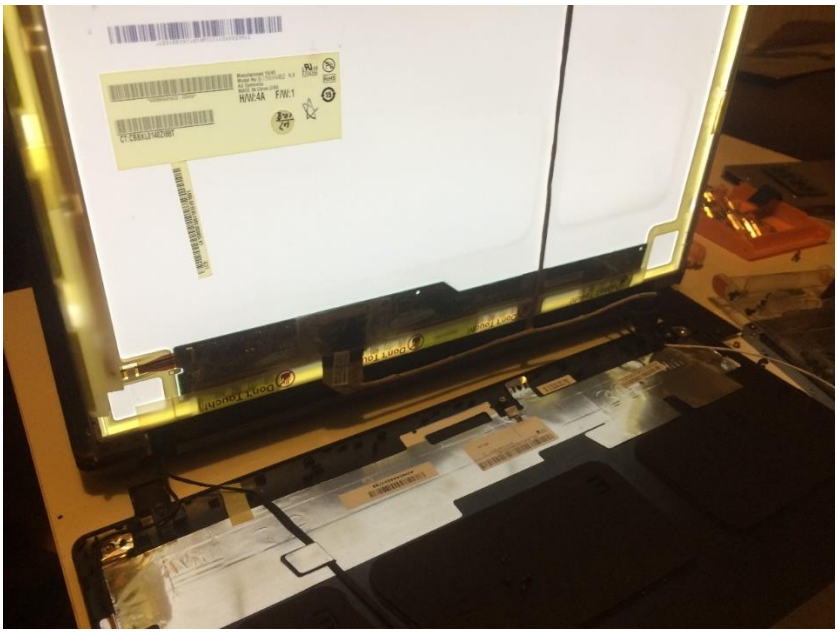

*Figure 4.2*. Shows dismantling process of the monitor

The other strategy that is focusing on sensorial knowledge is vital for both not harming the material and discerning how to interact with it. For example, Kaan exemplified how he put significance on the interaction with the material. He states that he follows the hands of the repairer to gain a better understanding of repair steps and physical interaction.

> On the other hand, I am trying to watch all the fingers of the repairer, especially the dismantling phase of the monitor is a bit more sensitive issue. That's because there are weird, strange clicks. [The monitor] is a product that has been brought together with a few screws, so if you break it once, you cannot assemble it. While watching [the video that shows how to disassembly the monitor], I pay attention to the main steps, first, where do we start, which is how much pressure I need to apply while forcing some points. [Kaan]

Since the computers are assembled through the diverse joints (see Figure 4.2), the amateur repairer might come across a version that they are not familiar with. There is also the fact that the monitor is kept together by snap-fit, which requires extra care and sensitivity. These are one of the results of the complexity and the compactness of the laptops that are assembled by machines and assumed to be disassembled by specific machines, tools or proffessional repairers. In conclusion, watching the videos does not only teach the amateur repairers about the steps and location of screws, etc., in other words, explicit knowledge. Also, it gives the repairer a sense of the tacit dimension of the repair task, the sounds, the pressure, the hand movements, etc. In other words, the repairman's bodily knowledge is transferred to the amateur repairers via the verbal, auditory and visual contents of the videos.

The findings show that amateur computer repair activities involve implicit knowledge. This implicit knowledge is mainly about how to act, how to use tools, and how to interact with the material. The explanations of the participants show that precision, the sensitivity of the body is critical. Further, bodily control and rhythm of the movements are highlighted by the participants. That is to say, bodily activities are critical implicit knowledge that generate characteristic of the amateur repair practice. Accordingly, transmission of this knowledge to amateur repairers is vital in order to circulation of the practice. The participants acquire the implicit knowledge by both practicing the material interaction and mimicking the other repairers' doings, ways and explanations. Lastly, the nature of the repair practice, qualities of the components and the structure of the computers shapes the implicit knowledge. Implicit rules that derive from the indirect clues from the material or component guides the participants movements.

To sum up, repair practice involves explicit and implicit rules, which include particular ways of doing that characteristic to the amateur computer repair practice. In the following sections, I illuminate the skills and abilities that are characteristic to the amateur computer repairers.

### 4.1.3 Skills and Abilities of Amateur Computer Repairers

All of the participants perform particular skills throughout practicing the repair activity. The skills of the participants are divided into five: carrying out the maintenance tasks, tool usage, particular interaction type with the material, reasoning the malfunction, and understanding the technical terminology. While carrying out the maintenance task, tool usage and interaction with the material require a hands-on approach, while reasoning the malfunction and understanding technical terminology relate to a particular way of thinking that will be detailed as part of my discussion of the amateur repairer's perspective (see section 4.1.4).

The first skill of the participants is doing maintenance tasks of their computer. Likewise, ordering the components and assembling a computer at home are prevalent behavior among amateur repairers. Most of the participants can quickly assemble and disassemble their computers to carry out their computers' maintenance. In the following excerpts, Kaan emphasized the difference between him and people who do not know how to fix the malfunctions of the computer. He stated that he was able to carry out maintenance contrary to his surroundings:

> At that time, we were assembling our computers in high school. For example, I am the first person who cleaned the inside of the computer in the neighborhood, and then I assembled a new computer for my friend [buying the separated parts and assembling it by myself]. Then [assembling a computer] was so complicated for other people. [Kaan]

Mainly, disassembling a laptop is challenging work, so that it requires being careful and acting delicately. However, an amateur repairer practices assembling and disassembling a computer several times. Therefore, it turns into a simple and easy task for an amateur repairer. As this quote illustrates, Kaan makes a comparison between himself and his friends. He differentiates himself based on specific skills that are for achieving computer-related tasks.

The second skill is interacting with the material in a particular way. During the skill acquisition process, most of the participants learn to engage with the materials as components, such as the plastic case of the computers. One of the prevalent results of physical interaction is understanding how far you can force the material, such as while prying the plastic case apart or plugging on and off the graphic card. Accordingly, amateur computer repairers comprehend how to interact with the material in a particular way. During the observation session, Kaan explained what he did while renewing the thermal paste of the processor as follows:

> Now I am starting from removing the paste. I wet it slightly at this stage. I am not acting too hard so that it can soften with the wetness of towels; I did not apply too much pressure. I just pressed the wet wipe only for absorption [to moisten the dried thermal compound]. [Kaan]

As this quote illustrates, amateur repair practice involves the material interaction skills which can be adopted only by practicing the repair activities. Further, the participant said that he did not apply pressure. However, there is not a certain rule of the quantity of pressure. That is why acquiring material interaction skills is challenging. Moreover, it is observed that he transforms his behavior according to his implicit knowledge, which I discussed in the implicit rules section (see section 4.1.2 about implicit knowledge)

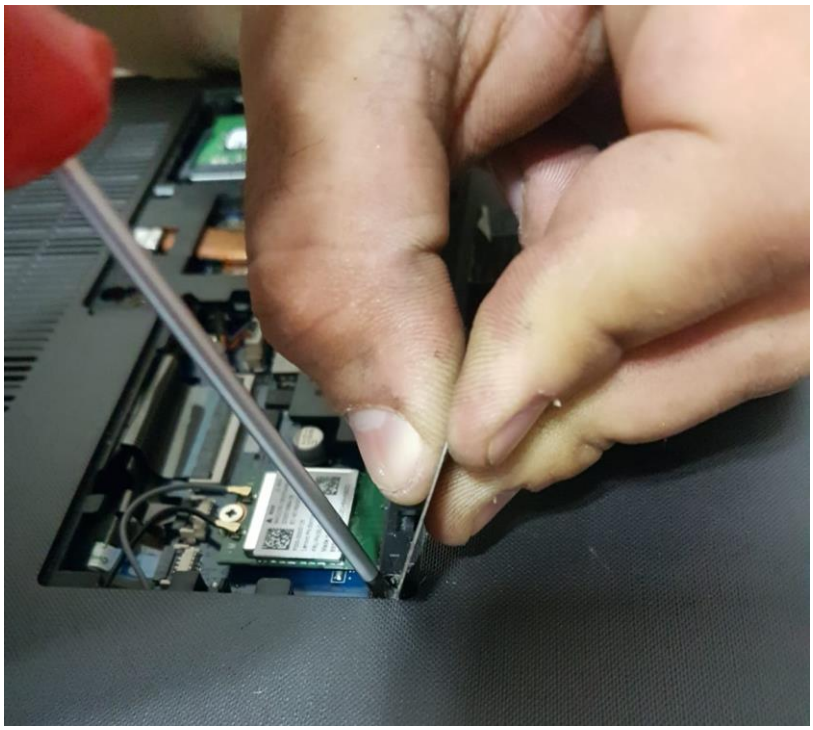

Figure 4.3. Dismantling process of the laptop by using screwdriver and a card

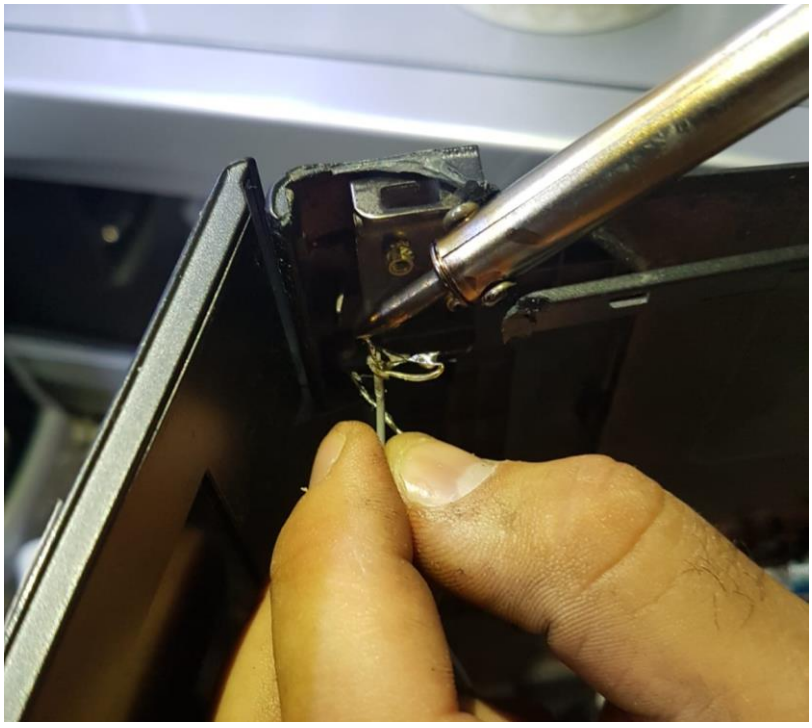

Figure 4.4. Participant uses the solder to fix the Wi-fi cable of the laptop

As presented above, repair practice involves practical skills of disassembling the computer by using tools (see Figure 4.3 and Figure 4.4) and interacting with the materials in a particular way. Furthermore, repair practice is a processual task that requires mental skills. The reasoning skills consist of thinking, analyzing, and problem-solving phases. Because reasoning skills help to diagnose a problem and create solutions, it is a comprehensive skill. The following quote shows how reasoning skills are applied to the repair practice:

> Depending on where we limit our ability to repair, the simplest one, [repair skill], always adds to you the ability to solve when you have trouble or when you talk to a friend who has trouble. That is because as long as you do these repair tasks, you will understand that all of these are processual. As you get the ability to see the whole process, you can parse your steps. One of my friends asked me that their phone is not working. No matter what brand the phone is, you have general knowledge, you can say "enter the menu and do something from there." It becomes a skill; you can repair when something is not working, or when you are asked about a mechanical or repair-related process. [Hasan]

In this process, reasoning skills have a critical role in offering a solution. By using reasoning skills, problems and causes of failure are detected. Accordingly, a solution is projected. As the participant points out, the repair is a processual practice. That is to say, fixing a is not discrete event, but it happens in the process. Therefore, the problem becomes clear, and the feasible solutions are generated in the repair process.

Furthermore, reasoning skills are transferable. That is to say, if a person comprehends the repair process, they can apply the same steps to another process. The reasoning skills provide a general understanding of the repair process. Therefore, the amateur repairers would fix or maintain objects other than computer through their reasoning skills.

Besides the reasoning skills, repair practice involves using technical terminology. During the interviews, most of the participants used technical terminology frequently. The following quotes exemplify how the participant used the terminology

in terms of distinctions of computer hardware from each other. Melih explained to the dual-core processors as follows:

> Dual-core dual processors. Why is this important for the hardware? RPM stands for revolutions per minute. It has to be 4500 or 7200. It determines that, I mean, when you upload anything to your computer, [RPM] determines how many seconds your computer needs to transfer 1 GB [data]. [Melih]

As this example points out, the participant has detailed knowledge about the operation mechanism of the computer. Prominent advantage of having technical terminology for the amateur repairer is that of using the same language with the world and using the same terminology that is used by professional repairers. For example, amateur repairers would understand technical instructions in the technical literature of repair practice. Therefore, technological knowledge beyond the computer infrastructure becomes available for the amateur repairer.

This section discussed that amateur repair practice involves practical and analytical skills. Accordingly, the amateur repair practitioners have four types of skills. First is that participants can do maintenance and assembly by themselves. Second, they know how to use the tools and how to touch to a computer in the material interaction level during the repair task in the correct way. Thirdly, they can make reasoning, therewith they can create solutions to fix the problems. Fourthly, they can use technical terminology. The next part describes the particular perspective of the amateur computer repairers.

### 4.1.4 Amateur Computer Repairers' Perspective

During the interviews, some of the participants compared themselves with "normal users" as follows:

> If it is an average person, they would take this [computer] to the technician and say "my computer gets very hot," and they would pay extra money. Then

> the technician would tell them to come back in three days, and three days would be wasted. [Ozan]

This comparison illustrates that by describing the other user as "normal person," Ozan emphasizes that the amateur repairer is more than an ordinary user. This comparison opens a discussion about the amateur repairers' dissimilarity. Since amateur repairers interact with the components of the computer and learn how these components function, they have particular skills and views. Therefore, their perception of computer is distinct from people who do not experience the repair activities. In this section, I define the amateur repairer's particular points of view.

While most of the participants explained how to solve a malfunction on a computer, they started to explain from unscrewing the first screw to the last step of replacing or fixing the component. I call this "disassembly perspective." For example, when I asked how he put the thermal compound Melih answers:

> There are screws. There's a pin. There is one fan at the top of the processor. When you disassemble that fan, there is a physical cooler made of metal. The processors are connected to the motherboard with their feet. We were applying thermal paste there. [Melih]

As demonstrated by the quote, the repairer describes his practice, starting from the outside (the case) to the inside of the computer. Similarly, Serkan can explain how to disassemble a computer from his memory. He started to describe the steps from outside through inside of the computer:

> For example, to open this computer, you unscrew the screws on the back. Wi-fi wireless internet is something like a card. There are two antennas. They also come out with the cable. You remove them, then remove the RAMs and hard disk, remove the CD-ROM, open the case. The keyboard is holding the protrusion from here, and there are protrusions. You remove the keyboard from the bottom and four or five screws in the front. Then there are three screws on the motherboard. You remove them, put them all aside. After that, you remove the copper plates on the motherboard, renew the thermal paste, lubricate the fan. [Serkan]

Although I have not opened a computer with him, he started to indicate some point over his computer. He explained how to clean a fan as an instruction manual. As seen in both examples, participants have a different perspective on the computer. Instead of seeing the whole computer, they see it as a result of a process. By saying that, according to the participants, the computer is an assembled object, and they can imagine the whole steps that makes the computer with the assemble order. Thus, participants experienced repair activity; they can describe each step in the repair process. In addition to that, it reveals that participants processual thinking ability.

A second perspective among the interviewees is identifying the cause and effect relationships about breakdowns. Accordingly, making predictions about reasons for crashes is characteristic of amateur computer repairs. Predictions are made in two levels. The first level is related to component functions. For instance, while Ozan was describing how his friend caused a fault, he explained the reasons behind the occasion: "There are pins, some of them are crooked in the processor socket. My friend plugged in the processor to the motherboard and the processor burned. That caused it to short-circuit." In additions, Serkan's quote shows that he knows the function of the thermal compound and why it is used as follows:

> The thing about the thermal paste is exactly like that. It is used between the processor and heatsink, so it is used in order to leave no air gap between the copper plate and the heat sink. [Serkan]

As seen in this quote, amateur repairers are aware of the structure of the computer. As I mentioned before, participants know the aim of a component or a material that is placed in the computer. Thus, most of the amateur repairers can explain the reason for the malfunction by using their knowledge of the components' operation mechanisms.

Besides the predictions on component level, the second level of predictions is related to the usage context of the computer. For instance, during a repair activity, Hasan

encountered a broken solder defect, then he questioned the computer's use conditions. He stated:

> Some of the solders came off. Probably, [the product] was used in a very hot place. Also, because [the computer case] is made of aluminum, the heat outside affects [the solder]. [Hasan]

By making predictions about the usage context, the participant found that incorrect usage habits caused the broken solder fault. Thus, malfunctioning reason becomes obvious. The other quote shows how software usage can affect computer parts.

> I have to use many programs open at the same time. This is also a problem. It will cause to wear out of ram. Then this causes trouble on the computer. [Serkan]

Consequently, the amateur repairers make the reasoning to find the reason for the malfunctions. More precisely, applicants can see the relations between the component, software, and the breakdown. Thus, they can understand and solve the problems of the computer that occurred. Most importantly, the amateur repairer can foresee the possible problems due to the reasoning perspective.

A third perspective is creating new possibilities, which are developed in terms of knowledge about components and their function. The perspective of creating new possibilities occurs on two levels. The first level is an imaginary step that Kaan called "reverse engineering." Although not all of the participants mention their opinions about the whole mass production system, Kaan explained that he analyzes details of the manufacturing process, and he used to do reverse engineering from his mind after experiencing repairing. Furthermore, he considers that the whole manufacturing process and all objects around the world show us the technological progress.

> This is what I call reverse engineering. I would ask myself, for example, if I was in charge, how would I produce it? Can I do it better? Do I have any idea which can improve this object? That is why most of my friends says to me you don't like anything. For example, while we were hanging around, we

> make a chit chat that pop-ups at the moment. Whatever that might be, motherboard or electronic product or food on the other hand, the table that we sit around. How did they do this? Is this fabricated lamination material or wood workmanship? How did they make its joints? I usually check them. [Kaan]

As the quote illustrates, he fictionalized imaginary steps by thinking how an object can be made better through his "reverse engineering perspective." This particular perspective would enhance considerable knowledge of the manufacturing methods. So, that knowledge might create a possibility to take the amateur repairer to the next level through defeating the alienation to the object. By doing imaginary production, the participants both develop their knowledge of production methods and their perspective that is related to the product.

A second level of creating possibilities takes place by using components for the purpose of creating various functions. The majority of the participants were aware of how elements of computers might be used in other products. Hasan's quotes indicate that:

> When the wi-fi adapter of my computer is broken down, I used old broken phones and connected them to another screen to reinstall it. Then I used them as a wi-fi adapter. [Hasan]

The participant can repurpose leftover components in different projects. Thus, leftover components are used with a new function. Due to their particular perspective that has a facilitator role on amateur repair practitioners' creative approaches, amateur repairers would create new solutions for repurposing the objects.

