Anticipated User Experience in the Early Stages of Product Development

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Dedication

To Margaretha and Kiralee for bringing light into my life.

Keywords

Anticipated User Experience (AUX)

AUX Framework

Design for Experience

Early Stages of Design

Human-Computer Interaction

Interaction Design

Pragmatic and Hedonic Qualities

Product Design

User Experience

Abstract

People no longer use a product solely as a tool, but more importantly for the pleasurable experiences it provides. Positive user experience, therefore, has increasingly become the goal in designing and developing interactive products. To ensure this goal is reached, user experience assessment should be conducted from the earliest stages of product development. However, the early assessment of user experience is difficult and challenging, as no functional prototypes to be tested are yet available. Moreover, the majority of existing user experience frameworks and evaluation methods have not fully supported the initial design phases.

This research aims to gain a deeper understanding of *anticipated user experience* to support early assessment of user experience. In this context, anticipated user experience is defined as the experiences and feelings that users *expect* to have when *imagining* an encounter with an interactive product or system. The study is driven by two research sub-questions: How do users anticipate experiences with interactive products; and what are the differences between anticipated and real user experiences?

Two qualitative studies were conducted. The first experiment investigated anticipated user experience by asking twenty pairs of participants to individually imagine and sketch a desired product, and to anticipate their experiences with the conceived product. The second experiment explored real user experience by prompting forty participants to individually use a given digital camera over a period of three days, to report their experiences using a diary, and to discuss their experiences with another participant. The first study shows that when anticipating experiences with an imagined product, users perceive the pragmatic (instrumental) quality of the product as the dominant factor that determines their positive future experiences. The second study, however, demonstrates that while the users also mostly focus on pragmatic quality when judging an actual product, it is its hedonic (non-instrumental) quality that contributes more to their positive real experiences. The studies also show that real user experience involves *familiarisation* and *expectation disconfirmation* factors, which are not identified in anticipated user experience. The main outcome of this research is the Anticipated User Experience

(AUX) Framework that describes the processes through which users imagine a desired product and anticipate positive experiences with the conceived product. Furthermore, based on the findings, design recommendations are proposed.

This research provides new knowledge of anticipated user experience. It contributes to the area of design for experience, and concurrently addresses the knowledge gap related to user experience *before* interaction. The AUX Framework provides a guide to assist designers to identify and prioritise the key factors that need to explore during the early stages of design. The exploration of these factors allows designers to better predict users' underlying needs and potential contexts related to positive experiences with the designed product. The design recommendations also support the creation of pleasurable interactive products. Thus, the application of these research outcomes can potentially support design for positive experiences from the very outset of product development.

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Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signed:

Thedy Yogasara

Date:

13 January 2014

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Chapter 1: Introduction

The source of economic value has progressed from extracting commodities to making goods and delivering services, and now to staging experiences (Pine and Gilmore, 1998, 2011). Consumers undeniably desire experiences, and this has forced companies to deliberately design and promote them (Pine and Gilmore, 1998). As a result, the continuing delivery of compelling user experience (UX) must be embedded in companies' business strategies to help them to compete in consumer markets (Sward and Macarthur, 2007).

More specifically, in the field of user-product interaction, positive user experience has increasingly become a design goal (Mahlke, 2005; Roto, Rantavuo, and Väänänen-Vainio-Mattila, 2009; Sward and Macarthur, 2007; Väänänen-Vainio-Mattila and Wäljas, 2009). Creating products that can integrate into users' everyday lives, rather than products that simply support their everyday tasks, is a new focus (Kort, Vermeeren, and Fokker, 2007). This is because users no longer merely need a product to be useful and functional; rather, they now demand product experiences that encompass fun, enjoyment, and pleasure (Blythe, Overbeeke, Monk, and Wright, 2004; Jordan, 2000). To ensure a product's success, therefore, an understanding and assessment of user experience is paramount in the process of product design and development.

