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## Quality of Experience and Learning in Information Systems

Incorporating Learning and Ethics into Characterizations of Quality of Experience





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### Preface

This book undertakes the notion of evaluating the experience of a user, when the user experiences a new technology. We focus mostly on learning scenarios and we observe the experience aspect from a number of perspectives. We investigate how specific changes in the interface itself can affect experience, but also how the performance of the infrastructure and technology can affect this experience. We explore user expectations, when these expectations have to do with ethics such as trust, bias in design and personal freedoms. The reader navigating through the chapters will come to explore different considerations of user experience for designing new technology products, characterising new types of interactions between users and technology, and understanding how experience is affected by the context of interaction, e.g. learning scenarios.

Well-known notions of experience are presented and discussed, such as user experience, often abbreviated as UX, and user quality of experience, often abbreviated as QoE. We come to the conclusion that a truly positive experience for the technology needs to incorporate aspects of both UX and QoE. These concepts are investigated in different chapters through simple examples and models. In order to address the quantification of experience there needs to be a consideration of how the user experience can be affected by a number of factors. Some of these factors are the contextual environment, the system setup and the network efficiency, but also the interface aesthetics, the software mechanisms, the user behaviour and, in some of the scenarios, the ease with which learning can take place.

Terms such as QoE or UX are coined to refer to the different ways in which user response to a technology is captured. QoE and UX is of interest to us throughout this book, which aims to approach these terms by looking at motivation and decision making that different scenarios, including learning-specific scenarios, may inspire. QoE is an emerging paradigm that puts the user in the centre of the design and evaluation processes of new innovative technological products while still focusing on the quality of the technology itself. UX is an approach that encompasses aspects that deal with the interaction of the user with a particular product or interface. This is mostly focused on user requirements that should be achieved through a satisfactory, simple and aesthetically pleasing solution. Interface design is part of but not all that UX aims to address and evaluate. Changing and emerging technologies motivate us to combine these notions and investigate the experience of the user, as this experience relates to these technologies and to specific scenarios.

Investigating the user experience implies that the user is an active, decisionmaking entity in the investigated interaction models. The user in different scenarios is required to make decisions based on both complete and incomplete information. The information that the user lacks access to often has to do with another entity's decisions and actions or with matters of technology performance, such as network traffic during the usage of a 5G network, or information about co-existing virtual machines during the usage of a cloud platform.

In fact, user experience can be controversial. On the one hand, interacting with the emerging new technology may turn out to be an easier and more comfortable experience than other alternatives. On the other hand, it can create a sense of lack of control in terms of privacy or personal data protection and other ethical aspects that are important for a satisfying user experience. The increasing deployment of 5G, IoT, Cloud and AI technologies can be either a catalyst for improved user experience, or the opposite, depending on the development and usage approaches. We are not concerned with the overall quantification of user experience but, instead, we aim to offer a closer look into a selected number of interactions and decision-making scenarios, especially in situations where learning or education aspects exist.

The book uses examples of learning and ethics, in several of the investigated scenarios, as well as the way in which these example relate to technology and to the user experience. This approach is chosen in order to investigate relevant decision-making scenarios that may arise with the increasing use of the emerging technologies outlined in the book.

Chapter 1 presents an overview of emerging technologies, focusing on factors and parameters that will be revisited during the following chapters. Emerging technologies are becoming popular, affordable and pushing for a technological revolution in many disciplines. Innovative technology solutions are proposed across the board and increasing numbers and types of users are becoming dependent on them. This revolution has managed to find its way to educational platforms, applications, and both physical and virtual learning tools. The challenge with such educational innovations is that the growth and change in the education practices has not been as rapid as the growth and change in the technology field. Therefore, the user participating in the merging of these two fields to create new solutions may find it challenging in terms of a comfortable experience.

Chapter 2 investigates ways of adopting new educational technologies as part of learning in formal, informal and non-formal educational environments. Towards that goal, there is a need to revisit digital pedagogies to align with new technological capabilities and new user needs. In fact, digital pedagogies need to consider the idea of integrating technology in education as more than just a tool for learning but as an active part of the pedagogy, especially as the need for distance learning delivery and

virtual learning environments is increasing. In addition to the idea of digital pedagogies, which are part of more formal environments, concepts such as digital citizenship, whole-school and whole-child approaches are presented to emphasise the widespread need for improved experience with education when it comes to any form of learning (informal, non-formal).