In sum, the findings reveal that the amateur computer repairers have a different perspective on the objects in three ways. The first perspective can be detected through their order of describing the repair activity. I called that "disassembly perspective." Because the laptops are assembled as a form of different layers, the repair activities require following the particular order. This influences the amateur

repairer's perspective about the objects in a way that amateur perceives the computer as a combination of different layers. Further, this perspective includes the ability to break the laptop down into its constituent parts as the components, screws, materials, and layers. Secondly, they can make reasoning about the computer and malfunctions by linking the cause and effect. This correlation works on two levels, which are the level of component functions and level of the usage context. This particular perspective provides an ability to make assumptions about the malfunctions and their solutions. Thirdly, the amateur repairer can use their knowledge to create new possibilities on two levels; doing imaginary production, which one of the participants called "reverse engineering," and repurposing the components to create a new object which is used for different aims. This perspective provides a creative approach to repair practice.

### 4.1.5 Amateur Computer Repairers' Identity

A specific identity is a crucial element of amateur repair practice. In order to identify the aspects of amateur repairers' identity, two questions should be answered: How do amateur repairers describe their characteristics, and how do their social surroundings perceive them? In the previous section, Kaan (see section 4.1.3) and Ozan's (see section 4.1.4) quotations indicate that amateur repairers distinguish themselves by defining the people who cannot achieve to fix computers as "other" or "normal" people. In this section, amateur repairers' statements about their characteristics will be explained in detail.

One of the amateur repairers' characteristics is being good at practical tasks. The repair practice requires the ability of tool-use and therefore being able to use tools skillfully is emphasized by the participants. For example, Ülkü described herself as a "handy person" when she narrated her repair cases related to both computers and other objects. As seen in this example, being skillful at tool use is a part of the repair identity. In addition, being productive is highlighted by most of the participants

during the interview. Notably, most of the participants highlighted having technical knowledge and the ability to fix an object breakdown. That was one aspect of how the amateur repairers identified their personality.

A typical specification among the participants is to experience various breakdowns during their skill acquisition process. Accordingly, they can guide others with their accumulated know-how by offering possible solutions. One of the participants stated that he sees himself in the expert position. Accordingly, he guided others. Kaan affirmed that:

> In many cases, I am already involved in words. When they say their computer has the problems, I say, as if I am such a repairman: What exactly is your problem? Does anything like this happen? Have you tried to do this? If he says he has not tried, I go into detail accordingly. Suddenly something like this happens. Surprise! Kaan's knowledge on this issue is revealed. A lot of people say, why do you know that? How do you know that? [Kaan]

As the quote shows, when he listens to other people's problems, he puts himself in an expert position. The participants see themselves as having the authority to speak on repair-related topics. It can be evaluated that participants have a repairer identity. Besides participants, also people around them see the amateur repairer as a professional or an expert at repair activities. Consequently, the amateur repairer has the authority and becomes a decision-maker on computer repair activities. Even if participants do not have any professional title, technician identity is constructed by their surroundings and themselves.

Another significant statement is that amateur repairers compare their ability with other technical knowledge owners such as computer engineering students, technicians, and technical service staff. It shows a duality between being amateur and professional, as well as self-learning and training. For example, Serkan compares himself with computer engineering students in the context of practical experience. He claims that he has more practical experience than trained repairers. He criticizes

engineering graduates because they have more theoretical knowledge and less practical experience.

> In engineering, at least let me tell you that I know that the engineering graduates of Celal Bayar University do not know the hardware, so they do not memorize or teach hardware, so they have memorization, that is, only a student reads what a part of a computer hardware does, but it does not have a practical application, they do not know how to assemble computer. Once a person who can assemble the computer alone, then it can assemble and disassemble, and repair any kind of computer. [Serkan]

He continued by giving another example to prove the lack of practical knowledge of one computer engineer.

> Computer engineering graduate, I mean she is doing the internship in the Turkey's best companies. She grabbed the power cables and asked: "Where we insert this?" She will be an engineer soon and called the computer engineer. Her title will be a computer engineer. [Serkan]

The comparison between computer engineers and amateur repairers is based on the knowledge of computers. In this context, the participant wants to prove his professionalism in computer repair without any education. Accordingly, he points out that he is more capable than a person who learns the computer in high-level education. Both comparisons, which are practical versus theoretical knowledge and being educated versus self-trained, show that knowing repair is a part of identity for the participant. They are capable of repair activities, as much as educated ones. Therefore, they see themselves as experts in a way that complements Kaan's quote.

Other accounts draw attention to the skill level of professional technical repairers. Ozan asserts that he is comparable with any technician in terms of mending abilities. According to him, in most breakdown cases, technicians prefer replacing rather than fixing broken components.

> Their job is to replace the motherboard. I can do that too. If they say that your RAM is broken, you will change it with a new RAM. I know that. I brought it to you to repair anyway. If it is going to change, I can change it myself. In

> that sense, I consider computer services like people who can use a screwdriver or who knows how to assemble or disassemble a computer rather than who knows how to repair it. [Ozan]

As seen in this example, the participant compares himself with technicians. He asserts that they have equal abilities in repair activities. By saying that, the participant's high level of competence and the expert identity are reinforced due to amateur-professional comparison.

The second aspect of the repairers' identity is other people's perceptions of amateur repairers. According to Cem, he received permission for dismantling the electronic product's in the house from his family right after he opened up an electronic product completely, then reassembled it. He stated as follows:

> A shattered computer. After putting it in one piece, they allowed me to play with many electronic devices at home. [Cem]

The more amateur repairers fix the objects the more people trust them. Therefore, they gain social acceptance to interfere with any object. It results in the perception that an amateur repairer can somehow find a solution. Thus, their acquaintance consigns their computer to be opened without fear.

Most participants' acquaintances often ask favors about repair or maintenance of their computers from the participants, so that the amateur repairers are perceived as experts on computer repair. The majority of interviewees stated being uncomfortable with receiving help calls about computer malfunctions constantly. Serkan said:

> Because I open and close my computer, or I can check my friends' computers and I assemble them again, [generally] if their [his friends] computers broken down, my help is demanded. Then I opened one computer after another, I thought that what am I doing? What happened? I yelled, do you have more [laptops] or come one by one. [Serkan]

After that, the participant complained that if he had wished to do mending and maintenance tasks regularly, he would have chosen to be a computer technician. It can be evaluated that the participant does not want to be seen as only a computer repairer. According to the participant, being able to repair is their additional qualifications. Therefore, they mostly emphasized their actual occupations. Oğuz narrated that his neighbors asked help from him even for simple tasks:

> When I built my computers at home like this, I became a computer mechanic of neighbors and was a free-of-charge technician. My mother is telling my son is repairing his computer, and he can install software by himself. They were calling me even in the most effortless upload. In the phone call, I was explaining you will click the next button. Next, next, next, that's all. They summoned me by saying, "Ok, even so, come please maybe we might muddle". Then I go and settle the matter. [Oğuz]

Öykü mentioned a parallel experience of constant help calls. She was staying in the dormitory and working part-time in the computer center of the university. She is seen as a competent person about computer repair even if her task was connecting internet cables. Thus, besides her friends, the other residents in the dormitory asked for help. She emphasized she is not an expert in repairing. She expressed having equal skills with others:

> They ask for help for even simple problems, or problems which I do not know any solution for. After a certain point, who ever problem with their computer has a problem was coming to our room day and night. However, I do not have computer knowledge, and I was sending them while saying you could do something like this... However, I don't have extreme knowledge. Either I understood better what I read from Google, or they were approaching a little more cowardly in case something crashes because they weren't very interested. [Öykü]

People ask for help from amateur computer repairers not only about computer malfunctions but also while buying a new computer. They are perceived as persons who know the components of a computer. Therefore, they can carry out an actual valuation of computers. Friends and associates want to consult the amateur repairer while buying a new computer or pricing of work done by a technician. Aside from

their repairer identity, they attain a decider or value negotiator position. For example, Melih said:

> Most people call me about buying or repairing computers. I thought, well, if I open a computer repair shop outside of my software office… That's because there are 3-5 phone calls per week, such as "I will buy a computer on the second hand, do you think this computer is worth it?" Or, "my computer broke. I gave it a technician. It has this problem and that price. How much should it cost?" Or, "I will buy a new computer. I'm planning to use these programs. Which specification do I look for in a computer?" [Melih]

It is another shared assumption that the amateur computer repairer can fix other complicated electronic devices. Although the amateur repairer has not encountered that malfunction before, their accomplishment on computers results in translation of achievement into other repair tasks, which are related to different objects. For instance, Cem's mother asked him whether he can repair the popcorn machine.

In this part, I clarified that amateur computer repairer identity stems from two types of perception. The combined findings revealed that the first factor that constructs identity is a self-perception, which means how individuals define themselves. One of the participants identified herself as a handy person who is solution-oriented. Most of the experienced participants describe themselves as having knowledge and experience about repairing a computer without any formal education. Furthermore, they see themselves as capable of what the technician already does. Lastly, they see themselves as giving guidance to others about computer problems. The second factor that constructs identity is social perception, which means how their social circle perceives the amateur computer repairers. They are defined as people who have the right to intervene in objects.

### 4.1.6 Valued Concepts in Amateur Repair Practice

The conversations with the participants show that there are particular prominent concepts in amateur repair practice. The first highly valued concept is performance.

The amateur repairers that I interviewed are divided into two according to their approach to the concept of the performance. The first approach is demanding to increase the performance of the computers without any particular reason. I call this "performance for performance." The second approach is demanding to increase the performance of the computers for specific usage purposes. The common point in two approaches is that participants for the high-performance components. In order to make this clear, two excerpts are elaborated. The first excerpt shows "performance for performance" approach. Melih stated that he puts high value on increasing the performance of his computer. Accordingly, he narrated as follows:

> Increasing the performance. It's because it was as basic level, because it includes elements that haven't been tried before. By trying it yourself, you see that the risk belongs to you. For example, you take a device that operates with 2 giga hertz to 2.30 gigahertz, while the machine was not exceeding 36 degrees before idle, it catches 40 degrees in 0.5 gigahertz increase. When no stable program is working, accordingly, electricity consumption gets higher. There a a potantiol of fire because of inflammability of the power supply. We just talked about. The fused power supply has a certain potency to supply power. You are approaching that limit. Other hardware parts need energy power accordingly, so you have to stop at a certain limit. This is something you will always try. [Melih]

In this excerpt, the participant experiments with the computer. His purpose is to see the capacity of the components under specific circumstances. This task involves potential risks. For example, while the participant increasing the capacity of the component, he faces the possibility of explosion of the component by increasing the electric charge of the component. Accepting the risk and experimenting with the component gives an opportunity to overcome the company's limitations that are related to optimization of the components.

The second excerpt represents "performance for use" approach. Oğuz states that his computer performance was important for him, because the upcoming computer games demand the higher performance.

> New games have been launched for computers. I realized that my computer can't run these games. I wondered why. Back in the day, there used to be written system requirements on the back of CD's. For example, how much RAM and which graphics card the game needs and so forth. I checked and I realized that there is no problem with the graphics card. I needed to change the RAM. [Oğuz]

As seen in this excerpt, for the participant having a high-performance computer is crucial for a better gaming experience.

Almost all interviewees affirm that they feel happy when they repair computers. Moreover, some of the participants stated that helping others by repairing their computers make them emotionally satisfied. Melih affirmed that being appreciated by social surroundings motivates him to repair computers. Following account illustrates this:

> To see that you are helpful for your environment may be an initiator. I was taking pleasure from both the work I had done and the social reaction I had gotten. [Melih]

As examples indicated that being appreciated by others is a common motivation for participants besides their positive feelings which stem from repairing. Furthermore, the motivation of using the repair to help other people constitutes their repairer identity which is discussed in the identity part (see section 4.1.3).

Further, Cem's statement shows his positive feelings about repairing others computers. However, Cem is distinguished from Melih in terms of his key motivation. The following example illustrates this:

> There are very few people around me who [repair computers]. Being appreciated by people with their high expectations from me, I also think like that. Is it boasting? I don't know but it is an emotional satisfaction. Money is not the issue for me either. For me, every computer I have repaired makes my job more professional. [Cem]

As this except indicates, taking complements from his social circle is valued. He also wishes to advance his repair skills. This might be evaluated that the participant gave value to the repairing performance in the process. Therefore, the participant is distinguished from a participant who values either performance or better use quality. The valued concept of this participant can be called as "repair for repair". Furthermore, some of participants see the repairing activities as a leisure activity, whilst the majority of the participants' motivations arise from a purpose of using the computer again. This motivation arises from the pleasure of knowing new things about the computer, which I will call "knowing in order to know." It means that participants are enthusiastic about repair activity as acquiring new information about the computers without attaching importance to the practical use-value of the information. For instance, Serkan checks websites related to computer repair and reads them continually. Also, he examines components' specifications. Following quote illustrates his motivation:

> For example, I'm browsing [a computer forum]. I may also have clicked on the website because I had wondered how to carry out maintenance for the processor without a thermal paste. I also read such interesting titles for information. I like doing this… There are sites where you can compare the brand and model of a graphic card on a laptop and a graphic card in the case. For example, I would wonder and compare them. It is a sort of evaluation on benchmark. [Serkan]

As this excerpt illustrates, the participant's motivation is to be informed about current news related to the computer. Oğuz emphasized that acquiring the computer-related knowledge makes him happy even if he does not get any monetary profit.

> Knowing something makes you happy. Frankly it makes me happy. There is a plus of that happiness; other than that, it has never been an extra income source in my life. It remained as something I do as a hobby. [Oğuz]

As seen in the accounts presented above, participants give priorities to reading forums for learning new information, doing the repair as a hobby, or developing themselves about computer repair. Furthermore, the participants are involved continuously with either doing repair or keeping up with new knowledge about

computers, contrary to other participants who search for information only when a breakdown occurs. Participants are motivated to repairing a computer or knowing more about computer components since they approach repairing computers as a leisure activity.

However, money is a crucial parameter when increasing the performance of a computer. Participants indicate their intentions for solving their computers' malfunctions as decreasing the cost of repair. For instance, Melih declines to get help from either warranty service of computer brand or repair technician. Following statements shows that:

> I use the computer again and it makes a loud noise as if a plane is taking off. I thought it wouldn't go on like this and I disassembled it. I did not want to send the computer to the technical service again. There was still one-year warranty then when I made this decision up. I didn't want to bother, because it is good to open the laptops once a year and clean the dust and renew thermal paste and so forth. I was going to do that, you know. I did not want to give my money to another computer guy since I was a student. I did not want to send it to the service either. [Melih]

As it is seen in the example, Melih prefer to do maintanence works by himself for saving money. Similarly, Kaan emphasized that solving the malfunction by spending a minimum amount of money is great for him. The following example indicates that.

> I saw that the tip of the condensers was swollen, which was an indication of a problem. Then, I noted those and went to Karaköy, bought the parts. I paid 2 liras in total at the end. I placed them along with their back-up parts again by applying a simple soldering action. And then, it worked. It was an incredible satisfaction and success because instead of calling a mechanic, reanimating a monitor by spending just a couple of liras is something big. [Kaan]

This excerpt shows two critical points. First is that some of the amateur repairers can have economic concerns. Second, they see themselves in equal capability with a technician (see section 4.1.3) and being self-resilient is critical for the amateur repairer. By saying that, I mean the participants' aspirations for repairing their computers by themselves. As a conclusion, participants' self-resilience increased. To

exemplify, one of participants' motivation was experiencing the repair herself. Öykü stated that she wanted to check her computer to see if there is anything she could do by herself:

> It happened like this: when the screen become black, I searched for a few pages from Google on my friend's computer, why did the screen go dark and how to fix the darkening of the laptop screen. I read it a little later, as I understood it, I thought: It is already broken; I have no chance to spoil it any more. If I take this to service, they will fix it anyway so I can try it. Maybe I can fix it. So, at least I have a chance to experience it because it is already in bad condition, so I have no chance to make it worse. [Öykü]

The participant was motivated to solve her own repair problem by herself. In this case there were low risks that if any damages occur it might get fixed by a professional repairer. It seems that she gives priority to get experience. She feels enthusiasm for understanding the problem. Therefore, she wants to try to solve it by herself.

Not being cheated by technicians is critical for some of the participants. For example, Cem highlighted that the retailers who seek profits might lead the customer in a wrong way as follows:

> They try to cheat me by giving me a high price. But I know the cost of the components therefore I won't be cheated. I shop from the same places. [Cem]

As seen in the excerpt, it can be evaluated that the participant's technical knowledge is critical for not being cheated by the retailer. He deals with the problem by developing social relations. Both technical knowledge, and the social relations protect the participant from a possibly unpleasant situation as a customer.

The repair activity might be occupational responsibility. For instance, carrying out one's occupation may depend on having detailed knowledge about capacity of hardware. For instance, Melih works as a web developer. He has to plan a website according to the hardware specifications of servers:

> You programmed software, you need to give it to the online network from a server. Then what kind of needs does the software you make have? What kind of workforce does your software use while ten people use it at the same time? How much RAM does the cache consume? How fast should the internet speed on the server be? We need to learn server logic. After establishing the logic of this website, it all started to come to hardware. For example, which model should that Ethernet card be? [Melih]

In that case, Melih's motivation to be knowledgeable about components capacity is arising from his occupation. Similarly, Ozan told that, he uses the computer to earn cryptocurrency. In order to make crypto money, components operate all day and night in a special setting (see Figure 4.5). Some of the components frequently break down. Therefore, if any malfunction occurs he needs to repair it to carry on to making cryptocurrency.

