A DESIGN METHOD FOR END-USER ENGAGEMENT AND INTERACTION WITH SOCIAL MEDIA TECHNOLOGIES

Y. OYEDELE

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A DESIGN METHOD FOR END-USER ENGAGEMENT AND INTERACTION WITH SOCIAL MEDIA TECHNOLOGIES

By

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Submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Information Technology, in the Faculty of Engineering, Built Environment, and Information Technology at the Nelson Mandela University

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Promoter: Professor Darelle van Greunen

DECLARATION BY CANDIDATE

I, Yemisi Oyedele (214148203), hereby declare that this thesis is my work and that it has not previously been submitted for assessment to another University, or for another qualification.

……

Yemisi Oyedele

DEDICATION

James, Victoria, Opeoluwa, John, Ifeolu, and myself.

ACKNOWLEDGMENTS

All the glory to the Almighty God who made all things work out for my good and the successful completion of this study.

To my promoter: Professor Darelle van Greunen: My deepest gratitude and appreciation to you for your constant encouragement, guidance, and suggestions throughout my study. You always see the best in me. Thank you so much for the immense support and exceptional kindness especially when I get carried away with my thoughts during our meetings. You have done so much for me on this PhD journey that not enough words can describe.

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My sincere gratitude to the NMU Office of Research Development and the NMU School of ICT for financial support. Last, but not least, a special thank you to many other persons that walked this journey with me.

LIST OF PUBLICATIONS

The publications contained herein have either been published, accepted for publication; or are in progress (under review). The following publications stemmed directly from the work in this thesis:

Oyedele, Y., & van Greunen, D. (2022). An approach to developing UX heuristics for engagement and interaction. *2022 IST-Africa Conference (IST-Africa). Under Review*.

Oyedele, Y., & van Greunen, D. (2022). Characterization of end-users' engagement and interaction experience with social media technologies. *Computers in human behavior. Under Review*.

Oyedele, Y., van Greunen, D., & Veldsman, A. (2018). UX Engagement and Interaction. *2018 7th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO)*, 792–798. https://doi.org/10.1109/ICRITO.2018.8748639

ABSTRACT

Social media technologies are ubiquitous and have become essential information and communication technology applications for society. These technologies provide end-users with the experience of interacting with different social media platforms and socialising with other end-users on these platforms. They also contribute towards the personal development of end-users and the development of the social media community, which has become an important part of their everyday lives. As social media technology evolves, measuring end-user engagement becomes challenging. In the existing literature, the measured engagement, such as the end-user's activities, typically represents an aspect of the experience that the end-users have with the technology. This view is a single dimension of the end-user's engagement and, at the same time, a limited representation of the actual interaction the end-users have with the technology. In addition to the behavioural aspect, other dimensions that occur during the interaction are the emotional and cognitive aspects. Together, these three aspects of end-user engagement occur simultaneously during the interaction period. Therefore, there is a need to define and design a broader view of the end-user's engagement with social media technology.

The main research objective of this thesis is to develop an artefact that informs the design of social media technology based on the knowledge or understanding of the end-user's perspectives of the emotional, cognitive, and behavioural aspects when engaging with social media technology. Also, this study has three sub-research objectives. The first sub-research objective is to define end-user's engagement and interaction using a concept called User experience engagement and interaction. This concept is proposed to holistically represent the three-dimensional engagement that end-users have with social media technology. The second sub-research objective is to identify an approach to derive some design guidelines and heuristics for social media technology engagement and interaction. The third sub-research objective is to determine how to constitute the end-users experience and design elements into a method.

Moreover, this study follows a design science research paradigm. This approach, which combines a literature review, a case study, and an illustrative scenario, was used in the research process to achieve the three sub-research objectives. Specifically, the literature

review and the case study focus on defining the end-users' emotional, cognitive and behavioural engagement with social media technology. Findings were used to interpret end user engagement and develop the design method that would aid designers and developers to enhance end user engagement and interaction with social media technologies.

Keyword: end-user experience, engagement, social media, interaction, behaviour, emotion, cognition, design method.

PREFACE

In 2014, when this research commenced, social media technologies were largely dominated by Facebook. The social media landscape in which the target population of this study reside in, looks markedly different now than it did as recently as three years ago. In 2018, other than Facebook, the social media space was dominated by YouTube, Instagram, and WhatsApp.

The unfolding of the COVID-19 pandemic has demonstrated how quickly the technology landscape can evolve. Technology advancements and social media created opportunities to keep people safe, informed and connected.

The COVID-19 pandemic came with restrictions, regulations, and stay-at-home orders. This meant that people stayed indoors, offices remained shut, playgrounds were empty, and streets remained barren of human interaction. Many individuals could not return to their homes, many stuck in foreign countries and many in solitude. As a result, the usage of digital devices has increased manifold across the globe. Irrespective of age, people were pushed to rely on digital platforms. Education, shopping, working, meeting, entertaining and socialising suddenly leaped from offline to online. Digital technology came as a blessing in disguise, enabling individuals to remain emotionally connected despite the social distancing.

It is necessary to keep the above in mind as the data for this study was collected in 2018 and 2019 and the applicability of the findings had to be determined in a different manner as the world of social media technologies had changed.

The findings of this research are therefore based on qualitative interpreted findings underpinned by arguments from literature fused with recent changes in end user engagement and interaction with social media technologies.

NOTES ON WRITING STYLE

Spelling:

United Kingdom (UK) spelling is used in this thesis, except in citations or direct quotations. Words that can be spelt with either an "i" or "e" are spelt with "e". For example, "artefact" is used in place of "artifact". Another instance is the use "ou" or "o" such as is in "behaviour" However, the original spelling of words such as authors' names and the responses of the case study participants with typo issues have been preserved.

End-user:

Generally, the term "user" refers to a person or a group of persons that interact with a product (Dix, Finlay, Abowd, & Beale, 2004; International Organisation for Standardization, 2010). The terms "end-user", "end-users" and "user" have been interchangeably used to refer to people who interact with ICT. Any of these terms implies that a product must have been designed for, developed for, and/or deployed for people. The early phase of the product development life cycle elicits the business goals and user needs for the product idea. The "users" are represented as "target users" in that the product is not yet in a state where people can interact with it as end-users. "Representative users" correspond "appropriately to the target end-user population" and are involved in design decisions related to determining which functions of an ICT product will be automated or assigned to human performance (International Organisation for Standardization, 2010).

For this study, the terms "end-user/end-users" refer to a person(s) who interact with an ICT product for the primary purpose of meeting their own needs in the context of use.

End-users interact with these ICT products differently to meet their needs (Dix, 2016; Roto, Law, Vermeeren, & Hoonhout, 2011).

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LIST OF ABBREVIATIONS AND ACRONYMS

Acronym	Description
API	Application Programming Interface
HCI	Human-Computer Interaction
HEI	Higher Education Institution
ICT	Information and Communication Technology
MVP	Minimum Viable Product
NMU	Nelson Mandela University
OECD	Organisation for Economic Co-operation and Development
REC-H	Research Ethics Committee – Human
SDLC	Software Development Life cycle
UGC	User-Generated Content
UX	User Experience
UXD	User Experience Design

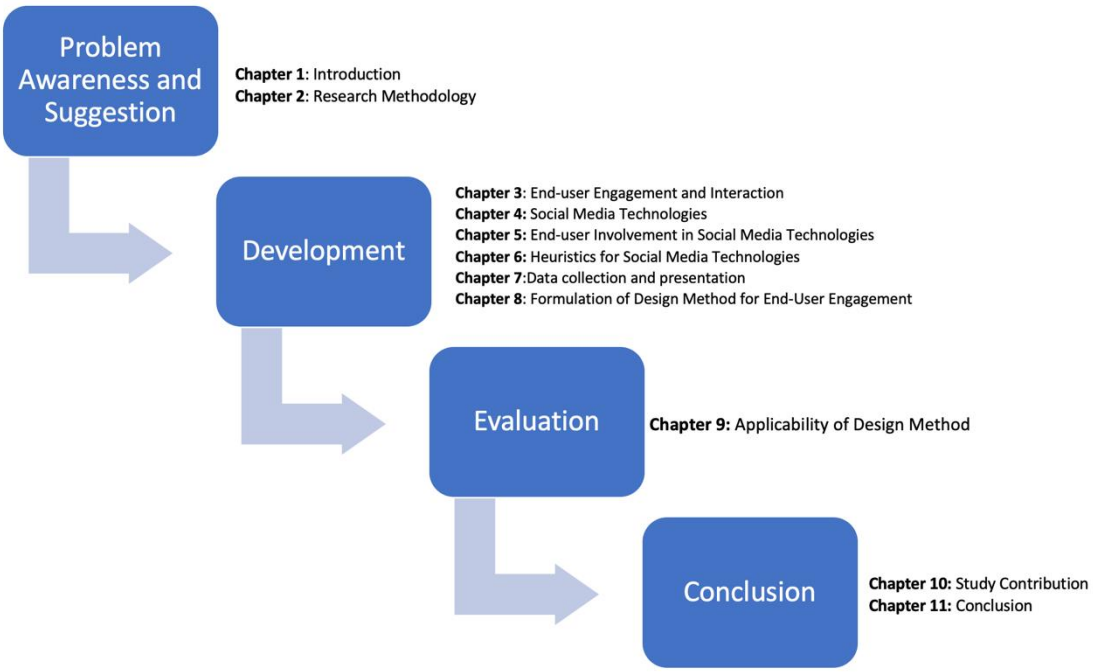
LIST OF APPENDICES

Appendices are listed at the end of this document and are available in the included DropBox link.

https://www.dropbox.com/sh/bfrlsharpmo3jgr/AAB2E-HMuticiX3Hh3kMIDEja?dl=0

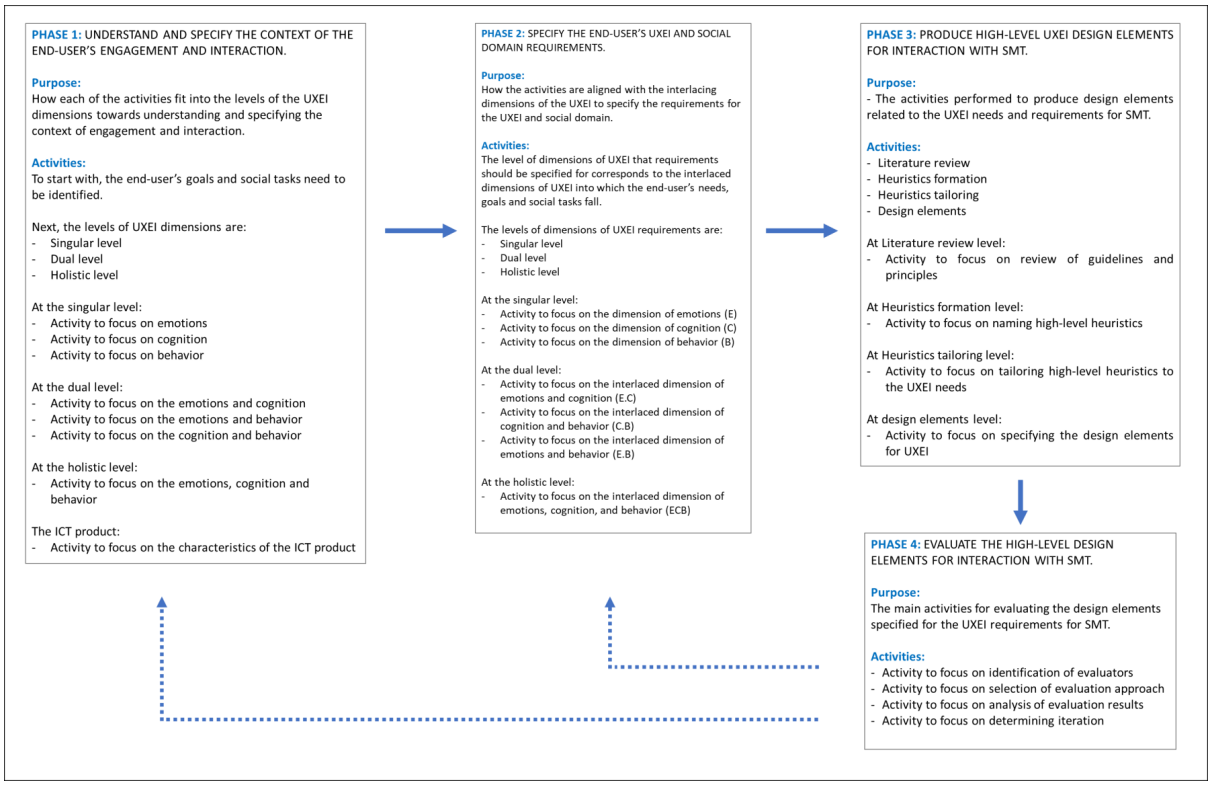
THESIS MAP OF ALL CHAPTERS

The thesis map provides a generic illustrative overview of the structure of this thesis based on the selected synthesised design science research (DSR) model motivated in Chapter 2. The map also includes the chapter numbers and important sections within this thesis in respect of each of the phases and processes of the DSR method applied.

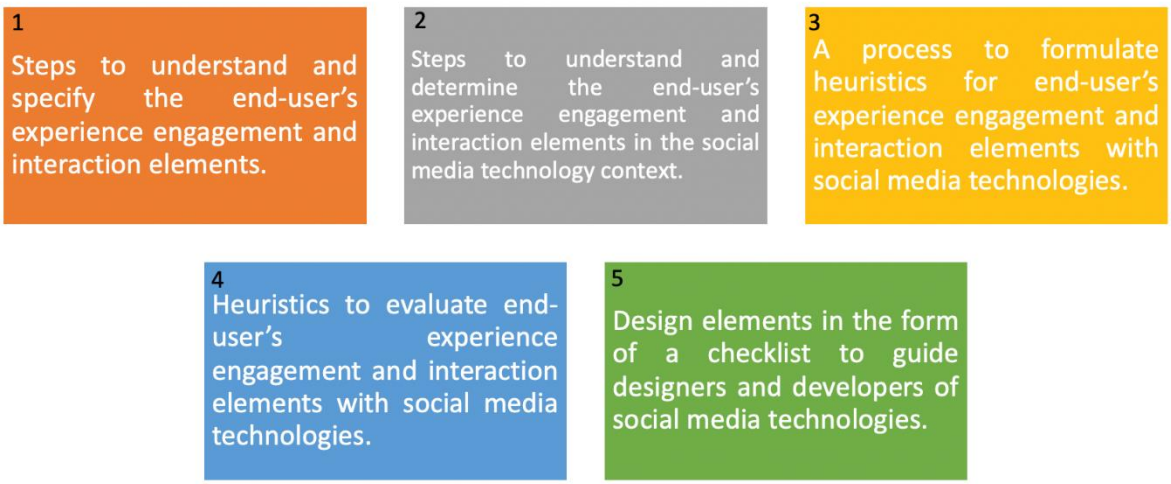


SUMMARY OF THE KNOWLEDGE CONTRIBUTION

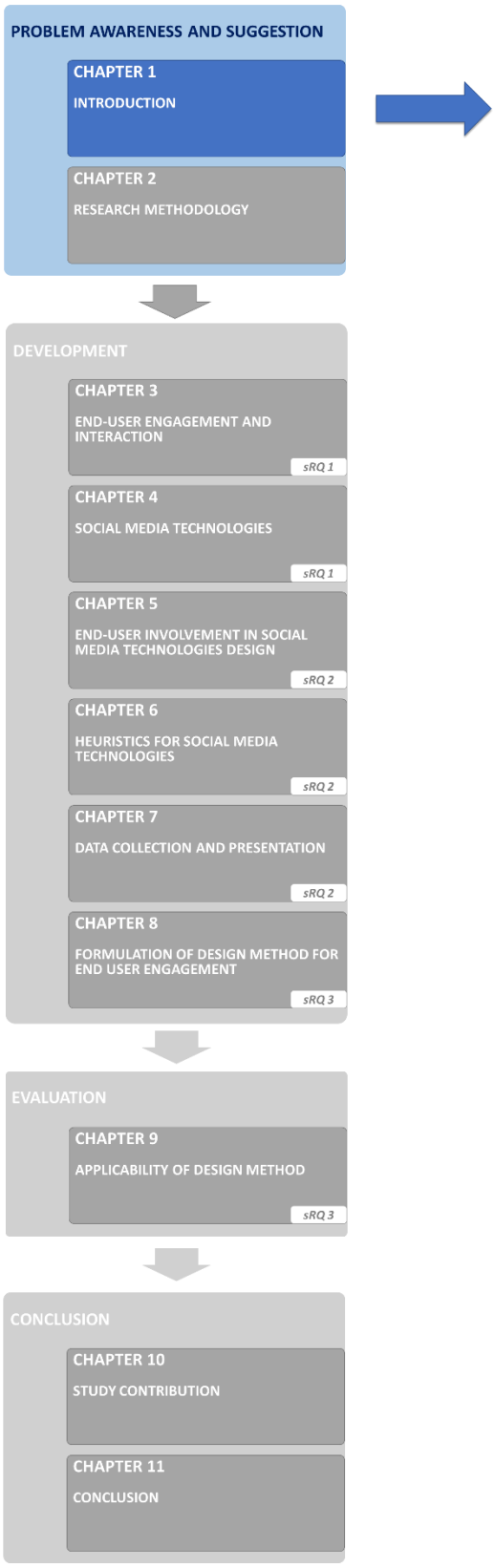
The diagram below presents a summary of the five interrelated meta-artefacts that constitute the research contribution to the body of knowledge pertaining to end-user experience engagement and interaction with social media technologies.



The contributions of the research presented in this thesis to the body of knowledge can be summarised as depicted below:



CHAPTER 1 – INTRODUCTION



1.1 Introduction

The continuous evolution of information communication technologies (ICT) spreads to aspects of societal living such as personal development, business, child education, social networking, banking, and engineering, to name a few. The proliferation of ICT has helped bring about the 4th Industrial Revolution, which focuses on the enhancements of the economic and social aspects of society using disruptive technologies. These include the Internet of things, robotics, virtual reality, and artificial intelligence. Social media technology is one of the profound ever-growing ICT that continue to be embraced and used by people from all walks of life. As people continue to embrace and use social media technologies, their expectations of a better and easier user experience increase. It is essential to understand the ever-changing experience a person has before, during, and after interaction with an ICT product to meet their increasing expectations. An artefact is needed to understand the users' perspective of engagement with an ICT product like social media technology.

This chapter presents an overview of the study conducted to develop a design method for end-user engagement and interaction with social media technologies. Section 1.3 presents the problem statement for this study, and Section 1.4 the research questions and objectives. Sections 1.5 and 1.6 present the research design and the scope of the study respectively. Section 1.7 presents the envisaged contribution of the study, while Section 1.8 presents the ethical considerations made for it. Section 1.9 presents an outline of the remaining chapters of this thesis followed by Section 1.10 which presents a summary of this current chapter. But first, Section 1.2 presents the background of the research problem.

1.2 Background of the problem area

1.2.1 Interest in social media technologies

Social media technologies are very significant in the behaviour of people at different levels of society and the world at large (We are social & Hootsuite, 2021a). Figure 1.1 shows the annual growth rate of the global social media use. The use of social media technologies, a part of ICT, continues to be prevalent in human society for day-to-day activities. Staying in touch with friends and family, brand research, video calls, work activities, advertising, filling up spare time, reading news stories, watching live events, marketing, and learning are some of these activities on social media technologies (Ornico & World wide worx, 2021; We are social &

Hootsuite, 2021a). The popularity of social media technologies continues to increase among different nations, communities, organisations, and even individuals. The use of social media technologies is more diverse in this era than in the past. According to a study on the digital landscape, the use of social media technologies in the world increased by 9.9% (that is, by over 409 million active social media users) between October 2020 and October 2021.

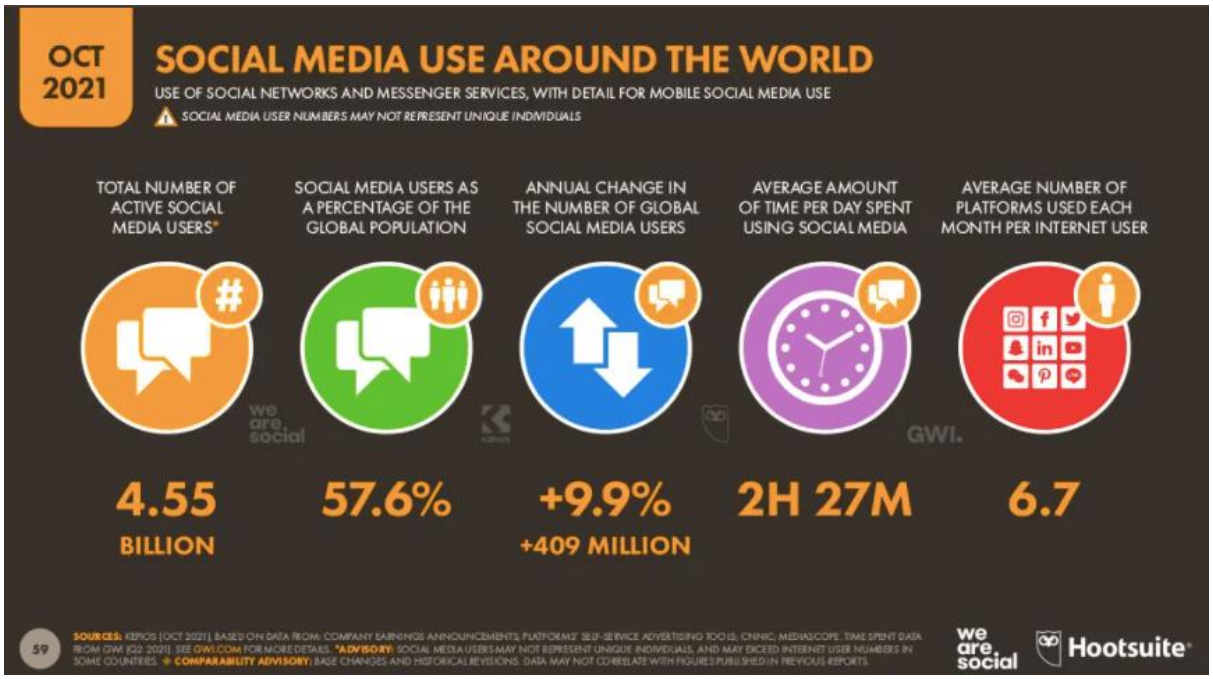


Figure 1.1: A snapshot of the growth rate of social media users between October 2020 and October 2021 (Adapted from We are Social & Hootsuite, 2021).

The popularity of social media technologies is aided by the predominant use of mobile devices combined with an affordable Internet connection to access its services as well as social apps whose data costs have been zero-rated by mobile telecommunication network operators (Ornico & World wide worx, 2021; We are social & Hootsuite, 2021a).

Owing to social media affordance, organisations and institutions incorporate the use of this platform into their regular processes, either at the organisational, service-delivery, or individual (personal) levels. Designers and developers strive to prompt and sustain user engagement and to keep user loyalty and retention with social media technology applications among the ever-growing ICT products.

The elements that constitute social media technologies are still evolving. On the one hand, new programming languages, interaction design, user interface designs and platforms and design teams are used to develop social media technologies. In the COVID-19 era, social media technologies are supported on mobile, Web, desktop, and wearables. Developers use the knowledge of these technological advances to develop the elements of social media technologies. The elements, especially the user interface, are seen by end-users. End-users interact with these elements. On the other hand, end-users contribute to the changes in social media technologies through their interactions, logins, logouts, and the social networks they belong to. Each end-user activity is displayed or reported on the user interface. As a result of the various forms of input from both developers and end-users, social media technologies continue to evolve.