Chapter 3 explores such new technological learning environments and focuses on distance learning platforms. The chapter considers the student preferences as a factor that can affect user experience metrics. Student preferences can be contradicting in group learning environments, and this can be even more challenging in distance learning environments. The chapter explores student preferences as reflected by individual learning styles und used game theoretic models to investigate the interaction between a teacher and the group of students as well as between the students themselves. The chapter tackles user experience and how this is affected by individual learning characteristics and preferences of the students, but also explores the teacher's goal of satisfying those student preferences. Given that learning preferences cannot be completely revealed to the teacher, then ways of improving student experience must be investigated. In addition to the teacher perspective, the chapter focuses on the dynamics between the students themselves during some simple interactions where information processing preferences are used as the parameter that affects students' overall positive experience.

Chapter 4 shifts focus to the technology and discusses the use of Cloud Computing and how this is a trend that has many positive aspects for its users. However, the idea of trust comes into play because Cloud Computing technology is a very abstract concept for many users, and details of its operation are often not revealed. The chapter discusses the technology overall, but quickly shifts focus to a specific example and explores the interaction between a cloud provider and a cloud user from the perspective of trust. Trust between the two interacting parties can affect the user's positive experience. This is even a bigger factor when considering a recurring interaction or an interaction that is continuous over time. The chapter focuses mainly on the perspective of the user. The cloud provider is also significant in the discussion as well as the elements of chance and overall policy. The overall aim is to discuss the motivation for an interaction that will provide a positive experience for the user and a positive payoff for the cloud service provider, as the interaction progresses in time.

Chapter 5 discusses the interface aspect and explores the concept of user experience design and how this design is affected by emotions evoked by interface aesthetics and interface functionality. Concepts such as usability and sociability are presented, as well as challenges in decision-making that the designers face. The selected example deals with digital interfaces that allow for interactions between different users, and the design considers the element of user-to-user communication as part of the experience. The type of digital interface explored in the example is one used for mentoring, i.e. it allows for knowledge exchange between the different types of users. The design of the interface can play an important role in improving the user experience. When referring to experience in relation to a specific interface, we generally refer to elements such as interface usability and design features. To achieve improved UX, designers need to consider elements of user experience as part of the design process, and the overall process is referred to as user experience design.

Chapter 6 addresses emerging AI technologies, but not from a technical aspect. It explores the need for ethics to be integrated with the technical design aspects during the development process of AI products. In order for designers and developers to be able to consider and include ethics in to this process, they have to learn ethics as part of their acquired skills. Therefore, the chapter deals with the teaching and learning aspects of ethics for emerging new technologies, especially AI. It is important to recognise that there are ethical issues associated with the development and use of such technologies. Furthermore, the chapter recognises the trend of an increase in the development and use of AI across many application areas, and ethics must be considered. Moving forward, necessary learning and teaching practices need to be integrated into software development courses. AI is not a standalone technology but a technology that is integrated with society and people and needs to be understood in such an inter-disciplinary manner. The assumption that such courses exist and developers can decide to integrate them into ongoing professional development goals is what the chapter scenario addresses, in an attempt to demonstrate that expectation of ethical design by users can be reflected into resulting user experience from usage of the specific technologies.

Chapter 7 returns the focus to the technology itself. It explores how technology can approach resource management in a user-centred manner. Specifically the chapter takes a look at a 5G resource management scenario to provide a network perspective on the user experience, more as a QoE evaluation in this case. It presents the 5G mechanism of network slicing, which is planned by 5G as a mechanism to address user QoE. Given that network slicing is a wanted solution to support user OoE in 5G networks, specific aspects are explored such as the need to limit the amount of slices in order to avoid a resource scarcity issue and the need to deal with groups of applications assigned to each slice. Groups of applications assigned to a specific slice have similar resource requirements and corresponding quality requirements, but resource management mechanisms still need to address the needs of individual services or applications. The challenge that arises from this grouping of services is that in such a scenario, each service or application has its own specific requirements in addition to the main target requirement for the group, which characterises any specific slice. The scenario presents a scenario that deals with having two applications sharing a slice and having some different requirements. The simplicity of the example gives us the opportunity to discuss some important concepts related to the evaluation of system efficiency in relation to individual user decisionmaking and how selfish behaviour can affect a system's social good.

Overall, the chapters follow a similar structure. Other than the first two chapters, which focus extensively on technology and learning background knowledge necessary before moving forward, the rest of the chapters follow the following structure.

They, firstly, present the technology and necessary theory or background to understand the scenarios. Then, the scenarios are presented, followed by a mathematical model of the scenario in order to give the reader a more detailed view of decisions and consequences for the entities interacting in each scenario. The chapters finish with a brief discussion of the chapter conclusions.

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