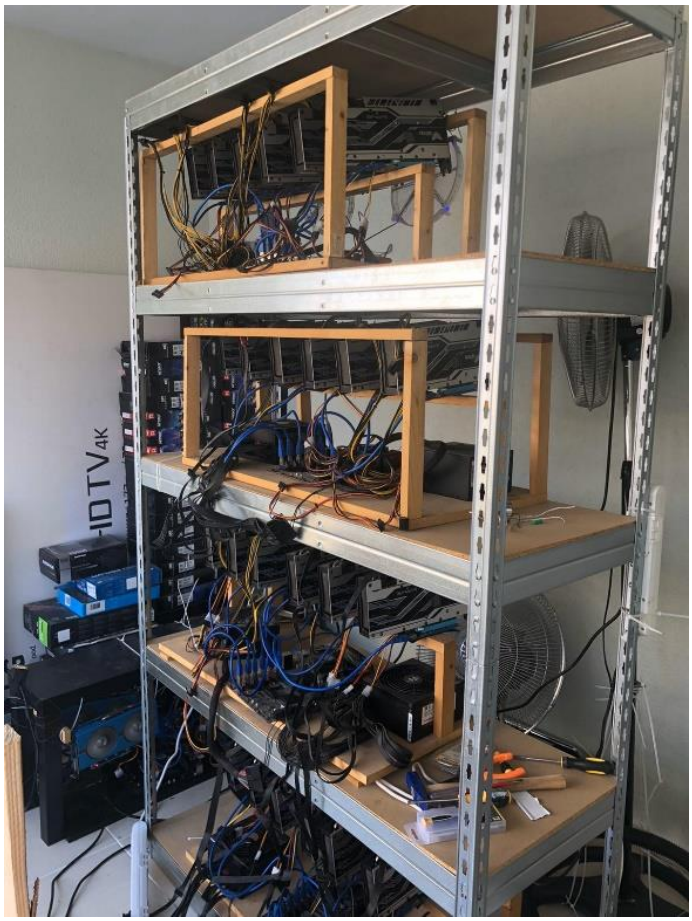


*Figure 4.5.* Shows Ozan's setting to make cryptocurrency

During the interviews, only one participant stated the sustainability concern. However, it may be a significant aspect of repair activities. Melek emphasized that she is repairing to keep using her computer instead of throwing it away. Following account indicates that:

> Actually, my goal is not to waste, in fact, it is to save the items in my house. To be able to use it immediately without wandering around, right and left ... Not to consume so quickly and prolong its lifespan. Not to say that I have consumed it all, so as not to turn it into garbage. If it is possible, why not do it? When you think about it, you understand that if it's still available, why don't I keep it on? [Melek]

As seen in the excerpt, the participant states that she aims to "save the objects" in her house. It shows that her sustainability concern covers most of the objects around her. Even if she is not enthusiastic particularly about computers, her sustainability concerns motivate her to get involved in repair activities.

Firstly, the participants assign importance to the performance of the computer, spending the minimum amount of money for fixing a malfunction, and having technical knowledge in order not to be cheated. The prominent concepts reveal that the participants have the same concerns with any other consumer or user. More exactly, it is evaluated that the participants are trying to be conscious consumers. Accordingly, if we combine this claim and the data presented in the identity part (see section 4.1.5), it reveals the hybrid identity structure of the participant. That is to say, the participants show both the characteristics of a consumer and repairer.

Moreover, there are various motivations to get involved in computer repair practice. Performance is one of prominent values which has two aspects in amateur repair practice. First, called "performance for performance" is adopted by participants who focus on the performance of the computer. Conversely, the second aspect is called "performance for use". It is adopted by participants who do repair activities when they encounter a malfunction. In this case, repair is not the main focus; in fact, repair is a mediator activity that helps to use a computer properly. These groups generally

make experiments and try to increase their components' performance through alternative tactics (see 4.1.5).

The other prominent value is in the repair activity itself called "repair for repair". In other words, some of amateur repairers are interested in repair process. These participants perceive repair as a leisure activity; therefore, they want to acquire repair knowledge more and more, which I called "knowing in order to know." Moreover, the values concerning sustainability, being self-resilient and appreciated by others are distinguished among the interviewees. In the light of findings, understanding the motivations of amateur repairer enlights the amateur repair process. Incidentally, the values of participants that are presented above reproduce the amateur repair practices by persuading the amateur computer repair to do repair activity or maintain the repair practice continually.

### 4.1.7 Setting

Amateur computer repairer's work setting has a significant role through the amateur computer repair practice constitution. Furthermore, the setting distinguishes amateur repair practice from professional repair practice. Accordingly, knowing their work setting sheds light on the characteristics of the amateur practice that is distinct from professional repair practice. The setting of amateur repairer consists of repair tools and work environment. In order to describe amateur repair practice, I portray the participants' working environments, which I observed during the think-aloud protocol sessions.

Firstly, amateur repairers generally use basic tools as presented in Figure 4.6. Kaan captures this picture after the think-aloud protocol. In that session, he renewed the thermal compound the processor of his desktop. Kaan used basic equipment like screwdrivers, prying tools, tweezers and thermal compounds. Further, İsmet have a tool box that include spare parts, USB that include software programs, various screws and toothbrush to clean the dusty fans (see Figure 4.7).

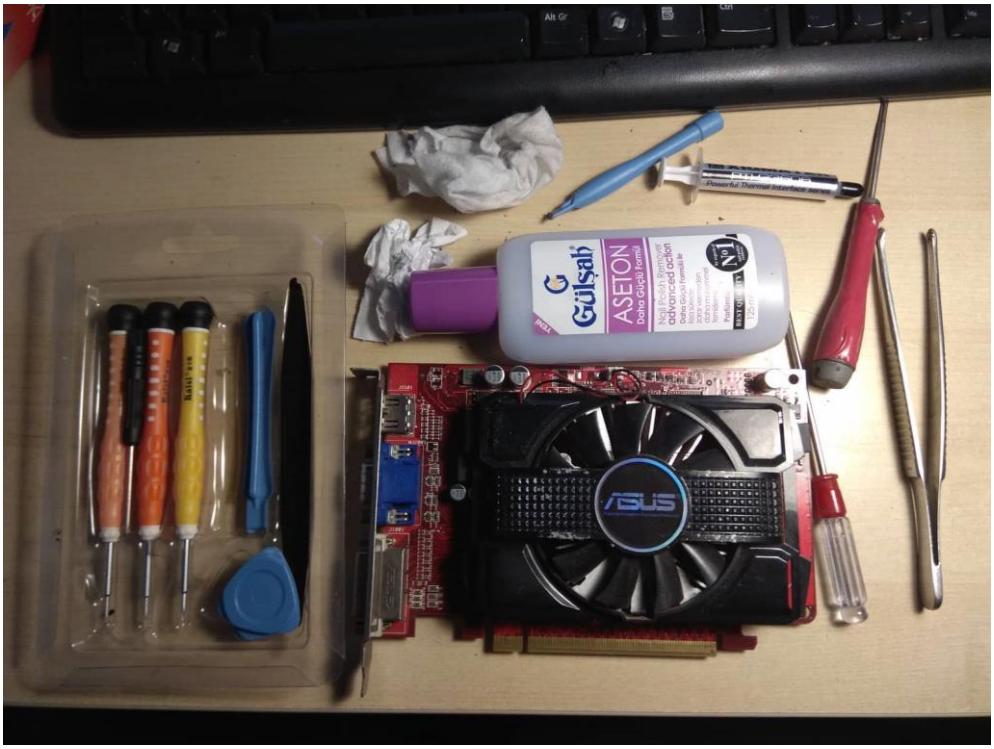


*Figure 4.6.* Example of the toolset of the amateur repairer


*Figure 4.7.* İsmet's tool box

Amateur computer repairers do not have a workshop for repairing. They use their living space as a temporary workshop. Most of the participants stated that they repair the computers on a desk (as seen in Figure 4.6), which is used for other purposes such as studying or using their computer. In other words, most participants do not have an organized space for repair, such as a workshop. For instance, Ozan described his working environment:

> I have got myself a table lamp to work. I have tools and toolbox to do repair, and all of them stand on the balcony. I clean, dissemble, and assemble the computers on my desk. Sometimes I need to be clean the dust, or I have to grease the fans I do this stuff on the desk in my studying room. [Ozan]

This account clearly states that this amateur repairer is using domestic spaces for repair tasks. The domestic space is not designed for repair tasks. This leads the participant's create temporary work settings. Even though there is no formal workshop, the participant purchased a lamp, tools, and a tool box for specific purposes related to repair. However, because of the temporariness of the equipment, the participant creates makeshift storage solutions. Having a formal work setting or not might be a critical distinction between amateur and professional repairer practice.

Another account provides insight into having a temporary work setting. Because most of the participants repair in their home, they do not have a permanent setting for repair activity (see Figure 4.9). For this reason, amateur repairers have to tidy up the setting. During the observation session, after İsmet completed the repair on the dinner table in the kitchen, his wife tidies up his tools, and she storages them in the shoe cabinet (see Figure 4.8). His wife and İsmet's dialogue showed she is unhappy because of the use of the kitchen as a workshop.

> *İsmet:* As you see, my wife has also learned how to braze and everything because I repair and she tidies everything up, you know. She isn't happy with my work in the kitchen.
> *His wife:* I mean I don't like it at all, find yourself another place.
> *İsmet:* We have been facing this kind of stuff, you know.

> *His* wife: There can be five maybe six computers in front of us with several parts. It's already a small kitchen. There is barely enough room for just me alone.

As this quote indicates, due to his repair process, kitchen usage becomes limited, which makes the co-habitant unhappy. Because the participant does not have a specific place for repairing, he is obligated to set up his repair setting temporarily.


*Figure 4.8.* Repair equipments and old computers in the shoe cabinet

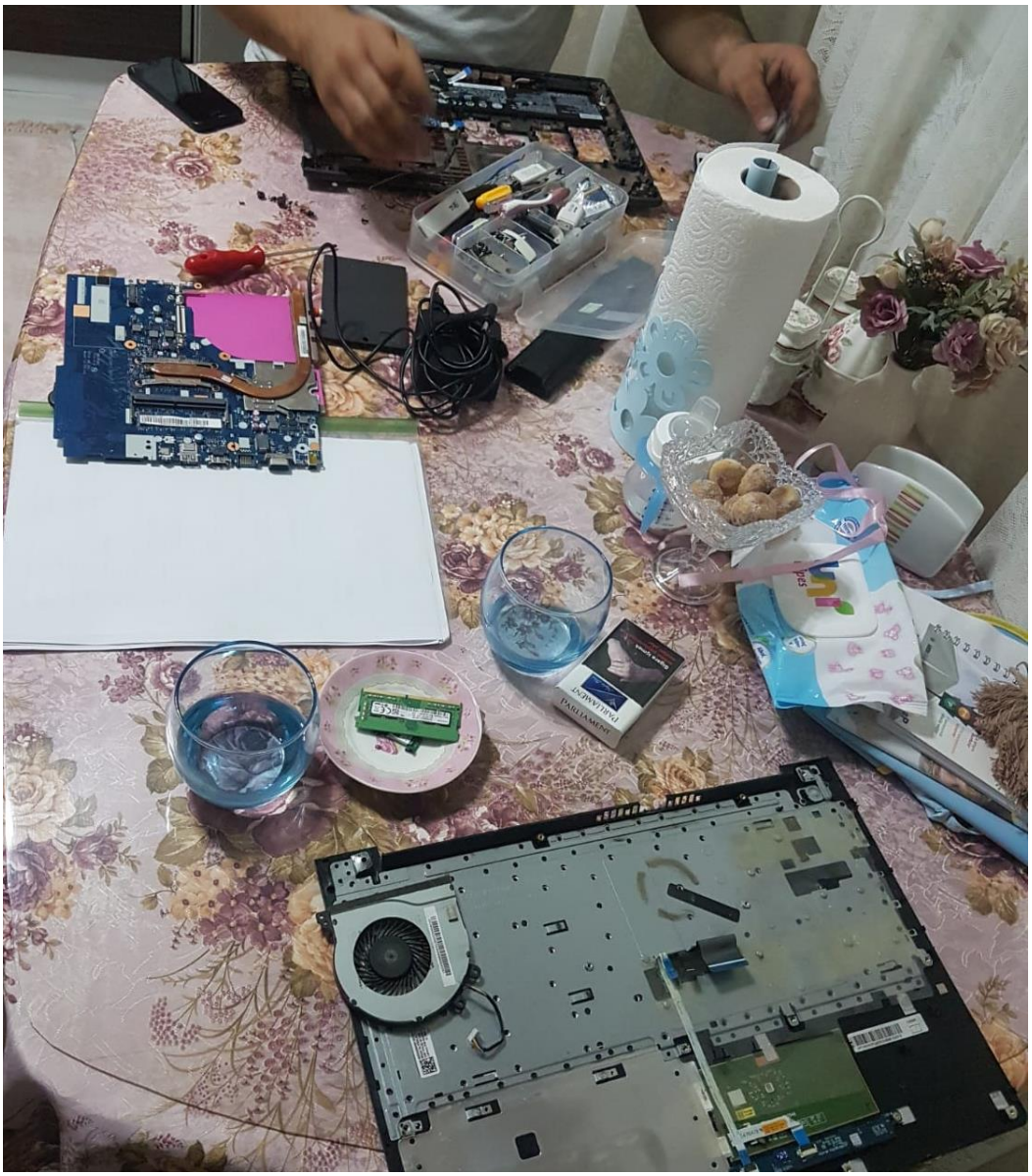

*Figure 4.9.* Example of a repair setting

Two of the participants were repairing in their workplace, contrary to most of the participants. They explained that their workspace, where is an internet cafe and a fab lab, is appropriate for doing repair tasks. It is convenient to work in the workplace rather than at home, because of the repair tools that are available in the work place. Hasan stated:

> I do it in the lab where I work. I rarely do it at home, lab has its own opportunities such as machine tools. Plus, since I spend most of my life in the lab, I mean, it is like working in a studio at METU, I am already there. Something comes up and you handle it there. You don't bring it to the lab specifically, because you live ninety percent of your life in the lab anyway, and it breaks down while you are there. [Hasan]

As seen in this example, Hasan prefers to repair in their workplace, in terms of repair tool availability. Furthermore, they spend most of their time in their work. Because of these two reasons, these participants have a chance to work in a particular place for the repair.

Compiled findings show that amateur computer repairers mostly do not use a specific space for repair tasks. Therefore, their setup has to be temporary. Accordingly, two criteria emerge from data that shows the difference between an amateur and professional repair practice. One is having a particular space for repair or not. While, professional repairers have a workshop, amateur repairers do not. That is why, amateur repair practice is an open practice for many people because it does not demand a professional setting. Further, the availability of the essential tools such as a screwdriver or solder democratizes the amateur repair practice. The specific aspect of the workshop is one of the characteristics of the repair practice. As I draw a general sketch of the amateur repairers' setting, it is quite different from a professional working setting. That aspect can be summarized as temporary settings, available tools, makeshift storage solutions, and sharing the space with co-habitants in the house.

### 4.1.8 Conclusion

This section presented the amateur computer repairer's statements, which are reported during the interviews and the observation sessions. The data is analyzed to explore amateur repair practice and its elements. Accordingly, it became possible to draw a general sketch of amateur computer repair practice in terms of its elements.

The elements of the repair practice are grouped into five sections, based on skill and abilities, perspective, identity, value and morality, and work settings of amateur computer repairers.

In the first place, amateur repair practice involves explicit and implicit knowledge. The practitioners know the safety precautions, how to mimic the repair tutorial, following the disassemby order of the computer and specific ways of handling specific components such as protecting from dust, sunlight, or shaking. Also, the practitioners control the speed of their body movements and the rhythms and use tools with sensitivity and precision. They have an expertise in interacting with the computer according to their implicit and the explicit knowledge, which make it possible to the practitioners to repair the computer.

In the second place, an amateur repair practitioner has practical and analytical skills. They undertake the responsibility of maintenance tasks of their computers. Further, they know how to interact with the tools and the materials. Then, their reasoning skills help them create creative solutions for their computers. Lastly, they can use the technical terminology that enables them to reach repair resources. These skills and abilities differentiate them from the average computer user who only uses their computer. In that sense, it might be possible to describe the amateur repairers as responsible users that are involved in the maintenance and repair of their computers.

In the third place, amateur repairers' perceptions of the computer are differentiated. According to them, laptop is not only one object, but it is an assemblage of the several objects such as components, screws, and a plastic case which are placed layer by layer. Furthermore, they can make assumptions about the solutions both on the level of component functions and level of the usage context. Then, "reverse engineering" thinking facilitates the amateur repair by doing imaginary production through thinking of production methods of the objects. Lastly, they can repurpose the components by finding new functions for them. In brief, the amateur repairer

perceives the object different from the users in terms of structure, production process, the functions of the objects.

In the fourth place, section 4.1.5 reveals that both participants' and their social circles' perceptions construct the identity of the amateur computer repairer. The participants see themselves as handy persons who can do what a computer repairman does and who is more expert on repairing the computers than computer engineers. As such, the amateur computer repairer is placed in the expert position without taking formal training. Therefore, people take their advice and ideas and let them disassemble their computers. On the other hand, section 4.1.6 indicates that the participants have several concerns as the amateur repairer itries to increase the performance of their computer, to spend a minimum amount of money by repairing their own computers, and not to be cheated by the technicians. These concerns would be identified as a typical computer consumer's concern. When the sections 4.1.5 and 4.1.5 are evaluated together, it is illuminated that amateur computer repairers have hybrid characters that include common characteristics of a consumer and a repairperson. Still, this hybrid character differentiates them from both of regular consumers and professional repairers.

In the sixth place, the setting is one of the characteristics in the amateur repair practice. The amateur computer repairer does not have a workshop but a temporary repair setting. Therefore, they use makeshift storage solutions for their tools and equipment. Furthermore, they use fundamental tools in general. They can also make a specific purchase for repairing activities. These specifications differentiate the amateur repairer from the professional repairman.

Finally, amateur repair practice does align with the theory of Shove et al. (2012) that practice would be characterized by its snapshots of competences, meanings, materials, and skills. Accordingly, amateur repair practice can be described through the knowledge, skills, perceptions, valued concepts, identity, tools, and settings of

the practitioners. The following chapter aims to explore the amateur repair practice process.

## 4.2 Process of Amateur Repair Practice

In order to understand amateur repair process, it is crucial to focus on not only actions made in the repair duration but also factors that transform the repair practice. For that reason, this section is organized under three subsections. Firstly, I briefly demonstrate prevalent repair steps and tactics, from detecting the malfunction to its solution. Second, I describe the learning process of amateur repairers by introducing their strategies and motivations. Lastly, I elaborate on disruption moments during the repair process. By doing that, I detail the amateur repair process extensively.

### 4.2.1 Amateur Repair Process: Steps and Tactics

During the interviews and think-aloud protocol sessions, I observed the amateur computer repair process. In this section, I will briefly introduce the main phases of the repair process. There are three main phases: diagnosis, assessment, implementation. For each step, I will present prevalent approaches among the participants.

#### 4.2.1.1 Diagnosis

In this part, I explain how the amateur repairer locates the malfunctioning component or the broken part of the component. In this phase, in order to diagnose the malfunctions, amateur repairers use various tactics. After the symptoms are collected, more than one malfunction scenario is created in order to detect the cause of failure based on the causality of the computer operating system. The amateur repairer thinks about a wide range of reasons that might cause the problem. Then, they create tentative malfunction scenarios. In other words, amateur repairers make

predictions and claims about the potential cause of failure in the scope of possible problem scenarios such as cause and effect relationship that I called as reasoning in section 4.1.5. In this stage, there are five prevalent diagnostic tactics that are used to understand how the failure occurs.

The first diagnostic tactic is collecting the symptoms. The understanding of the problem phase starts with collecting symptoms of the malfunction. In order to accurately portray the repair process, I drew a flowchart (see Figure 4.10) based on Kaan's acts during the think aloud protocol session. In this diagram, how a process is created can be seen according to specific symptoms.

As seen in Figure 4.10, amateur computer repair process depends on creating scenarios based on causality. After assessment process, repairer decides to implement a solution, then verifies it by trying. However, during the observation sessions, from time to time, the problem-solving phase did not go as planned. Some amateur repairers did not foresee the problems, which created other problems. Therefore, even if the amateur repair process based on assessment in the implementation phase, some of the decisions might change. This proves that amateur repair process emerges in situ, therewith it cannot be fully planned before implementation.