1.2.2 Research motivation

User participation has been popularly used to describe the interaction that people have with the social media technology environment and yet it does not show the holistic nature of that interaction. For example, between 2010–2014, higher education and marketing institutions conducted studies on the use of social media technologies. These included education and community activities and how users engaged with the technology. Within the education and marketing activities, the literature reported different types of user participation, particularly low, inactive, or lurking behaviour. This type of user participation in the social media technology environment is behavioural (Trunfio & Rossi, 2021). Additionally, social media technologies have built-in analytical services that monitor and report the status of user actions and inactions on the platform. These are special features that are found on the user-generated content, profile, social network, and architectural levels. Typical evidence that shows how people have engaged with these technologies includes the number of views, likes, thumbs up/down and claps. As the number of end-users increases, the way to define and understand the nature of engaging experiences with the characteristics of the technology evolves. However, a problematic situation occurs when a person with low participation is considered to have low or no engagement with the social media technology. This is discussed in more detail in Chapter 4 of this thesis. A person's engaging experience with social media technology goes beyond clicking and typing. It is important to recognise that there is a need to understand and support the engaging experience of people regarding these technologies.

This study centres on re-conceptualising end-user engagement through an inquiry. It uses the elements of a holistic user experience (UX) approach to describe a person's engagement with social media technologies and design for it. UX is a term that covers everything that has to do with a person's perspective of an ICT product or service, before, during, and after an interaction (Roto et al., 2011). The approach for studying end-user engagement stems from the HCI domain, which attempts to bridge the participation knowledge gap as identified in literature (Trunfio & Rossi, 2021). This results in the identification of design components that influence an end-user's choice to engage with social media technologies or then designing for end-user engagement with social media technology-enabled environments.

Furthermore, this study argues that an end-user's engaging experience with social media technology is more than just their participation during interaction with the technology. Understanding an end-user's holistic engagement with social media technologies, and designing for it, could inform the view of social media technology end-user participation. This study produced an artefact that informs the design of social media technology based on an understanding of an end-user's perspective of the emotional, cognitive, and behavioural engagement with social media technology. Also, the artefact considers how the UX elements in a design could enhance interactions with social media technology. Understanding the engagement, a person has with social media technology could guide institutions and software developers to know which elements to take into consideration when designing, adopting, and integrating social media technology with their environment.

1.3 Research problem statement

Many of the attributes of end-user engagement and interaction with ICT have proved to be relevant in social networking applications. However, understanding the concept in this context and how to design the attributes and other characteristics (other stages) of the engagement still needs to be clarified. Thus, there is a need to guide future social media technology designers and developers to understand end-user engagement and design ICT products that engage end-users more.

Based on the background discussed in the preceding section, the problem statement for this study is formulated. It states that "*There are limited methods and approaches for understanding and designing a unified measure of an end-user's engagement and interaction with social media technology.*"

1.4 Research questions

Based on the premise of the problem statement, the main research question for this study is: "What are the components of a design method for unified end-user engagement and interaction with social media technology?" The context for this study is the social ecosystem of an educational institution, where it shares information related to education and the activities of the institution with its community.

The main research objective of this study is *to identify the components of a design method for unified end-user engagement and interaction with social media technology.* Three sub-research questions are as follows:

1) How can end-user engagement and interaction be defined within the context of social media technologies? The objective is to determine which key UX elements constitute an end-user's engagement and interaction in the social media technology context. The study emphasises the importance of understanding the UX-related aspects and the end-user's perspective of engagement and interaction.

2) What are the design elements that correspond to unified end-user engagement and interaction? The objective is to identify an approach to derive some design guidelines and heuristics for unified social media technology engagement and interaction. This study demonstrates the design guidelines and heuristics development for end-user engagement.

3) In what way can the UX and design elements be formulated into a method to support an end-user's unified engagement and interaction with social media technologies?
   The objective is to determine how the UX elements and design elements can be formulated into a method. This study aims to formulate a generic set of steps to align the UX and design elements with social media technology end-user engagement and interaction.

1.5 Research design and approach

1.5.1 Research approach

Research philosophy concerns how a researcher thinks about the research process. It also reflects on how the researcher views the world. This view supports the research strategy and method aimed to address the research questions (Saunders, Lewis, & Thornhill, 2016).

A design science research methodology was chosen for this study. It aims to provide an artefact as a way to identify and solve real-world research problems (Hevner, March, Park, & Ram, 2004). A design science research approach is applicable because this study aimed to generate an artefact consisting of UX elements to enhance social media technology end-user behaviour. Also, the artefact developed could guide software developers and designers on which elements to consider when designing for end-user engagement and interaction. The research process for this study is an adaptation of the design science research process as described by Vaishnavi and Kuechler (2013), and is further discussed and explained in Chapter 2 of this thesis. Figure 1.2 illustrates the process model.

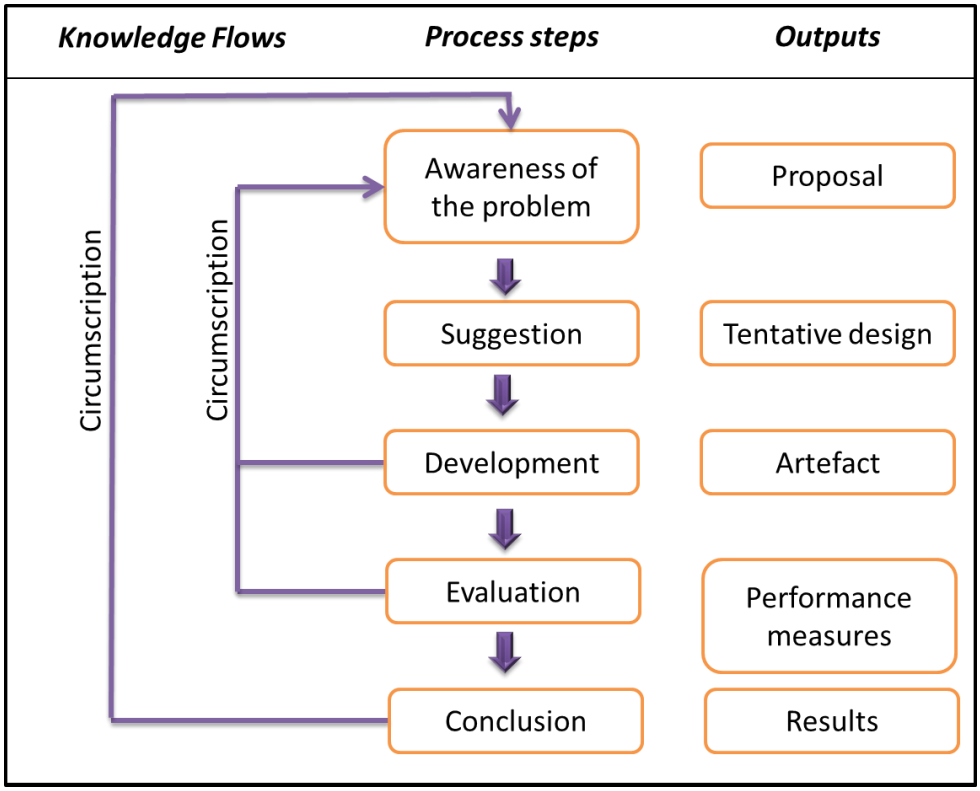


Figure 1.2: Design science research process.

Awareness of the problem: The background and description of the research area found in the literature review brought awareness of the problems to be addressed in this study. Following this, potential solutions to the problem were suggested.

The suggestion of a tentative solution: Meeting the objectives helped with identifying and proposing components for the artefact that was developed.

Development of the artefact: An initial design method was developed as an artefact based on the tentative components identified in the preceding step.

Evaluation of the artefact: In this step, the artefact is evaluated for its utility (applicability). This helps to determine the appropriateness of the method for the identified research problem.

Conclusion of the study: The findings of this study, such as the research process outputs and the artefact, and the applicability of the design method were discussed and are to be published.

1.5.2 Main data collection methods and expected outcomes

In this study, a mix of different sources and methods for data collection were employed as Table 1.1 illustrates.

Table 1.1: Sources and methods for data collection.

Sub-research questions	Main data source	Methods
1) How can end-user engagement and interaction be defined within the context of social media technologies?	Literature Questionnaire data	Literature study Case study
2) What are the design elements that correspond to unified end-user engagement and interaction?	Literature	Literature study Heuristics development
3) In what way can the UX and design elements be formulated into a method to support an end-user's unified engagement and interaction with social media technologies?	Literature	Literature study Argumentation

1.6 Scope of the study

On the premise that this research falls within the ICT field of study, Figure 1.3 depicts the overview of the scope of this study.

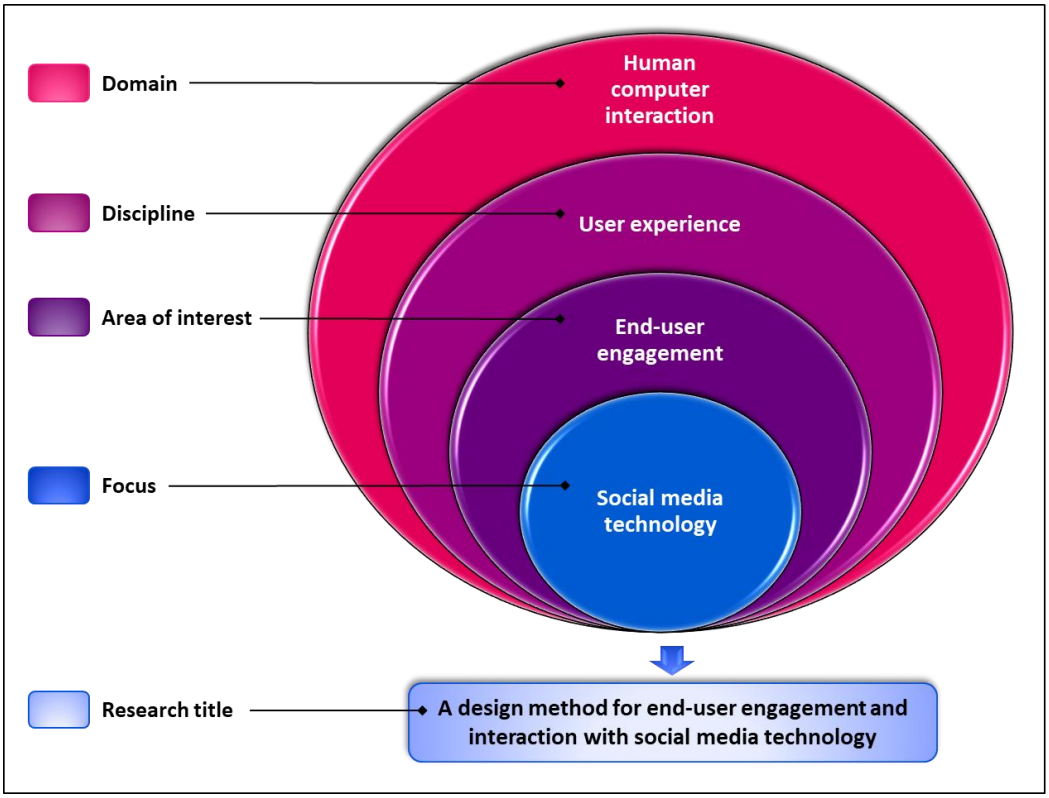


Figure 1.3: Scope of the study.

From the HCI aspect of the ICT field of study, this research focused on identifying the UX elements that support the design of unified end-user engagement and interaction with social media technologies. The focus was centred on four social media technologies and their end-users from a typical higher education institution in a developing African country. The scope of this research was limited to higher education institutions in South Africa. The case study used on a higher education institution that is categorised as a "comprehensive university", offering qualifications to learners who have had a high school education. Other criteria included the proximity of the institution to the researcher, and access to data for the research.

The emphasis of the research is on identifying the components of a design method for understanding and supporting end-users' unified engagement and interaction with social media technologies. Though the components were used to build the design method, the

implementation of the design method developed was beyond the scope of this study. This is because such a process would have required a longitudinal study for its implementation and evaluation, consequently exceeding the time permitted for this academic study. However, the applicability of the components of the design method was explored.

1.8 Ethical considerations

During the preparation of the case study, ethical clearance was obtained. The Nelson Mandela University guidelines for the Research Ethics Committee – Human (REC-H) research were followed, and the ethical clearance certificate (reference number H18-ENG-ITe-001) was obtained from the university.

1.9 Outline of the thesis

Chapter 2 – Research methodology

This chapter discusses the paradigm followed for the research. It also presents the philosophical assumptions, the research process, and the methods used in the study.

Chapter 3 – End-user engagement and interaction

This chapter explores the concepts that define end-user engagement and interaction and how these apply to the context of user experience.

Chapter 4 – Social media technologies

This chapter discusses the concepts that constitute social media technology and presents a view of end-user interaction and participation in the social media technology context. It also presents the need for a broad view of end-user engagement and interaction.

Chapter 5 – End-user involvement in social media technology design

This chapter presents the results of the literature findings on the design methods that consider end-user involvement.

Chapter 6 – Heuristics for social media technology

This chapter presents the results of a heuristics development process undertaken to identify the heuristics for guiding the design of end-user's experience management and interaction.

Chapter 7 – Data collection and presentation

This chapter presents the results of a case study undertaken to identify the end-user experience engagement and interaction elements in the social media technology context as well as the heuristics formed in the heuristic development process.

Chapter 8 – Formulation of a design method for end-user engagement

This chapter presents how the concepts in Chapters 3 to 6 of the thesis, and the findings in Chapter 7, relate to form a design method for end-user engagement and interaction with social media technology.

Chapter 9 – Applicability of design method

This chapter presents how the design method for end-user engagement can be applied to social media technology.

Chapter 10 – Study contributions

This chapter presents the contributions made in the course of answering the research questions in this study.

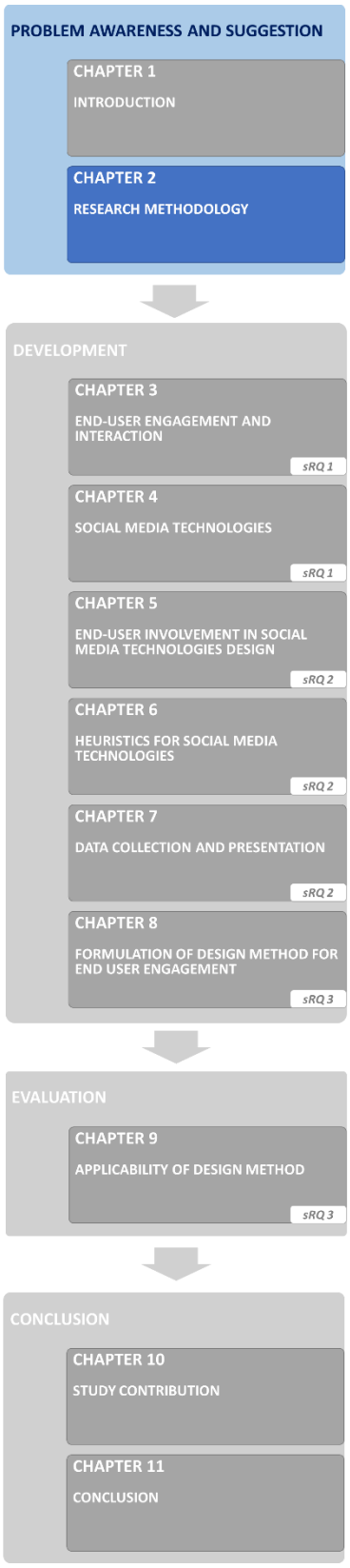
Chapter 11 – Conclusion

This chapter reflects on the research questions and findings and has suggestions for further research.

1.10 Summary

In this era of the Internet of things, people are more connected to different technologies, software, hardware, mobile platforms, cloud services, social networking services, and other forms of ICT. An ICT product such as social media technology is said to be successful when more people adopt and continue to engage with it. It is important to understand the end-users' engagement with the product and how to design for it. This chapter presents a summary of the whole study. It has shown how the study's efforts were channelled towards providing an answer to the main research question. In so doing, it has contributed an artefact in the form of an end-user engagement design method for interaction with social media technology. The next chapter presents the research methodology for the study and the assumptions, philosophy, and methods followed in it.

CHAPTER 2 – RESEARCH METHODOLOGY



2.1 Introduction

This chapter outlines the methodology followed to develop an artefact in the form of a design method for unified end-user engagement and interaction in social media technology. The overarching approach followed for the research is design science research, as it has been found suitable for research focusing on developing artefacts to solve problems that have previously not been solved (Vaishnavi, Kuechler, & Petter, 2019).

Design science research is appropriate as it does not follow a single or unique philosophical paradigm but combines various philosophical perspectives (Vaishnavi et al., 2019). This composite perspective is shown to be the case with the research presented in this thesis. Design science research has been used in other research projects in the information system and information technology domain and the development of various design methods, including those of microservice-based applications, performance measurement, and others (Gacenga, Cater-Steel, Toleman, & Tan, 2012; Ghani & Zakaria, 2018). A similar study to the one presented in this thesis also used design science research and focused on gamification design (Morschheuser, Werder, Hamari, & Abe, 2017).

Section 2.2 presents the philosophical assumptions of the study. Sections 2.3 and 2.4 present the research approach and methodology, respectively. Section 2.5 presents the data collection, analysis, and evaluation methods. Section 2.6 presents the ethical consideration, whilst Section 2.7 concludes the chapter.

2.2 Philosophical assumptions

This section briefly provides the philosophical assumptions with specific emphasis on what is relevant to this study. Design science research has a philosophical design assumption in contrast to the positivist and interpretive research perspectives, as Table 2.1 presents.

Table 2.1: Design science research philosophical assumptions (Adapted from Vaishnavi, et al., (2019))

Basic belief	Research perspective		
	Positivist	Interpretive	Design
Ontology	• A single reality • Knowable • Probabilistic	• Multiple realities • Socially constructed realities	• Multiple, contextually situated alternative world-states • Socio-technologically enabled
Epistemology	• Objective • Dispassionate • A detached observer of truth	• Subjective, i.e., values and knowledge emerge from the researcher-participant interaction	• Knowing through making, i.e., objectively constrained construction within a context. • Iterative circumscription reveals meaning.
Methodology	• Observation • Quantitative • Statistical	• Participation • Qualitative • Hermeneutical • Dialectical	• Developmental • Measure artefactual impacts on the composite system.
Axiology	• Truth is universal and beautiful • Prediction	• Understanding, i.e., the truth is situated and based on the description.	• Control • Creation • Progress (i.e., improvement) • Understanding

Regarding knowledge creation, Table 2.1 shows the design science research perspective of the study and the description of the nature of reality in design science research (ontology). It includes studies on the nature of knowledge (epistemology) and values held (axiology). Also,

the knowledge claims and other design science research artefacts are based on pragmatic validity, not truth.

Ontologically, multiple contextually situated alternative world-states and socio-technologically enable realities are assumed since the uses of social media technologies vary. This assumption depends on whether the context of engagement with technology is at either a personal, organizational, local, or global level.

From an epistemological perspective, the development of the design method for end-user engagement and interaction in social media technologies is derived through the knowledge obtained from analyses of exiting literature, and knowledge obtained from case study findings on their engaging experience with social media technologies. The subject matter of the existing literature included end-user experience, social media, user engagement, design guidelines for user engagement, end-user involvement in design processes.

Methodologically, the review and analyses of existing literature were employed. A peer-review of findings presented in the form of a UX engagement and interaction construct at a conference was done. Further, an exploration of the end-user experience engagement and interaction elements in a social media technology context via a case study was employed. In addition, a scenario approach was used to illustrate the applicability of the design method.

Axiologically, the development of the design method requires an understanding of the complexity of people's experience, their roles in the social media technology context and engagement in the HCI domain.

2.3 Research approach

The research process for this study adapted the design science research process, as described by Vaishnavi and Kuechler (2013). This choice was a result of a two-stage validation based on the main research objective: the first is the evaluation of different research strategies followed by the second, where the appropriation of the design science research guidelines for the research objectives was carried out.

Design science research focuses on two major facets: the design process and the innovative product. The design process is a set of activities carried out in the production of an innovative product. The innovative product, also known as the "design artefact" or "artefact" goes

through an evaluation process to check its validity in a real-world situation. The evaluation forms part of a “build-and-test” loop in design science research. The quality of the artefact with the design process evolves through the feedback information from evaluating the artefact.

The role of a design science researcher in the HCI domain revolves around developing and evaluating new and innovative ICT-related artefacts for solvable problems in more effective or efficient ways (Hevner et al., 2004). Each artefact is a symbolic or physical representation of a chosen design idea for making ICT solutions more effective and efficient in organisations (Gill & Hevner, 2013; Hevner et al., 2004). For this study, the artefact is a design method.

2.4 Research methodology

This section presents the application of the research process model to the research objectives, as Figure 2.1 shows. The design science research process as described by Vaishnavi and Kuechler (2013) was adapted for this study. Figure 2.1 illustrates the adapted process model and Figure 2.2 the detailed steps for its execution.

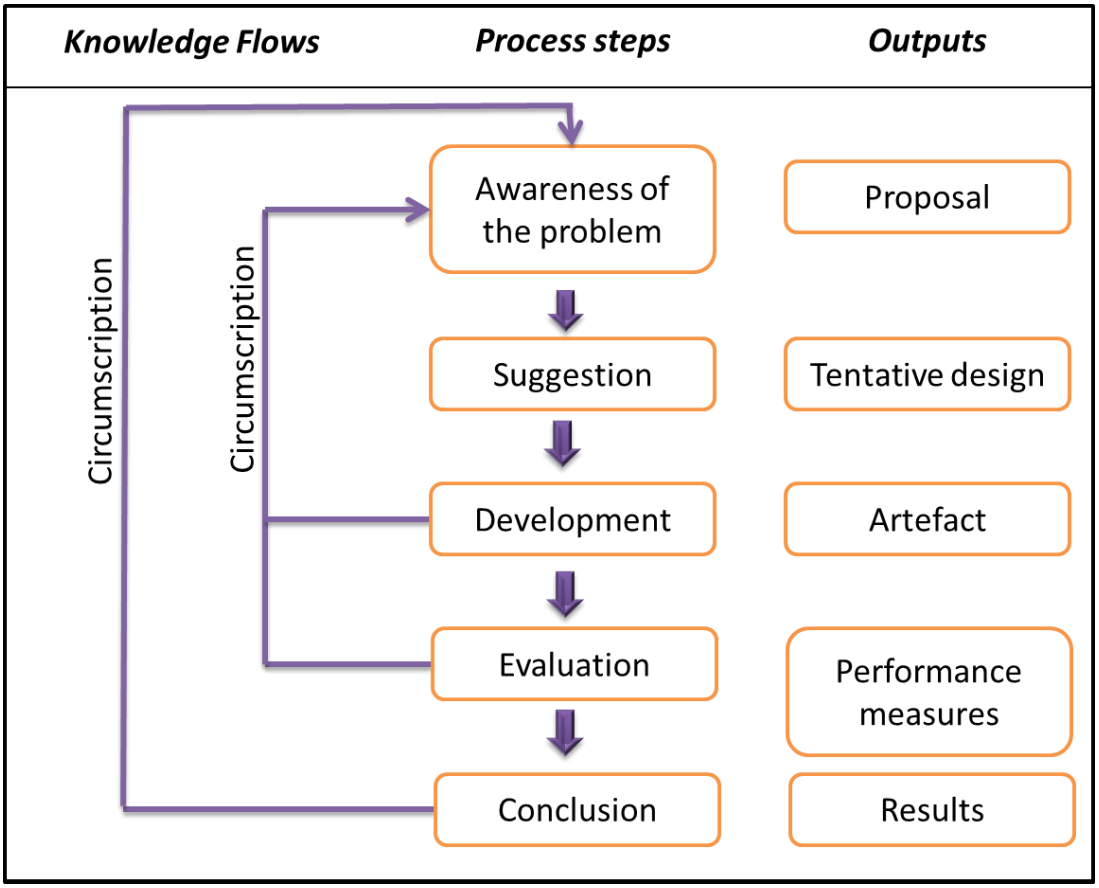


Figure 2.1: Design science research process for this study.