This study argues that the assessment of user experience must be conducted as early as possible to facilitate the design for experience. This early assessment, in turn, can support high quality experiences through product use. The research is driven by the aspiration to fill a gap in existing knowledge of *anticipated user experience* and its

role in assessing user experience in the early stages of product development. In this context, anticipated user experience is defined as "the experiences and feelings that the user *expects* to occur when *imagining* an encounter with an interactive product or system" (Yogasara, Popovic, Kraal, and Chamorro-Koc, 2012, p. 2). There is evidence that most existing research focuses on 'real' user experience (that is, on actual experience with products). This focus does not fully support the initial stages of the design process. Therefore, the main purpose of this study is to explore how users anticipate their experiences with interactive products, and how this understanding can be utilised to support the early assessment of user experience.

This introductory chapter initially presents the background of this study, and the research problem and questions. It then elucidates the research aim, scope, objectives, and significance. Finally, the thesis structure is outlined.

1.1 RESEARCH BACKGROUND

Within today's fast-paced and competitive environment, the economic success of product developers depends on their ability to identify consumers' needs, and to design and develop products that meet those needs. As previously stated, as technologies, markets, and consumers mature, product users begin to seek out products that offer pleasant and engaging experiences. For instance, one may look for a food processor that is not only fully functional and easy to use, but which also, more importantly, is able to provide sensory gratification, pleasant emotions, positive meaning, and support for one's self-identity.

These experiences increasingly serve as differentiators for people when selecting a particular product from other similar and available products. Providing positive user experience, therefore, has become a key factor in product development so as to generate a product's competitive advantages (Obrist, Roto, and Väänänen-Vainio-Mattila, 2009; Pine and Gilmore, 1999; Sward, 2006; Väänänen-Vainio-Mattila, Roto, and Hassenzahl, 2008a). The development of interactive products is no longer only a matter of applying features and ensuring their usability; it also has to understand users' everyday lives and to create products that harmonise with basic human needs (Väänänen-Vainio-Mattila, et al., 2008a).

According to Väänänen-Vainio-Mattila et al. (2008a), there are two fundamental aspects to consider when designing for pleasurable user experience. First, experience-centred design demands an understanding of how to meet the needs for both pragmatic and hedonic qualities of interactive products (Hassenzahl, 2003; Väänänen-Vainio-Mattila, et al., 2008a). Pragmatic quality refers to a product's perceived ability to support the achievement of behavioural goals (related to usability and functionality); hedonic quality, on the other hand, refers to a product's perceived ability to support the fulfilment of basic psychological needs such as stimulation, identification, and evocation (Hassenzahl, 2003, 2008). Second, designing for user experience requires iterative evaluations throughout the stages of product development (ISO 13407:1999, as cited in Väänänen-Vainio-Mattila, et al., 2008a). This means that user experience assessment and improvement need to be undertaken from the early phases of the design process. The first requirement facilitates the setting of product development targets, while the second requirement helps to ensure, improve, and attain high quality user experiences from the use of the final product.

In relation to the above requirements, different theories, frameworks, and models have been developed over the last decade to enhance the understanding of user experience (Sections 2.2 to 2.5). These range from basic user experience models (e.g. Forlizzi and Battarbee, 2004; Forlizzi and Ford, 2000; Hassenzahl, 2003; Mahlke, 2005; Roto, 2006; Wright, McCarthy, and Meekison, 2003); theories of pragmatic and hedonic qualities (Diefenbach and Hassenzahl, 2011; Hassenzahl, 2007, 2008); a product experience framework (Desmet and Hekkert, 2007); and social user experience frameworks (Battarbee, 2003; Battarbee and Koskinen, 2005), to theories and models of user experience temporality (Karapanos, Zimmerman, Forlizzi, and Martens, 2009, 2010; Roto, Law, Vermeeren, and Hoonhout, 2011; von Wilamowitz-Moellendorff, Hassenzahl, and Platz, 2006).