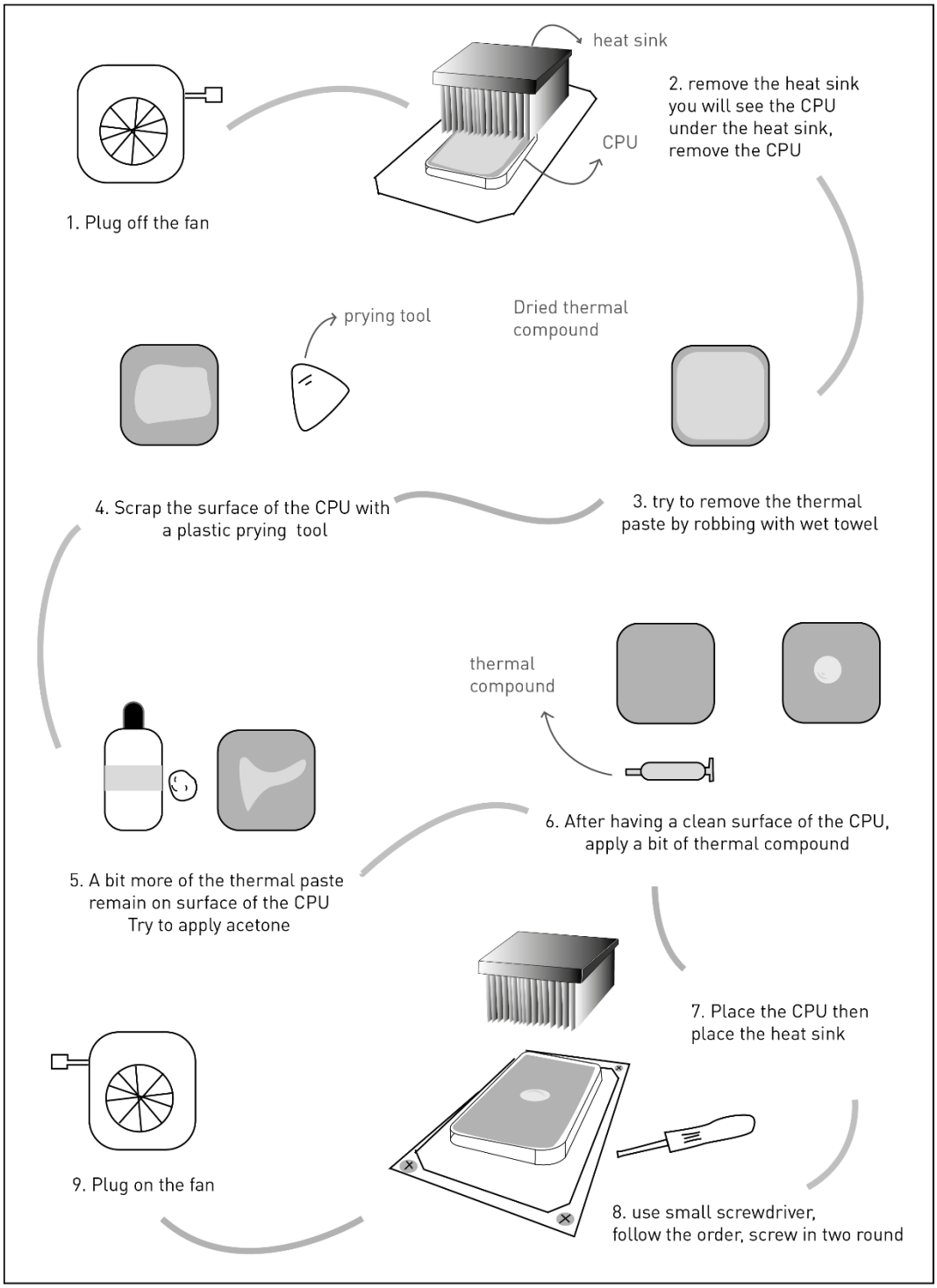


Figure 4.10. Example of think aloud process

The second diagnostic tactic is replacing each component individually with spares. It is a simple but effective tactic to detect the cause of failure. Berk described below how he managed to find the malfunctioning component:

> While repairing, I always had a properly working computer with me because when I was not able to diagnose which part was malfunctioning, I would try them on the working one you know. I kept doing it until I found the problematic part. [Berk]

This quote indicates that adopting primitive tactics such as replacing components with working ones, creates the possibility to fix complex products even for novice repairers. That's because, replacing components with substitutes helps narrow down the malfunction from whole computer infrastructure to a particular component. In other words, malfunction reason becomes simplified; therefore, amateur repairer can solve the failure without expertise on what each part does.

The third diagnostic tactic is looking for physical or sensorial clues in the infrastructure of the computer. After participants dismantle their computer, they look for sensory or physical clues on tips of computer cables as well as junctions of components and surface of the motherboard. Ozan gives details of how he looks for physical or sensorial clues (see 4.1.2) as following:

> If there is a problem in the motherboard, you take the motherboard in your hand, and look at the back of it under light; if it is necessary, you can smell it, if there is a burnt smell anywhere or something. Again, if it is necessary, you check it with your hand by moving it on the surface to see whether you can feel electricity or any changes or if there is a form deterioration. You can then search on the Internet when you find out the defective point. [Ozan]

Sensorial clues are the signifiers of the malfunctioning parts of the component. Particularly, visual clues address the problem of the component without disassembling the whole system. Also, how participants translate the visible problems into a proper problem statement before producing solutions is significant while searching for previous repair experiences.

The fourth tactic is understanding the problem via listening to the computer sound when it is turned on. Since each sound refers to a particular type of malfunction, most of the interviewees detect the problem through the alert sound. Oğuz affirmed that after he takes notes on the feedback sounds of the computer, he checks its meaning on the web.

> When it is opened, the case makes a sound. In fact, that sound tells all the errors to you. It informs you about the problem and demands repairing. I composed them for myself by researching. I even noted them on specific places with my hands so as not to lose them. I was checking which error causes this sound and then taking action according to it. [Oğuz]

As seen in this quote, the computer itself gives information via a particular sound regarding functioning status. The meaning of feedback that is gathered from online forums can reveal the reason for the malfunction. With this simple tactic, it becomes easy to understand the cause of failure.

The fifth tactic is measuring electricity transmission in the computer infrastructure. Hasan explained how he follows the path of electricity transmission by providing the electricity power to each component:

> If there's no signal, that's the fun part: you get a potentiometer and touch everything with these two ends. For example, you fold it to the charging adapter to find out whether there is current or the adapted block is burnt. If there is current, you cord it to the PC, there come the riskier parts because if you touch anything else you don't want to, you may cause a short circuit or screw it up in another way. After that, is there a current power flow through the motherboard or the power supply? If my computer never turns on, there is probably a problem with the processor already. You would check the processor, if there is no problem with the processor. Either it does not see anything in the operating system on the hard disk or there is a problem elsewhere. You check other things on the motherboard; you check the hard disk, whether there is current flowing through it. [Hasan]

As seen in the excerpts, the participant describes measuring the electricity as "fun". The reason for this might be a fact that there is no clue that signifies a malfunction. Therefore, finding the problem might be perceived as a game. Next, because there is

no clue about the risk if it is increasing, anything can happen anytime. That is why the risk management becomes more crucial in the cases where there is no trace. Lastly, the amateur repairer starts from a certain point, then goes deeper and deeper into risky territory. Because the participants know how a computer works, they are following an order of hierarchy of the problems (see sections 4.1.3 and 4.1.4).

In conclusion, all of the steps are used in order to understand the reasons for malfunctions and detect the malfunction type. The diagnostic tactics include primitive tactics that do not require advanced level of knowledge including collecting symptoms, replacing each component with spare, understanding the problem via listening to the computer sound. On the other hand, the rest of diagnostic tactics might require a particular knowledge or skills. For example, searching for physical or sensorial clues (see section 4.1.2) requires know the previous conditions of the components. The repairer should know the technical terminology to be able to translate the symptoms to visible problems. The repairer should make reasoning in order to collect the symptoms of the malfunction. Also, measuring electricity transmission requires knowing to use the potentiometer. After naming the problem, participants pass to the next phase, which I call “assessment.”

#### 4.2.1.2 Assessment

In this phase, amateur computer repairers make two types of assessments. First one happens when amateur repairers try to verify their claim about the cause of failure. This tactic is used for detecting or verifying if a component is the cause of failure. As Serkan asserted:

> Motherboard will be changed but you cannot say that the motherboard is broken directly to check the integrity of other parts. There may be a problem with the power supply, maybe one cable is working and the other is not. So you cut everything apart, you take out the motherboard, you try one by one. You take those RAMs and plug them into a working motherboard. If it is turned on, it means that the RAMs are working. If the RAM is installed, the computer remains on the start screen, it does not progress. [Serkan]

Replacement task is not a random procedure, rather it has an order. There is a hierarchy that amateur repairers follow while replacing components. To verify the problem, the participant should know how the computer would respond if a certain component is removed. After verification of the problem, a second assessment is made to decide which solutions are applicable. Participants search for the solution in terms of feasibility according to four criteria.

The first criterion is the easiness. The participant decides which solution is applicable easily. Ozan's excerpt indicates how he decides:

> Is this device something that can be replaced, for example? I mean, if your hard-disk has a problem, it is easier to replace the hard-disk with a new one instead of opening the old one up and striving with it. It is a little harder to repair the inside. [Ozan]

A second criterion is based on cost and performance comparisons. Participants decide whether the solution is affordable or worth the cost. Following example indicates that:

> Since replacing the power source is an expenditure for me, I started to look for the thing… how that thing in the SATA port located on the tip of the power source can be replaced; because I can't put a brand new power source just because of a problematic cable. [Ozan]

The third criterion is durability. Participants make inquiries about the longevity of the solution. Öykü's account demonstrates how she decides to buy a new computer fan.

> You know, actually, I did something like this: I tried several times to balance the fan to be able to place its fan block. I put a support in-between with the hope of its being fixed this way. It was constantly unbalancing itself. Then, I tried some other things and googled it also. Fan is something very cheap so, in the meantime, I searched its model. It was being sold for a little amount of money on AliExpress, I said to myself. Even if I repaired it, it would crash again in one or two weeks. Instead of doing it, I said, let's buy from AliExpress and try to assemble it. [Öykü]

The fourth criterion is measuring risk factors. Participants assess what type of risks occur if the solution is applied. For instance, buying second-hand hardware, repairing the motherboard, or soldering the components include various risks. Ozan's account indicates that:

> You need to solder on the back of the motherboard but nobody wants to take this risk because there are millimetric roads that connect to each other in there. [Ozan]

Shortly, in the assessment phase, participants make inquiries about possible bad scenarios of the solutions, and they decide which solution is more applicable. Furthermore, risk management and value become critical determinants in this phase. For example, participants' decisions are based on the values that are "performance for performance" or "performance for use" (see 4.1.6). The value and risk management skill of the participant (see section 4.2.3) have impact on which road they choose before implementation.

#### 4.2.1.3 Implementation

In this phase, participants apply the solution. The following long excerpt is valuable for portraying a whole repair process, including the implementation. Melih states how he solved his fan noise, which is one of the prevalent malfunctions in laptops.

> The copper area that transfers heat in the infrastructure of the computer can't emit the heat quickly enough because it is a narrow area and it is not a long canal. Also, the fan inside is a small one – they had put a fan that would turn at a higher speed. This increases the noise. Moreover, the air canal's not being decent causes a whistle-like sound constantly. I thought to myself: "What can I do? What can I do?" Now, the capacity of the slot is obvious so I can't put there a bigger fan. The thing is obvious: the electrical power… I can't increase it either. I need to enhance the air flow somehow. I also can't remove the comb that looks like a radiator from the air outlet because if I do, dust access becomes easier causing faster heating. So, I couldn't remove that comb. I removed that canal all together and broke the side walls of the fan increasing the area and leaving a place to secure the motor. It is going to work at the same electricity level but provide more air flow thanks to its larger area and bigger fan. When

> I broke the side walls around the fan, automatically, I had more space. Turning on the flight mode while doing minimal things such as using internet or Word and watching movies was'nt necessary anymore. I started to turn it on while playing a game and doing more serious jobs like running After Effect or Dream weaver. It was a good solution for me you know. It also makes one happy. [Melih]

In this long excerpt, there are five points that are worth mentioning. First the participant comments on the infrastructure design of the computer. By doing that, he locates the malfunction by predicating it on a cause and effect relationship. He points out the narrow air ducts and the size of the fan as the cause of the sound. In the second step, he assesses the different types of solutions by considering them according to the particular criteria of feasibility. He counts the long-term effects. He considers the whole working system and infrastructure design of the computer and he tries not to harm the general performance of the computer. In the third step, when he could not find a solution that is appropriate to the infrastructure design, he breaks the slot for. This shows that the amateur repairer might use a non- formal tactics to solve the problem. After this improvisational tactic, he gets a bigger space in the infrastructure. As a fourth step he finds a bigger fan that has compatible energy consumption with the rest of the system of the computer. In this step he uses the cause and effect relationship. In the fifth step he feels pleasure, because he gets a result that matches his values, which is "performance for use".

Taking pictures of the infrastructure of the computer is important before disassembling it. Most computers have complex infrastructures, thus, repairing them becomes troublesome. For example, Berk expresses that he copes with the complexity by shooting pictures of the infrastructure while disassembling the computer. When he fails, he glances at the photo to restore the infrastructure.

Amateur repairers use various one-of-a-kind improvisational tactics to solve computer malfunctions because of various reasons. Amateur repairers may need to find alternative ways due to the lack of a material, tool, or a component. Furthermore, improvisational solutions are created as low-cost alternatives way. As I discussed in

section 4.1.6, cost is an important issue for the participants. For example, İsmet try to fix the broken plastic case of the laptop by heating with a screwdriver (see Figure 4.11).

Figure 4.11.Fixing the broken plastic case of the laptop

Another example, during the interviews Cem narrates how he solved a problem by putting a beer lid into the computer. Although the graphic card was unstable since computer infrastructure was broken, he created an alternative solution to make it stable. Therefore, a quick and cheap result has emerged. Later on, Cem emphasizes that professional repairer would not solve this problem:

> Most people who would like to have it done somewhere else would probably have it made at exorbitant prices due to lack of knowledge, or the repairmen would say that this computer can no longer work, trying for it is useless and then turn it down. Actually, it's all about thinking hard about it, it's about wanting to do the job. I don't know if today's people don't want to do this job because they are occupied or because they don't like it, but they're doing some sloppy work. [Cem]

The cases given above might prove that improvisational tactics can solve the cases which cannot be repaired through more formal repair. In other words, amateur repairers have advantages with their improvisational tactics, whereas some of the cases are declined by the technicians because of warranty concerns or time concerns (see section 4.3.1).

Another improvisational tactic is that of heating the components. Oğuz mentions when his graphic card broke down, he searched for alternative solutions to solve his problem without buying a new graphic card. He encountered a comment which offered heating the graphic card in the oven. He trusted that comment and tried the recommendation. Oğuz states:

> The graphics card's circuits are likely to be burnt and there may be a problem caused by it. I threw the graphics card in the oven. You heat it at a 180 centigrade degree for five to ten minutes. Now, they have thin circuits. The solders are able to complete and run them very randomly, and so it happened. In other words, heated solders flowed and the graphics card I baked worked. [Oğuz]

This quote shows that participants solve their problems with one-of-a-kind solutions. It was not a sure solution for this problem; however, he took the risk and tried the alternative way without hesitation. As a matter of fact, if things went wrong, he would have bought a new graphic card. Therefore, the amateur repair is open to trying a tactic even if there is a low chance of success by calculating the risks (see section 4.2.3).

The other improvisational tactic is that of canalizing the electricity to ground with a copper cable. When Berk's computer did not turn on, he asked for advice from his acquaintances. He learned that accumulation of electricity on the computer case might cause this type of problem. Afterwards, he used a cable to discharge the electricity. Accordingly, he solved the problem without having technical knowledge on the subject, just by employing his acquaintance's recommendation.

Last but not least, an improvisational tactic is using alternative materials when there is material shortage. Serkan states as following:

> You lubricate the fan, for which I use sunflower oil. I think it works just fine. For example, you are in a student house, no thermal paste, what are you going to do? For example, you will use tooth paste [instead of thermal paste]. You need to find a way. [Serkan]

To sum up, the implementation process includes risk management, reasoning, emergent problems, and improvisational solutions. Therefore, amateur repair process as a situated process is based on planning the actions and verifying the decisions based on cause and effect relationship. Improvisational and non-formal repair tactics affect the forms and usage of the objects and they help overcome the technologic barriers. In the following chapters, examples are presented.

#### 4.2.1.4 The Objects After Repair

Alternative repair tactics can cause permanent alterations in some cases. In other words, the repair process might transform the usage or form of the computer permanently. One example from Berk illustrates that:

> The end of the cable can be broken. I was cutting the cable, and I was removing the jack. I was soldering that cable directly to the motherboard. I called it a flat contact. There was no problem, here you have a wired computer. You just can't cut it off from the charger. Most of my friends use their computers like that. [Berk]

Similarly, Melek mentions that their laptop's turn on-off button was broken. Later on, she and her husband created another solution to turn the laptop on by using only the cables. After fixing their computer, they have to use two cables to turn their laptops on. Her husband tells how they repaired the laptop with Melek.

> We opened the case and soldered that part directly to the place where the cables to which the disconnected part of the power input is connected, to the motherboard. The on-off key is the most interesting key. When you press it a

> little, it lights up green, when turned off, it turns yellow, then turns off completely. There is such an electronic part in it. There were 4 cable entries, but when that piece of cable fell off, cables broke of course. I found the two wires [that is turn the computer on and off] and cancelled the other two wires, the wires that light up. I attached extensions to both cables. [Melek]

As seen in both accounts, even if the computer's usage is affected permanently, the participants can still prefer these alternative ways to keep using their computers. Furthermore, not only the usage but also the shape of the computer can be transformed through these improvisational tactics. For instance, Melih had to place a new fan into his computer. In order to use the same computer case, he cut off a piece from it.

> Since replacing the case and buying a case with more fan inlets would be costly, we were instead installing separate fans, which cost five to ten liras, cutting out the case, creating new locations. [Melih]

This excerpt illustrates that participants prefer to transform their current computer for the sake of solving the malfunctions without spending money. On the other hand, Kaan prefers to transform the infrastructure of the computer by placing an extra component into computer infrastructure. He mentions that, while he was reviewing comments on the forums, he encountered that some of the amateur repairers advise putting an additional heat sink on the transistor for decreasing computer temperature. In brief, the characteristics or features of objects in terms of form and the usage might change after the repair process.

#### 4.2.1.5 Transgression of the Technologic Barriers

It was previously discussed that amateur computer repairers put great importance on the performance of their computers (see section 4.1.3). In order to increase their computer performance, some of the participants overcome the technologic constraints through repair practice (see section 4.2.2). In this part, I discuss the transgression of technological barriers through the repair practice a. Firstly, I will

mention the deleting operation, then I will present the overclock operation, followed by the jailbreak.