Awareness of the problem

In this step of the research process, the research problem area was explored. The details of the problem centred around the reductive views of end-user engagement and interaction with social media technologies, and the need for a method to support the design of a more holistic view of the engagement and interaction. The process started with a review of topics from several sources in academia and practises relevant to the research problem area. The topics include user participation, UX, user engagement, end-user behaviour, and social media technologies. Figure 2.1 indicates the scope of the study. Next, a potential solution was suggested.

The suggestion of a tentative design

In this step of the research process, an approach to develop a suggestion was initially formed when a possible solution to the problem was not immediately evident. Once evident, the solution was suggested as a tentative design. The suggestion was drawn from relevant fields of knowledge such as UX, Usability, and user engagement. Also, Table 2.2 indicates the

research methods used to achieve the research objectives and to guide the answers to the research questions. The output of this phase is the initial structuring of the UX engagement and interaction construct and the UX-based design method.

Development of the artefact

The UX engagement and interaction construct and the UX-based design method (i.e., tentative design from the suggestion step) were implemented as an artefact in this step for end-user engagement and interaction with social media technology. The findings from the achievements of the sub-research objectives informed the identification and assembling of the components. The evaluation of the arrangement of the components and the demonstration of the usability of the artefact was carried out as part of the evaluation step of the research process.

Evaluation of the artefact

In this step, the reviews of academic and domain experts were elicited. The approach helped to determine the appropriateness of the UX engagement and interaction construct and the UX-based design method concerning the identified research problem. The output of the evaluation of the artefact consists of a performance measure such as utility (applicability). The performance measure is expected to guide the artefact users to apply it in an appropriate environment. A descriptive approach is used for the evaluation of the artefact (Hevner et al., 2004). The utility of the design method was demonstrated using a scenario, while the UX engagement and interaction construct was presented as a peer-reviewed conference paper.

Conclusion of the study

Here, the cycle of the research process ends for this study. Its findings, such as the research process outputs, the artefact, and its applicability, are discussed. Also, the outputs from the research process are represented as chapters in this thesis document, as Figure 2.2 indicates.

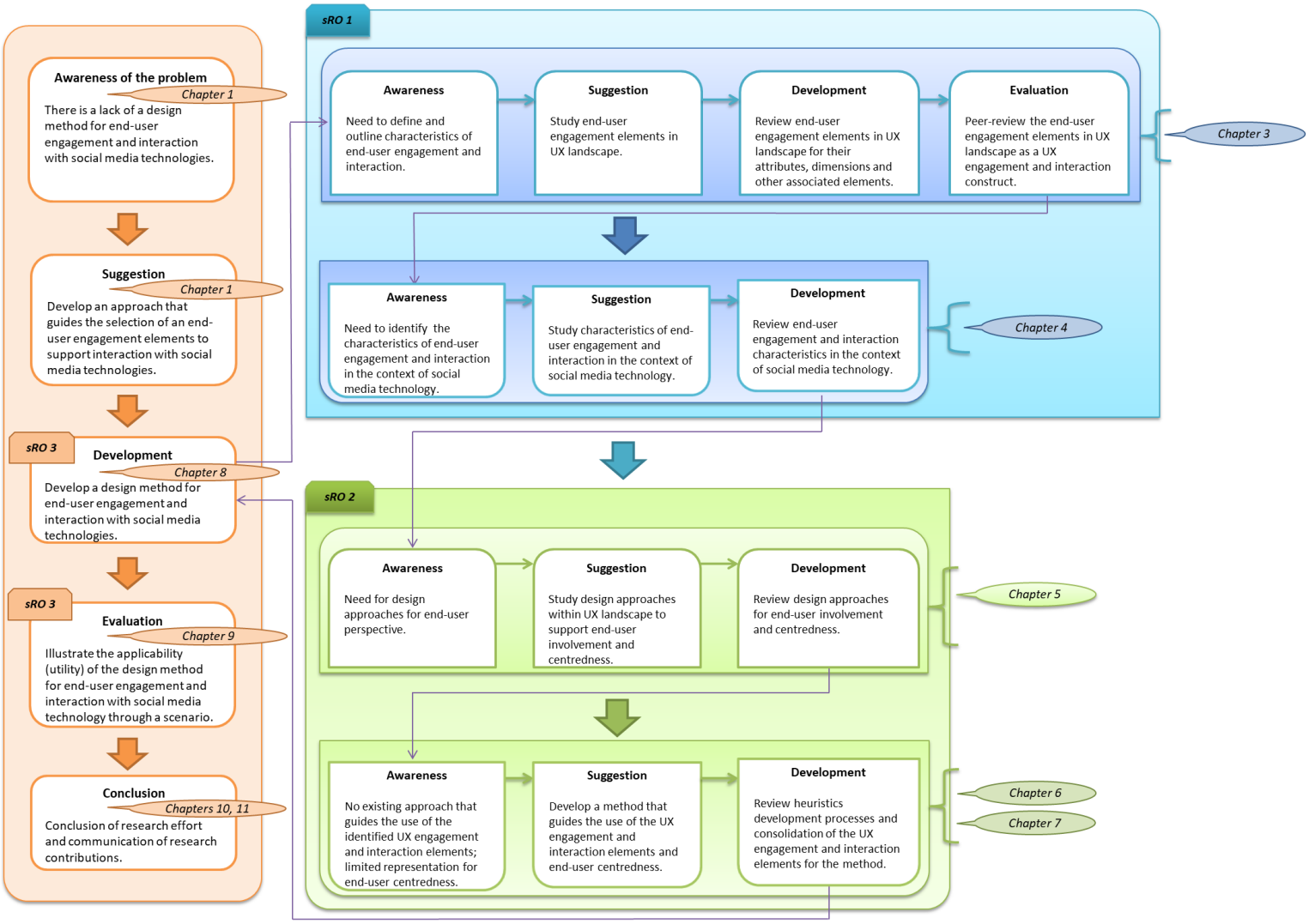


Figure 2.2: Research process applicable to this study.

2.5 Data collection, analysis, and evaluation methods

Three methods were used for data collection, and two methods were used for data analysis in the study presented in this thesis. Peer-review and illustrative scenario approach were used to evaluate the construct and the design method respectively.

2.5.1 The data collection methods used

A mix of qualitative approaches was used to collect data in the study. Examples of qualitative data collection methods include literature reviews and interviews, as well as the unmoderated remote user testing.

Literature review and analysis: An extensive literature review was conducted on the end-users' engagement with technology, user experience, design guidelines for user engagement, and social media technologies. Chapters 3 – 6 presents findings from the areas covered. Sources include journal publications, conference proceedings, research reports, websites, and available technical publications. The review allowed the researcher to be abreast of the current and future works around the selected research areas.

Unmoderated remote user testing questionnaire: The approach used for the first section of the questionnaire was unmoderated remote user testing (Section 7.2 in Chapter 7). In this type of environment, the researcher does not have access to the user. The participants' activity on the software is not monitored. Given that the participant's anonymity is a high priority in this study, the identity of the participants was not monitored. As such, fictitious credentials were created for the sole purpose of this research and were made available only to the participants. During the online questionnaire fill-in, participants were prompted to use software they had not used before. If participants voluntarily chose to use the software, a set of information as well as a list of tasks were presented to them to complete while using the software.

Semi-interviews: There were two types of semi-interviews (Section 7.2 in Chapter 7). One for social media technology end-users and the other for social media technology end-users who are social network group administrators or owners. These were conducted using an online questionnaire approach. The participants included those who are social media technology end-users, those who are social media technology administrators and group/channel owners,

and the unmoderated remote user testing participants who were willing to participate in the online interview.

2.5.2 The data analysis techniques used

Qualitative analysis approaches were used for the data obtained in the study, including the unmoderated remote user testing data. The focus was on measuring the quality rather than the quantity of the end-users' engagement during the unmoderated remote user testing.

Thematic analysis: Thematic analysis was used on the literature findings to develop the UX engagement and interaction construct. The literature on HCI, UX, and user engagement-related fields was explored. Based on the findings, key elements were identified. These elements represented the main aspects of engagement and interaction and were transformed into the main dimensions for UX engagement and interaction, which Section 3.5 (UX engagement and interaction) in Chapter 3 presents. Another round of thematic analysis was used to develop the heuristic development process and the heuristics for UX engagement and interaction. Based on the findings of the literature review on HCI, UX, and user engagement-related fields, key themes representing the main elements of design were identified. These themes were transformed into high-level heuristics for UX engagement and interaction and Section 7.4, in Chapter 7 presents the results of the development process.

As the case study on social media technology was completed, and the unmoderated remote user testing and interview data were collected, it was explored before the actual data analysis process started. The exploration provided a way to make more sense of the different forms of data collected. The collected data were then put in a format that would make the analysis easy to do. The results from the unmoderated remote user testing and interview were exported in Microsoft Excel format from the online questionnaire tool used. Thematic analysis was performed on the interview data collected from the online questionnaire tool. Sections 7.3.2 and 7.3.3 in Chapter 7 discuss the results and analysis of the interview data.

Descriptive statistics: Descriptive statistics are used to summarise and explain the findings in the unmoderated remote user testing data. The method used for the descriptive statistics is frequency tables which is a simple method to represent categorical and ordinal data. The frequency table is commonly used as an exploratory procedure when the aim is to establish how different categories of values are distributed within a set of responses. Three frequency tables are used to summarise the responses of the participants in the unmoderated remote

user testing, as frequency counts for how the participants engaged with the social media technology emotionally, cognitively, and behaviourally. Section 7.3.1 in Chapter 7 presents and discusses these frequency tables.

2.5.3 Evaluation technique used for the design science research artefact developed

Evaluation methods available from the knowledge base, and the established requirements from the business environment, were adapted to evaluate the artefact. A scenario demonstration approach was used to evaluate the design method (Chapter 9). The UX engagement and interaction construct was presented in a conference paper that was peer-reviewed (Appendix G). The design artefact was considered applicable when it met the requirements and constraints of the problem it was meant to solve. The utility (applicability) of the artefact was evaluated appropriately.

2.6 Ethical Consideration

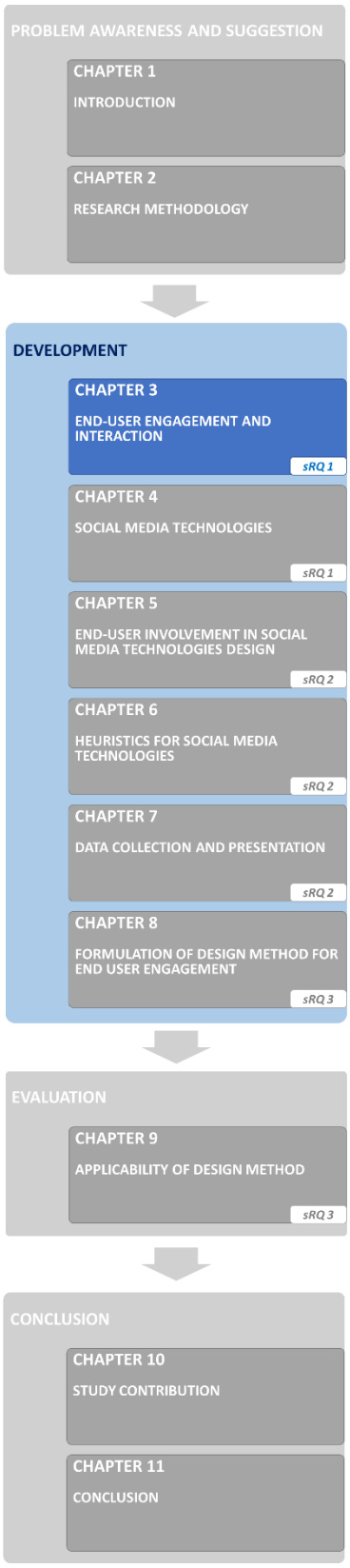
The ethical considerations of the research methods and the research participants were considered in the study. The use of the case study method required some research participants to share some information that contained personal information and their use of fictitious social media technology accounts. The information was protected by creating accounts using pseudonyms instead of actual names and information. An application for ethics clearance was submitted to the Nelson Mandela University's Research Ethics Committee for Human Research, and the application was approved. Details of the approved ethics clearance are in Appendix A of this thesis. The approval of the application allowed for due diligence to ethically carry out the study.

2.7 Summary

To summarise, this chapter presented issues underlying the choice of data collection techniques and analysis procedures for this study. It discussed the applicability of the design science research paradigm in this study. The research paradigm guided the choice of research methods used to meet the objectives of this study.

The next chapter presents the literature findings on elements of user engagement within the context of UX.

CHAPTER 3 – END-USER ENGAGEMENT AND INTERACTION



3.1 Introduction

This chapter outlines the foundational construct that resulted from the first sub-cycle of the research process applied in this study. The construct and the end-user engagement and interaction appropriately focus on the elements of experience formed between an end-user and an ICT product. The construct relates to the first sub-research question of this study, which states: "How can end-user engagement and interaction be defined within the context of social media technologies?" The objective of this question is "to determine which key UX elements constitute an end-user's engagement and interaction in the social media technology context".

Sections 3.2 and 3.3 each present aspects of end-user engagement and interaction, respectively. Section 3.4 presents end-user engagement and interaction as a construct. Section 3.5 concludes the chapter.

3.2 End-user engagement

There are diverse views of end-user engagement in the HCI domain, particularly within the end-user experience with ICT products. This section presents key views that relate to UX. These views are end-user judgement, end-user engagement as a process, end-user engagement as an experience, and end-user engagement attributes.

3.2.1 Definition of end-user engagement

There are many views of end-user engagement in the literature. One of such views is that end-user engagement is a characteristic facet of end-user experience (UX) that reflects that the product is not only usable but also engaging. End-user engagement is considered either as a process of engagement, a state of engagement, a set of metrics or a level of end-user involvement (H. L. O'Brien, Cairns, & Hall, 2018). This study adopts a holistic UX-oriented approach of end-user engagement from scholarly literature. Several scholars have defined end-user engagement in several contexts of use in ICT products, and Table 3.1 presents these.

Table 3.1: Several definitions for end-user engagement in the HCI domain.

	Definitions	Context of definition	Authors
1)	**Definition**: "engagement is a quality of user experiences with technology that is characterized by challenge, aesthetic and sensory appeal, feedback, novelty, interactivity, perceived control and time, awareness, motivation, interest, and affect." (O'Brien & Toms, 2008). Also, "engagement consists of a point of engagement, a period of sustained engagement, disengagement, and (possibly) re-engagement." (O'Brien & Toms, 2008).	Web applications from a UX perspective	(O'Brien & Toms, 2008) What is user engagement? A conceptual framework for defining user engagement with technology
2)	**Definition**: User engagement is the emotional, cognitive, and behavioural connection that exists, at any point in time and possibly over time, between a user and a resource (Attfield, Kazai, Lalmas, & Piwowarski, 2011).	Web applications	(Attfield et al., 2011) Towards a science of user engagement (Position Paper)
3)	**Definition**: engagement is considered as "the process by which two (or more) participants establish, maintain, and end their perceived connection. This process includes initial contact, negotiating a collaboration, checking that other is still taking part in the interaction, evaluating	Human-robot interaction	(Sidner et al., 2004) Where to Look: A Study of Human-Robot Engagement

	Definitions	Context of definition	Authors
	whether to stay involved and deciding when to end the connection." (Sidner, Kidd, Lee, & Lesh, 2004).		
4)	**Definition**: defined "engagement as a sustained level of involvement caused by capturing a person's interest, holding much of a person's attentional resources, and placing the person in an immersive state." (Chen, Kolko, Cuddihy, & Medina, 2011).	Games	(Chen et al., 2011) Modeling but NOT Measuring Engagement in Computer Games
5)	**Definition**: the authors reasoned that user engagement consists "of a series of potentially interrelated metrics that combine to form a whole. The metrics are recency, frequency, duration, virality, and ratings." (Zichermann & Cunningham, 2011). -pg. 69: "engagement can be gamified" (Zichermann & Cunningham, 2011).	Non-game applications	(Zichermann & Cunningham, 2011) Gamification by Design Implementing Game Mechanics in Web and Mobile Apps
6)	**Definition:** "User engagement is the quality of the user experience that emphasises the positive aspects of the interaction, and in particular the phenomena associated with being captivated by a web application, and so being motivated to use it." (Lehmann, Lalmas, Yom-Tov, & Dupret, 2012).	Online services	(Lehmann et al., 2012) Models of user engagement

	Definitions	Context of definition	Authors
7)	**Definition:** "user engagement is defined as two constructs which are user participation and involvement." (Diana, Bahry, Masrom, & Masrek, 2016). "In the context of the website, user engagement is the extent to which [a] user connect[s] himself or herself to the website by either assessing information or transacting with online services." (Bahry et al., 2016).	Website	(Bahry et al., 2016) Website credibility and user engagement – A theoretical integration
8)	**Definition:** "User engagement is the emotional, cognitive, and behavioural experience of a user with a technological resource that exists, at any point in time and over time." (Lalmas, O'Brien, & Yom-Tov, 2015).	Online services	(Lalmas et al., 2015) Measuring User Engagement. In a book titled "Synthesis lectures on information concepts, retrieval, and services"
9)	**Definition:** User engagement describes "how people are attracted to use interactive products." (Sutcliffe, 2010). Also, user engagement is reserved to explain "how and why applications attract people to use them within a session and make interaction exciting and fun". (Sutcliffe, 2010).	Interactive products	(Sutcliffe, 2010) Designing for User Engagement: Aesthetics and attractive user interfaces

	Definitions	Context of definition	Authors
10)	**Definition:** defined "engagement as the quality which guarantees that the connection between a user and a computing product remains active." (Ribé, 2017).	Computers	(Ribé, 2017) From attention to participation: Reviewing and modeling engagement with computers

The concepts from the definitions in Table 3.1 show a complex view of end-user engagement. Each definition focuses on different viewpoints of end-user engagement, namely, the quality of end-user experience, the involvement level, the psychological aspect, a process, and the ICT product metrics. As a quality of the experience with an ICT product, the end-user's engagement has characteristics or attributes which are end-user oriented or product metric oriented. End-user oriented attributes include interest, motivation, challenge, aesthetic and sensory appeal, feedback, novelty, interactivity, perceived control and time, awareness, and affect. (Chen et al., 2011; Diana et al., 2016; Lehmann et al., 2012; O'Brien & Toms, 2008). Attributes such as involvement, participation, attentional resources, and attraction are also end-user oriented characteristics (Chen et al., 2011; Diana et al., 2016; Sutcliffe, 2010). Product-oriented attributes include recency of the end-user's engagement, frequency, duration, virality and ratings (Zichermann & Cunningham, 2011).

Another side to end-user engagement from the definitions in Table 3.1 is the emphasis on the triad-dimensions which are the emotional, cognitive, and behavioural aspects of the end-user's encounter with an ICT product. Further, the end-user engagement occurs either before the usage period, the short-term sessions of usage, or the longitudinal time-span of the whole UX. Though, the other definitions of end-user engagement excluded the period of non-interaction, the definition by O'Brien and Toms (2008) considers the periods where end-user interactions do not take place. Such periods are the disengagement period, the period before re-engagement, and the period before non-engagement. In essence, within the period of

experience with an ICT product, an end-user spends time engaging, disengaging, and re-engaging with the ICT product. The next section presents another view of end-user engagement in the form of the end-user's judgement of an ICT product.

3.2.2 Importance and benefits of end-user engagement

The importance of end-user engagement differs across different disciplines and contexts. Disciplines include software development, marketing, community events, fashion, branding, education, human resources. Contexts include the use of an app/online product as a mediation tool (such as for lead/team, branded company/client, educators/leader, health pro/patient, org/community), app/online product as an interactive/service tool, product/users, health, education, social, and leisure activities).

The beneficiaries of user engagement include the owner, developer, and the community of end-users of the ICT product. User engagement ensures that the product is not abandoned, is used frequently used by current or new users. This results in more end-user interaction. More end-user interaction results in more sales and content, more responses and social capital, and more return on investments for the product owners. Also, end-user engagement highlights the interaction and involvement of both end-users and product developers and, consequently, the product owners. Scholars could use their knowledge of end-user engagement and apply it in a different context to improve it.

3.2.3 How to measure end-user engagement.

An end-user's engaging experience with an ICT product can be measured using several UX evaluation techniques. The techniques include a self-reporting approach, physiological approach, and product-oriented analytics as Table 3.1 shows (adapted from Albert, 2017; Lalmas et al., 2015; O'Brien, Cairns, & Hall, 2018; Tullis & Albert, 2013).

Table 3.2: Approaches for measuring a user's engaging experience.

Approaches	Examples
Self-reporting method	• User engagement scale • Questionnaire for user interaction satisfaction • Website analysis and measurement inventory • Net promoter score • Subjective mental effort questionnaire • Standard user experience percentile rank questionnaire • Net emotion value • Kano method • Product reaction cards • Verbatim
Physiological measures	• Eye-tracking (eye movement, pupil/blinks, fixation, saccades) • Behavioural observation • Skin conductance via electrodermal activity • Facial expression • Electroencephalography
Product-oriented analytics	• Activity logs and timestamps • Performance metrics (e.g. time, errors, task completion) • User-generated contents

The self-reporting approach involves the end-users being asked questions about their experiences and they respond verbally or in written text. Questionnaires and interviews are used for self-reporting purposes. The end-user can be asked "think-aloud" questions during interaction with a product or in retrospect. The focus of the evaluation is more about the end-user's reaction to the ICT product than how effectively they can use it. Several studies use questionnaires across different forms of ICT products. An example of these questionnaires is the user engagement scale which reveal the attributes of an end-user's engaging experience with an ICT product (O'Brien et al., 2018).

Physiological measurements include psychophysiological measurements, facial expression, eye-tracking, and cursor tracking (mouse and eye-movement). The eye movements of end-users and their states during the engaging experience can be measured using physiological

approaches. With eye-tracking technology, an end-user's eye movement is recorded to be measured and analysed. This helps to determine what end-users notice first, what end-users ignore, and what they find interesting to see. Other physiological approaches measure some inference about an end-user's emotional state, body pressure and stress level.

Reviewing activity logs or analytics from an ICT product is another approach to measure UX. Product analytics is an application within a product that captures data about itself, analyses the data, and reports its insights. These include the activities performed with the product and the users' performance with it.

In addition, some UX metrics focus on the post-initial (setup) stage. During the setup or first use stage, the onboarding stage occurs. Onboarding can happen at other ages of the product life cycle such as first-time product use and new feature use. However, in this study, an aspect of the post-initial (i.e., post-onboarding) stages of user interaction is explored in the unmoderated remote user testing session in the case study, as Chapter 7 presents.