Based on understandings provided by these developed theories, models, and frameworks, numerous evaluation methods have also been proposed to enable user experience assessment in the product development process (Chapter 3). Some of these methods adopt traditional product evaluation techniques, such as questionnaires (Laugwitz, Held, and Schrepp, 2008; Thayer and Dugan, 2009), focus groups, interviews, and think-aloud procedures (Jordan, 2000). Another technique uses non-

verbal self-reports that focus on the measurement of users' emotional responses (Desmet, 2003a; Desmet and Dijkhuis, 2003). Moreover, experience clip (Isomursu, Kuutti, and Väinämö, 2004), narration (Schrammel, Geven, Leitner, and Tscheligi, 2008), experience diary (Karapanos, et al., 2009; Swallow, Blythe, and Wright, 2005), and experience report (Korhonen, Arrasvuori, and Väänänen-Vainio-Mattila, 2010b) have been used to analyse and evaluate user experience related to new technologies. Researchers also employ an approach that combines several methods and instruments to measure users' total experiences during user-product interaction. This approach includes psychological, physiological, and cognitive measures, as well as facial expression and behavioural (performance) assessments (Hazlett and Benedek, 2007; Mahlke and Lindgaard, 2007; Mandryk, Inkpen, and Calvert, 2006).

Despite the plethora of user experience models and frameworks that have been proposed, most of these are dedicated to gaining an understanding of user experience elicited by the actual interactions between users and functional products. They assume that users must have a certain level of interaction with a product's features to form their experiences of the product (e.g. Hassenzahl, 2003; Mahlke and Thüring, 2007; Roto, 2006). Roto (2007), for example, stresses that user experience involves a product or service and interaction with that product or service. Little information exists, however, on how user experience can be anticipated or constructed without actual interaction with an end product. This anticipatory aspect of user experience requires systematic exploration in order to support designers in assessing and designing for user experience during the early stages of product development.

The majority of user experience assessment methods also require the assessment to be conducted *during* or *after* users' interactions with existing products (Bargas-Avila and Hornbæk, 2012; Vermeeren et al., 2010). This implies that the evaluation of user experience must be delayed until the late phases of product development when a complete product, or a close to fully functional prototype, becomes available. The identification of design flaws at these final stages of product development is unfavourable for product developers, as it leads to costly late design changes (Magrab, 1997). In view of this, the current approaches to assessing user experience do not, for the most part, support the early phases of the design process. Thus, there is a crucial need to develop methods to enable product designers and developers to

assess user experience in the earliest possible stages of product development so as to avoid expensive amendments and failures.

1.2 RESEARCH PROBLEM

As indicated above, there is a lack of research on how user experience can be assessed in the early phases of the design process when the actual product or working prototype is unavailable. While a few studies have actually touched on this area, further research is needed to address their limitations.

Experience prototyping (Buchenau and Fulton Suri, 2000), Wizard of Oz (Weiss et al., 2009), speed dating and user enactments (Davidoff, Lee, Dey, and Zimmerman, 2007), use before use (Ehn, 2008; Redström, 2008), and social interaction prototyping (Kurvinen, Koskinen, and Battarbee, 2008) are examples of methods already developed to explore design concepts and to assess users' experiences before their use of the actual product. These methods are valuable for evaluating and generating design ideas, as well as for simulating what it will be like to use the designed product. However, they appear to rely strongly on the use of low-fidelity or computer-simulated prototypes, models, and usage scenarios, through which users encounter design concepts created by designers. This approach is not always applicable as, in the conceptualisation stages of product design, the information required to build such prototypes, models, and scenarios may be inadequate. Moreover, the above methods may be difficult to implement and – as Vermeeren et al. (2010) note with regard to *before usage* evaluation methods – they may have reliability and validity problems. It also appears that the design concepts and contexts of use in such methods are created by designers with minimal input from users.