As the first example, increasing the capacity of a brand-new product is possible. Removing the thermal compound from the processor is called “deleting”. The deleting task is generally made to renew thermal compound on the processor. After removing the thermal paste, the repairer put a new thermal paste on the processor. Consequently, the laptop performs better because the high-quality thermal paste decreases the heat of the processor. Hasan explains this situation:

> When you get a processor, it comes with its standard sink. Sink consists of cooling block and fan but the paste that is used is generally not that high-quality. So, there is a process called “deleting”. You open the surface of the processor and cleanse it to use a high-quality paste. Then you close it and change the fan or etc., so that you can get a better performance. [Hasan]

This task is one of the maintenance tasks for an amateur repairer. As this quote shows, the participant mentions deleting the brand-new computers’ thermal compounds because his key argument is that it makes the product better than the factory. This application opens a discussion on the common belief that a new product always has a better quality than a repaired one.

As the second example, increasing the capacity of processors through overclocking operation is possible. Hasan claim that companies make optimizations on computers in order to create harmony between the operating systems of the components during the manufacturing phases. According to him, Consequently, the capacities of the hardware and software are constrained through optimization progress. Also, in this process, the computers are tested in various conditions for optimum configuration of the components. However, some of the users want to increase the performance of a component. The overclock operation is to increase the clock rate of processors and exceed the capacity of the computer. The following account mentions the overclock competitions.

> Of course, when increasing the performance of the processor at the highest level they can with their methods and in overclock competitions, the aim is not to work any program at all. The main goal is to get the performance of a specific processor at the possible highest level. Meanwhile the heat gets incredibly high. That's why they use pure water or nitrogen to cool down the device rather than air cooling systems of regular fans so as to balance the heat. [Melih]

The overclock operation creates a possibility to make changes in the capacity of processors. Therefore, it can be evaluated that the amateur repairers might overcome the technologic barriers through overclock operations. Moreover, jailbreak operation creates the possibility to make changes in the software. Generally, the jailbreak operation is made on phones. However, it is possible to jailbreak the computers.

> That's the way, right. When you do that this way, you start to be able to do everything you want. Most basically, if there are 4 levels of vibration on your phone, they limit the screen brightness at a specific level so that they can optimize the battery life of the device. Or else, the screen may be able to take more power. You can change these settings when you get into the BIOS of the phone. On computers, for example, you install any program, there's no problem with using an unlicensed program. [Hasan]

Besides, jailbreak imitation software is possible for the computers. As seen in the examples above, the overclock, the jailbreak or downloading an imitation program helps overcome the technological borders. In short, the capacity of the component can be increased by the amateur repairers, which distributes the authority to the user.

#### 4.2.1.6 Conclusion

Based on the data gathered from interviews, amateur repairers use several tactics to solve computer malfunctions. While some of them were formal repair practice tactics, such as replacing the hardware, taking computer infrastructure photos, and listening to the sensory feedback of the computer; others are improvisational tactics such as fixing with a cap, connecting with a cable to ground, putting the component in the oven, soldering the battery cable into the motherboard, cutting the case, putting

extra components into infrastructure, and using alternative materials. Most of the improvisational tactics derive from lack of supply, spare parts, or budget. To counter the deficiency, amateur repairers search for alternative solutions. Therefore, the creative form of repair occurs through improvisational tactics. Besides, it is possible to state that the nature of amateur repair practice is open to discovering new approaches. That is, most of the participants took the risk and tried questionable techniques without hesitation. Amateur repair tactics constitute characteristics of the amateur repair process. As such, amateur repair process distinguishes itself clearly from the professional repair process.

### 4.2.2 Learning Process of an Amateur Repairer Practice

Learning the repair practice requires a process like other practices. In the amateur repairer case, training progress has a significant role in defining amateur practice. Therefore, it is critical to understand the amateur repairers' training progress. In this part, I state the learning process of the participants. When I asked the participants how they started to repair, surprisingly, some of the participants narrated a story from their childhood. Therefore, I provide their beginning stories, learning strategies and motivations.

#### 4.2.2.1 Beginning to the Repair

Firstly, I introduce the childhood stories of the repairers, which is divided into two groups. One group took formal learning, while the others did not take any formal education. Most of the participants' learning process goes back to their childhood or primary school years. One reason is that, one group of amateur repairers associate their current interest in computers with their curiosity to open up products to see their interior mechanisms. Also, playing with mechanical components such as servo motors is indicated as a factor associated with their computer repair activities. A second factor is that, back in those days, computer laboratories had opened in

Turkish primary schools as an education strategy, and most of the schools had a computer teacher. Two participants who took formal education in primary schools pointed out the importance of having a computer laboratory in their school at the beginning of learning. In this case, the role of computer teachers in primary schools on the learning process of amateur repair is highlighted. For example, Melih's learning process of computer repair started in his primary school years in school computer laboratories. He was permitted to interact with broken-down computers in the laboratory. He emphasized that his teacher's guidance, in the beginning, was a critical factor for his learning process of computer repair.

> In the 6th grade, we started to take computer lessons. Our teachers taught us the parts of the computer. Graphics card, motherboard, processor, RAMs, Ethernet connection… They taught how to change parts, how to diagnose errors, how to set up a collaboration network on these computers. It was then that it started to attract me. Then, because the teacher noticed our interest, he directed us. How? You know, at the school, I set up a work network between computers, and at the same time, the teacher was calling us during the repair as I performed well on hardware parts. As I was looking at the pieces at school, I started to ask how they work. My teacher was very helpful. He gave various information such as what the working logic of the motherboard is, what the working logic of the processor is, what the working logic of the RAM is, how the image comes to the screen of the computer. We got this technical education. [Melih]

As seen in this quote, the participant acquired fundamental knowledge through formal education. During formal education, computer laboratories at the schools have a significant role, since there are broken computers and repair tools. Therefore, easy access to computers and tools enabled a suitable learning environment for students. As the participant told me, the computer laboratory was the starting point for Melih, who later kept on learning much more due to his curiosity and competence in comprehending issues related to computers.

Contrary to the two participants who had formal education in primary school, the majority of the participants interacted with a computer for the first time by themselves. Berk declares that when he opened a desktop for the first time, he

thought the infrastructure of the desktop was simple because there were not so many components. He stated that;

> It didn't seem like a very complicated thing to me. That's because there are not so many parts that you can disassemble. You have three or four, and after removing a part, you will not be able to attach it to another place. [Berk]

Contrary to the perception that computers are complex, for Berk it seemed simple as he could easily follow clues which are the physical signifiers. For example, different types of cables have particular jacks; accordingly, the participant could easily assemble the computer, because each cable could be plugged into one particular socket. Feeling the curiousity about the interior of a computer and courage to open a computer encouraged the participants for this process. Two following quotes illustrate the role of curiousity and courage through experimenting. For instance, Cem stated his curiosity made him disassemble his computer:

> Since my childhood, I grew up among computers while going to primary school. As a result, I developed a curiosity about computers. I broke a fully assembled device and dismantled it just because I was curious about its components. My computer shredding method developed like this. [Cem]

As this quote indicates, Cem used to experiment with the inside of the computer since he was a child. He emphasizes that he learned to disassemble the computer by practicing it. Similarly, when Berk needs to dismantle the notebooks, his courage motivated him. Following account indicates this:

> The only useable parts were RAMs and hard-disks in these small notebooks. Now, there are these portable hard disks. They work with USB when you insert a normal hard disk into a case and insert a circuit board into its head. I was buying hard disk cases for them. I was putting those hard disks in the cases and making portable hard disks. [Berk]

As the participant narrated that he already knows how to open the desktops and laptops, but notebooks were not familiar to him. He used his previous knowledge

while opening a notebook the first time. It revealed that participants' previous engagements with the desktops, facilitated the upcoming tasks.

While experimenting with the repair tasks, allocating a particular time for repair practice is a contributing factor for the participants' learning process. In the following example, Melih emphasized that he spends most of his time interacting with computers and hardware:

> I was spending all my time three or four times in a week. Particularly, weekdays I was spending my all time on this job. Sometimes in weekdays, because of my curiosity, night to morning, I mean, until going to school. Without sleep, constantly I was spending my time. It was a regular job for me.

The participant spends a particular time with the repair activities. He allocated most of his time to the disassembling and assembling his and other people's computers. This is an evidence that participants are really keen on the repair activities.

Checking the documentation that are related to the computer supports the learning process. When Öykü was engaged with the interior of a laptop, she stated that the structure was more straightforward than she had imagined. She first wanted to replace her laptop's RAMs in order to increase its performance but did not know how to do it. Then, she found an infrastructure plan of her computer while searching for the methods for replacing components. By using the infrastructure layout of her computer, she could recognize the components in her laptop. That was how she learned the functioning mechanism of her laptop. Öykü explains it as it follows:

> They drew the infrastructure diagram of the computer. For example, the CPU is next to graphic card, that's why it heats up too much and constantly turns off. You cannot reach full efficiency. When read the information about the computer and saw the diagrams, I said, let me see how it was on my computer. I turned on the computer and looked at it and thought, "Oh yes, the placement of the components in my device is like this and because of it the malfunction is not getting fixed." I was in a situation like this: "Huh, so this is what they call CPU. Yes, there is no such graphics thing in these." Because I was a little bit interested, I noted the codes on them and searched

> for their meanings and the reason of their existence on Google. Out of curiosity. [Öykü]

The example given above demonstrates that the participant benefitted from both having the technical drawings of computer layout and interacting with the tangible components. Therefore, the participant started to solve the problems of their computers on their own by discovering its way of working through interacting with the computer.

To sum up, various methods are used at the beginning of the learning process of how to repair. While Melih got help from his computer teacher, Berk and Öykü comprehended the functioning mechanisms of computers by experimenting with repair. Another participant whose learning process was based on exploration, Hasan described the learning process of repair as a "trial and error process." As seen in this definition, regardless of whether the participants took formal computer education in primary school or not, all learned how to repair a computer by adopting exploratory approaches.

#### 4.2.2.2 Exploratory Approaches and Motivations

In this process, two main aspects occurred during the learning process of repair practices. First is doing experimentation, second is mimicking other repairers through reading forums and watching videos. Next, I illustrate these two main approaches. Firstly, I provide motivations and experimentations. Then I give examples of online learning that are based mimicking other repairers and following instructions.

Almost all participants were experimenting in order to understand the computer's operating system. Understanding the computer's infrastructure is critical for an amateur computer repairer. As declared above, making experiments to comprehend the computer's operating system is shared among the participants. However, some

of the participants went further in experimenting. In other words, these participants were aiming to test their computers by changing their circumstances rather than aiming to comprehend fundamental knowledge of computers. For example, Kaan said he tried different materials to test the performance of the processors.

> It was very complicated for people to understand computer technology. Then, we started to do some little experiments on it. Someone had a thermal paste. When there was no thermal paste between something, we started to try some hearsay tactics such as using creams and somethings like that. In those times, there was not that much opportunity anyway. There was this Vatan Computer, which was too far away. We said, let's apply moisturizing cream and see what will happen. [Kaan]

As seen in this example, the participant tried hand moisturizer instead of a thermal paste in order to test how different materials work for the computer. Therefore, it reveals that amateur repairers are testing their computers to see what will happen to their computer when they change the components. That is to say, they aim to learn how their computer will be affected by their interpretation. Similarly, Oğuz narrated that he and his friends were taking off the computer components to see how a lack of component will affect the operating system so that he could analyze the function of components.

> We did things with the of trial and error method. You know, we were taking out the components. What does it do? What will happen if we didn't have this? What sounds does it make? [Oğuz]

Furthermore, one participant transformed his computer into a laboratory. He emphasized that he was continually making experiments; therefore, his computer case was not assembled and left open:

> At that time, I was using my computer like a lab. I was regularly removing the parts. I was cleaning it myself. We were also maintaining our computers ourselves. At the same time, I was doing the software work I could do with those hardwares myself. I started watching movies from a computer at the university because my case was always open. I would take it off and put it in another piece. Increasing its performance was the main aim. When you are at home, by trying it yourself, you see that the risk belongs to you. For

> example, you take a device that operates with 2 gigahertz to 2.30 gigahertz, while the machine was not exceeding 36 degrees before, it catches 40 degrees with 0.5 gigahertz increase. [Melih]

As seen in this excerpt, Melih's main motivation was to increase the capacity of his computer. He was learning the specifications of components by testing them. Contrary to using the computer as a mediator for ordinary tasks such as watching movies, he was interested in the way the computer components work. Moreover, Kaan, Oğuz and Melih's statements showed that they were experimenting in order to learn more details of how a computer function. The participants aspire to increase the performance of the computer without any particular reason; hence high-performance computers are more valued among amateur computer repairers. Previously I called this "performance for performance" (see section 4.1.6.)

Besides personal achievements such as experimenting and practicing, cumulative amateur repair knowledge is important. In other words, repair knowledge is accumulated by professional and amateur repairers on online platforms. Therefore, learning from others' experience through online learning is essential for amateur repairers.

Online learning includes mimicking other repairers by reading forums, watching videos on the internet. To illustrate, Ozan opened his computer for the first time by reading comments on forums and watching videos on the internet. The following quote exhibits his experience:

> In order to be able to do crypto mining, I had to buy various graphics cards and I bought three graphics cards. I have always learned which part was installed where or how the pins on the motherboard should be by searching and reading on the internet. So, you don't even know the names of the cables. I learned their names on the internet by typing in English and searching for "bla bla cable". Then I learned how to make connections like how to read, where to install, how many watts it needs. [Ozan]

This example shows that the participant has learned both technical information and hands-on practice while mimicking other repairers. Hands-on practice requires the repairer to comprehend the implicit rules of computer repair practice (see section 4.1.2.). Further, learning by watching other repairer refers to the notion of community of learning, which will be briefly discussed in section 4.2.3.

As proven with examples, mimicking is the most effective way to learn how to repair a computer. Again, Kaan's account clearly stated the importance of learning from others' experiences by mimicking their process. Also, he mentioned that sharing knowledge is what humans have always done.

> In fact, everything is based on mimicking. The repair process should be the same, especially if you are making the same product. In other words, if you are not going to make any improvements and if you can't apply something that you have done in this way before, it goes like this: you have to mimic the same order not to mess up. Because the video you watch or the forum you read shows a story of success or failure. If there is not enough information, you should go that way and improvise. So I completely mimic what I watch. It's actually a very simple thing, which points out something very humane. Sharing knowledge or learning continues throughout human history. [Kaan]

By elaborating on all findings, the learning process of the amateur repair process is portrayed. Compiled findings show that most of the amateur repairers learned repair by practicing it themselves. Although some of them took formal education at the primary level, the majority get help from amateur repairer communities through online resources during the learning process. The participants often used forums and other online resources. Also, they get help from their acquaintances, friends and sometimes from a person in their neighborhood. In order to learn how to repair a computer, most of the interviewees adopt the method of first searching on the internet about the reasons for malfunctions of the computer, then finding the solution. It is a prominent result that these participants generally start to do research when they have a computer problem. Participants are mostly focused on solving the problems that occurred at the moment. Accordingly, two particular groups emerge based on their learning approaches. While one group was mostly doing experiments to learn more

about the computer, the other group learned how to repair in order to use their computer again. While mimicking other repairers' approach is used on malfunctioning computers, experimental approach is used with fully-functioning computers. Hence, the distinction between the two approaches plays a vital role in determining the value of amateur repair practice. Accordingly, different learning motivations affect amateur repairers' learning progress. Previously, I called this "performance for usage" (see section 4.1.6). The distinction between "performance for performance" and "performance for usage" roughly corresponds to the two approaches: experimenting and mimicking. As it is seen in the first group, they are more open to learning and experimenting, the second group is more interested in mimicking rather than experimenting. Therefore, I grouped the data under the subject of experimenting and mimicking to indicate the different learning approaches. Although I made this separation, it does not mean the learning process is strictly divided into two. Both experimenting and mimicking are entangled during the learning process.

### 4.2.3 Disruption of the Amateur Repair Process

In previous parts, principal steps and aspects of the amateur repair process are presented. These aspects have positive effects on the amateur repair process. However, concerns, access problems, or limitations of practitioners might interrupt the amateur repair process. Just as these factors cause interruptions throughout the computer repair process, the interruptions also shape the repair practice. With the purpose of explaining the factors that cause disruptions and how these disruptions affect the amateur repair process, concerns, access problems, and limitations of amateur repairers are going to be presented. In this part, I discuss the participants' perception of risk and their limitations of skills and knowledge. Then, I focus on issues of cost and access to tools and components. Lastly, I reflect on warranty specifications.

The first factor which causes considerable disruptions to the amateur repair process is the participants' perceptions of risk. One of these concerns is the fear of damaging the computer. For instance, Melek stated that she hesitated to disassemble her laptop after she poured the liquid on the computer's keyboard. She explained how her fear affects her repair process as follows:

> Of course, I was afraid; I wasn't as brave with computers like I was repairing my iron. I was afraid because assembling details are so fragile and delicate. Which one to move, where to start, If it's irremediable or not? But I am curious. When you disassemble all the layers of the body, you can reach the buttons at the bottom. I was happy when I reached it. [Melek]

As referred to in the quotation, computer repair is a delicate task because of the connections or electronics of the computer hardware as in the slightest harsh movement, they can quickly become dysfunctional. So, the participant hesitates while repairing the computer. However, avoiding the risk results in the satisfaction that comes from achieving a risky task as I discussed how the participants minimize risk by learning the explicit rules (see section 4.1.1.) and the implicit rules to interact with the components. Since amateur practice involves potential risks, calculating the risk is a critical issue. Even the prior experiences that are shared in online forums (see section 4.3.1) help to calculate the risks beforehand, the participant deal with managing risk throughout each repair process.

Although the worries for calculating the risk of damaging the computer are widely seen at the beginning of the amateur computer repair practice, it is not mentioned by participants who are at a further level on the practice. However, in some cases, even a practitioner who is at an expert level might hesitate to take responsibility for potential risks. For instance, Berk points out that he hesitated while he was helping other people to repair their computers. His excerpts indicate that:

> When I am to work on [my own computer], I can act more bravely. That's because I used to think that it is mine even if it's broken. But when it's another person's, I used to act kind of a bit more delicate. I disassemble my computer in a quick way because I used to do so. But I wouldn't do that in

> case I might have broken another part. That's why repairing someone else's computer used to take longer. [Berk]

Both accounts show that the repair process is blocked by participants' fear of damaging the computer. In addition to these accounts, previously discussed argument that courage being among most participants' motivations (see section 4.2.4) at the beginning of doing repair activities supports that once participants overcome this fear, they become more comfortable doing repair activities.

Besides, the computer itself increases the risks. As quoted in 4.1.2, disassembling the desktop is not equivalent to disassembling a laptop. On the material level, some parts of the laptops are highly fragile, and it is quite risky to interact with these parts. Oğuz's words also support that assembling laptops are particularly more challenging.