3.2.4 Psychology of end-user engagement

This section outlines the major areas of end-user engagement by focusing on the decision-making, human cognitive, and engagement processes, and engagement as an experience. Each area reveals different aspects of the nature of an end-user's engagement but together shows the complex nature of the term end-user engagement.

3.2.4.1 End-user engagement as user judgement

During the period of experience with an ICT product, the feelings of the end-users are evoked. As this happens, the end-user assesses the ICT product. The assessment and evaluation result in a decision. This decision-making process is termed user judgement and constitutes a cognitive view of an end-user's engagement with the product, as Figure 3.1 illustrates. Thus, end-user engagement also concerns a subset of UX that refers to a person's judgement of the ICT product qualities. The theory proposed by Hart, Sutcliffe, and di Angeli (2012) is an extension of a cognitive UX process model proposed by Hartmann, Sutcliffe, and de Angeli (2008). The extended model focuses on the underlying mechanisms of an end-user's decision-making process about preferences for the ICT product and qualitative assessments of it. Further, the extended end-user engagement model accounts for the interactive experience, the importance of differences among individual users, the changes of the constructs that may

occur over prolonged use and time, and the factors that lead to the end-user's acceptance of the ICT product (Hart, 2014). User judgement, interactivity, user groupings, and UX, over time, influence user judgement.

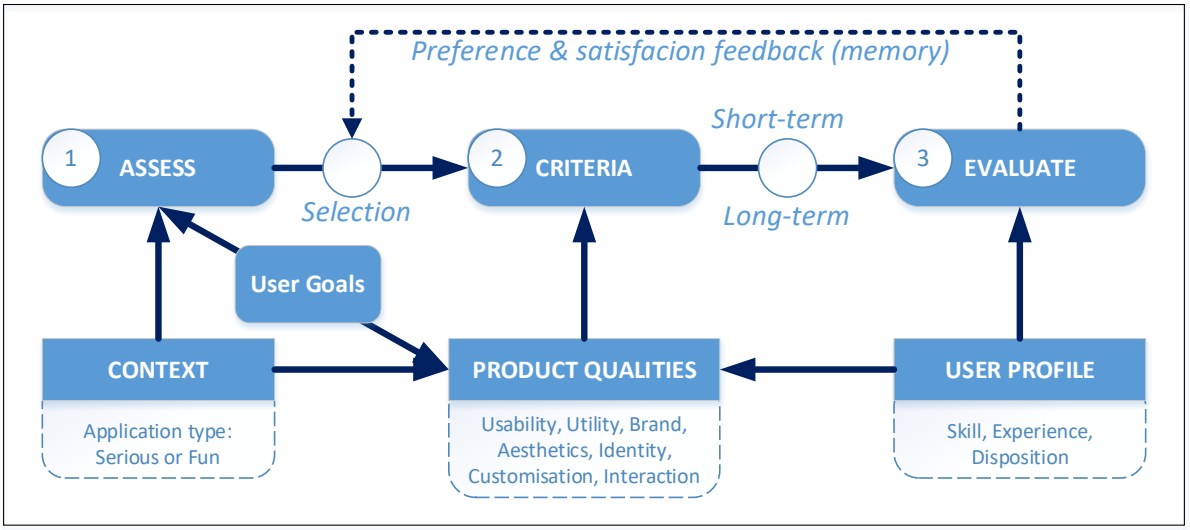


Figure 3.1: The three-stage process model of end-user engagement through the lens of the end-user's judgement of the ICT product (Adapted from Hart, et al., 2012).

As illustrated in Figure 3.1, the stages of end-user judgement during the engagement with ICT products are the Assess stage, the Criteria stage and the Evaluate stage. The Assess stage represents the first stage of an end-user's decision-making process. The context of the end-users' experiences with an ICT product determines their assessment of its qualities. Attributes such as serious or fun, the task in hand and the motivational goals of the end-users affect their assessment of the ICT product. Next, the end-user selects a criterion to evaluate the ICT product, as depicted by the criteria stage in Figure 3.1. At this stage, various product qualities influence the user's decision-making process. These ICT product qualities include usability, utility, content, brand, aesthetics, and customisation (Hart et al., 2012). In addition, interactivity influences the user's judgement. Interactivity is linked to specific interactive features of the ICT product, affecting both short- and long-term use. It occurs through the end-user's repeated exposure to the product. From the end-user's initial perception of the ICT product to post-interaction, the affective and hedonic measures increase. Once the criteria have been selected, end-users evaluate their experiences with the ICT product. The end-users' preferences for various interactive features, and their pre-disposition to the ICT product, influence their evaluation of the ICT product.

Concerning end-user engagement, the end-user judgement model explains the cognitive engagement an end-user has before, during, and after interacting with an ICT product. The criteria used to judge the product qualities shift as the end-user spends more time and sessions with the ICT product. For example, the aesthetics of the ICT product and the end-user's hedonic needs are attributes in the initial impressions. After more periods of experience with an ICT product, an end-user's perception of its usability, utility, and usefulness dominates the engagement process. Capturing end-users' feelings (affect, arousal, flow, and presence), as they occur in the moment or the retrospective, is essential to show the importance of their judgement as they engage with the product.

3.2.4.2 Aspects of end-user cognitive processing

The end-user's cognitive processing is a result of the designer's considerations for the ICT product as well as the end-user's reaction when encountering the ICT product, as Figure 3.2 illustrates (Komninos, 2020; Norman, 2004). Appearance and utility are examples of the considerations that designers take when the product is been designed and developed. There are three cognitive processing aspects that end-users experience with an ICT product. These are the visceral, behavioural, and reflective levels. End-users make a rapid judgement about an ICT product instinctively. This instinctive reaction occurs at the visceral level, in the form of emotions and sensible thoughts, end-users react to the appearance, touch, and feel of the ICT product.

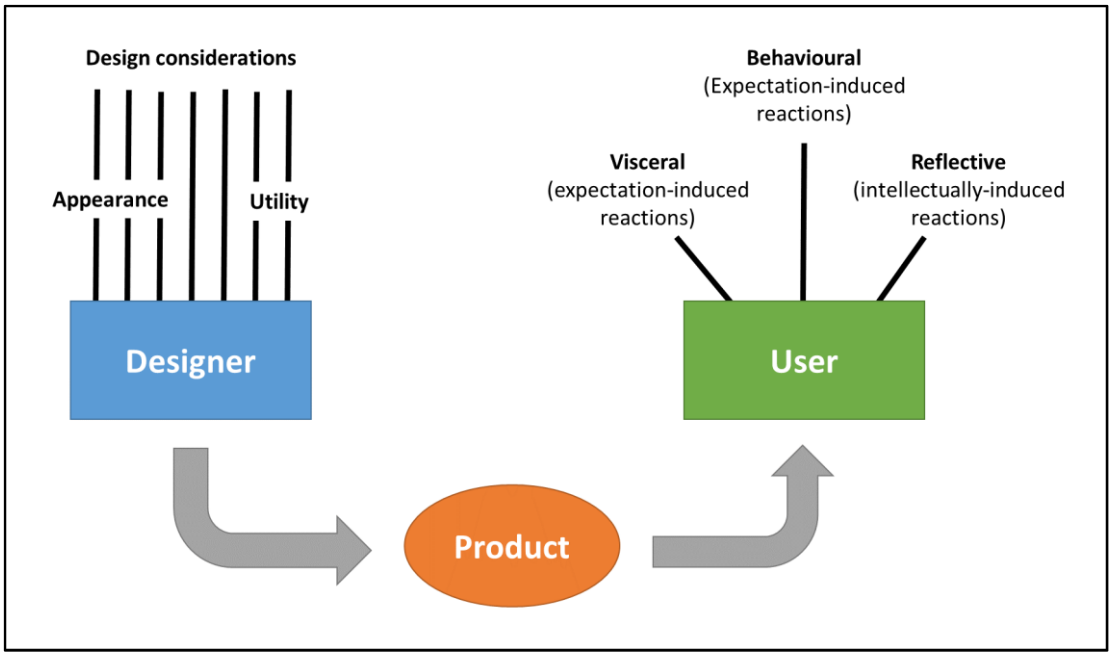


Figure 3.2: The three levels of end-user cognitive processing (Adapted from Komninos (2020) and Norman (2004)).

Based on emotions and thoughts, end-users physically (or peripherally) interact with an ICT product and have subconscious emotional responses during their interactions. The subconsciously controlled aspects of the end-users' actions occur at the behavioural level of the cognition processing model. When end-users complete physical/peripheral interactions with an ICT product, they reflect on those periods of interaction. Here, they form conscious thoughts about the ICT product. The thought process occurs at the reflective level. End-users' moments of reflection may be influenced by their prior responses to the ICT product until the next period of experience with it. Also, the flow between the cognitive processing levels is continuous during the end-users' experiences with an ICT product. The end-users' reactions at one level influence another level, thereby creating an overall emotional and cognitive experience with it.

Concerning end-user engagement, the model of human cognitive processing explains the cognitive engagement an end-user has before, during, and after interacting with an ICT product. The human cognitive processing model also shows how end-user cognition occurs along with emotions during the period of experience with an ICT product.

3.2.4.3 End-user engagement as a process

End-users go through a cycle of stages of interactions with ICT products. O'Brien and Toms (2008) formulated a process model showing the stages of end-user engagement in which end-users interact with an ICT product. The stages are the point of engagement, the period of sustained engagement, the period of disengagement, the period of re-engagement, and the period of non-engagement (O'Brien & Toms, 2008). Figure 3.3 illustrates the stages of end-user engagement. Each stage is shaped by different attributes. Each attribute of end-user engagement is an aspect of an end-user's interaction with an ICT product. The attributes either influence end-user engagement with an ICT product or form a part of the engagement process. The descriptions of the attributes are in Appendix B of this thesis.

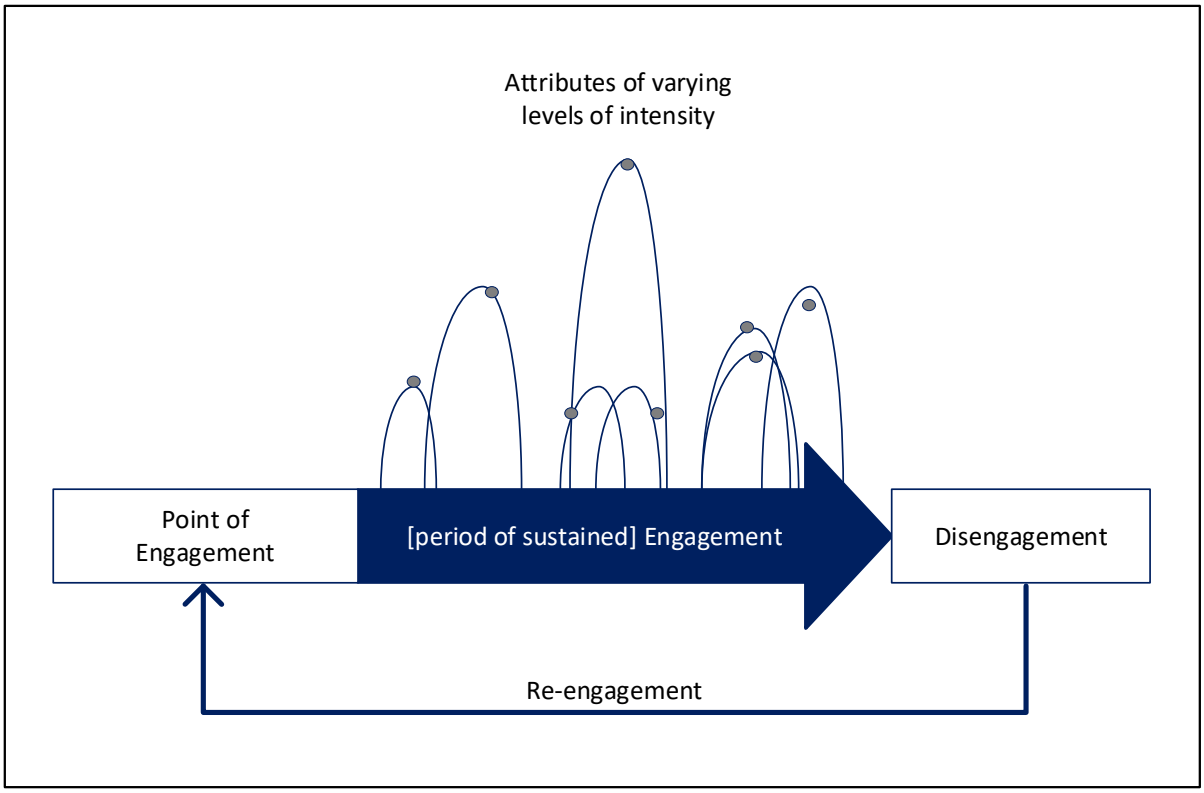


Figure 3.3: A process model of end-user engagement (Adapted from O'Brien and Toms (2008) and O'Brien, Roll, Kampen, & Davoudi (2021)).

The first stage in the process model is the point of engagement. In this stage, end-users initiate interactions with an ICT product, as certain attributes have captured their attention. Personal goals (either specific or experiential), interest, motivation, novelty, and aesthetics are examples of influential attributes at this stage. The reasons for an end-user's initiation of the interaction are also represented at this stage. The second stage is the period of sustained

engagement where the interest of the end-user is retained during the period of interaction with the ICT product. As in the first stage, attributes such as interest, novelty, control, interactivity, challenge, positive affect, awareness, and aesthetics and sensory appeal, feedback and attention influence the end-user's engagement. At some time during the interaction, the end-user decides to and eventually stops interacting with the ICT product. This stage of halted interaction is known as disengagement. The halted interaction is either intentional on the end-user's side or because of external factors. Attributes that further describe the disengagement stage are the end-user's perceived time, usability, positive affect, negative affect, challenge, and interruptions from the ICT product in the end-user's environment.

After some time, the end-user returns to continue the interaction with the ICT product. This stage is referred to as re-engagement, which occurs as either a short- or long-term activity. An attribute in this stage is the positive experience the end-user has had. However, when an end-user does not return to continue the experience of interaction with an ICT product, certain factors are at play. These include overwhelming content, uninteresting content, completed tasks, and usability issues. This stage is referred to as the non-engagement stage.

Holistically, end-user engagement consists of periods of interaction and non-interaction with ICT products. In other words, according to the engagement process model, engagement goes with interaction. In addition, as end-users continue to perceive the usefulness and availability of an ICT product, their engagement iterates between the point of engagement, the period of sustained engagement, disengagement, and re-engagement. Together, these stages of engagement constitute a compositional thread of end-user experience with an ICT product.

3.2.4.4 End-user engagement as an experience

The engaging experience of an end-user with an ICT product is depicted by different attributes. These attributes, some of which are mentioned in Section 3.3.3, are related. They show how an end-user's engagement with an ICT product is embedded in the overall experience in terms of the sensual, emotional, spatiotemporal, and compositional threads of experience (O'Brien & Toms, 2008).

The auditory, visual, and motion components of an end-user's interaction with ICT products constitute a sensual thread of experience. The pleasure derived from an ICT product's

aesthetics, and the novelty of its presentation of information and user interface, influence the point of experience, the period of engagement and the re-engagement of an end-user with an ICT product. However, the usability issues and boredom (lack of challenges) characterises the sensual thread of experience within the disengagement stage.

The positive and negative emotions (i.e., affect or the affective experience) of the end-user's interaction, and motivation to use the ICT product are part of the emotional thread of experience. Affect (or affective experience) refers to the human's biological response to external stimulus, which is interpreted as emotions, moods and temperament (Dix et al., 2004; Hassenzahl, Diefenbach, & Göritz, 2010; Lottridge, Chignell, & Jovicic, 2011). It changes how people deal with different situations, consequently influencing how they interact with ICT products (Dix et al. 2004). Also, affect is used as a general state descriptor for people's positive or negative responses (Hassenzahl, Diefenbach, and Göritz 2010; Lottridge et al. 2011). Some examples of such descriptors for negative affect are being afraid, scared, nervous, jittery, irritable, hostile, guilty, ashamed, upset, and distressed. Positive affect descriptors include being active, alert, attentive, determined, enthusiastic, excited, inspired, proud, strong, and interested. Positive affect includes emotions such as enjoyment, physiological arousal, fun, feelings of success and accomplishment, while negative affect includes emotions such as feelings of having information overload, uncertainty, boredom, guilt, as well as frustration.

Interest and motivation to either complete a task or to interact forms part of the point of experience. The stage of re-engagement includes positive affect such as fun, enjoyment and physiological arousal. Also, the positive affect characterises the sensual thread within the period of engagement. However, some aspects of a positive affect, such as feelings of accomplishment and success, fall into the disengagement stage, coupled with negative affect such as guilt, boredom, uncertainty, frustration, and information overload.

Another thread of the experience is the spatiotemporal thread. In this thread, end-user engagement occurs within the period (i.e., time and space) of the interaction with the ICT product. Other areas in the thread are the end-users' perception of time, their awareness of the external environment (i.e., the physical environment as well as the ICT product), and their internal state. Besides becoming involved in the content of the ICT product and developing the ability to allocate time to use it, the product falls within the point of experience and the

re-engagement stage. In the period of engagement stage, elements of the spatiotemporal thread of experience are the end-user's perceived time, unawareness of people in the physical environment and control and feedback. In the disengagement stage, spatiotemporal attributes include not having enough time to interact with the ICT product and interruptions/distractions from sources outside it. The compositional thread of the end-user's experience concerns the combined threads of experience and the stages of the end-user's engagement, which Section 3.2.4.3 discusses.

Essentially, these threads of end-users' experience are interwoven with the stages of their engagement with the ICT product. The underlining principles of the end-user's engagement found during this study are outlined in the next section.

3.2.5 End-user engagement design principles

This section presents the findings of a literature study on the design guidelines that were considered for end-user engagement. Four approaches were found for designing for user engagement, namely:

1) Sutcliffe's (2010) Seven design guidelines (A. Sutcliffe, 2010)
2) Sutcliffe's (2016) design guidelines (A. G. Sutcliffe, 2016)
3) Geisler's (2014) Ten basic principles for user engagement on the web (Geisler, 2014)
4) Hart's (2014) Twelve design guidelines or heuristics for user judgement (Hart, 2014)

Each guideline is intended to support the design environment and goals for a specific application domain.

3.2.5.1 Sutcliffe's (2010) design guidelines for user engagement

Sutcliffe (2010) proposed seven user engagement guidelines that are primarily based on aspects of visual design, graphical design, and interaction design (A. Sutcliffe, 2010).

1) Immersion and presence: concern the use of avatars and the provision of a world in which users interact to provide immersion and a better sense of presence. Adding audio and haptic feedback could enhance the user's presence. The user's social presence is enhanced in a few ways, namely, by richer communication media, by providing more information about people being conversed with, and social awareness functions (for example, newsfeeds found on social networking sites).

2) Flow in interaction: concerns flow and natural interactions with the ICT product through metaphors and affordance. Affordances concern how the shape of an object suggests how it can be manipulated and used, including cues to its functionality. Affordances rely on learned common sense knowledge as opposed to natural suggestibility of shape, though the extent of this is an open question. Metaphors refer to shapes and graphical structures that either suggests a group/categories of objects possible actions or provide the context in which action and functionality of components are suggested. Metaphors and affordances provide memory cues to suggest actions from common sense knowledge and analogical memory.
3) Selecting and designing media for mood and arousal: concerns the use of dynamic media, natural images, sounds from nature, unusual or challenging images, depth of field and oddity to stimulate users' curiosity and increase arousal.
4) Selecting media to attract and persuade concerns the use of *photographs of people*, *faces of average people*, and *polite praise* to attract the users' attention and increase their tendency to judge the ICT product as pleasant and enjoyable.
5) Selecting media for emotional effects concerns the use of *dangerous and threatening episodes* (content), *characters* (familiar from popular culture), *dialogue* (e.g., spoken dialogue), and *music* to invoke emotions (fear to anger, fear to disgust, threats to empathy, anxiety, and fear). These produce pleasurable emotional responses and set the appropriate mood (e.g., calm).
6) Selecting and designing media to attract attention: concerns the use of dynamic media and visual salience to draw the user's attention. Dynamic media consists of images of people with their gaze directed at the user, as well as video, speech, and audio. Visual salience refers to the attention-grabbing stimuli in order of salience, such as change (blink, move) and oddity effects using colour contrast, shape, or size, within images and text.
7) Design for aesthetic appeal: concerns judicious use of colour, gestalt effects, depth of field, use of shape (such as curved shapes, blocks, and rectangles), and visual structure and organisation (i.e., image division and size ratio) to stimulate interest, attract by promoting curiosity, provide attractive visual organisation, and aesthetic pleasure. Colour use should be balanced for backgrounds and have alerting danger/safety and positive/negative associations, as well as a calming effect. Gestalt

effects are a collective term for the several visual patterns that users recognise and interpret instinctively. Examples of Gestalt effects are closure, good continuation, similarity, proximity, pragmas, symmetry, and figure-ground. The depth of field refers to the use of layers in images to provide depth for foreground and background components.

3.2.5.2 Sutcliffe's (2016) design principles for user engagement

Sutcliffe (2016) proposed some guidelines for designing for user engagement. These guidelines extend the universal principles of design, multimedia, and virtual reality, and guidelines from Sutcliffe (2010). The principles are grouped according to high-level user engagement constructs and desired psychological effects. The high-level user engagement constructs are immersion, presence, flow, and aesthetics, followed by principles associated with desired psychological effects on attention, mood, arousal, and emotion.

1) Basic constructs in interactive graphical worlds: This principle is concerned with the use of metaphors and affordances in the user interface and UX to provide "memory cues to suggest actions from common sense knowledge and analogical memory" (Sutcliffe, 2016). User interaction is more realistic and engaging when the user relates directly to the domain world rather than interacting via navigation user interface elements. The user interface represents the domain directly or via metaphors. Metaphors suggest the action and functionality that are possible with the icons and other user interface elements. Affordance in each user interface element "suggests how it can be manipulated".

The principles associated with high-level user engagement constructs are immersion/presence, flow, and aesthetics:

2) Immersion and presence: concern the enhancement and promotion of immersion and presence through the user interface. Design of naturalistic graphical worlds in which affordances and metaphors intuitively suggest obvious ways of interaction could enhance immersion. The creation of an avatar for the user, which is placed in the specific application domain, promotes user presence, and enhances immersion. The addition of audio and haptic feedback could enhance presence. Social presence

for the user could be enhanced by adding rich communication media such as the creation of avatars, audio, videos, and social awareness functions.

3) Flow: concerns the promotion of the sense of a good flow experience. This could be done through novel interactions whereby the user has control of their interactions with the ICT product. Dialogue structures or guided discovery could be used to implement a good flow experience.
4) Aesthetics: concerns the use of aesthetic design components such as colour, gestalt effects, depth of field, and shape to set a positive tone for user engagement. The use of colour should be appropriated for alerting, danger/safety association, calming effects, and converse effects. Gestalt effects such as visual patterns (for example, symmetry, similarity, closure/completeness of a shape) and proximity clustering are recognisable and interpretable instinctively. Depth of field or the use of layers in an image, such as background image, figure-ground effect, the juxtaposition of visual features or grouping of shapes, stimulates interest and could attract by promoting curiosity. Shapes convey attractive visual style (for example, curved shapes) or portray structure, categories, and order in layout (for example blocks and rectangles).