This research investigates *anticipated user experience* to support design for positive experience. It focuses on facilitating designers' use of user anticipation to conduct early assessment of user experience. To this end, the study empirically explores how users imagine a desired product, and how they anticipate their experiences with the desired product. This exploration includes identifying the characteristics of anticipated user experience. Here, the design concepts and contexts of use are entirely conceived by the users themselves without the use of any prototypes or scenarios. Thus, compared to existing methods, this approach can be conducted

much earlier in the design process, and can also provide rich design ideas and potential contexts of use that are completely based on users' real needs and expectations. This deeper understanding of anticipated user experience will, in turn, lay a firm foundation for the development of practical user experience assessment methods that support the initial phases of product development.

1.3 RESEARCH QUESTIONS

Industry undertakes user experience evaluation in order to improve their products. Väänänen-Vainio-Mattila, Roto, and Hassenzahl (2008b) highlight the importance of early and frequent evaluations in a product development process, as the earlier these evaluations can be conducted, the easier it is to modify a product so as to reach its design targets. However, assessing user experience in the very early phases of product development is difficult and challenging, and thus requires more research (Roto, 2007; Roto, et al., 2009; Väänänen-Vainio-Mattila, et al., 2008b).

Existing user experience models, frameworks, and evaluation methods have largely been related to the final stages of product creation in which users can interact with functional products. It is argued, however, that the incorporation of user experience assessment in the initial phases of product design and development can potentially support designers in designing better products to meet users' experiential needs. Such practice is also essential for preventing design modifications in the very late development stages, which are far more difficult and costly.

Based on the research background and problem (Section 1.1 and Section 1.2), the overall research question is formulated as follows:

> ***How can designers be supported in assessing user experience in the early stages of product design and development?***

To address this primary research question, two important issues need to be considered. First, in the early stages of product design, neither a functional prototype nor the real context of use is usually available. Consequently, prospective users may only be able to construct an anticipated use or anticipated experience with a conceptual product based on their prior experiences, knowledge, needs, and

expectations. Authorities refer to this as user experience *before usage* (Bargas-Avila and Hornbæk, 2012; Law, Roto, Hassenzahl, Vermeeren, and Kort, 2009; Roto, et al., 2011; Vermeeren, et al., 2010). It has been suggested that episodes beyond the actual usage of a product, including anticipation and recollection, play a central role in forming the holistic user experience (Karapanos, et al., 2009; Norman, 2009; Roto, et al., 2011). In particular, anticipation affects the actual experience when that experience eventually unfolds (Mäkelä and Fulton Suri, 2001; Roto, 2007). Desmet and Hekkert (2007) refer to the anticipation of product use as non-physical interaction, which can result in affective responses. Likewise, Karapanos et al. (2009) posit that anticipating experiences of product use can be more emotional, influential, and memorable than the actual experiences per se.

A number of user experience definitions (e.g. ISO 9241-210, 2010; Sward and Macarthur, 2007) also contain the terms 'anticipated use' or 'anticipated interaction', indicating that user experience should be explored and assessed not only *during* or *after* interaction, but also *before* the users actually use the product. Vermeeren et al. (2010) concur by stressing that user experience before interaction should be considered as something evaluable. Therefore, this study argues that a deeper understanding of *anticipated user experience* would be advantageous for supporting user experience assessment in the early stages of product development. This understanding requires insights into the way users anticipate experiences with an imagined interactive product, and into the characteristics of these anticipated experiences. However, limited information on these matters exists in the literature (Section 4.2). Filling this knowledge gap, therefore, will assist in answering the main research question.

Second, to effectively assess user experience without involving any working products, it is crucial to distinguish between anticipated and real user experiences. Real experience stems from physical user-product interactions in real contexts, and is unlikely to occur in the early phases of the design process. An understanding of how anticipated user experience differs from actual experience will allow the identification of its unique characteristics. This, in turn, can determine the way in which early assessment of user experience should be conducted. Moreover, this new understanding will indicate important user experience elements that may be missing

in the anticipated experience. This will help to ensure that no essential factors are left out when user experience is assessed according to users' anticipation. There is, nevertheless, no clear explanation of the differences between anticipated and real user experiences in the existing literature. In a survey involving user experience researchers and practitioners as participants, Law et al. (2009) found that the relationship between anticipated use and real experiences is not well understood. This suggests that more clarification of both 'anticipated use' and 'real experience' is required. In the case of this study, the differences between anticipated and real experiences must firstly be identified to better address the primary research question.