> Also, motherboards in laptops are hidden underneath the keyboard. People are afraid of breaking the body for it is not easy to open the motherboard. You need to apply a sort of power to disassemble it and when you do that there comes crackle sounds. You say "Oh my God! I broke it!" You feel like some parts are torn away inside. It is what it is. People hesitate to do something for its fragility**.** [Oğuz]

As seen in this excerpt, the feedbacks that occur in the moment of interaction with the material is critical for the practitioner. In this case, the sounds of breaking make the user nervous during the disassembly process of the laptop. It might be evaluated that laptops are not designed for encouraging users to repair them. Also, in this case, it is not merely the participants' perceptions of risk that hinder the process, but the material qualities of the product that is being repaired. Accordingly, the infrastructure design of the laptop makes the disassembly phase more difficult and riskier.

The second constraint is the practitioner's limitation of skills and knowledge. Since the participants can interfere with the components up to a particular limit, the repair

process might be disrupted at certain points, that dependings on the participants' skills and knowledge. Berk asserts that he can repair up to a certain point as follows:

> Okay, you assemble the processor and you have something like this: your other hardware is working well. You bought a sturdy graphic card. To be able to use these hardwares, you need a motherboard compatible with them. Those motherboards are also produced with hardware. In fact, they're all separate things. The more important the motherboard is, the more important the other is. The graphic card is also a circuit. If there is a problem with the graphic card itself, I cannot solve it either. Because I don't understand the logic of the circuits on it. What I can do most is to check if there is a problem with the capacitors, if there is a problem with the fan on it, or if there is a burn. If there was a problem with the motherboard itself, I mostly couldn't fix it too. [Berk]

As seen in this quote, even a participant who has comprehensive knowledge at an expert level might not be able to handle the issues such as electronic circuits. Further, how the components are produced limits the ability to replace the electronic circuits. An example is the graphic cards that are integrated into motherboards. It is not possible to repair them because of the limitation of electronic knowledge, and it is not possible to replace the broken part because of the subcomponents' integration. Another limitation is not having comprehensive repair knowledge and skills. In this study, all of the participants are amateurs; they have repair knowledge to a certain point. To be able to comprehend advanced repair knowledge, professional education is required.

> From the forums, you get enough information at least to satisfy your simple logic and curiosity. After a point, you start to look more confused because your curiosity's capacity has been passed. After a while, you come to a point which you look at it and not processing anymore and that is the time when you give up and skip. [Hasan]

The issues of cost and access to tools and spare parts disrupt the amateur repair process. When the participants do not buy the high-priced spare parts, the repair process is not completed. In some cases, it is preferred to buy a new computer instead

of repairing the computer by replacing a spare part. The decision of whether to repair or not can depend on the cost of the spare part. That is why cost concern has a disruptive influence on the amateur repair process (see section 4.2.1). The following example from Berk is illustrative:

> It was mostly like this: I completely solved the problem, but I didn't have the necessary part and I didn't want to buy it either. I probably thought it wasn't worth it. [Berk]

Besides risks and spare part costs, another factor that disrupts the repair process is the access problem. Amateur repairers have disadvantages in accessing spare parts of components when compared to professional technicians. While professional repairers have many opportunities to have particular components due to bulk purchases as corporations, amateur repairers mostly access only prevalent components. Ozan's statements indicate that:

> Let us say a piece of your motherboard has burned. Let's say the sound card has burned. Now, while you are buying that motherboard, they market the motherboard to you as follows: 7 plus comes with a superior 0 second delay sound card. If you burned the transistors in it, you would not be able to find a new one after you solder them out because they do not sell its new versions. Well, if you find another motherboard, second hand, then why did you buy that motherboard, if it will not have the voice recording feature in it? It would already lose its feature. [Ozan]

As the participant explained, it is not possible to buy certain components as an individual. Accordingly, the repair process is interrupted. Further analysis of the differences between being a technician at a company and being an amateur repairer is presented in the next chapter (see section 4.3.1.1)

Since participants use principal repair tools in amateur settings (see section 4.1.7), the lack of particular professional tools can isrupts the amateur repairer process. Cem further asserts that sometimes he cannot repair a computer's malfunction due to a lack of professional tools, although he has the ability to repair it. The following account indicates this.

> Usually [I borrow the tools] from friends and relatives. Since, I do this job in my own home, this kind of machine usually comes from my friends and relatives. Because I don't have some machines at hand, I have to turn down many bad computers brought to me. In fact, I do turn them down not because I don't have the skill, but because I don't always have the necessary equipment, so I refuse it or I suggest another place. [Cem]

Access to professional repair tools shows the differences between being an amateur and being a professional. Although the amateur repairers might partially overcome this limitation by sharing the tools (see section 4.3.2.1.), most of the professional machines are available in professional workshops. For instance, Ülkü claimed that she would try to open her laptop to repair it if she had a particular type of screwdriver.

> Theese [laptops] do not have standart screews. In my home, I do not have a screwdriver that can open these screws. [Ülkü]

As seen in this excerpt, besides the lack of tools, the manufacturer's use of non-standardized screws prevents access. Furthermore, during the observation session, Cem highlighted that computer infrastructures vary from company to company.
It might be evaluated that (see Ülkü's and Oğuz's quotation) laptops are not manufactured as repair friendly.

The last factor that disrupts the repair process is warranty specifications. The warranty specifications refer to the list of specifications that are required to get free technical support for a particular period. However, these specifications are not valid if the computers have been dismantled by anyone other than the authorized technicians of the company. By doing that, companies keep their customers away from their computers. The following excerpt presents that warranty specifications stop the participant from repairing their computer.

> In fact, I would open it and do the same job if it wasn't for the warranty service. I would probably check their capacitors. After that, I would handle the transistor cooling job I've seen before and try warranty service again. But then, [the technical service] changed the monitor so I didn't have to open it up. [Kaan]

The participants avoid repairing their computers in order to keep their warranty even when they are able to do so. In addition, many of the participants stated that they do not open their computers even if they could handle the problem. Therefore the warranty specifications of computer companies disrupt the repair process.

The presented excerpts illustrate insights about the disruptions in the amateur computer repair process. While some of the disruptions are due to participants' limitations or perceptions, such as participants' risk perceptions, limitation of skills and knowledge, other factors are designed into the system, such as snap-fit connections for laptops, non-standardized screws, integrated parts and warranty specifications. Furthermore, if the amateur repairers do not have access to components and tools, it causes inevitable disruption in the amateur repair process.
As a conclusion, the amateur repair process is shaped by the disruptions: (1) The participants deal with the factors that lead the disruptions through social cooperating as component and tool exchanges. (2) The participants developed strategies to snap-fit connections by learning risk management, learning from others' experiences, such as example by watching repair videos that warn the practitioners about how to handle as fragile snap fits of a laptop.

### 4.2.4 Conclusion

In this second part of the findings I elaborated on firstly the repair process of amateur computer repairers; secondly, learning process; and thirdly, disruptions that occurs in the repair process.

Firstly, it is revealed that amateur repair practice is divided ito three phases of diagnosis, assesment and implementation. During theese, phases amateur repairer uses improvisational tactics. Therefore, after repair, the object might be transformed in terms of form, usage, function and performance; so that amateur repair practice

creates a space for creativity. It is also observed that amateur repair practice has iterative and proccessual characteristics.

Secondly, the compiled data shows that amateur repair practice is expanded through the learning process. Experimenting and mimicking are two main strategies in the learning process. Generally, both approaches are combined through learning process.

Thirdly, disruptions are critical moments in the amateur repair process. The factors that lead to disruptions in amateur repair process can be listed as risk management, the limitation of the skills, and material limitations.

In the next chapter I will discuss the larger network of amateur repair.

## 4.3 Networks

In this part, I introduce the networks in which the repair practice has strong interactions under three headings: consumption networks, social networks, and technology networks.

### 4.3.1 Production Network

The prevalent idea is that repair practice decreases the consumption; however, it also increases consumption by creating commercial value in the particular market of computers and its components, increasing the sales of repair tools and materials. The production network also includes trade, exchanging good and information. On the other hand, the computer is an industrial product; it is a part of a production network. In order to understand the repair practice comprehensively, in this part, I review how the production networks affect the repair practice. In this part, I introduce spare part sales, warranty services of computer companies, and transformation of the technology.

Firstly, spare part sales have great importance in terms of access to components in the repair process, as I discussed in section 4.2.5. There are many channels, such as online websites, technology markets, and flea markets, to buy brand new or second-hand spare parts. Although prevalent electronic materials in these markets are easily accessible from these various channels, finding particular and less-demanded electronic materials is challenging. Hasan's excerpt indicates that:

> *[A component] may not be widespread in such places. Standart components that usually used in most of the projects or the ones used explicitly by manufacturers can be found. For example, a 220 ohms resistor is generally used to light the LED, so they can be found everywhere, or there are ten thousand potentiometers or something. There are so many of them, but there are not many versions in-between. Even if there are some, the seller doesn't have them in hand. In this case, you cannot go and order one from China because they usually send ten thousand of that things. You don't want to go into that business, either. You want to give up or look for a new component directly. You want to get rid of it eventually. [Hasan]*

As seen in this excerpt, being an individual customer or a wholesaler changes the shopping process. While a wholesaler easily accesses particular electronic materials, the amateur repairer might not buy the minimum amount of electronic materials. Besides, the considerable difficulty in getting the necessary and particular electronic materials might cause replacing the brokendown component instead of changing the electronic subcomponents of the component.

Small companies have a critical role in spare part sales so that they have a mediator role between the producer company and individual customers. As Gürkan works in a professional repair company, his insights about the wholesale process illuminates the other side of the consumption network. Gürkan's explanation about how they are having the spare part as a repair company as follows:

> There are only 3 or 4 wholesale parts suppliers. Arena, Penta Bilgisayar, Idex, and Armada are the four leading distributors in Turkey, but Arena and Penta are the two biggest suppliers to buy parts from. There is a portal called business to bussiness. They work with open accounts like an e-trade web site. You add the product you want to your cart, and it in 3 weeks is delivered to you. You

> can buy with payment at the door option. You need to be a firm to do that. [Gürkan]

As a company, it is possible to buy various spare parts from different distributors. However, an amateur repairer cannot get involved in such spare part networks to reach a particular component. Moreover, Gürkan points out that technology markets do not sell particular parts of the components. For example, it is hardly possible to buy OEM parts, which refer to parts produced by a different company from the technology market. Gürkan explained how he ordered the OEM parts via distributors:

> Some OEM parts are not sold at [electronic retailer markets], etc. You can't find the OEM you want there. You know the most extreme part they sell RAM or a graphics card. There may not be stock of the product in Turkey, but nVIDIA [a producer of graphic processing units has a distributor. The distributor of GIGABYTE and ASUS is again Arena [a distributor company in Turkey]. Products are brought to Turkey via these distributors. You can't buy these products directly from the distributors as an individual customer; you need to purchase them on behalf of a company. [Gürkan]

He stated that the producer companies give the products to the distributors. They sell them to the wholesaler, and then the wholesaler sells them to the individual customers. For the amateur repairer, it is very challenging to access OEM products required to repair a component.

On the other hand, amateur repairers find different ways to get involved in spare part networks. During the observation session, İsmet told me that he built a friendship with wholesalers by dialing them frequently. Hence, he can buy components by using his personal connections. Furthermore, Ozan stated that he purchases the imitations of spare parts from importers from China, such as AliExpress.

> I ordered a battery compatible with the device at my hand, and I got both the battery and the fan from a Turkish company. I wasn't able to find the fan in Turkey and got it from AliExpress [Ozan]

As seen in two excerpts, participants create alternative ways to reach components. While one of them uses his personal relationships, the other purchases components from the global market. Besides the brand-new components, the trade of second-

hand components is a choice for amateur repairers. For example, Cem states that he finds several second-hand components in the flea markets as follow:

> I usually look for used spare parts from websites. There are treasures, even in the flea market. You can find the parts you cannot find outside normally. In the places where there are scraps, you can find scarce parts for a little amount of money. [Cem]

According to the participant, the components that are out of the product cycle can be found in flea markets, which creates a possibility for recycling these old products.
To sum up, even if getting the common components are easy, amateur repairers face with the difficulty while finding the subcomponents, non-standard spare parts, and old model spare parts difficulty. To cope with this difficulty, participants have access to the parts through their personal connections, global suppliers, and the flea markets.

Secondly, warranty services of computer companies have decisive role. Many global manufacturers in the world produce laptops and desktops. The computer companies are the significant actors of the consumption network. Besides the computer producer, they have responsibility for the maintenance of computers. Therefore, most of the companies have technical support services for their customers. The technical services provide a free repair service, replacement of the hardware, and replacement of the computer with a new one. Melek stated that the service guides the user and helps them to overcome the difficulties they face.

> The service is more educated, conscious, and more knowledgeable about the procedure. They know what information to give to the user, and they can understand and answer the questions I ask without tinkering around with them. They can say yes or no in certainty. Then they inform you about things like possible malfunctions during use. [Melek]

As I discussed in section 4.2.5, participants do not want to lose their right to use free service in case they encounter expensive malfunctions. Therefore, the warranty system has a decisive role in repair practice.

Further, warranty concerns also affect the technicians in terms of component replacements. Ozan highlighted that repairer does not take risks as follows:

> If you take it to the authorized service, they say "Sorry, there is nothing we can do, even though your motherboard has been repaired, it is now garbage." [Ozan]

According to participants, it is hard to find a technician who agrees to repair the component rather than replacing it with the new component. This situation cause increases the consumption. (see Ozan's quotation in section 4.1.5)

Thirdly, transformation of the technology has a critical effect on the whole system. The transformation of technology causes significant changes in computer hardware so that the repair practice is directly affected by these developments. For instance, the design of the computer infrastructure or the production methods of the computer can change. Consequently, the dismantling phase of the computer can also change. While these changes in technology offer new possibilities for repair activities, at the same time, they might limit the amateur repairer.

With the transformation of technology, disassembling or assembling hardware has become a simple task as Melih stated as follows:

> In those days, it was difficult to disassemble the parts on the computer, including the motherboard itself. These things are more portable now, you know, they are easier to open and close. What was it called? They are easy to disassemble; they were not like this then. [Melih]

The participant narrated that after technological developments, replacing a broken-down component with the new one becomes an uncomplicated task in desktop computers, participants. On the other hands, this is not valid for laptops. Melih states that:

> It is much easier to change and level up the hardware in the cases. You can disassemble an old piece and replace it with the more advanced part. They have

> a supported range of shares. The energy capacity of your power supply comes into play here. If the part you just installed consumes more electricity than the part you installed, you can solve it by changing the power supply. But this is not the case with laptops. Laptops cannot be replaced with a more advanced part; the same part has to be equivalent to the old one because the energy balance inside must be maintained. [Melih]

In conclusion, technological changes transformed the infrastructure. Some computer parts become more complex and compact that might cause difficulty in the assemblage phase. On the contrary, some other products transform in a way that makes easy disassemble and assemble the components.

As a conclusion, the production network is portrayed based on the spare part sales networks, warranty services, and transformation of the technology. In this network, the actors can be list as the computer companies, the subcomponent manufacturer, technology markets, wholesalers and influencers. These actors have an impact on the amateur repair practice. First, even though the technology market is selling the components, accesing some non-standard components might be difficult for an amateur repairer. Participants deal with this through their personal relations with the wholesaler, global online markets, and flea markets. Second, warranty services affecs the repair activity in a two way; prevent the consumer and the professional technician from repairing. Lastly, the technological change either cause hardship on assembling the computer or make a product more accessible for upgrade and easy disassemble.

Accordingly, the production network around the repair practice both disrupt and motivate the amateur repair practice. Next, the social network that has a strong correlation with repair practice is presented.

### 4.3.2 Social Network

In the field study, I observed that a particular social network is organized around the computer repair practice. In fact, the repair practice and the social network have a reciprocal influence on each other. Previous sections (sections 4.1 and 4.2) illuminated that repair practice has a social compound. In this part, I explain how social networks influence repair practice. While doing that, I introduce, firstly, the social network organized around the repair practice. I called that a repair community. Then I introduce how the social relations outside repair communities influence the repair activities.

#### 4.3.2.1 Online and Offline Repair Communities

I call the social network organized around the repair practice a "repair community." For the amateur repairers, repair communities are significant social compounds that transmit the repair knowledge. The information that is related to technology, computer components and repair experiences are shared among the members of repair communities. As I discussed earlier in section 4.2.3, most of the amateur repairers learn to the repair owing to the online and offline communities. While sharing knowledge, the members of the community contribute to the development of amateur repair practice by spreading it. The repair community is comprised of both the members who see each other in their daily life and members who do not know each other. Therefore, it is observed that the repair communities are divided into two, as online and offline communities. In this part, I explain the role of online and offline communities.

Offline repair communities are mainly comprised of people who know each other such as friends, neighbors, and technicians in the neighborhood. Since their common interest is in computers, helping and learning from each other and exchange of tools and components are prevalent behaviors in offline repair communities. Most of the

participants mentioned exchanging components among their friends. For example, Melih narrated that he was involved in the component exchange activities.

> We used to exchange parts with our friends. I can use DDR2 RAM with these frequency gap on my motherboard. And a friend of mine says "I got that RAM," or "I don't have that one," and we exchange the parts and test the components' performances. [Melih]

In the offline repair community, members cooperate with each other by making non-monetary component exchanges. Besides, they were experimenting with the components of the computer. Doing experiments together might enhance repair when the repair activity is perceived as a leisure activity.

Online repair communities have similar characteristics as offline networks. The dialog among members is based on helping each other and sharing their knowledge. However, online repair communities are more inclusive and widespread than offline repair networks. All participants stated they often got involved in online communities such as forums, technology websites. Currently, online communities are primary sources of advice for amateur repair. Many people around the world write about their malfunction solving process in the forums for experience sharing. Following example illustrates that:

> Just because I write on Reddit, I encounter with things like where to find a new graphics card or where to repair it, or someone's computer has got dusty and says "Unless you clean it, this happens etc." I mean I can I reach up to date information there. [Ozan]

This excerpt shows that community members take advantage of various experiences and guide each other. The lack of physical boundaries facilitates people can get involved in the online community through sharing their ideas, experiences. Also, the participant learns the up-to-date information through online forums. The knowledge and experience steadily accumulate in these mediums by creating an amateur repair practice repertory that includes problems and solutions. Repairers can foresee potential problems before living them, owing to people who share their experiences.

The following example shows that Hasan foresees the possible errors, and learns its solution from others' experiences.

> You learn this thing through other people's experiences. For instance, a man says "I tried 2019 [version of update] and I couldn't do the update because it encountered with something else and I got an error. I read and searched for the error and found out the conflicting parties," so there is the 2017 update that doesn't have that function and then you install that update and close the update option. This kind of crazy stories are going on. [Hasan]

Another positive result of the accumulation of various types of repair knowledge in online forums is alternative solutions. The nature of the forums embraces alternative solutions, which is indicated in section 4.2.2. Accordingly, the interaction between community members encourages being creative in the repair practice by a diversity of the repair experiences.

In the forums, since the amateurs write about their experiences, there appears a credibility problem. For instance, Ozan explained how he decides whether to trust a comment or not.