The principles associated with desired psychological effects on attention, mood/arousal, and emotion are:

5) Attention: concerns directing the user's attention to the navigation cues and other important content in the goal-oriented products. The attention could also be used to control the user's emotions and manipulate their mood for the entertainment-style products. Attention can be attracted using dynamic media (video, speech, audio, change in an image or elements in the image) and the use of attention-grabbing stimuli in order of salience within images and text (any blink/move or any changes, oddity effects using colour contrast, shape or size, and the onset of audio).
6) Mood and arousal: concerns influencing the user's mood and arousal, stimulating curiosity, as well as matching the experience to the specific application domain. This influence is important for maintaining the flow of experience. This principle can be created using dynamic media (video, speech), natural images (images of designated artefacts and unusual objects to stimulate curiosity). It can also be created using

natural sounds (audio) music (loud, strident pieces, romantic music), and unusual or challenging images (images that disobey normal laws of form and perspective to stimulate imagination and increase attraction). Lastly, oddity can be used (when one or more elements in an image don't fit, as it invokes cognitive dissonance or the user's ability to spot the irregular among regular).

7) Emotion: concerns designing for emotions. These are important for the experience of flow and for applications that aim to influence users' decisions. The use of dangerous and threatening episodes to evoke emotional responses can elicit these. Familiar characters (threatening or benevolent) and spoken dialogues could stir up desired emotional reactions.

Though these principles primarily focus on improving the attractiveness of the interfaces of the ICT products, the perception and the subjective opinion of the users is necessary to check interpretations, critique ideas, and evaluate acceptability (Sutcliffe, 2010; Sutcliffe, 2016).

3.2.5.3 Geisler's (2014) Ten basic principles for designing for user engagement on the Web

The authors in Geisler (2014) proposed ten principles for designing for user engagement on the Web, particularly web-based communications. The principles were formulated based on the collaborative research effort of several researchers. The focus area and the title of each principle are presented below:

Principle 1: user diversity (designing for diverse users): multiple options meet the needs of a variety of user groups that are based on age, gender, ethnicity, literacy, and technical experience and expertise.

Principle 2: usability (designing for usability): design builds on what users know (traditional web usability standards/conventions) and helps them learn new genres and the epistemological assumptions that gird them, i.e., making the ICT product more usable.

Principle 3: Technological backbone (test the backbone): ensuring (through testing) that appropriate supportive hardware and software (also known as the backbone) are available to users, with reasonable set-up time and (its contribution to the) positive UX with the ICT product.

Principle 4: Cross-cultural communication (extend a welcome): use multisensory and personal experience to make the audience (other users) feel welcome in a cultural context.

Principle 5: Collaboration (set the context): prepare users for the experience and motivate them to participate by identifying an appropriate context of use, making changes to embed the communication in the context, and acknowledge the inherent contextual dynamics.

Principle 6: Storytelling (make a connection): focus on narrative or storytelling as a powerful design element that helps users engage with people, experiences, and/or products in an ICT product.

Principle 7: user control (share control): the provision by the designers to maximise user options, provide for a wide range of user choices and preferences, permit rich and varied user-product and user-user interactions.

Principle 8: user interaction (support interactions among users): Focus on supporting interactions among users, and creating opportunities for them to interact with one another, share what they create, and develop protocols to support those interactions.

Principle 9: Pace (create a sense of place): Create a sense of place in two ways. The consistency in look and feel that is web-based communication signals a sense of physical space that is engaging. Communication through cross-cultural and culturally specific aesthetic cues about who users are gives a sense of cultural space.

Principle 10: engagement (plan to continue engagement): The design acknowledges an interaction beyond the initial one. This means that it invites users to continue connections past the current encounter, to move outside of the formal interactions, and to go behind the scenes. The design may present the users with opportunities to connect with other users, acquire more information, share a memorable experience, edit the current content, or even create new content.

The user engagement principles are based on Geisler's (2014) understanding of the "modern" social media users to guide developers and designers to create products for the users, particularly the design of social media products. The authors called theirs "design principles" and focused on "design principles for web-based communications whose main purpose is the

engagement of users" and "to guide the design and development of engaging UX", i.e., to make UX engaging.

3.2.5.4 Hart's (2014) Twelve design guidelines

Hart (2014) proposed twelve high-level principles or heuristics to facilitate the understanding of UX in which context, task, product quality, and individual differences play a role in the judgement and engagement a person has with technology. Table 3.3 presents the design guidelines.

Table 3.3: Hart's (2014) Twelve design guidelines.

	Guideline	Description
1)	Task framing effects	Interactivity is more relaxed and leisure-based tasks are favoured above usability. User judgement is more susceptible to task framing effects, with serious tasks favouring usability and utility, while aesthetics and interaction criteria are preferred for more fun-based tasks.
2)	Product framing effects	Work-related products select usability and utility attributes, while games or entertainment type products prefer aesthetics, pleasure, and enjoyment more. Prior information could promote framing effects.
3)	Usability ceiling effects	Usability improved over time due to product familiarity and long-term usage. Beauty (aesthetic) ratings can positively influence pragmatic judgements (usability), impacting the overall rating of the product.
4)	Brand image	The most favoured branded products are rated for their trusted content, despite their poor usability ratings. Brand image positively influences the usability ratings of a product, especially on the initial encounter. This heuristic is dependent on the

	Guideline	Description
		strength, quality, and visibility of the brand image, which can promote trust and loyalty.
5)	Support individual differences	Users' predisposition (preference and technology disposition) can impact user judgement, even among user groups. User groups could show a preference for different interactive features. Users' technical disposition shows that the more technically inclined they were, the less sensitive they are to usability problems. Some users have higher personal innovativeness and curiosity towards technology, and prior experience can influence user judgement.
6)	Use of avatars	Avatars should be designed and implemented well, and offer clear and easy functionality that gives users control, along with the option to not interact with it. Consider avatar types (for example, gender, realism, and anthropomorphism) and the level of functionality (e.g., chats, facial expression) for the required context.
7)	Alternative interactions	Alternative methods of navigation (for example, 3D fly-through and active-object links) may increase user engagement but may cause frustration due to usability problems if poorly designed. Employ an engaging interactive metaphor or provide a rich combination of interactive functions (avatars, 3D graphical world, active objects) to give users alternative options to traditional menu-link navigational methods.
8)	Keep interactivity fresh	Use adaptivity as the capacity for an ICT product to adapt according to the user's behaviour or the capacity of the ICT product to enable users to customise and adapt it to their needs). This would

	Guideline	Description
		enable the interactive features (for example, avatar, interactive media, etc.) to be revised regularly to avoid boredom and frustration, allowing for different levels (novice/expert) of UX. This also applies to customisation and user control.
9)	Customisation	This is also known as personalisation through self-selection of the variety of apps or features that satisfies different users' needs and use (work/leisure), enhancing long-term satisfaction.
10)	User control	Given a high priority and enables users the freedom to control their interactive experience with minimum support. It can lead to satisfaction, save time, and enhance trust. The extent of the interface control should be limited and transparent so as not to disrupt the users' interactive experiences.
11)	Provide training	Offer appropriate and timely training when implementing new technology to enhance user involvement, improve user confidence, and reduce anxiety, leading to greater user satisfaction. Initial training sessions should focus on how new technologies can provide benefits (usefulness, effectiveness, and efficiency) to the user, rather than on general familiarisation training that focuses on operating the technology.
12)	Avoid forced to use	Avoid forced mandatory use leading to negative UX and resistance to adoption. Provide flexibility, user choice, and alternative ways to interact with a product to improve users' perceptions of control and behavioural intention towards technology acceptance.

3.3 End-user interaction

3.3.1 Definition of end-user interaction

Within the Human-Computer Interaction (HCI) domain, the major areas of interest are the ICT product, the end-users of the product, and the relationship between the end-users and the ICT product (Dix et al., 2004). The relationship between the end-user and the ICT product encompasses the human characteristics and the hardware and software components that together primarily constitute an ICT product (Hewett et al., 1992). End-user interaction is an aspect of the relationship and has many facets. Three facets of the end-user interaction are initiation, attention and evidential.

An end-user initiates or re-initiates an interaction or a series of interactions with an ICT product for a period of time during which their attention and interests are attracted and sustained. The holistic process of the end-user reaching the point of initiating the interaction and sustaining the period of interaction is based on the pragmatic and hedonic needs of the user, and the affordance and persuasive characteristics of the product.

The second facet of end-user interaction is the interaction-attention continuum. This aspect explains the different levels of attention the end-user gives to an ICT product during the interaction (Bakker & Niemantsverdriet, 2016). For instance, when a person is viewing a video on a browser tab while opening messages on an email app on the same interactive system, the person is viewing the video from a peripheral view. This level of attention and interaction characterises peripheral interaction. However, if the person is viewing the video but this time watches the video screen, the person's interaction is focused. Thus, this level of attention and interaction forms the focused interaction level in the interaction-attention continuum. The third level in the interaction-attention continuum is implicit interaction.

Further, evidence obtained either before, during, or after an interaction is another facet. During the usage period, the end-user is considered as being engaged with the product. Evidence of the interactions is obtainable in different ways. Examples include the product metrics, body response monitoring, and elicited feedback from the end-users. These forms of evidence have shaped how user engagement has been defined and measured in the literature.

The initiation, attention, and evidential facets give various meanings to the relationship between the end-user and the ICT product within the HCI domain. In other words, an end-user interaction has elements of initiation, attention, and evidence.

3.4 User Experience

An ICT product is experiential in that a person (the end-user) anticipates and uses the product to achieve or complete a task, then reflects on the usage period. The term "user experience", or "UX" in the HCI domain, proposes a broader view of a person's engagement with and through the ICT product (Botha, Herselman, & van Greunen, 2010).

3.4.1 Engagement as a principle of user experience

According to the literature findings discussed in Sections 3.3.1 to 3.3.4, the engagement and experience an end-user has before, during, and after interacting with an ICT product are intertwined. Along with complex elements from the end-user, the ICT product, and the context in which the interaction takes place. Figure 3.4 illustrates the researcher's interpretation of the relationship between an end-user's engagement and interaction during the experience with an ICT product.

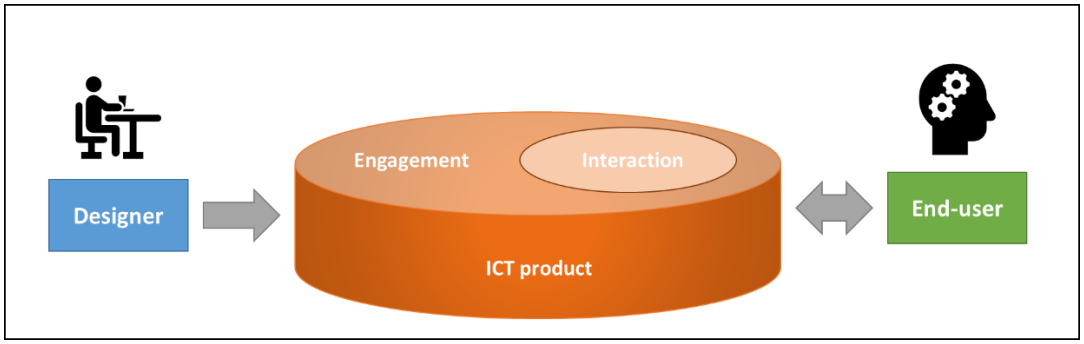


Figure 3.4: Researcher's interpretation of the relationship between an end-user's engagement and end-user interaction.

The overall experience end-users have with an ICT product occurs before, during, and after interaction with it. This implies that the end-users' feelings are subjective both when they are interacting and when there is no interaction. Moreover, the end-users' engagement with the ICT product occurs during their experience with it. The implication is that the end-users engage with the ICT product, both with and without interaction.

Further, the end-users' perceptions and feelings influence their level of judgement during their engagement process with the ICT product. This captures the emotional and cognitive aspects of the experience. As the engagement process continues, behavioural aspects such as intention and interactivity emerge.

Sub-sections 3.4.1, 3.4.2 and 3.4.3 also discuss the three dimensions of the holistic view of the end-users' engagement with an ICT product, followed by a discussion on the concept that captures the holistic view in Sub-section 3.4.4.

3.4.2 Emotional engagement

From the point of experience to the post-interaction period with an ICT product, emotional responses or reactions are evoked in the end-users. For instance, the end-users' attraction to the ICT product, its sense of beauty, perceived usability, interest, and the motivation to perform a task evoke the end-user's emotional engagement level (Norman, 2004; O'Brien & Toms, 2008). Affect is another aspect of the emotional engagement the end-user has with the ICT product. This part of the experience triggers the end-users to immerse themselves in using the ICT product and to sustain their involvement. End-users could experience either a positive or negative affect when engaging with the ICT product.

Emotions such as enjoyment, physiological arousal, fun, and feelings of success and accomplishment are positive affects. Emotional feelings of information overload, uncertainty, boredom, guilt, and frustration with the ICT product form part of a negative affective experience. Also, factors of the end-user's experience such as reliability, satisfaction, delight, and adjustability indicate the extent of the emotional engagement. Essentially, emotional engagement concerns the emotional feelings or affective responses of the end-users and maps with the emotional thread of their experience of the ICT product.

The manifestations of emotional engagement within the experience process are obtainable by analysing the verbal expressions made during the interview sessions and by observing the body movement of the end-users. These manifestations are measurable using subjective- and behavioural-oriented approaches, typically performed during usability testing or user testing the ICT product. An example of such an approach is the Positive Affect Negative Affect Schedule for measuring the end-user's affect (Hassenzahl et al., 2010). Also, physiological measures are applicable. These measures are obtainable through sensors to capture the state

of the emotions expressed by the end-user. Eye trackers, mouse pressure, biosensors, oximeters, as well as a camera for recording and detecting are examples of physiological approaches (Attfield et al., 2011). The end-user's emotions have an influencing effect on the thoughts and responses and are consequently connected to the cognition process in the period of experience (Norman, 2004).

3.4.3 Cognitive engagement

From the model of cognitive processing and end-user judgement, and the sensual and spatiotemporal threads of experience, there are manifestations of thoughts/perceptions, emotions and actions that constitute the cognitive engagement the end-user has with an ICT product. End-users subconsciously and consciously devote available perceptual resources during their experience with the ICT product. At the visceral level, instinctive thoughts are formed by the end-users, along with thoughts of the workload involved to complete a task at the behavioural level. This is followed by reflective thoughts about the period of experience with the ICT product. Further, some emotional responses are evoked in the end-users during the cognitive processing or judging levels, thus influencing their emotional experience with the ICT product. The emotions could occur during their first impression of the ICT product, during the interactive0 period with it, and/or during the reflective stage of the experience. In this stage, the end-users mentally form thoughts about their encounters with the ICT product or decide to have further experience with it. End-users could feel a level of attraction, fun, and curiosity for the ICT product and the cognitive effort to perform tasks with it (O'Brien & Toms, 2008; Oh & Sundar, 2016). Also, arousal of imagination, curiosity, boredom, enjoyment, evoked interest, and a challenge, are some attributes of the end-user's cognitive engagement (Oh & Sundar, 2016).

Self-reported measures and physiological measures apply to cognitive measurements. Indicators of the cognitive involvement of the end-users include focused attention, subjective perception of time, and follow-on task performance. In attentional research, these indicators involve having end-users reporting on their estimation of how time passed during their experience with the ICT product (subjective perception of time) (Attfield et al., 2011; Lalmas et al., 2015). They also reported on how well they performed new and different tasks following a period of an engaging experience with the ICT product (follow-on task performance) (Attfield et al., 2011; Lalmas et al., 2015).

Further physiological data capture through sensors are also indicators of the cognitive states of the end-users. Mouse pressure, oximeters, eye-trackers and cameras are examples of sensors that are used for physiological measures (Attfield et al., 2011).

3.4.4 Behavioural engagement

There are other views of the behavioural involvement that end-users have with an ICT product. Interactivity is a component in the sensual thread of experience that end-users have with an ICT product and is associated with the behavioural aspect of the end-user's engagement with it. Within the HCI domain, interactivity concerns the physical connection and cognition process during the period of usage of the ICT product. End-users interact with the interface of the ICT product during the usage period, for either a short session or a longer period of multiple sessions. The ways that end-users interact with the interface of the ICT product include clicking, touching, body movement or human motion and sound for either a short session or longer periods of multiple sessions. In addition to interactivity, a period of zero interaction is a manifestation of the end-users' behavioural engagement with an ICT product. This period of zero interaction occurs when the end-users temporarily halt their physical or peripheral interaction with the ICT product. The halt could be either intentional or accidental, such as abandoning the ICT product for another, doing activities with it, or completing a task.

Other manifestations of the end-users' behavioural engagement with an ICT product are body responses and modality actions. When end-users are confronted by an ICT product, either passively or actively, their bodies' responses form part of the behavioural manifestation. The modality actions occur as the end-users interact with the interface of the ICT product.

Measurements of the end-user's behavioural engagement could be either self-report-oriented, product-based, or psychophysiological measurements. The actions end-users perform with ICT products and their responses during the interactivity process are both part of the measurements that they consider in their self-reporting approach. Further, the amount and frequency of the interactivities, and the time taken to view, complete or ignore a task with the ICT product, are associated with product-based measurement. These measures can be captured through the analytics of the ICT products and are used to measure the short- and long-term periods of experience.

Also, the revisits, dwelling time, the number of pages or screens viewed, and click-through rates are measured as part of the intra-session engagement. Return rates, total use, and direct value are associated with inter-session measurement. Eye-tracking, facial expression and cursor-tracking are examples of psychophysiological measurements used for the end-users' behavioural engagement with the ICT product (Lalmas et al., 2015).

3.4.5 End-user experience engagement and interaction

Understanding the nature of the end-users' engagement requires viewing the interactions through the UX aspects of the interactions with the product. This study focuses on the end-users' subjective feelings of engagement from the perspective of the emotional, cognitive, and behavioural dimensions. A concept was formulated to capture this focus area of end-user engagement during an experience with an ICT product.

The concept is called the UX engagement and interaction, and it holistically refers to the emotional, cognitive, and behavioural engagement that end-users have with an ICT product. UX engagement and interaction as a concept is a focused area within the vast but emerging area within the HCI domain and UX field. It could benefit researchers, software designers and developers to understand the engaging experience and interaction that end-users have with ICT products (Oyedele, van Greunen, & Veldsman, 2018). Table 3.4 illustrates some of the attributes, manifestations, and possible measuring approaches for UX engagement and interaction. The definitions of the UX engagement and interaction attributes are in Appendix B.

Table 3.4: Possible measurement approaches of UX engagement and interaction (Adapted from Oyedele, van Greunen & Veldsman (2018)).

	Emotional dimension	Cognitive dimension	Behavioural dimension
Attributes	• Affect • Motivation • Interest • Perceived usability • Delight • Reliability • Adjustability	• Challenge • Interest • Focused attention • Aesthetics (visual, audio) • Attractiveness	• Interactions (intended, non-intended) • Amount of interactions • Frequency of interactions

	Emotional dimension	Cognitive dimension	Behavioural dimension
	• Satisfaction	• Subjective perception of time • Follow-on task performance • Perceived worthiness, reward, and success	• Sensory responses
Manifestations	• Feelings • Body responses	• Thoughts/perceptions • Completed tasks	• Body/sensory response • Modality-based actions
Measurement approaches	Self-based reports Physiological measures Product-oriented analytics		

The dimensions of UX engagement and interaction, though separate, are also intertwined during the period of experience (Oyedele et al., 2018). This implies that approaches to measuring a specific dimension might extend to other parts or manifestations of the other dimensions. Measuring UX engagement and interaction requires end-users to consider all its three dimensions. Essentially, the elements of the end-users' engagement and interaction with an ICT product are intertwined and occur in the forms of expressed or captured emotions, cognition, and behaviour. This view applies to arbitrary ICT products.

3.5 Conclusion

A short summary of the contributions from this chapter is listed in Figure 3.5. The summary shows that this chapter is relevant for finding UX elements that would be applicable for insertion into a design method for end-user engagement and interaction with social media technologies. The literature review was conducted to answer part of the first sub-research question 1 which states: "How can end-user engagement and interaction be defined within the context of social media technologies?" The objective of this question is "to determine which key UX elements constitute an end-user's engagement and interaction in the social media technology context." More specifically, the UX elements of end-user engagement and

interaction in the context of ICT products were determined in this chapter. The other part of the sub-research question and its objective is the social media technology context, which will be reviewed and present in Chapter 4.

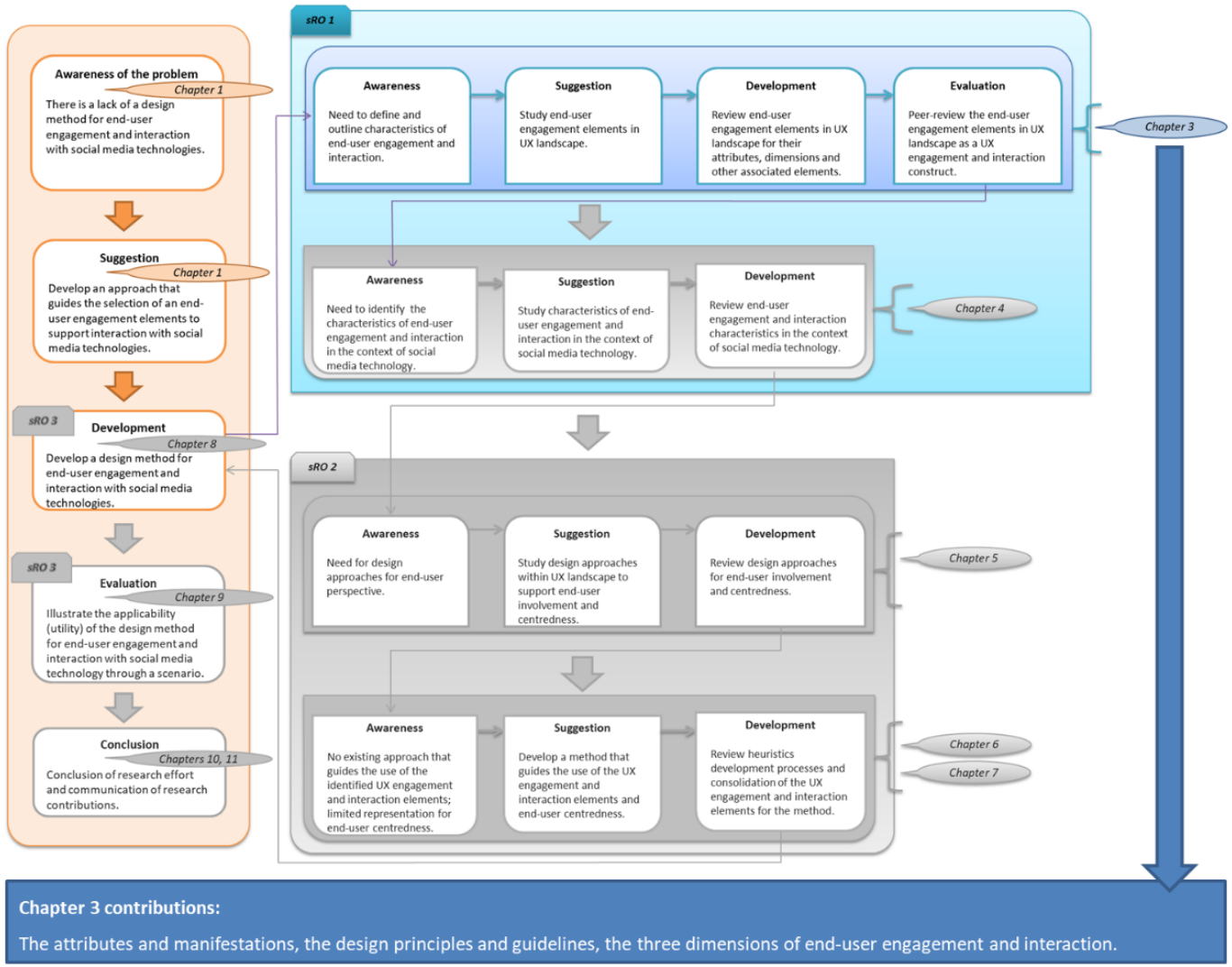
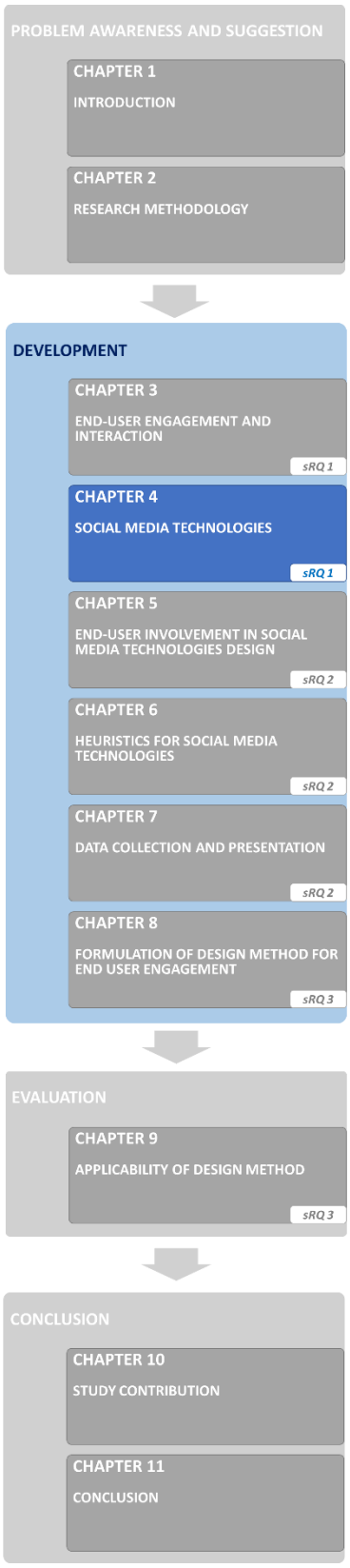


Figure 3.5: Contributions from the literature review on the UX elements in the end-user's engagement and interaction with ICT products.