Figure 1.1 illustrates the aspects and areas of research that have been discussed. These lead to two research sub-questions:

Research sub-question 1: ***How do users anticipate experiences with interactive products?***

Research sub-question 2: ***What are the differences between anticipated and real user experiences?***

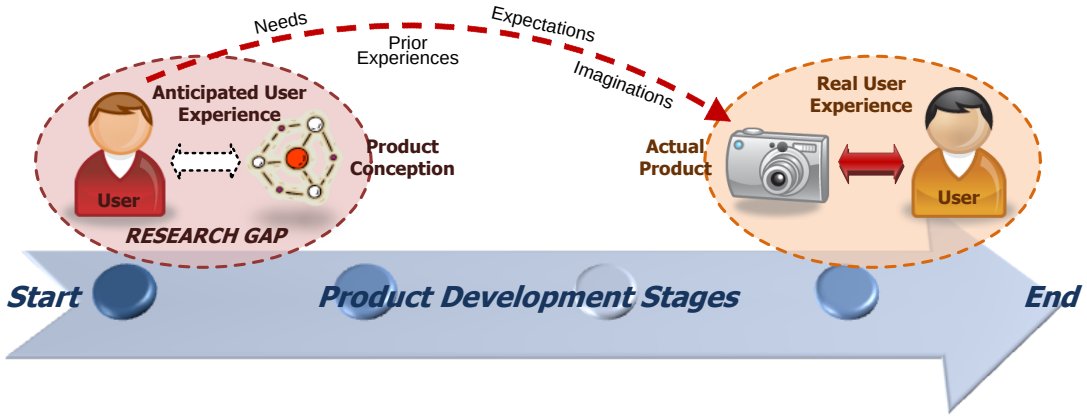

Figure 1.1 Anticipated and Real User Experiences

In the following section, the research question and sub-questions are further related and translated to relevant research aims and objectives.

1.4 AIM, SCOPE, AND OBJECTIVES OF THE RESEARCH

This research aims to provide new knowledge of anticipated user experience to support the initial stages of product development. This knowledge will facilitate the design of high quality products that engender positive experiences for their users.

The scope of this study is limited to the area of everyday interactive products (e.g. digital cameras, mobile phones). With regard to the exploration of the characteristics of anticipated and real user experiences, substantial focus is placed on users' perception of the importance of pragmatic and hedonic qualities, which are fundamental aspects of experience-centred design (Section 1.1). Furthermore, in the present study, the research outcomes are limited to the new understanding of anticipated user experience, user experience frameworks, and design recommendations for researchers and designers. These outcomes are not in the form of practical support for designers yet. A practical tool or method for the early assessment of user experience will be developed in future studies.

In light of the research question and sub-questions (Section 1.3) and the aim and scope of the study, three research objectives are defined:

1. To gain an understanding of how users anticipate their experiences with interactive products. This includes identifying the characteristics of anticipated user experience.
2. To identify the differences between anticipated and real user experiences.
3. To develop a framework and design recommendations for supporting designers in assessing user experience in the early stages of product design and development.

Figure 1.2 shows the components and basic plan of the research according to the defined objectives. As can be seen, the investigations of anticipated and real user experiences are the underpinning steps of this study. The results of these investigations contribute to a comparative analysis of the two experience types. This knowledge, with the inputs of specific findings with respect to each experience category, underlies the development of a framework and design recommendations for supporting the early phases of the design process.