> I look at the comments, whether people thank or report the solution of the problem, especially on the computer repairing issue, for example when people face a problem, write on the websites "thank you, this has solved my problem". That's when I realize that I can try the same method. [Ozan]

Credibility is established by other amateur repairers' comments under the recommended solution. Ozan's quotation highlights the social aspect in the process of confirmation of the knowledge that creates an independent confirmation system. Rather than searching an expert in the repair process, they check the positive comment to understand whether the solution serves the purpose or not. This approach shows that the community might get enhanced both for sharing the knowledge and establishing the trustworthiness of the solutions.

All in all, the social network has a strong influence on repair practice as the participants' statements shows that online and offline communities transform repair activities into a collective activity. As presented in the excerpts presented in this part and earlier in section 4.2.3, the amateur repairers learn from each other. Accordingly, peer-to-peer learning is actively used, and being a community becomes an advantage. Furthermore, the social community creates a credibility system based on the confirmation of its members. In this way, the solutions do not need to be approved by professional technicians. Moreover, they share the tools, components, knowledge and experience in the repair process. The feeling of sharing might positively enhance the repair activities. For example, the diversity of the experiences which are presented in the online communities encourages creativity by leading the participant to try alternative solutions in the repair process. Also, the repair knowledge is accumulated; so that it facilitates to foreseeing possible problems or solutions. Lastly, the participants keep themselves up to date through networks. In the following section, I briefly introduce the role of social relations other than those in the repair community.

#### 4.3.2.2 The Role of the Social Relations on the Repair Activities

Besides the repair communities, the immediate social environment of the repairers affects repair practice. Interviews show that social relations outside the repair networks have a critical influence on the participants' perspectives related to repair. For example, Öykü becomes familiar with repair activities of the lectronic goods for example the iron by seeing her father's repairing process at home. She stated that:

> I was watching my father. You disassembled it from there, so you need to assemble it here. Let's say you put it to the wrong spot. You know, there are negative, positive and grounding ends of the cable. You can change the end of a damaged cable of the iron with the help of your previous observations. And I believe, these color codes have always been used. When working with my father, I say "You need to attach the blue one to this side." Because it was like this way before, it needs to be the same now. My father goes like "Here we have the transistor." He doesn't bother himself working with it anymore

> but he used to lecture me about it sometimes. So, you have a kind of tendency. [Öykü]

As seen in the example, repairing the electronic was a familiar activity for the participant. Growing up with a family who is often doing repair activity initiated her to prefer carrying out repair activities when she encountered malfunctions. Furthermore, there is some additional advantage of living with people who do repair activities. For instance, they can easily access various repair tools. Hasan stated that he had a great chance to reach the tools thanks to his father.

> Since my father is a mechanical engineer, we had a lot of tools in hand. You know, the soldering machines which we had since the times my father was working as an engineer. The tools were in a small electronic gear cabinet; therefore, I had the chance to play with them without even knowing what they were. [Hasan]

As seen in both examples, memories of repair activities have a great influence on the participants. Being involved in the repair activities with the family in daily life, no matter which object is repaired, might have reinforced the tendency of the participants for repair activities. Accordingly, participants have a positive perception of repair activities. Moreover, increased awareness of the repair activities shapes the participant's perception of the objects. Öykü claims that:

> Thanks to my reception that everything can malfunction and everything can be fixed even at home within my family's house, it's not a big deal that an electronics device is broken. That's because I think that it can be fixed somehow. That's why electronics are not that much important; they can be fixed anyways when broken. I never take good care of my electronic devices or tools. So, I don't hesitate to disassemble them with the fear of not being able to fix it. I don't think I don't have that mentality that keeps people away from taking action. I realized my being so relaxed about these by spending time with other people [Öykü]

On the contrary, Ülkü mentions that her parents are afraid of technology and hesitates with repairing activities. However, Ülkü likes repairing. According to Ülkü, the reason for the different approaches of her and her parents to repair is the

transformation that comes with generational changes. She described the young generation as “the new generation who is not afraid of technology.” This idea shows us that the perception of the repairing activities is affiliated with larger social circumstances.

Lastly, during the observation and interviews, a minority of the participants emphasized gender discrimination, even though it is not in the scope of this research. One of the participants asserted that men are more interested in repair than women.

> And of course, men are more interested in repairing computers; they play games, watch films etc. but girls just use it. [Serkan]

The claims that men know more about components make the gender discrimination about repairing activities. In another case, one of the participants stated that she is annoyed to ask help for repair activities from her husband.

> What’s the big deal that I can’t do it? Of course, I can. That feeling, I mean expecting something from another person… It doesn’t bother me calling someone “master” because the men are the shark in his field who have the license for it. But a person who lives in this house like me, why should I wait for him? And also, when he procrastinates and prevents my daily work, what is it that he can do and I can’t? This can’t be true. I mean it shouldn’t. It’s a shame to ask for someone to do something like this. I was kind of annoyed, why not? If [my husband] can do it, I can do it. [Melek]

The participant gave a reaction to asking for help from her husband. Also, she made a comparison between herself and her husband, then she claims that both of them have equal abilities. It might be reinterpreted as resistance against the fallacies that relate to gender roles.

In conclusion, social relations influence perceiving repair activities. First, repairers who are members of families that deal with repair become familiar with the repair activities. Repairing an object might be a culture in the family. This familiarity might lead to perceiving the malfunction as an ordinary mode of the objects. Moreover,

these families generally have repair equipment. Lastly, there are gender biases that repair activities attain to the men would create reactions.

### 4.3.3 Conclusion

In this chapter, I discussed that repair practices are placed in more extensive networks. Accordingly, data is divided into two: production networks and social networks. After the analysis of the findings, it is portrayed how amateur repair practice is affected by these networks. Firstly, production networks are examined as three factors that are: spare part sales, warranty services of companies and transformation of the technology. It is revealed that production network includes manufacturing and exchanging goods and information. Accodingly, computer companies, subcomponent manufacturers, technology markets, wholesalers are actors in production networks. Finding non-standard spare parts and the subcomponents might be difficult. However personal connections, the global purchases and flea market enable finding non-standard parts. Warranty services might refuse repair in risky cases. At this point, the amateur repairer might choose to repair the component by themselves. Furthermore, technological change in the infrastructure design might cause difficulties or convenience in disassembling phase.

The influence of the social network to the amateur repair practice can be divided into two groups. First group is repair communities that consist of members who are interested in computer repair. Both offline and online networks are media for amateur repair practice. The participants' ideas show that networks support the learning process of computer repair. Secondly, the network helps to expand the experiences and new knowledge. Thirdly, credibility of the solutions is ensured through confirmations of members. Lastly, the knowledge and experience accumulate in these mediums. All these factors enhance the amateur repair practice in a positive way. Second group is the social surroundings of the participants. Social relations might support the repair activities by providing repair equipment or a

familiarity to the repair activity. At the same time, the social relations might influence negatively the repairers by attributing gender roles. All in all, these three networks and the repair practice generate a circular reproduction system. That is why, while the repair practice constructs itself, it constructs the other networks.

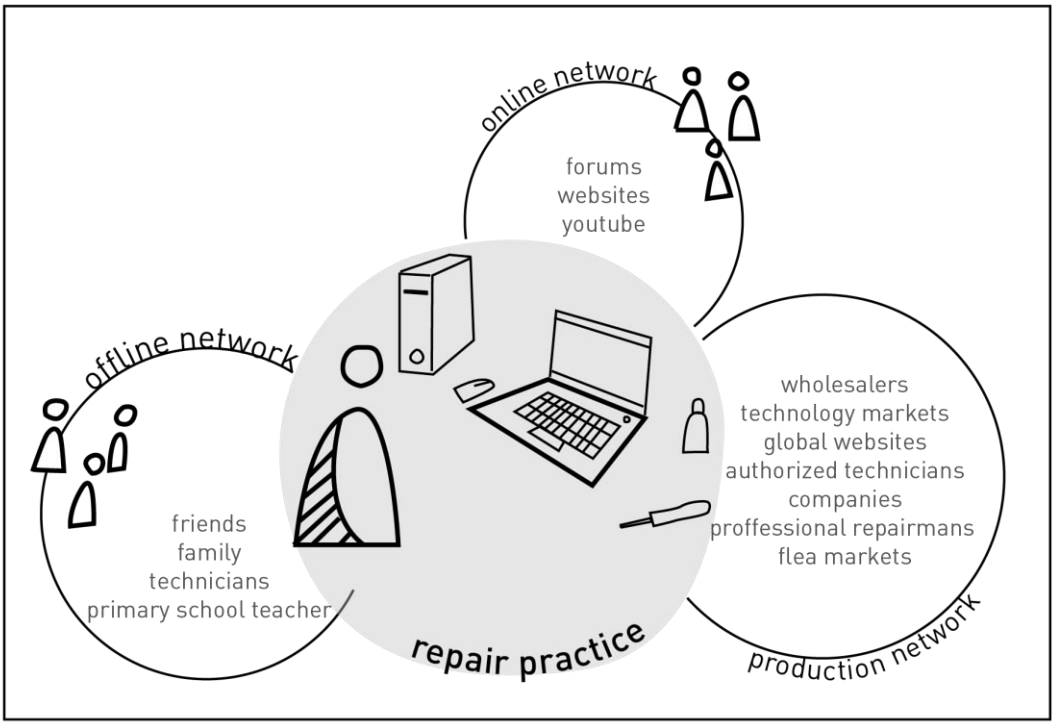


*Figure 4.12.* Networks around repair practice

As Figure 4.12 shows. the repair practice is related to the production networks and the social network. I defined the actors in production networks as wholesalers, computer companies, global websites, technicians, warranty services, technology markets and flea markets. The actors in the social network is family, friends, technicians, forums and video platforms. That is to say, online platforms function a source of the knowledge and a interaction platform. These networks all together shape the amateur repair practice. While social networks enhance the distribution of the knowledge, skills, tools and components, the limitation of the accesing the subcomponents limit the amateur practice.

## 4.4 Conclusion

In Chapter 4, the findings are presented, which are derived from semi-structured interviews and observation sessions. First, I aimed to describe amateur repair practice. Therefore, I divided the practice into its elements such as explicit knowledge, implicit knowledge, skill, perspective, identity, value and setting of amateur repairers. These revealed that amateur repairer is inline with the definition of Shove et al. (2012). In addition to their definition, amateur repair practice involves skills, identity and perspectives that are characteristic to the practice. Therefore, this information generates a characteristic amateur computer repairer and a specialized amateur repair practice that is distinguished from professional repair practice in terms of the elements of the practice.

In the second section, the process of amateur repair is discussed. This section is divided into three headings: the process of the amateur repair, learning process of the repairer and disruptions in the repair process. The amateur repair process comprises of firstly definition of the problem, secondly assesment of the solution, lastly implementation. However, the process does not go as it is planned since repair process has an iterative and processual nature. In the learning process, mimicking and exploratory approaches are the two main strategies of the repairers. Lastly, disruptions in the process can have critical effects on the repair proces. Material qualities, limitations of the participants are limits to amateur repair practice.

In the third section, it is discussed that repair practices are placed in more extensive networks of production network and social network. The production networks provide tools, spare parts, knowledge to the amateur practice. On the other hand, they limit the amateur repairer though access problems to subcomponents and warranty specifications. Social relations support the repair practice in terms of knowledge, and tool sharings. As a conclusion, the amateur repair practice is shaped by social networks and production networks.

# CHAPTER 5

# CONCLUSIONS

This study aims to understand the user-product interaction characteristic to amateur repair practice and reveal how that interaction is related to the dimensions of the practice and the networks at various levels. In order to achieve this aim, I have conducted semi-structured interviews and concurrent think-aloud protocols while performing the repair tasks with amateur computer repairers. My findings provided a description of the amateur repair practice and the repairers as well as the larger networks within which they are situated. In this chapter, I present an overview of the chapters. Then, in light of the related literature, I discuss the prominent conclusions along with the introduced concepts. Lastly, in the last section, I present the limitations of this study and recommendations for future research.

## 5.1 Overview of the Study

In Chapter 1, I made an introduction to the thesis by explaining the background of this study. Second, I defined the aim and scope of the study by presenting its significance for design research. In this part, I explained the primary purpose of the thesis, which is to understand users' interactions with the insides of products. Then, I introduced the main and sub questions of the research.

Chapter 2 reviewed related literature, introducing practice theory and practice theoretical approaches in various academic fields to provide a theoretical framework for this study. I demonstrated the concepts related to practice as elements of the practice, nature of the practice, and the examples of the practice theoretical approaches. This part stated that practice theory is a valuable theoretical framework that adopts a broad view and pays equal attention to the actors as humans, objects, and the structure of the practices. Next, I reviewed the repair literature by elaborating

on the seminal and recent studies. This part indicated that many actors are involved in repair activities. Therefore, each actor both transforms and is transformed by other actors. The section also underlined the importance of perspectives, skills and knowledge involved in the repair, and their transfer among repairers. Lastly, I reviewed the design literature focusing on the repair activities from the sustainability and HCI points of view. Accordingly, research on design for sustainability underlines that repair is a concern that is critical for both production and consumption. HCI underlines the need to understand users' experience during the repair activity. In the light of literature, it is seen that there is currently limited work focusing on repair activities from practice theoretical perspective, and investigating repair practices and experiences of users from the design perspective. Specifically, there is a need for design research that

- studies repair activity as an experience;
- focuses on repair activities by paying equal attention to actors, objects and the networks in the repair practice, and
- investigates the amateur repair activities and the repair networks.

In Chapter 3, the methodology is discussed. The research is based on a constructivist epistemological approach, and the fieldwork includes a qualitative data collection process through semi-structured interviews, and concurrent think-aloud protocols while achieving repairing tasks and making observations. The sampling consists of both women and men amateur computer repairers who have diverse repair skill levels.

Chapter 4 presented the findings of the fieldwork. It included elements of the amateur repair practice that comprise of knowledge, skills, perspectives, identity, valued concepts, and settings. The characteristics of amateur repair practice revealed that it consists of particular skills, identity, and perspectives that can be distinguished from professional repair practice. Next, I described the amateur repair process by

explaining steps, learning processes, tactics and disruptions. This part both reveals the lifecycle of the practice, and its iterative process, which evolves in time, can be interrupted, and overall reproduces itself. Lastly, repair practices are placed in more extensive networks: production networks, and social networks. It is demonstrated that these networks are organized around repair practice. The amateur repair practice shapes, and is shaped by production networks, and social networks.

In Chapter 5, the prominent conclusions and their implications are discussed in the light of literature. I elaborate on repair practice, users, products, networks and sustainability studies. I finalize this thesis by pointing out the limitations of the study and making further recommendations.

## 5.2 Prominent Conclusions

This study aimed to investigate the user-product interaction that is characteristic of amateur repair practice. To answer this question, I examined from practitioners' perspectives the elements and the process of amateur repair practices, and the networks that envelop the practice. The literature review pointed out that the repair practice involves several actors as objects, users, online-offline communities, networks and companies. These actors have a critical and transformative effect on users, products, and user-product interactions. The literature points out that repair activities can inform design in several ways (Houston et al., 2016). However, there are limited studies that (1) approach the repair activities as an experience, (2) provides broader views of the practice by paying equal attention objects, humans and the networks in the repair practice, (3) investigating amateur repair practices and the networks. In line with the research framework, the main research question of this study is formulated as follows:

- *How is the user-product interaction that is characteristic of amateur repair practice?*

To answer this question, I need to answer three sub-questions in the context of amateur repair practices:

- *What are the characteristics of amateur computer repair from the practice theory perspective?*
- *What are the characteristics of amateur computer repairers, including learning processes, skills, and motivations?*
- *What type of networks appears around amateur repair practice? How do the networks and the practice shape each other?*

The answers to these questions are comprehensively elaborated under five headings below.

*1. Amateur repair should be considered a practice as defined by practice theory. Following that, using a practice theoretical framework for understanding repair activities is meaningful for understanding user-product relationships.*

Practices are defined as a routinized type of behavior that includes particular background knowledge and doings, thinking, and sayings (Reckwitz, 2002). This study has shown that repair activities are considered a practice that includes particular elements and specific knowledge. Warde (2014) points out four specifications: The first is that it must be possible to write an instruction manual about the practice. As I discussed in section 4.2.1, computer repair practice has a procedure to follow. I debated this under the headings of diagnosis (see section 4.2.1.1), assessment (see section 4.2.1.2), and implementation (see section 4.2.1.3). Warde's second specification is a significant time allocation to practice. Many of the amateur repairers told me about their individual development through repair activity historically. Also, Melih defined the repair activities as a regular job for him (see section 4.1.1). A third specification is the existence of debatable criteria for assessing the quality of the performance. It is also valid for repair practice as I discussed in

sections on explicit rules (see section 4.1.1), implicit rules (see section 4.1.2), and amateur repairers' skills (see section 4.1.1). Lastly, the fourth specification of practice includes the specific toolsets and objects that are linked to the practice. In this case, amateur repair includes specific toolsets used such as a screwdriver, solder, thermal paste, so forth and informal, basic tools as plastic cards, plastic threads, magnets, acetone, so forth (see section 4.1.7).

Shove et al. (2012) state that amateur repair practice comprises elements such as materials, meanings, and competences. In line with their definition, I categorize the elements of the amateur computer repair practice as rules, skills, valued concepts, and settings. The authors' definition of materials corresponds to the section on settings (see section 4.1.7); the description of meanings corresponds to valued concepts (see section 4.1.6); and the definition of competences corresponds to the skills of amateur repairer, the implicit (see section 4.1.1) and explicit rules (see section 4.1.2). Furthermore, I add two new element categories as the identity and perspectives of the practitioner. I show that these two elements distinguish the amateur computer repair practices from both regular users and professional repairers. In light of the literature and the findings of this study, amateur computer repair activities describe a practice that comprises particular rules, understandings, skills, identity, values, and settings. These elements create a particular experience for the amateur computer repairers. Therefore, investigating repair activities from the practice theoretical approach can provide design literature with a broader understanding of the practice.

The interaction between user and the interior surface of the product that is characteristic to the amateur repair evolve around the elements of the practice (see section 4.1), the practitioner, the product and the network. The next prominent result provides a detailed discussion about the practitioner, product and the network.

*2. Amateur computer repairers are critical actors who sustain and shape the practice. More significantly, for design research, they are users who assume a particular identity, perspective, and skills through their involvement with amateur repair practice.*

Repairers have the responsibility of readjusting, repairing and maintaining the objects. In section 2.2.2, the studies show that professional repairers assumed full authority in the technical issues of the products. Bovet and Strebel's (2019) study emphasize that repairers guide the users on how to interact with the product after repair both on material and social levels. Particularly independent professional repairers are responsible for distributing the knowledge, skills, and experience to other repairers (Houston, 2019; Ahmed, Jackson & Rifat, 2015). On the other hand, the owners or users of the product adopt the role of the repairer by actively engaging with the product (see section 2.2.2). Kohtala et al. (2020) create a taxonomy from various user types. In that list, a user who deals with repair and maintenance activities is described as "active users" (p.34). For example, Lindsay (2003) stated that are TRS-80 users build their identity through this computer because they are developers, producers, retailers, advertisers, publishers, and technical support staff" (p. 50) of their computers.