3.6 Summary

Understanding the end-users' views of their experiences with an ICT product is essential, especially when the interaction is driven by them, resulting in the look and feel of the ICT product that other end-users perceive. This chapter presents discussions on the nature of the end-users' engagement, interaction, and overall experience with the ICT product. This was followed by a discussion on the conceptualised term called the end-user experience engagement and interaction. It also presented the attributes, manifestations, and possible measuring approaches. The next chapter presents the results and discussion of the literature findings on social media technology and the understanding of the end-users' engagement in this context.

CHAPTER 4 – SOCIAL MEDIA TECHNOLOGIES



4.1 Introduction

This chapter outlines social media technology, an aspect of the ICT world where the human relationship with technology goes beyond traditional user interaction. The study explores this area of end-user experience and interaction construct. The outline presented in this chapter is part of the contribution to the first sub-research question of this study. It states: “How can end-user engagement and interaction be defined within the context of social media technologies?” The objective of this question is “to determine which key UX elements constitute an end-user’s engagement and interaction in the social media technology context”.

Section 4.2 presents the trans-disciplinary nature, the definitions, types, and elements of social media technologies, and the barriers to social media technology usage in controlled situations. This is followed by Section 4.3 which presents a discussion on the aspects of designing social media technology for end-users’, while Section 4.4 concludes the chapter.

4.2 Social Media Technology

4.2.1 Definition

Every ICT device today, whether mobile or desktop, has applications that allow its end-users to have social communication with members in their circle of contacts. Each end-user is able to connect with other end-users. Each circle of end-user contacts in social media is referred to as their social network. Further, these social communication applications are either in the form of a mobile app, website, desktop or laptop application and they fall under the umbrella term social media.

With growing uses and means of accessibility, various descriptions of social media are based on either the technologies used to create the applications or the type of social interactions of the user (Aichner, Grünfelder, Maurer, & Jegeni, 2021; Kaplan & Haenlein, 2010; Tess, 2013). Several studies attempted to define social media in terms of either mobile technologies, web-based technologies, or affordances of technologies, as Table 4.1 shows. These definitions are concerned with establishing the identity of users, the conversations among users, the sharing of content, the presence of each user, the relationship with other users, the reputation of other users and content, and group formation (Kietzmann, Hermkens, Mccarthy, & Silvestre, 2011). Furthermore, online applications that are considered social media have been grouped according to the level of social presence/media richness and self-presentation/self-disclosure.

These groups are blogs, social networking sites, collaborative projects, content communities, the virtual social world, and the virtual game world (Kaplan & Haenlein, 2010).

Table 4.1: Some descriptions of social media.

Social media descriptions
Social media are defined as new technologies and applications that utilise the Internet and Web 2.0 technologies and allow users to create and participate in various communities through functions such as communicating, sharing, collaborating, publishing, managing, and interacting (Mao, 2014).
Social media employ mobile and web-based technologies to create highly interactive platforms through which individuals and communities share, co-create, discuss, and modify user-generated content (Kietzmann et al., 2011).
Social media are "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content" (Kaplan & Haenlein, 2010). User-generated content "is usually applied to describe the various forms of media content that are publicly available and created by [the] end-user" (Kaplan & Haenlein, 2010). Using social presence/media richness and self-presentation/self-disclosure, these applications are classified into collaborative projects, blogs, social networking sites, content communities, virtual social worlds, and virtual game worlds.
Mobile social media are described as "leveraging the affordances of student-owned mobile devices (such as smartphones, wireless handheld computers like the iPod touch and the iPad) alongside the collaborative and user-generated content affordances of social media." (Cochrane & Antonczak, 2013).
Social media has different types of platforms including social networking sites, text messaging/blogging sites, multimedia sharing sites, and conference sites (Boyd & Ellison, 2007; R. Chen & Sharma, 2013; Kaplan & Haenlein, 2010; Mao, 2014; Ralph & Ralph, 2013).

The differences in these definitions of social media widen in their context of use with the growing trend of the web, mobile, and Internet technologies, and social activities (offline and online). In the recent past, instant messaging software and mobile applications, primarily used for group-based social interaction, have evolved in terms of design, and are considered part of the social media landscape. For example, Skype is primarily a voice over internet protocol application. It has an instant messaging service that allows one-to-one and one-to-many conversations within a session and gives its users options to take advantage of traditional

telecommunication services. Skype, Zoom, Microsoft Teams, Cisco WebEx, and Google Meet fall into the landscape of social media Mobile Internet-based instant messaging applications such as WhatsApp, Tiktok, Snapchat and Telegram, and content management systems such as Moodle and Picasa are regarded as instances of social media (Elletson & MacKinnon, 2014; Mao, 2014; Munyoka et al., 2014; We are social & Hootsuite, 2021a). Also, the difference between the current social media and early versions of it includes support for cross-channel/cross-platform features and support for proximal communication via mobile devices.

These views on social media arise either from the features of the product or the affordance given to the users through the applications to create, share, collaborate with and terminate virtual social units or groups of like-minded users (Kaplan & Haenlein, 2010; Silius et al., 2010).

Unlike the traditional messaging applications such as email, SMS, MMS, voice calls and instant messaging chat, social media allows the members (that is, other end-users) in an end-user's circle of contacts to view and use past social interactions. These social interactions are presented in an orderly and similar arrangement for the members in the end-user's circle of contact to review.

In the era of the fourth industrial revolution (4IR), social media are used with existing ICT products, services, processes, and activities. Examples include the integration of social media with customer/client relationship management systems, adoption of social media as a customer/client relationship management system, social media integration for login processes, and social media for marketing, engagement, and management activities (Ornico & World wide worx, 2021; We are social & Hootsuite, 2021a). The terms "social media" and "social media technologies" have been used interchangeably in both literature and everyday conversation, although they can be differentiated to some extent, they are still conflicting with each other. In this paper, social media technologies are the aspects of social media that can be combined with a system, process, or activity. The primary focus is on the technical aspects and its end-users.

4.2.2 Overview of social media technologies

With over three billion people (out of a world population of over four billion people) using social media, online socialisation has become part of the everyday life of human society (We are social & Hootsuite, 2018, 2021a). The adoption of social media increases globally and across Africa. Across the globe, as at January 2018, over three billion (80%) Internet users are using social media platforms while over two billion (74%) Internet users are on mobile social platforms. The number of global social media users is a 13% increase from 2017 statistics (We are social & Hootsuite, 2018). This adoption increase of social media provides insight into its popularity and support for communication and learning in everyday life.

According to a study on a digital landscape by We are social and Hootsuite (2018), the usage of social media in the world increased by 11% (328 million active social media users) between July 2017 and July 2018 while on the mobile platform is increased by 11% (316 million active mobile social users).

Moreover, the event of the COVID-19 era in which world pandemic and lockdown occurred, caused a surge in the adoption of social media technologies. With over four billion people using social media worldwide, online socialisation has become part of everyday life and the adoption of social media keeps increasing globally (We are social & Hootsuite, 2021a). In South Africa, over 25 million members of the population are actively using social media technologies (We are social & Hootsuite, 2021b). Facebook, YouTube, WhatsApp, Instagram, Twitter, Tiktok, and Telegram are some of the globally used social platforms (We are social & Hootsuite, 2021a). Figure 4.1 presents some social media technologies and their respective number of monthly active users.

Besides supporting different cross-platform and cross-channel user interfaces, social media technologies have built-in analytical services. The built-in analytical services in social media technologies are used to monitor and report how people have engaged/interacted and the status of their actions and inactions on the social media technologies. Typical findings include the number of views, likes, thumbs up/down and claps, and post engagements such as reactions, comments and shares (Ornico & World wide worx, 2021; We are social & Hootsuite, 2021a). WhatsApp, YouTube, Facebook, Instagram, Facebook messenger, Twitter, LinkedIn, Pinterest, TikTok, snapchat, skype, and telegram are some of the most-used social media platforms in South Africa (Ornico & World wide worx, 2021; We are social & Hootsuite,

2021b). These are special features found at the user-generated content, profile, social network, and architectural levels.

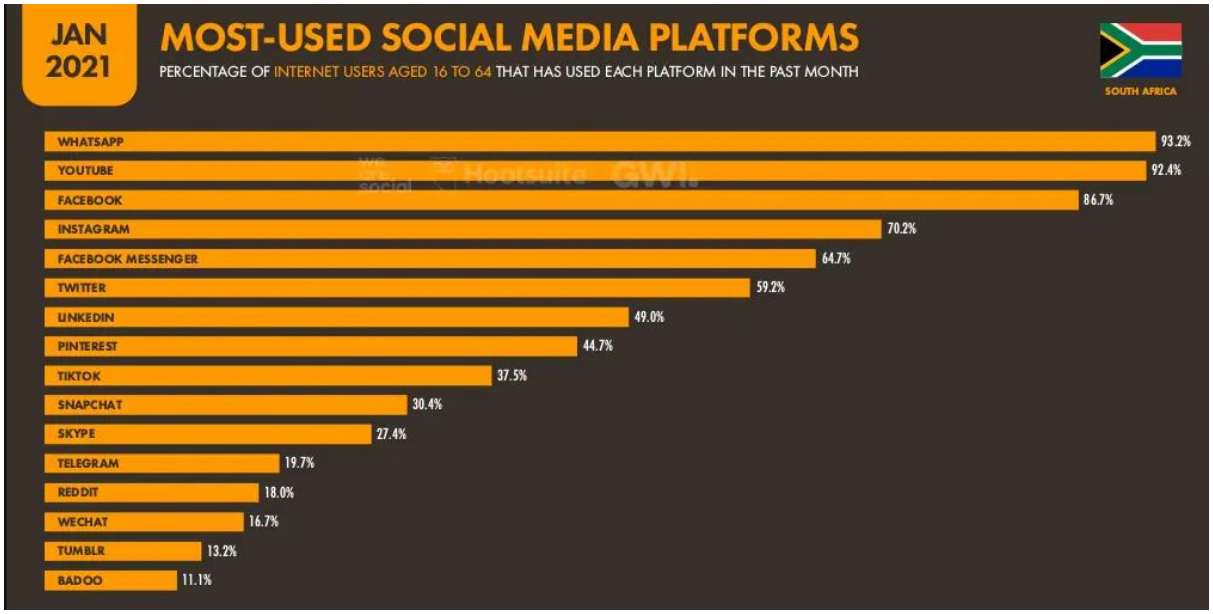


Figure 4.1: Most used social media platforms in South Africa as at January 2021 (Adapted from We are social & Hootsuite (2021b)).

With the growing uses and means of accessibility, various descriptions of social media are either based on the technologies used to create the applications or the type of social interactions that take place on Web 2.0 applications.

4.2.3 Elements of social media technology

Social media technology started on the ideas and technological foundations of the Web 2.0 platform. From the early 2000s to the early 2010s, the concept of "social software" has been used to refer to websites that are designed to enable social interactions among people. The concept in which people create and share content across the web is synonymously referred to as Web 2.0. The term Web 2.0 reflects the changes in the creation and utilisation of the content on web applications/services from "user-product" interactivity to "user-user" interactivities. Users have the option to view and engage with the social activities of non-associated users. Applications based on the Web 2.0 platform follow the principle that users are trusted as co-developers who contribute content regularly. They harness collective intelligence (user-generated and device-generated data in real-time), cost-effective scalability of the social media technology services, service support for many devices, and user self-

service. Similar to Web 2.0, social media technology can be web-based, desktop client and/or mobile-based (Kaplan & Haenlein, 2010; O'Reilly, 2005; O'Reilly & Battelle, 2009).

Social media technology has evolved since the mid-2000s. In the current era of Industry 4.0, changes are currently being made to social media technology. It should be noted that as the adoption of social media technologies continues to increase in the world, some social media technologies such as MySpace and Vine have come to an end. This change can be seen in terms of low user engagement, a high number of uninstallations, long periods of abandonment, low participation, and vanity metrics for measuring engagement. Understanding social media technologies from a broader view (besides being a popularly used service) could better inform how true engagement could be evaluated and designed.

Social media technologies are continuously being designed with new and more defined features to facilitate social interaction through web technology (software) and mobile/desktop devices (hardware). Other views of social media technologies include an instrument or medium of communication (real-time two-way digital interactivity between the users, the content, and other users, unlike print media, broadcasting media, and electronic media). They also include a collection of social software of interactivities, Web 2.0 applications, and online social technologies. In the current era, defining social media technologies is challenging for developers who need to decide whether it should be described using technical characteristics, social networking capabilities, or user perceptions. No established umbrella definition constitutes all the characteristics of social media and the range of ICT products considered as applications of social media.

Social media technologies are classified in differing ways from other forms of ICT products. One of the classification approaches is the social software honeycomb in which an ICT product is considered as social software if there is an implementation of the building blocks of the framework (Kietzmann et al., 2011; Smith, 2007; Webb, 2004).

The attributes of social software building blocks in social media technologies are identity, presence, relationships, conversations, groups, reputation, and sharing (Smith 2007). Together, the seven blocks provide a good foundational definition for social software and for thinking about how social software works. The building blocks are a good conceptual framework for understanding social software as Figure 4.2 illustrates. Identity is the most

basic requirement of any social software, hence its location in the centre of the honeycomb with other elements grouped around it.

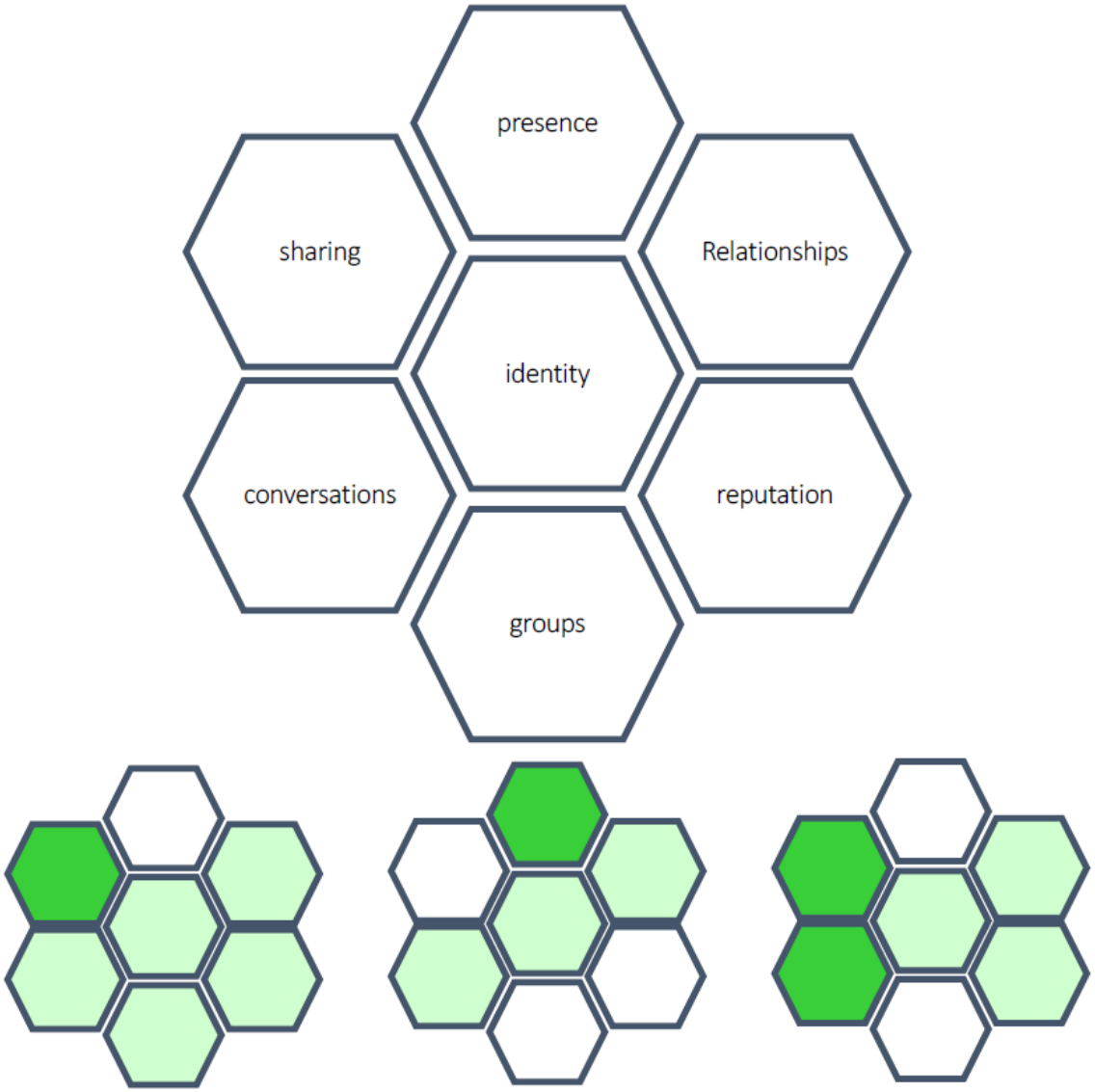


Figure 4.2: Honeycomb lens for social media technologies building blocks (Adapted from Smith (2007), Kietzmann et al. (2011)).

Social software focuses on two or three of the building blocks. Next, are the "presence" element and other supporting elements (Kietzmann et al., 2011; Smith, 2007). Most of the software systems at the time had three or more building blocks. Pereira, Baranauskas, Cavalcante, and Mantoan (2010) extended the blocks of social software to thirteen elements. The added social software elements are adaptability, awareness, collaboration, object, privacy, and usability. In the pre-COVID-19 era, social media technology includes most of the

building blocks in its system and these are accessible across mobile, web, and desktop platforms. Table 4.2 presents other honeycomb lenses that describe social media technologies.

Table 4.2: Honeycomb approach to define social media technologies.

SS elements	Webb 2004	Smith 2007	Pereira et al. 2010	Kietzmann, et al. 2011	
Name	Mechanisms of social software	Social software building blocks	Elements of social software	The honeycomb of social media (Social media functionality)	The honeycomb of social media (Implications of functionality)
SSS examples	AOL instant messenger (desktop application)	Flickr, Twitter, Digg (websites)	YouTube, Delicious (websites)	LinkedIn, Foursquare, YouTube, Facebook (websites)	
Identity	A user's identity is shown by the screen name, which remains engaging through time	A way of uniquely identifying people in the system	A unique identifier of a user within the system, e.g., the user profile	The extent to which users reveal themselves	Data privacy controls, and tools for user self-promotion
Presence	The awareness of sharing the same space and is implemented as seeing	A way of knowing who is online, available, or otherwise nearby	Resources that allow knowing whether a person is online, sharing the same space	The extent to which users know if others are available	Creating and managing the reality, intimacy, and immediacy of the context

SS elements	Webb 2004	Smith 2007	Pereira et al. 2010	Kietzmann, et al. 2011	
	when your friends are online or busy		at the same time		
Relationships	A way to add people as buddies or friends	A way of describing how two users in the system are related (family, friends, spouse, etc.)	A way to determine how users of the system can relate/are related to others, e.g., friends, followers, fans, etc.	The extent to which users relate to each other	Managing the structure and flow properties in a network of relationships
Conversations	Implemented as synchronous messaging (exchange of text) or conversation (messaging has its presence and wants to be continued) after the closure of the window.	A way of talking to other people through the system	Possibility of two or more users establishing direct communication	The extent to which users know the social standing of others and content	Monitoring the strength, passion, sentiment, and reach of users and brands
Groups	Group chats where loyalty to a group is formed when there is some	A way of forming communities of interest	Functionalities for supporting the formation of communities of users who	The extent to which users are ordered or form communities	Membership rules and protocols

SS elements	Webb 2004	Smith 2007	Pereira et al. 2010	Kietzmann, et al. 2011	
	kind of "joining" step or cost.		share common interests, ideas, or opinions		
Reputation	A way that allows users to meet new individuals	A way of knowing the status of other people in the system (who is a good citizen, who can be trusted)	A way of knowing the status of a user in the system, the perception of collective opinion about an individual constructed by others	The extent to which users communicate with each other	Conversation velocity, and the risks of starting and joining
Sharing	A way to share a link, photographs, and other small transactions or exchange with other users	A way of sharing things that are meaningful with participants (like photos or videos)	Refers to the possibility of users sharing objects that are significant, important to them	The extent to which users exchange, distribute, and receive content	Content management system and social graph
Adaptability			Features that allow users to modify a system according to the context of the use		
Awareness			Resources that provide individual and		

SS elements	Webb 2004	Smith 2007	Pereira et al. 2010	Kietzmann, et al. 2011	
			collective perceptions about who is doing what in the system		
Collaboration			Resources that allow users to cooperate, working together on the same object		
Object			The social object being built/modified, e.g., talks begin, the focus is maintained, the collaboration happens, etc.		
Privacy			Features that allow individuals to determine what information about them will be available and who will have		

SS elements	Webb 2004	Smith 2007	Pereira et al. 2010	Kietzmann, et al. 2011	
			access to this information		
Usability			This refers to user interfaces that are consistent, controllable, that is, predictable, and easy to use. The system cannot require users to have a high level of expertise in the use of computers		

In other words, social software focuses at least three building blocks and elements. Not every social software has all these elements. The social software system is an implementation of design for group interaction. The challenge is that people bend social software tools for their social purposes.