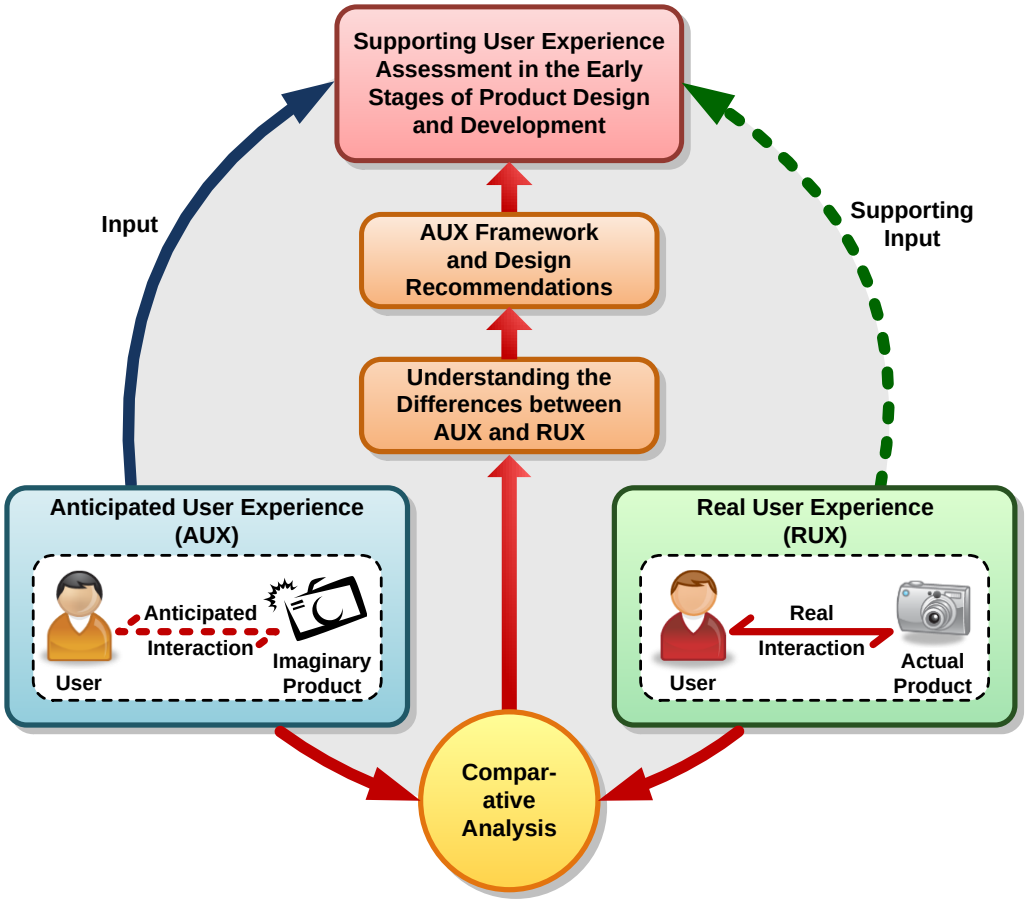

Figure 1.2 Components and Basic Plan of the Research

1.5 RESEARCH SIGNIFICANCE

This study contributes to the design for positive user experience. The contribution lies in three areas: (1) providing new knowledge of *anticipated user experience* in the fields of product design, interaction design, and experience-centred design; (2) addressing the gap within current research with regard to user experience *before usage*; and (3) addressing the need for user experience assessment in the early phases of product development. Specifically, the study generates a greater understanding of the following aspects: (1) a user's process of anticipating experiences with interactive products; (2) the characteristics of anticipated user experience; (3) the differences between anticipated and real user experiences, which focus on the key elements of each experience type and on the roles that pragmatic and hedonic qualities play in those experiences; and (4) the essential factors and design recommendations that need to be taken into account in supporting the initial stages of the design process.