In line with Lindsay's claim, in my fieldwork, I found that amateur computer repairers adopted the repairer role, but also, they have values that related to being a user. The amateur repairers construct the hybrid identities between being a user and having the skill or expertise of a technical professional. Firstly, as discussed in section 4.1.6 some of the participants are motivated to the "repair for repair." That is to say, the participants enjoy the process itself; in addition to that, they see the repairing the computers as a leisure activity. For example, a user who aspires for "performance for performance" likes experimenting with computer components. Furthermore, they acquire repair knowledge because they like to know more and more about computers.

Secondly, the amateur repairer takes the responsibility of the repair and maintenance task, malfunctions, and the potential risks. Therefore, they develop strategies to calculate risks beforehand (see section 4.2.1.2), and they learn risk management by practicing it throughout each repair process (see section 4.2.2) However, while they are repairing their computers, they also have a user's concerns and motivations. As I showed in section 4.1.6, some of the participants consider "performance for use." They are interested in using their computer without a problem. Furthermore, the cost of repair is one of the primary concerns of the participant. Considering that, the cost of the repair is one of the criteria in the assessment phase (see section 4.2.2). Then, some of the participants consider sustainability, being self-resilient and appreciated by others.

Thirdly, the social circle of the amateur repairer asks for advice from them about their computers as to what causes the malfunctions or which component to buy (see section 4.1.5). They let the repairer disassemble their computers. On the other hand, the participants describe themselves as handy. Some of the participants claim that they are more skilled from computer engineers in terms of repairing the computer. Some of the participants even point out that they can do what a computer repairman does. Also, it is observed that some of the participants are well versed in computer repairing (see section 4.1.5).

Furthermore, amateur repairers are perceived as persons who have the competence and right to intervene in various objects so that they are assumed to be able to repair other products than computers. Both participants' self-perception and their social circle's perceptions construct the identity of the amateur computer repairer. Accordingly, participants assumed the authority to repair computers and guide others in topics that are related to computers.

The findings have shown that the amateur computer repairer has hybrid identities. Besides, amateur repairers have a particular perspective. More clearly, interactions

with the interior surface of the product provide a particular understanding for the amateur computer repairers. Houston (2019) states that repair provides a different way of knowing the objects. Also, Terzioğlu (2017b) notes that repair activity gives the user information on the material level, as the material, form, and structure of the object become more transparent while fixing it. Findings of this study revealed that as a user, amateur computer repairers have particular perspectives towards the products (see section 4.1.4). Firstly, what I called the "disassembly perspective" indicates that amateur computer repairers perceive the computer as a combination of different layers and components. Therefore, the unity of the objects is broken into its pieces. Secondly, the relations of cause and effect becomes clear for the repairer. The combination of these two perspectives helps the repairers develop assumptions about the reasons behind and solutions for malfunctions related to both component functionality level and the usage context. Lastly, the amateur repairer can do imaginary production, which is stated as "reverse engineering," and, based on that, can repurpose the existing components to reconfigure, and even create a new object. It can, therefore, be seen that amateur computer repairers undertake creative activities beyond merely fixing the product. As such, knowing and interacting with the object's infrastructures broaden the understanding of amateur repairers. The implication is that the apparent unity and mystery of the functions and components under the cover of the products can be challenged through repair activities. As a result, repair re-establishes a bond between users and products that can delineate the user. The particular perspective of the amateur repairer differentiates them from other users.

In addition to having a particular identity and perspective, amateur repairers have remarkable skills, as Ackermannn (2018) stated that skill is a necessary component to convince the user to fix their product (see section 2.3.1). In the case of the computer repair, I revealed that repairerers are involved in both practical and analytical skills as follows: (1) Amateur computer repairers can do repair and maintenance tasks such as fixing broken parts, renewing thermal compounds, spare

part replacements, performance updates, so forth (see section 4.1.3). (2) The amateur computer repairer knows how to use the tool and interact with computer parts on the material level (see section 4.1.3). (3) The amateur computer repairer can interpret, especially during the diagnosis phase (see 4.2.1.1). (4) The amateur computer repairer can use technical terminology (see section 4.1.3).

Furthermore, amateur repairers differ from both users and the repairers in terms of the settings, motivations, repair methods. For instance, they do work in temporary settings (see section 4.1.7). They use improvisational tactics in the implementation phase (see section 4.1.2.3) which are contrary to the formal repair procedure. They undertake experiments. Also, they see the repair process as a leisure activity.

In sum, it might be stated that amateur repairers have a hybrid character consisting of both a technician's and a user's concerns, motivations, aspects and skills, a hybrid of the two positions in user-product interactions. For instance, as users of the product, they can be mainly interested in its performance, while at the same time, when they encounter a malfunction, they try to solve or at least predict what caused the malfunction. Consequently, a particular type of user can be defined, which I call the "enlightened user."

*3. The design of the product is a critical determinant of the repair practice. Repair practice makes it possible for users to transform the characteristics of the products, independent to some degree of how the product is designed.*

As I review in section 2.2.3.1, Jordan and Lynch (1992) list how a product becomes the black-boxed. In line with the specifications of the list, the field study showed that the computer is a "black boxed object". Similarly, Denise & Pontille (2017) refer to the enactment of the object in terms of openness, fragility, authority and transformation. In the findings, it is revealed that material qualities such as snap-fit connections in laptops, non-standard screws and integrated parts block the repair (see

section 4.2.3). On the other hand, perception of the risk makes the repairers uncomfortable. For instance, the participants calculate the potential risks and undertake risk management in order to deal with the fear of damaging the computer. In addition, the lack of tools and components causes disruption in the repair process (see section 4.2.3). Last but not least, even when the some products are in ways that enable the repair, maintenance, and replacements of the components, the warranty specifications of the companies can limit repair activities (see section 4.2.3). In brief, the findings show that the perception of the risk, the material qualities of the product, difficulty in accessing tools and spare parts, and warranty limitations factors that black-box the computers (see section 4.2.3).

Repair practice creates a possibility to transform an object both on the material level and in the perception of the user. Firstly, I state how repair practice enables the transformation of the object on the material level. As Dant (2019) highlights, objects are repaired in order to be protected from decay or damage. Therefore, the main aim of repair is to keep the object's performance and form. Thus, if a repairer completes the task properly, generally, there is no trace to prove that object is repaired (Dant, 2010). On the contrary, as I show in the field study, amateur computer repair practice enables the transformation of the computer's characteristics as independent of how the product is designed or manufactured. Since amateur repair practice can support strategies of intervention that are different from formal repair practice, the form of the product might differ from initial versions, or usage context might be transformed. Employing quick and cheap alternative methods, as discussed in section 4.2.1.3, such as putting the processors in the oven or using cream instead of a thermal compound) leads the repairer toward creative solutions. As it has been shown in section 4.2.1.4, objects are transformed in terms of form and usage.

Furthermore, these alternative ways of intervening in the products' characteristics can create ways to enhance the product's capacity and performance, for example through overclocking (see section 4.2.1.5.). Also, it is possible to increase the

performance of the processor by renewing the thermal paste. By doing that, amateur repairer breaks technological barriers. Next, as I mention in conclusion 2, amateur repairers intervene in the function of the object by repurposing the leftover components (see section 4.1.4 and 4.1.7). Lastly, the life span of the old versions of the products can be increased by replacing the spare parts.

Secondly, the object is transformed in the perception of the user. In line with Houston (2019), this study revealed that interaction between user-product that is characteristic to the amateur repair practice provides a different perspective to the user. As Ed van Hinte stated (1996; cited in Verbeek, 2005), the product is divided into cover and the inner surface of the product that is accessible only for the technician. In line with the literature, the interaction between the object and used happens in the context of transparency through amateur repair practice (see sections 4.1 and 4.2). This leads to the transformation of the characteristics of the object in the perspective of the user (4.1.4)

To summarize, amateur repair practice enables diverse ways of intervention to the products. By doing this, users might overcome the manufacturing and design decisions by transforming the characteristics of the objects, which are performance, function, lifetime, or transparency. Therefore, authority is dispersed from manufacturers to the user through amateur computer repair.

*4. Online and offline networks are critical for expanding knowledge, accessing spare parts, and skill-sharing, which are vital components of amateur repair practice.*

The importance of the networks is presented in many studies focused on repair (Rosner & Ames, 2014; Ahmed, Jackson and Rifat, 2015; Houston, 2019; see section 2.2.4 for my review). Those studies highlight that networks help the transmission of knowledge, skills, and trade. Tacit and explicit knowledge are dispersed through online and offline networks. The findings of this thesis are parallel with the literature.

Broader factors such as production and social networks have shaped amateur repair practices. While some of the factors limit amateur practice, other factors facilitate the practice. As I show in section 4.3.2, the social network has a crucial impact on amateur repair practice. There is both an online and offline network that has evolved around amateur repair practice. As I discussed in section 4.3.2.1, offline members comprise of friends, technicians in the neighbors, primary school teachers and family. The members in the network support each other by sharing the knowledge, exchanging tools and components. Some of the members experiment together. The positive relations in offline relations enhance amateur repair practice. On the other hand, online communities are a crucial medium for the distribution of knowledge and experience (see section 4.3.2.1). Especially online learning through the videos or texts on forums is a main knowledge resource of the amateur repair. Further, the online social community ensures the credibility of the solutions based on the confirmation of other repairers. The main knowledge and experience of the amateur repair practice in the online network are generated by cumulative labor that expands, maintains and enhances the practice.

The production network including trading and exchange informations comprises of the computer companies, subcomponent manufacturers, technology markets, wholesalers and influencers (see section 4.3.1). Personal connections, and global purchases and flea markets enable the repairers to find non-standard parts (see section 4.2.3). However, participants cannot access particular subcomponents since they are individual customers (see 4.3.1.). Some of the subcomponents are available only in the form of wholesale. Production network includes the possibility of open or close repair practice.

*5. A broader approach that takes into consideration various elements of and actors in the repair practice can show their crucial role for sustainability.*

Studies in sustainability have underlined the importance of designing for repair. For example, Ahmed, Jackson, and Rifat (2015) state that strategies such as using glue or uncommon screw heads in products prevent repair and negatively impact product lifespan. In contrast, making the interior of the object accessible by the user through connections and documentation naturally align with sustainability. My findings also show that the amateur repairer saved the objects through improvisational tactics. Amateur repairers could repair many objects that are not available for repair via formal repairer methods. for example, by putting processors in an oven (see section 4.2.1.3). Therefore, amateur repair practice prolongs the lifespan of the objects beyond the formal repair methods.

On the other hand, repair activities are situated actions (Suchman, 1987; Orr, 1996). This means that the repair of the product cannot be fully planned. The repair activity emerges in everyday life (Rosner and Ames, 2014). Similar to literature, I observe that the nature of the amateur repair practice is both iterative and processual. As it is discussed in section 4.1.3, the repairer diagnoses the malfunction, makes assessments, then plans to apply, then verifies the solution; however, in the implementation phase, the repair might not be completed as planned. During the think-aloud process, this process was often observed by me (Figure 4.10). Aligned with the Terzioğlu (2017 b; see section 2.3.1 for my review), reframing the repair practice as an experience that emerges in everyday life can provide insights for sustainability studies.

The emergent character of the repair activities leads us to the importance of integrative approaches to sustainable product design that take into consideration production and consumption, such as circular design (MacArthur Foundation, 2012) and ISDPS (Doğan & Walker, 2008). The results of this study confirmed the literature. The production networks include the factors that discourage the repair practice, such as difficult to access subcomponents, onboard production methods or warranty specifications (see section 4.3.1), communities support and expand the

amateur repair activities and the networks. Accordingly, integrative approaches to sustainable product design would evaluate the repair activities as a phase of the systems that are enhanced or disrupted by the other factors in the system.

On the other hand, along with material durability and openness, emotional durability is critical (Chapman, 2005; Ackermann, 2018; Terzioğlu, 2017a), since the attachment between the user and the product has a decisive role in the sustainability of the products. Furthermore, the study reveal that repair activities embraces knowledge, skill, and identity. To support the materialy engagements of the user in terms of the repair activities, the ways that enhance the transmission of the repair knowledge, skill and identity should be developed. However, there is a lack that repair is not discussed from broad view in the context of design for sustainability. At this point this study offers a holistic approach that is distinct from others studies in design for sustainability. I propose that evaluating the knowledge, skills, perspective, identity, learning processes, disruptions, production and social networks as a unified system would contribute to sustainability studies. Upcoming sustainability studies might adopt the practice theory framework to examine the repair, maintanence, D.I.Y, and consumption practices. Along with, a system or a product experience might be designed that enhance sustainable engagements.

All in all, to understand the repair activities' role in sustainable systems, the social practices would be taken into consideration, in addition to concepts in the sustainability studies such as emotional durability, experience and integrated systems.

## 5.3 Limitations and Recommendations for Further Research

Even though a particular online website is used to enlarge the sampling, this study was carried out with amateur computer repairers that are accessible for the researcher. To improve the representativeness of the study, it can be supplemented

with surveys with larger groups. Because of the limited sampling, currently, some of the findings of this study may not be generalizable to the whole amateur computer repairers' online and offline communities in Turkey.

Secondly, the sample does not focus on other actors in repair networks, such as participants who are directly involved in consumption and technology networks as a decision-maker. Computer company workers, OEM producers, technical services and other similar actors could be interviewed for further insight into the practice.

Thirdly, even though equal representation was sought in sampling and enrollment, this study included only three women repairers. The experiences of women with a repair need to be studied specifically, and this may be possible without the focus on computers.

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# APPENDICES

## A. CONSENT FORM

**Bu formun amacı nedir?**
Bu form Orta Doğu Teknik Üniversitesi Endüstri Ürünleri Tasarımı Bölümünde yürütülen "Nesnenin içyüzü ile karşılaşmak: Bilgisayar tamir pratiği ve amatör tamirciler" adlı yüksek lisans araştırmasının içeriği hakkında bilgi vermek amacıyla hazırlanmıştır. Bu araştırma Ayşegül Özçelik tarafından Dr. Öğr. Üyesi Harun Kaygan'ın tez danışmanlığında yürütülmektir.

**Araştırmanın amacı ve tekniği nedir?**
Bu çalışmada, bilgisayar tamiri ile amatör olarak ilgilenen kullanıcının tamir deneyimi ve bilgisayarın donanımı ile etkileşimi araştırılmaktadır. Amatör tamirciler ile görüşmeler yapılacak, birlikte bir bilgisayarın içi açılarak sesli düşünme protokolü ile veri toplanacaktır. Mülakat ve sesli düşünme protokolü süresince ses kaydı alınacak ve üzerinde konuşulan bilgisayarın fotoğrafı çekilecektir.

**Bize nasıl yardımcı olabilirsiniz?**
Araştırmaya katılmayı kabul ederseniz sizinle nesneleri tamir etme deneyimi üzerine bir mülakat yürüteceğiz. Yaklaşık bir saat sürecek mülakat boyunca konu ile alakalı deneyimlerinizi paylaşacağınızı umuyoruz. Röportaj sonunda bir bilgisayarı açmanızı ve yaptıklarınızı yüksek sesle anlatmanızı isteyeceğim.

**Sizden edindiğimiz bilgileri nasıl kullanacağız?**
Bu çalışmaya katılım gönüllülük esasına dayalıdır. Araştırma sırasında paylaştıklarınız yalnızca yukarıda sözü edilen araştırmacı ve tez danışmanı tarafından görülecek, analiz edilip yalnızca anonimleştirildikten sonra akademik yayınlarda kullanılacaktır. Zaman ayırdığınız için teşekkür ederiz.

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Yukarıda belirtilen çalışmaya katılmayı kabul ediyorum.

**İsim Soyisim** **İmza** **Tarih**

## B. INTERVIEW QUESTIONS

### Başlangıç soruları

Yaşınız nedir?

Mesleğiniz nedir?

Neleri tamir ettiniz?

### Öğrenme Süreci

Tamir işlerine ne kadar vakit harcıyorsunuz?

Bilgisayar Tamir etmeye ne zaman başladınız? İlk tamir hikayenizi anlatır mısınız?

Tamiri nasıl öğrendiniz?

Öğrenme sürecinde kimlerden destek aldınız?

Öğrenme sürecinde destek aldığınız insanlarla ilişkinizi tarif eder misiniz?

### Tamir süreci

En son ne zaman bir bilgisayar tamir ettiniz?

Genel tamir sürecinizi anlatır mısınız?

Tamir sürecinde en ilginç bulduğunuz projeyi anlatır mısınız?

Başarılı olduğunuz bir tamir vakasını anlatır mısınız? Bilgisayarı nasıl tamir etmeyi nasıl başardınız?

Tamirinde en çok zorlandığınız örneği anlatır mısınız?

Tamir edemediğiniz bilgisayar oldu mu? Hangi problemler çözülmedi? (Bu problemler sizin bilgisayar kullanımınızı nasıl etkiledi?)

### Ortam ve kullanılan aletler

Aletleriniz neler? Kullanmayı en sevdiğiniz alet nedir?

Nerelerden edindiniz?

Almayı çok istediğiniz/planladığınız bir alet var mı neden?

Sınırsız bir alım gücünüz olsa hangi tamir ile ilgili ürünlerden hangisini alırdınız?

Hiç yedek parça aldınız mı? Nereden temin ettiniz? Kriterleriniz nelerdi?

Yedek parça ya da tamir ile ilgili bilgiyi nerelerden ediniyorsunuz?

Yedek parça ya da tamir ile ilgili ha bilgilere ulaşımda zorluk yaşadınız mı?

**Topluluk ağları**

Teknolojik yeniliklere nasıl ulaşıyorsunuz? Kendinizi nasıl güncel tutuyorsunuz?

Bilgisayar tamir eden arkadaşınız var mı? Onlarla tamir hakkında nasıl paylaşımlarınız var?

Bir araya geldiğinizde tamir ile ilgili neler konuşuyorsunuz? Örneklendirir misiniz?

Bilgisayar şirketleri hakkında ne düşünüyorsunuz?Sizce, bilgisayar şirketlerinin tamir bilgisi konusunda yaklaşımı nedir?

Teknik servis hakkında ne düşünüyorsunuz?

Tamir bilgisine nasıl ulaşıyorsunuz? Örneklendirebilir misiniz?

**Sonuç**

Neden tamir yapmayı seviyorsunuz?

Tamir etme becerisinin size katkısı nedir?

Sizce bir amatör bilgisayar tamircisinin sahip olduğu beceriler nelerdir?

## C. APPROVAL ETHICS

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21 AĞUSTOS 2019

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

**Sayın Dr.Öğretim Üyesi Harun KAYGAN**

Danışmanlığını yaptığınız **Ayşegül ÖZÇELİK'in "Nesnenin iç yüzü ile karşılaşmak: Bilgisayar tamir pratiği ve amatör bilgisayar tamircileri"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **325 ODTÜ 2019** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

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