Another classification approach is the use of theories from fields related to social sciences and media, as Table 4.3 illustrates. Elements from the media research field are social-presence (Social presence theory) and media richness (Media richness theory). That is, social media technologies could be classified based on the richness of the medium and the degree of social presence (i.e., intimacy and immediacy of the medium). These elements form the first classification. Self-presentation and self-disclosure relate to the social dimension of social media technologies and are elements from the field of social research. The second

classification is arguably based on the degree of self-disclosure the social media technologies require and the type of self-presentation the social media technologies allow.

Table 4.3: Classification of social media technologies by social presence/media richness and self-presentation/self-disclosure (Adapted from Kaplan & Haenlein, 2010).

		Social presence / Media richness		
		Low	Medium	High
Self-presentation/self-disclosure	High	Blogs	Social networking sites (e.g., Facebook)	Virtual social worlds (e.g., Second life)
	Low	Collaborative projects (e.g., Wikipedia)	Content communities (e.g., YouTube)	Virtual game worlds (e.g., World of Warcraft)

The authors used a set of theories from media research and social processes to distinguish or categorise social media technology applications.

Furthermore, there has been a paradigm shift in what ICT products (such as web, mobile, desktop) can be considered as social media technologies. These could be an exclusive social network system, e.g., WhatsApp, Telegram, Skype, other IM, etc., versus an inclusive social network system, e.g., Facebook, Twitter, YouTube, etc. Also, there are native mobile social networking applications, native web-based social networking applications, and mobile extensions of native web-based social networking applications.

Considerations for social media technologies include the technological foundation on desktop, mobile or web platforms, the frontend and backends, the social networking features, the user control over privacy and publicity, the necessity of membership, ease of access, the "always-on" nature of the users, the cross-platform-cross-channel content generation, and the architecture. Each social media technology will be discussed according to these categories. Also, the boundary between the user-technology and user-social network

becomes blurry. Thus, it is important to consider both aspects of the interactions through the end-user as an individual and social entity during interaction with social media technology.

social media technologies have different user interfaces and process flows. Other areas of difference are original and current ownerships, the evolving features, requirements for membership, and profile creation. Also, the level of accessibility of content without membership or login is possible on YouTube, while limited on Facebook, Instagram, and Twitter. The level of accessibility is non-existent for WhatsApp. Also, each social media technology has a traditional classification in terms of social software. For instance, Facebook is traditionally classified as online social networking, Twitter as microblogging, YouTube as Video-sharing, Instagram as mobile video sharing, and WhatsApp as a mobile instant messaging application. However, these social media technologies have evolved from the traditional classification to be more omnichannel social networking applications. Currently, elements of social networking are found in these social media technologies.

With a social networking lens, support for web services, group creation, and administration, an ICT product could be considered as social media technology. Also, social media technologies have requirements for user membership. These include active and accessible e-mail addresses, active and easily accessible cellphone numbers, and existing accounts from a different social media technology. These requirements are also needed in logins, verifications, and notifications.

There are a few perspectives on designing for social media technology users. First, the broad level or the “big picture” level of design. Design features could be added to social media technology. Also, features from social media technology such as social login, plugins, APIs, and content serve as design features that are added to different ICT products. Another level is the content and layout design of social media technology.

End-users also play the roles of the member, an administrator, and co-designer but within a part of the global social networks of the social media technology. Group/channel management is another level of design for social media technologies.

Another paradigm is the integration of social media technologies into new or existing ICT products, particularly for communication and publicity, for example, a higher education institution. The social media technology is implemented as either third party serviced or

privately-owned social platforms and social media Mashups. Figure 4.3 indicates these setups:

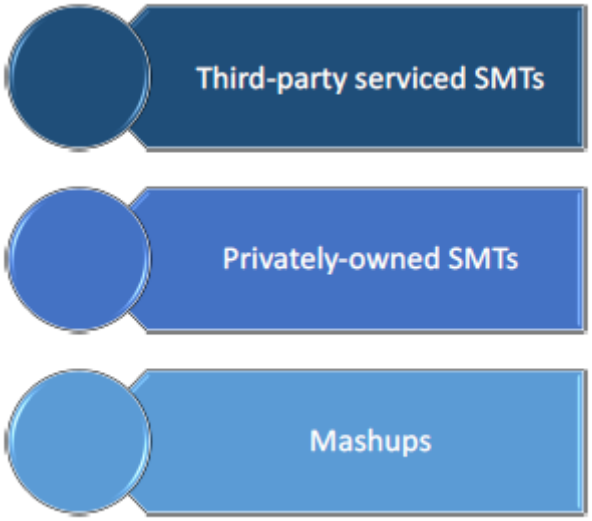


Figure 4.3: The researcher's interpretation of social media technology integration modes.

Third-party social media technology setups are web-based and device-based applications whose services are offered to the public to create personal and group profiles. Examples of third-party serviced social media technologies are Facebook, Twitter, Instagram, Google plus, Edmodo, NING, SlideShare and Wikipedia, to mention a few. Common approaches used to integrate these platforms are the use of hyperlinks and buttons embedded on the institution's websites to link to the corresponding SM profile or group page.

Some of the other social media technologies are similar to the third party serviced social media technologies except that they are available as either open-sourced or custom-built content management systems. In contrast to the third-party social media technologies, these are managed within an organisation along with associated data. These social media technologies are referred to as privately-owned or in-house social media technologies. BuddyPress and Elgg (Thoms & Eryilmaz, 2014; Veletsianos & Navarrete, 2012) are examples of this social media technology category and are complete custom-built social media technologies (Silius et al., 2010).

Social media technology mashups are software applications embedded with aggregation tools (a collection of several separate elements/content) that present selected data and functionalities from multiple social media technologies through respective APIs (He & Zha, 2014). For instance, traditional software applications such as learning management systems and enterprise systems have social media technology plugins and social logins. These plugins use APIs of either third-party social media technology or privately-owned social media technology to extract timeline data or feeds which are then displayed in an allocated section of the traditional ICT product interfaces. An example is the Twitter plugin for the Moodle learning management system, which displays tweets from a privileged learning management system user's Twitter account feeds on a course page using Twitter's widget tool. Also, these plugins or extensions afford the users a chance to sign into websites and other applications with their own social media technology account. As a result of these possibilities, the plugins or extensions turn the traditional ICT products into social media technology mashups when more than one social media technology is involved.

Likewise, enterprise-based Microsoft Office has evolved into an ecosystem. Its ecosystem is integrated with the Skype platform as well as OneDrive cloud services. Further, social media technology is integrated to form a bigger mashup. This form of mashup typically occurs when an social media technology company buys out another social media technology company, thereby absorbing the latter's social media technology architecture and services. Facebook Inc.'s acquisition of WhatsApp and Instagram demonstrates such a mashup.

Another element of social media technology is the end-user's social networks or circle of contacts. One of the driving forces of the growth and sustenance of social media technologies is the network of end-users and the extent of their creations. Social media technology end-users are connected through either a client application or a web browser to the social platform. They are grouped based on the extent of their creation as well as their social network on the social media technology platform.

There are two extreme groups of people that use social media technology platforms, namely, authenticated, and unauthenticated end-users. Unauthenticated end-users are not signed into the social media technology but can access the public areas of the social platform. These people can view public content, thereby contributing passive content, but cannot contribute content actively. For instance, people can view the video content of any public YouTube

channel without having to sign in. Every view of a video by an unauthenticated end-user of YouTube is counted and added to the number of views the video has received. The counted view of the social media technology end-user is considered passive user-content generation. Authenticated users have their own social media technology account and are signed into the respective social platform. These persons contribute both passive and active content on the social platform.

The stages to create an end-user on social media technology are profile creation, content generation (active or passive), social network administration (self-created or role-assigned). social media technology end-users start at any of the stages and switch in-between them.

Also, social media technology end-users have social networks. The social networks are grouped as follows: the universal social media technology network, the wide-area social network (friends and friends of friends), and the local-area social network (contact-list and private friends).

Besides, the universal network on an social media technology platform can be crossed to the networks of other social media technology platforms. This occurs when a person shares content from an social media technology platform with another social media technology platform. An end-user could share a YouTube video link on Facebook with friends on Twitter, for anyone that cares, and on WhatsApp group and status family, religious group, and anyone on his phone contact list.

Furthermore, the online participation of the social media technology end-user within a social network is another element of social media technology. In the ICT field, user behaviour is associated with the interaction of a user with an ICT-related product or service. User behaviour in online social networks is expressed in several ways. Examples include the frequency of user interactions (through views and ratings), the type of activities for which the interactions are conducted and the motive behind the interactions. The amount and quality of the content contribution of the user (through posts) and the completion of assigned tasks and the number of followings/followers are other examples (Brandtzaeg & Heim, 2011). Also, elements such as user-generated content and group users (other social users) attract an end-user to interact with social media technology and the social network.

Different users in a given demographic group have different attitudes, perceptions, lifestyles, and interests toward a given technology and its uses (Garrett, 2011). Within developing African countries, some traits, not necessarily the age generation they belong to, highlight the diversities among a demographic group of technology users. These are strong cultural practices, beliefs about the use of technology in a structured environment, technological constraints, and infrastructural constraints.

Using the Visitor-Resident model of participation (i.e., the engagement of users with social media technology activities) on a class of students using a social network for learning activities, Wright, White, Hirst, and Cann (2014) identified several end-user behaviour patterns. The identification of the patterns was based on the system data along with the end-user's perception of the usability of the integrated social media technology. The system data revealed activities that reflected the relationship between the individual user and other users and the content of posts/comments that the user made. User perceptions varied between users with a visitor participation pattern and those with a resident participation pattern. Perceptions such as social intention to access the social network rather than grading achievement and feeling at ease to share learning achievements with other users as part of course assessment, were expressed more by the residents than by the visitors. The same applied to finding content, created by other users, being trustworthy and viewing the integrated social media technology as personal space. Also, all visitors were satisfied with having options to make changes to privacy settings such as securing the profile and activities of the user from public view. In addition to the visitors and residents patterns, Wright et al. (2014), identified another behaviour pattern, namely, lurkers. The lurkers are users who, after the assessment element is removed, access the integrated social media technology without making any contribution or participation. Keane, Branch, But, Cricenti, and Klimovski (2013) also observed the lurker behaviour among users. They mentioned that such users preferred to lurk around to get new information rather than to create user-generated content for the online social network (Keane et al., 2013).

In a crowdsourcing-type survey, Brandtzaeg and Heim (2011) identified social media technology user types whose behaviour was based on participation objectives and frequency of participation among the end-users within a group. These user types are sporadic and on a rare occasion visit and use the social media technologies for informational purposes and make

a minimal contribution through the technology. The lurkers are the largest user type, visit more frequently than the sporadic for recreational purposes, consume other user-generated content but with no form of participation, and eventually lose interest in using the social media technology. The socialisers are the second-largest user type and are highly participative for recreational purposes. The debaters, who share similar traits with the socialisers. Contribute to the group for informative reasons and tend to be the lowest user type. The actives are the most highly participative in all activities in the group (Brandtzaeg & Heim, 2011).

Furthermore, the characteristics of each user behaviour pattern are viewable as those of user types. The patterns of the varied interactions among users are like the common behavioural types of social networking end-users. The majority of these end-users are the Lurkers who have minimal to zero interactions with the content and other end-users such as the Actives (Brandtzaeg & Heim, 2011). Also, similar behaviour patterns have been observed with the way teachers interact on social networking platforms, particularly when sharing educational lessons (Kamalodeen, 2013).

Besides identifying end-user behaviour patterns in terms of participation, the overall view of user participation is important to understand how end-users are engaged with social media technology in an educational context. A few studies have reported that although many end-users enrolled actively to use the integrated social media technology during their initial use, their participation in terms of the number of end-user interactions reduced throughout the respective study (Deng, Judith, & Tavares, 2013; Hung & Yuen, 2010; Keane et al., 2013; Veletsianos & Navarrete, 2012; Wright et al., 2014).

In summary, the elements of social media technologies are:

- Social software building blocks: seven (identity, presence, relationships, conversations, groups, reputation, and sharing) + six (adaptability, awareness, collaboration, object, privacy, and usability)
- Media and social classification/dimension: Social presence/media richness, self-presentation/self-disclosure
- Technological foundation: desktop, mobile, web, hybrid
- Interaction: user-technology interaction, user-social network interaction

- Accessibility and control: privacy/publicity, member authentication/non-authentication
- Social networking: Web services, group creation, group administration, membership
- System integration: 3rd-partied social media technologies, privately/custom-owned, mashups
- End-users: authenticated/unauthenticated participation roles
- Social network: universal social media technology network, wide-area social network, local-area social network

4.2.4 Barriers to social media technology usage

Social media technologies have evolved over the years and have gained a wide range of applicability and usage. However, some issues continue to arise regarding the engaging experience that people have with social media technologies. The issues discovered in existing literature relate to low user participation, a reductive view of the user's engagement, UX issues, and an unclear UX design approach for positive user experience.

4.2.4.1 Low user participation before the COVID-19 pandemic

Many institutions and organisations are adopting social media technologies mainly for content creation and social interactions. However, low uptake still exists in terms of user participation. After the initial stage of awareness and the first period of interaction, the level of engagement with the product reduces or in some cases fades away. A few studies have reported that, though many end-users enrolled actively to use an integrated social media technology during the initial use, their participation in terms of the number of end-user interactions reduced throughout the respective study (Deng et al., 2013; Hung & Yuen, 2010; Keane et al., 2013; Veletsianos & Navarrete, 2012; Wright et al., 2014). Two causes leading to the variation in participation are the end-users' feelings and the extrinsic motivators from the education domain such as the teaching and learning environment. Figure 4.4 shows the researcher's interpretation of the gap in the literature concerning the participation of the end-users in an integrated social media technology within the educational context.

Two causes leading to the variations in participation are the end-user's feelings and the extrinsic motivators from the teaching and learning environment. The participations are expressed in terms of interactions of the end-user with an integrated social media technology.

User participation is motivated through the extrinsic elements and the user's feelings that occur before, during, and after interacting with the integrated social media technology.

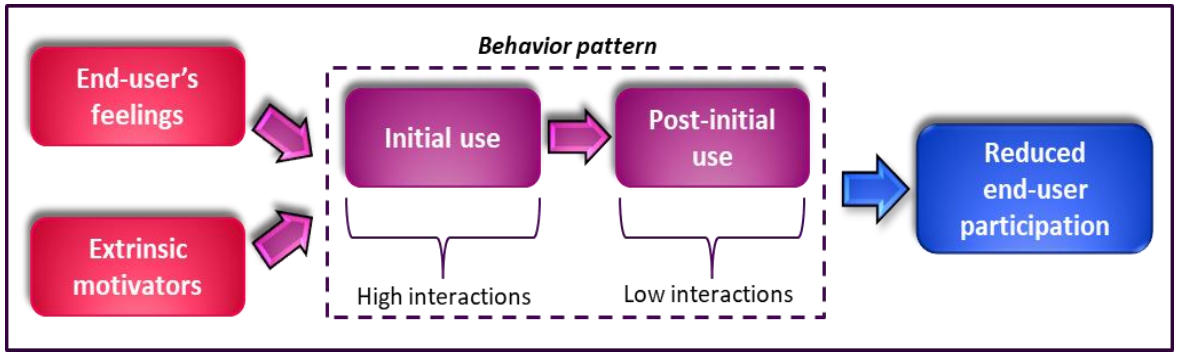


Figure 4.4: The researcher's interpretation of the literature on the gap in the participation of social media technology users in an educational context.

To encourage more online participation from the end-users on the integrated social media technologies, incentives in the form of extrinsic motivators are commonly given. Examples of such incentives include allocation of marks for course-related submissions, requests or instructions for posts and comments, and the introduction of more social features or tools into the platforms (Kent, 2013; Silius et al., 2010; Veletsianos & Navarrete, 2012; Wright et al., 2014). These studies indicate that the participation level of end-users increased for a short period after the introduction of these motivators. Then, the participation level was significantly reduced. Furthermore, with access to the technology and the encouragement and online presence of the teachers, end-users sporadically use the integrated social media technologies (Keane et al., 2013; Kent, 2013).

The end-users' feelings result from personal interactions with an integrated social media technology. Veletsianos and Navarrete (2012) highlighted the fact that the students were selective regarding the activities in which they participated. Many students become less inclined to take advantage of the social features because graded activities and other activities related to their academic courses were more appealing (Veletsianos & Navarrete, 2012). These decisions were attributed to end-users implementing their strategies to minimise the time required to go through the available content on the social network. They were also attributed to the amount of time required to respond to comments concerning the course expectation and non-related course activities. Other reported reasons behind these

behaviour patterns in the literature include the end-user feelings of intimidation and fear that personal contributions may be considered unacceptable. These also include the availability and appeal of other venues for social interactions, school sessions, limited time available for updating, and infrastructure constraints such as inadequate Internet quota and blocked social media technology sites (Deng et al., 2013; Hung & Yuen, 2010; Keane et al., 2013; Wright et al., 2014). These reported reasons reflect some of the characteristics of a negative user experience. User experience is an influencer of user loyalty to product or service use. Negative user experience leads to low user loyalty.

Participation is expressed in terms of the interactions of the end-users with an integrated social media technology. User participation is motivated by the extrinsic elements and the users' feelings that occur before, during, and after interacting with the integrated social media technology. Besides identifying end-user behaviour patterns in terms of participation, the essence of the end-users' engagement still needs to be explored.

4.2.4.2 Partial view

An aspect of the end-users' interaction is not enough to represent the whole engagement they have with an ICT product. There are two ways of initiating interactions between the user and an ICT product: from the product to the user (product-initiated) and likewise from the user to the product (user-initiated). Social media technology as an ICT product has two components, namely, the user-technology level, and the user-social network level. Existing artefacts on user engagement with ICT products focus on singular aspects and not the entirety of all the aspects. For instance, user engagement is typically viewed and measured by the behavioural analytics of the product, which logs the end-users' actions and inactions. In a crowdsourcing survey, Brandtzaeg and Heim (2011) identified social media technology user-types based on user behaviour in terms of participation objectives and frequency of participation among the end-users within a group. These focus on the consequence of the behavioural dimension of end-users' involvement, which is not a holistic view of the end-user's engagement with the product. Behavioural elements within social media platform are mostly used to measure social media engagement (Trunfio & Rossi, 2021). In addition to the behavioural aspect, the users' perspective of the engaging experience needs to reflect emotional and cognitive dimensions. As such, an artefact that promotes the process of designing for user engagement should support all aspects.

4.2.4.3 User Experience issues

The context of the non-personal usage of social media technology is misaligned with the user's goals. From, the literature on user experience, the internal state of mind of the user is susceptible to changes during interaction with the ICT product and the context of interaction (Roto et al., 2011). For instance, the nature of the tasks or activities performed through the user interface is different in an educational context and a leisure context. In the educational context of using social media technologies, the activities are either formal or informal. These activities are typically expected to meet certain educational goals (Dabbagh & Kitsantas, 2012). In the leisure context, the activities are not related to such goals. The social media technology end-users aim for activities that help to occupy their time to achieve personal enjoyment. The activities of interest range from communicating with friends within the online social network to following up on updates to "pass the time" (Brabazon, 2014).

Furthermore, all these activities and other forms of user interaction reflect on the user interface of the integrated social media technology. These interactions change the updates that are displayed on the user interface of the integrated social media technology. The users and other users, irrespective of geographical and technological differences, see the changed interface. As such, the nature of experience changes with each succeeding encounter the user has with the interactive product (Battarbee & Koskinen, 2005; Roto et al., 2011). The context of using social media technology still needs to be aligned with the end-user's perspective to provide a good experience.

4.2.4.4 Unclear design approach

A UX approach that promotes social media technology end-user behaviour where interaction meets the needs for user participation is limited in the literature. Several UX-based approaches such as frameworks and principles focus on guiding the design of interactive products to attract more end-user interactions with the product (Baird & Fisher, 2005; Estes, Schade, & Nielsen, 2009; Garrett, 2011). Literature findings on UX suggest that the use of product features and usability factors provide a positive engaging experience for the end-users. However, end-users still decide whether or not to participate in the engagement.

End-users drive their actions and non-actions, which form part of the whole engagement they have with social media technology. Without making a choice, end-users are not likely to partake in the engaging experience. Consequently, the actions and non-actions of the end-

users contribute to the ever-changing design of the social media technology interface. Social media technology is a product with social functionalities and other users of the same social media technology see the changes. The interaction of the end-users also causes changes to the interaction of the social media technology. These changes in social media technology interactions can be seen in the end-users' succeeding encounters with it and by other end-users. This illustrates how social media technology development is an ever-changing consequence of the end-users' interactions and non-interaction and the social media technology software developers. As such, a design approach is needed that takes into consideration the contribution power that end-users have in the lifespan of the social media technology.

In the HCI domain, existing UX-based approaches that have been postulated primarily focus on content-building for a group of uniformly experienced users, as perceived by the social network designer. Consider a formal teaching and learning environment. A UX-based approach postulated by Baird and Fischer (2005) concerns strategies based on elements such as the course language, course design, and user expectations for teachers to appeal to a group of end-users (students) (Baird & Fisher, 2005). The UX-based strategies guide a developer (the teacher) concerned with making the experience of using the course content on an integrated social media technology appealing to the learning styles and expectations of end-users (the learners) who are familiar with the use of the social media technology in a different use environment (Baird & Fisher, 2005).

However, Baird and Fischer's (2005) UX strategy approach has limited relevance for this era where a group of people in a learning environment have different levels of Internet and social media technology experience. Other issues of relevance include the following:

1) The UX strategy approach implies a single mental model is based on only social media technology-experienced millennial end-users who have been regular Internet users since early childhood. In contrast to the consideration for user grouping in the UX-based approach, the view of Baird and Fisher (2005) assumes a single user mental model expressed as a representative of all students in a given class. This approach neglects end-users who do not fall in the generational categorisation, technological experiences, and access. Such generalisation for all students in a given class is

partially representative of the realities of higher education within African developing countries.

2) Various cultural practices, beliefs about the use of technology in formal or structured environments, technological constraints, and infrastructural constraints are some of the characteristics of higher education institutions in developing countries that influence the adoption of social media technologies (Munguatosha, Muyinda, & Lubega, 2011).

3) There are diverse social media technology users, including non-users of social media in each class of students with different attitudes, familiarity, and social media usage behaviour. In their study, Ivala and Gachago (2012) reported that the low engagement of the end-users with an integrated social media technology occurred because of the challenges they faced. Challenges such as time limitation, academic workload, inadequate Internet quota and blocked social media technology sites were reported to influence the engagement of the end-users (Ivala & Gachago, 2012).

Furthermore, there have been dynamic changes in software development and the usage and design of social media technologies in diverse areas of human life. Also, the expectations of users are constantly changing. Users' perceptions, emotions, feelings, and expectations for the software start to evolve from the preceding moments of awareness of the software's existence to the first use and future usage. These changes inform the UX design that is captured through different monitoring, tracking or feedback elicitation approaches.