The main outcomes of this research include the sub-category networks that form the Anticipated User Experience (AUX) Framework, and design recommendations that are derived from the findings. These outcomes allow researchers to better understand how users appraise, perceive, and experience an interactive product before actual interactions. They also provide the researchers with a foundational knowledge of anticipated user experience on which future research in the area can build. In addition, this foundational knowledge will inform the development of practical methods for the early assessment of user experience.

The study outcomes will assist and guide product designers and developers in assessing and designing for user experience from the outset of the product development process. In industry, the early assessment of user experience is crucial, since it contributes to potential savings by reducing design changes in the final product development stages. This is supported by the fact that the later the design is changed, the more the product development will cost (Magrab, 1997). In addition, given that positive user experience has become a key competitive factor that enhances a product's success (Sward, 2006), this study is significant as it supports product designers and developers to deliver more pleasurable products that meet or exceed users' experiential needs.

1.6 THESIS STRUCTURE

Chapters 2, 3, and 4 review the substantial literature relevant to the primary and sub research questions stated in Section 1.3. They establish a knowledge foundation on which the study is grounded, and serve to identify the knowledge gap in the area of anticipated user experience and early assessment of user experience.

Chapter 2 introduces the notion of user experience, and explores its definitions, theories, models, frameworks, and temporal characteristics. This chapter also explores the roles of pragmatic and hedonic qualities in user experience. It points out that the existing work mainly focuses on user experience during and after product use, and that user experience before use needs more research to support the design for experience in the early stages of product development.

Chapter 3 examines the earlier methods for assessing and designing for user experience, highlighting those that are intended to support the initial stages of the design process.

Addressing the two research sub-questions (Section 1.3), Chapter 4 examines the literature pertaining to anticipation, expectation, expectation disconfirmation, and the roles that they play in user experience.

Chapter 5 presents the research design and methodology used to investigate users' anticipated and real experiences in order to address the research problem. These are integrated into the research plan, which outlines the study's two experiments. The procedures for the recruitment of research participants and for the data analysis are also discussed in this chapter.

Chapter 6 explains Experiment One, which explores how users anticipate their experiences with interactive products. It describes the data collection process, which involves co-discovery, sketching, and observation methods. The data analysis, which is based on the developed coding scheme and sub-category co-occurrences, is detailed. This chapter then presents the experiment's results in the form of the occurrence patterns of categories and sub-categories, the perceived importance of pragmatic and hedonic qualities in anticipating experiences, and the relationships among sub-categories.

Chapter 7 explains Experiment Two, which investigates how users actually experience a real product. The use of experience diary, co-discovery, and observation methods to gather the data is described. As in Chapter 6, the data analysis procedure is then outlined and the experiment's results are delineated.

Chapter 8 discusses the experiments' results within the context of the relevant literature, and identifies the research findings and emerging theories. It focuses on the characteristics of anticipated user experience, and on the process through which users anticipate their positive experiences with products. In this chapter, the AUX Framework is introduced and discussed. Further, the characteristics of anticipated and real user experiences are compared and differentiated.

Chapter 9 discusses the significance of the findings to the field of study. The potential use of the AUX Framework in the design process is explained. In the same chapter, design recommendations related to experience-centred design are proposed and discussed.

Finally, the implications of the research and its contributions to knowledge are outlined in Chapter 10. The limitations of the work are also identified, and future research directions are proposed.

1.7 SUMMARY

As users' needs shift from usability to positive experiences, product designers and developers are forced to provide users with enjoyable product experiences in order to compete in today's business environment. To facilitate this provision, the assessment of user experience in the early stages of the design process is required. However, the existing knowledge of user experience assessment in the initial stages of product development is lacking. This research addresses this deficit by investigating the area of anticipated user experience, and then applying this new knowledge to support product designers to assess user experience early in the design process.

Chapter 1 has introduced the research background that justifies the study and contextualises the research problem. The main and sub research questions were then formulated in response to the research problem. This chapter has also described the aim, scope, and objectives of the research. Finally, the research significance and the thesis structure were presented. Chapters 2, 3, and 4 will now review the relevant literature in the study area.