4.3 Conclusion

Currently the literature is limited on a UX approach that promotes social media technology end-user behaviour where interaction meets the needs of user participation. Several UX-based approaches used as frameworks stress guiding the design of interactive products to attract more end-user interactions with a product (Baird & Fisher, 2005; Estes et al., 2009; Garrett, 2011). Literature suggests that the use of product features and usability factors provide an engaging experience for the end-users. However, the end-users still need to decide on whether to participate in the engagement. Without making a choice, the end-users are not likely to partake in the engaging experience. Also, in the context of developing countries, particularly in Africa, the research has not been adequate on the use of design features to cater for diverse social media technology users. Some form of understanding is needed for

online social network designers on designing for online end-user participation, i.e., a UX approach for user engagement.

In the online social networking context, end-users are considered co-designers of social media technologies. Each end-user generates content on social media technologies. The content forms part of and shapes the user interface of the social media technologies, which is seen by other end-users. User-generated content (UGC) is essential for the continual usage of social platforms. With the ever-increasing presence, use, and convenience of social media technology in everyday life and sectors of the economy, user-generated content continues to increase and evoke consequential content from other end-users. User-generated content includes text (plain, formatted, URL-ed), emojis/emoticons, animated images (gifs), pictures, video clips, live video streaming, audio clips, voice notes, and shortcuts/reply links. This UGC is either created using the social media technology application, sharing/forwarding from an end-user, sharing/forwarding from a different social media technology or software application. End-users have control of the generation of this content for social media technology. Thus, end-users are considered content developers, and social media technology developers should make provision for the end-user's content creation and measurement. All content and measurement also attract UX engagement and interaction elements (emotional, cognitive, and behavioural engagement).

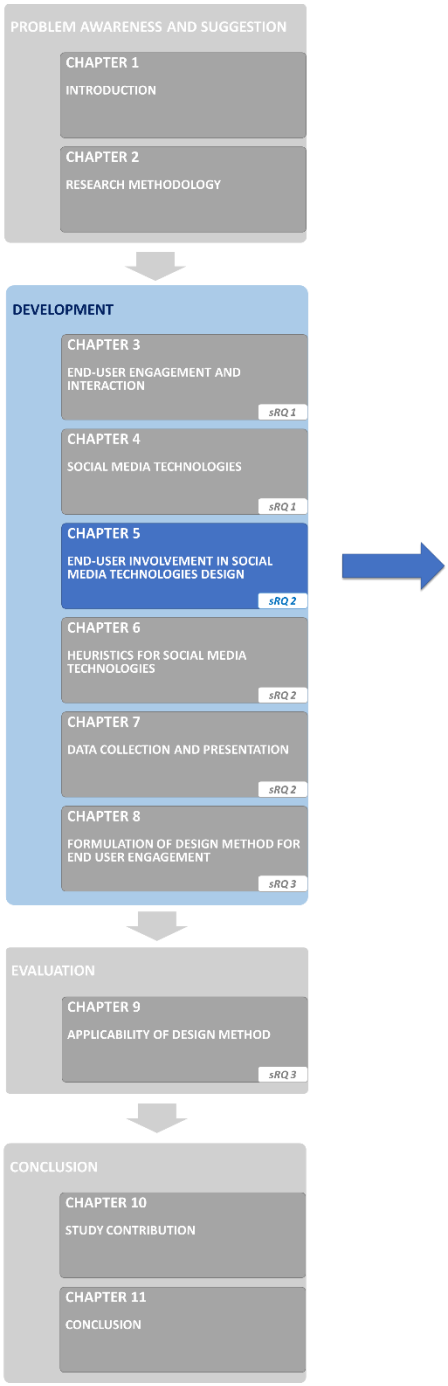
This study centres on re-conceptualising end-user engagement from the end-user's perspective. This is followed by identifying design components that influence the end-user's choice to engage with social media technology and, more specifically, to design for end-user engagement with outside social media technology-enabled environments. The approach for studying end-user engagement stems from the HCI domain and aims to bridge the participation gap identified in the literature. The focus is on user experience components aimed at the positive change of user behaviour from one level of online participation to another within a social media technology-enabled environment. An artefact that constitutes an understanding of the end-users' perspective of emotional, cognitive, and behavioural engagement with social media technology could enhance the design process. Furthermore, the activities of social media technology end-users and the features and functionality involved in the activities matter in the design process. The features and functionalities to consider for design and evaluation can be deduced from identified activities.

4.4 Summary

This chapter presented an overview of social media technologies followed by descriptions, categories, and user characteristics of the social media technology relevant to the research. It looks at the importance of social networking to define an ICT product as a social media technology. Aspects of the social media technology were discussed. These include the features of engagement and interaction, and the analytics and privacy aspects of social media technologies. The engagement metrics and analytics of five social media technologies, the emotional engagement metrics, the cognitive engagement metrics, and the behavioural engagement metrics connected to each social media technology were studied and associated features were identified.

The next chapter of this thesis discusses the literature findings on the design methods for social media technology and presents the end-user involvement in a social media technology as an ICT product.

CHAPTER 5 – END-USER INVOLVEMENT IN SOCIAL MEDIA TECHNOLOGIES DESIGN



5.1 Introduction

This chapter presents an outline of a set of steps conceptualised during the development of the artefact in this study. The conceptualised set of steps is the process to outline the end-users' involvement in social media technology design. The presented process relates to the second sub-research question of this study, which states: "What are the design elements that correspond to unified end-user engagement and interaction?" The objective of this question is "to identify an approach to derive some design guidelines and heuristics for unified social media technology engagement and interaction".

Section 5.2 presents social media technology as a product while Section 5.3 presents the involvement of the end-users in the development and post-development stages and the participation roles of end-users. Section 5.4 presents the development life cycle models of ICT products and Section 5.5 concludes the chapter by presenting the conceptualised process of end-user involvement. Section 5.6 gives a summary of the chapter.

5.2 Social media technology as a product

With the multi-levels of technologies and applications for creating, processing, and communicating system content and user-generated content, social media technology could be considered a product from the ICT sector.

After release, an ICT product goes through many more cycles of development during its lifespan. The cycles are prompted by changes in the technologies or features, changes in the end-user's needs or business goals. Input from the development team and the end-users into the product causes changes to the aspect of the product facing the end-user. The cycles continue until there is either no more interaction between the end-users and the product or the number of end-users abandoning it is higher than the number of new adoptees.

5.2.1 Definition of product

According to the Organisation for Economic Co-operation and Development (OECD), there are two categories of products in the ICT sector, namely, "ICT products" and "content and media products" (Spiezia, 2008). A bundle of technologies, particularly ICT technologies, constitute an ICT product that fulfils or enables the function of processing and communicating information and the result of the processing by electronic means (Inaba & Squicciarini, 2017).

Social media technology as a product in the ICT sector is part of the ICT product levels in terms of its online software nature. It is also a content and media product aimed at mass communication of online content, such as streamed audio and video content, a website search, and advertisement sales, to mention a few. (See Section 4.2.3 on elements of social media technology). As social media technology continues to evolve, the boundaries between its technologies become blurrier. Generally, a product in the ICT sector has a development life cycle that starts at the initial conception stage, moves to the maintenance stage, then production and maintenance of the product.

5. 3 End-User involvement

End-users and the development team play different roles in the ICT product development process. At the early stage of the software development life cycle (SDLC), the development team have the initial design control over the activities involved. The development team can choose the level of end-user involvement needed before, during, and after the product design process. The development team initiates the elicitation process to get information from the targeted end-users about their needs for the product, and then the elicited information is analysed. The findings from the analysis form part of the requirement specification for the product. The end-users could initiate the elicitation process by directly requesting the development team to design the product. Also, in the post-development stages, they could make changes to the user interface (UI) of the product. The changes and the impact of the changes become visible to the development team and other global end-users of the product. Sub-section 5.3.1 also discusses the definition of end-user involvement and how it occurs during development and post-development.

5.3.1 Definition of end-user involvement

In the SDLC, end-user involvement is generally a role in specific activities towards developing a product. This implies that end-users give information to the development team to use or test the product and/or give feedback about the product. In other words, the end-user contributes to the development team‘s work on the product when involved in the system development process.

During the post-release stage of the SDLC, the end-user's involvement goes to another level. At this level, the product is used, errors found are reported, permitted user interface elements are customised, personalised, or configured, and information about the product is shared with other people. Everything the end-user does with the product affects the product and what the other end-users of the product see or perceive. This level of end-user involvement is synonymous with user participation. In other words, the end-user is taking part in the changes in the product life cycle.

Another level of end-user involvement is the psychological and behavioural level that occurs during the period of usage. This level is associated with the variable "attention". This level of end-user involvement at the human-product interaction level refers to the psychological subjective feeling of being involved during interaction with a product.

For this study, end-user involvement in the product development process refers to the contributions end-users make to either the development team or to the product being developed.

5.3.1.1 During development

The aim of involving end-users during development is to understand them, to ensure that the product is usable and that it will be owned and used. The roles the end-users play during their involvement is mainly for requirement and feedback elicitation. During the early part of the development process, the actual and representative end-users provide information that might be useful for the development process. The reason for end-user involvement at the later stage of the development process is to understand and manage their expectations for the product (Sharp, Rogers, & Preece, 2019). This is done by involving the end-users in testing the product. Taking the end-users through training and/or a hands-on demonstration of the product before release are ways to involve them.

The extent of end-user involvement depends on the availability of the end-user and the intended group of end-users. In situations where the product project team does not have access to the intended end-users or to target the open public market, market surveys and personas are techniques typically used.

The end-users might also be part of the development team to make contributions to the product being developed. Part-time end-user involvement refers to situations where the end-users take part in specific activities of the SDLC. For example, end-users are involved in informing the development of evaluating prototypes and beta versions of the product. Alternatively, the end-users could be involved as major contributors in developing the product on a full-time basis. However, being involved to that extent tends to make the end-users lose touch with the end-user community (Sharp et al., 2019).

5.3.1.2 Post-development

This stage refers to the activities that occur after the product has been released to the end-users and market for use. The degree of end-user involvement is in two main areas, feedback elicitation and product population. At the feedback elicitation level, the end-user provides feedback on the released or preleased product on errors, satisfaction, and any other area of improvement. The product population level of user involvement at this stage is when the end-user usage of the product consequently affects the characteristics of the product seen by its other end-users. Examples are social software where some activities of one end-user are accessible to other end-users in the social network. These activities include a change of public profiles, status updates, posting and sharing of content to the universal circle of contacts within the product.

5.3.2 End-user participation roles

Sub-sections 5.3.3.1 – 5.3.3.4 discuss four of the roles played by the end-users in their involvement with the development of a product.

5.3.3.1 Testers/Feedback providers

End-users work with the design team during product evaluation, testing, and/or coding. The development team consults the end-users to elicit information such as end-user needs, contextual information, and other forms of user requirements. Following the consultation, the information received is analysed, and the development team bases the activities of the development process on the results of the analysis. The end-users could be consulted during different stages of the product development process, such as requirement elicitation, testing, post-deployment evaluations.

5.3.3.2 Personalisation/Configurator

Here the product is tailored to meet the specified needs of specific individuals or groups of users. This is typically done during the product's post-deployment. Users can change the settings, theme, background, and other product aspects the designers have given control over. The effect of these changes is limited to a specific user's version or package of the product. With more products embracing social technology applications, the effect of the changes users make affects the product's design and, in turn, how the users see the changes in the product. An example of configuration is the user-generated content on websites and social media applications. The user can configure their account and profile while sharing content with other users in their social networks. The contribution of the users forms part of the look and feel of the product. On a different note, the user is with the design team and contributes to designing the product to fit their own needs. Examples of co-designers include the design team members, users with special needs, users with specific types of operating systems in the ICT ecosystem, and environmental needs, etc.

5.3.3.3 Content creator

In this role, the end-user modifies characteristics without necessarily being part of the development team. Ways could be publicly sharing content on the product or sharing reviews about the product and other kinds of content for it. The modifications to the product's content are seen by its other end-users. Consequentially, any changes made to the product by others is seen by the end-user too.

5.3.3.4 Product innovator

The end-user decides to take on the role of full pledge designer of the entire development cycle of the product or part of it. For a full product, the "end-user as a designer" has full control of the product development stages and has the capacity to work in a design team as a designer. A low-end version of this is when end-users must create products from the main product. Examples are files from software, the social network game from a social media platform and a tailor-made version for an organisation, etc. Unlike the content creator, whose involvement is seen by existing end-users of the product, the product innovator targets a new set of end-users.

In essence, end-users provide insight and evaluation feedback on the design of an ICT product, with less involvement in the decision-making aspect of the design process. The end-user's control is in the data entry and configuration of the user interface within the restrictions that the designers and developers put in place. The user's input data form content that is displayed, manipulated, or stored in the ICT product. The content may or may not be seen by other end-users. However, in a social or enterprise setup, the user's content forms part of the user interface (UI) of the ICT product, which other end-users will see and interact with. Many ICT products, particularly web and mobile web platforms and social media technology rely on user input, such as user-generated content (UGC). This content attracts and engages other end-users. Here, the end-users have control over what goes on in the user interface of the product and the online social network. The UGC begins at an early stage of onboarding and then continues during the user's interaction cycles with the product. This means that these social media technology products rely on the initial and ongoing input from the end-users.

5.4 Software development lifecycle of a product

In the HCI domain, there are many generic sets of activities for developing a product or system in the ICT sector. These activities are typically represented in the form of a model referred to as the system or software development life cycle (SDLC) model or process model. An SDLC model shows how the activities are related to a software project. The level of detail in the SDLC model is dependent on the design and development team. Besides the activities and the sequential relation between them, an SDLC model could show the roles of the persons that are responsible or involved in the activities. A common generic representation of the development activities is the waterfall model from the software engineering field. It focuses on the activities involved in the development of an ICT product and shows the relationship between the activities. Though activity-driven, the waterfall model focuses less on end-user input in the product being developed. However, there are a few lifecycle models that focus on the end-user before, during, and/or after the development of the ICT product. Examples include human-centred design, the interaction design process, the Agile UX methodology, and the Lean UX process model. Sections 5.4.1 to 5.4.5 present a description of the waterfall model and five user-focused life cycle models.

5.4.1 Waterfall model

In this model, the activities in the development of a product are summarised into five stages. The stages cascade from one to another, with a principle that before a stage begins the plan and schedule for it is done. Figure 5.1 illustrates these stages.

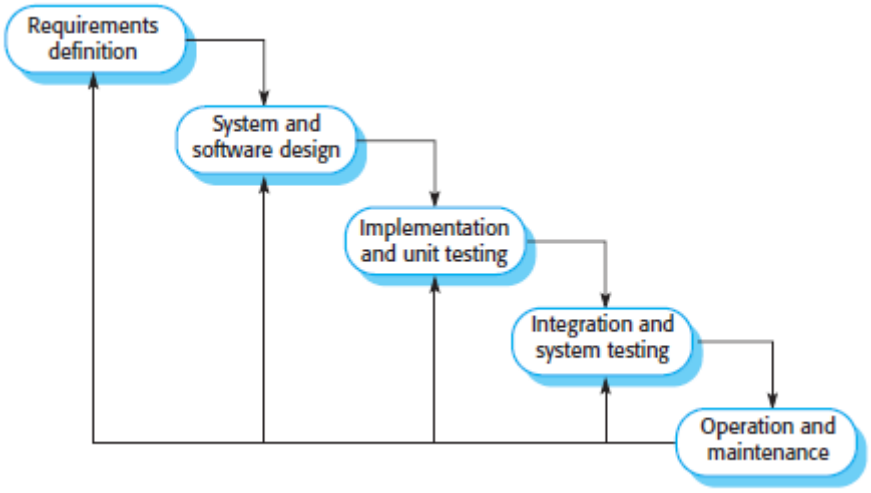


Figure 5.1: Waterfall SDLC (Adapted from Sommerville, 2016)

The initial conception of the product is represented in the first stage called requirements analysis and definition. In this stage, the functional and non-functional aspects of the product are determined. These aspects typically include the product's services, the constraints in which the products are expected to operate, and the user experience and usability goals for it. Targeted end-users or a representation of the intended end-users are consulted for more details on the product. Findings from the consultation are analysed to define the requirements for the product. The defined requirements serve as a system specification for the product (Sommerville, 2016).

When the requirements have been defined, they are assigned to the different parts of the product in the next stage of the SDLC. This next stage is the system and software design, which Establishes the system architecture and the software design. In addition, this stage identifies and describes the product's system abstraction and its relationships and the product prototypes before proceeding to the next stage.

During the implementation and unit test stage, a set of program or program units is realised in the form of coding and high-fidelity production. Then, each unit and aspect of the product is tested to find out if it meets the system specification for which it was developed.

Once the program units have been tested, the integration stage of the SDLC commences. Here, the individual program units are joined together as a complete product and tested to ensure that the software requirements have been met. The product is then made available to the intended user or customer for usage.

The fifth stage is the operation and maintenance stage, and its duration lasts as long as the product's life. The product is installed, and the end-user puts it into practical use. The development work continues on the product to detect and correct errors that were not detected in the earlier stages, improve the implemented aspects of the product, and enhance its characteristics as new requirements are discovered (Sommerville, 2016).

The flow across each stage is not always linear in that problems or challenges can be seen at any stage of the SDLC and these are documented. Iteration in the SDLC is needed to evolve the product so that it continues to be useful for the intended users.

The waterfall model is plan-driven to guide the development team through activities and possible iterations during the development process. End-user related activities are taken into consideration when the design team needs new information, product testing and feedback. The focus on changes of the user's needs is of minimal importance because the process is activity driven.

5.4.2 Human-centred design

Human-centred design is an approach to make ICT products usable and useful by focusing on the users, their needs and requirements (International Organization for Standardization, 2010). It promotes the application of knowledge and techniques from the fields of human factors/ergonomics, and usability. According to the ISO 9241:210 Standard, the term human-centred design is interchangeable with user-centred design. The human-centred design addresses the impact on users and other stakeholders of an ICT product.

The human-centred approach complements existing design approaches and can be incorporated in diverse approaches, and into all phases of the existing design and development life cycle (International Organization for Standardization, 2010). It provides a human-centred perspective that can be integrated into different design and development processes, appropriate to a context. This ensures that the development process is human-centred.

Furthermore, the human-centred design follows six major principles for the design activities, which are listed as follows (International Organization for Standardization, 2010):

1) The design is based upon an explicit understanding of users, tasks, and environments.
2) The users are involved throughout design and development.
3) The design is driven and refined by end-user-centred evaluation.
4) The design process is iterative.
5) The design addresses the whole end-user experience.
6) The design team includes multidisciplinary skills and perspectives.

In addition to the principles, there are four key activities involved in the human-centred design approach as Figure 5.2 displays. These activities are not strictly applied in a linear form; rather the interdependence of the human-centred design activities in Figure 5.2 illustrates that each human-centred design activity uses outputs from other activities. Also, a human-centred design activity and the preceding activity can be repeated.

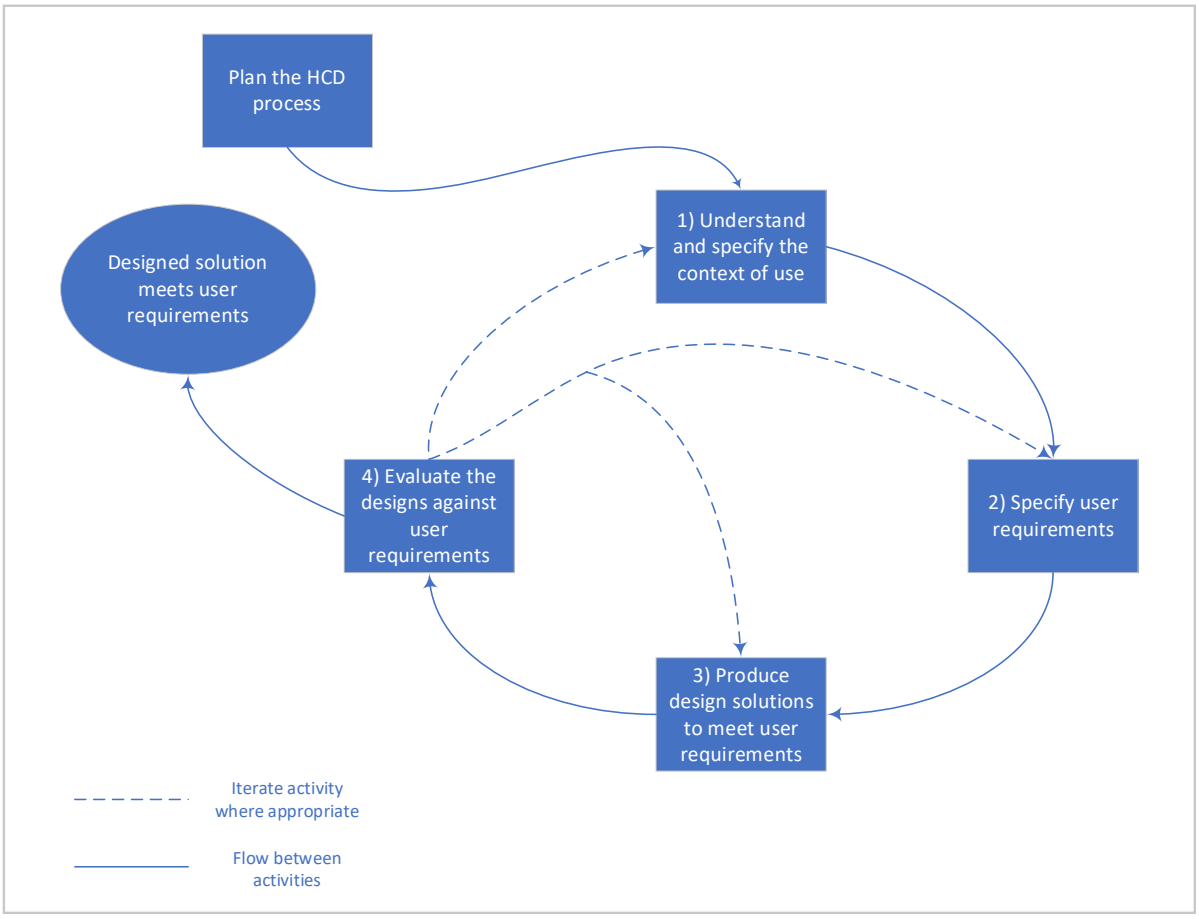


Figure 5.2: The human-centred design approach (adapted from the International Organization for Standardization, 2010).

Once the need for developing an ICT product has been identified and the decision has been made to use the human-centred design approach, the four key activities take place during its design. The four activities are:

1) *Understand and specify the context of use*: The user's context is defined by the characteristics of the intended users, their goals and tasks, the organisation, and the technical and physical environment in which the ICT product will be used.

2) *Specify user requirements*: This activity involves creating explicit statements of the user's requirements. The statements are made concerning the intended context of use and the business objectives of the ICT product.

3) *Produce design solutions to meet user requirements*: Potential design solutions are produced, along with the tasks and interaction between the user and the ICT

products during this activity. It draws on the description of the context of use, the results of any baseline evaluations, the established state of the art in the application domain, the design and usability guidelines and standards, and the experience and knowledge of the multidisciplinary design team. Also, more user requirements can emerge, as potential design solutions are detailed and evaluated.

4) *Evaluate the designs against user requirements*: User-centred evaluation (i.e., evaluation based on the users' perspective) is a required activity in human-centred design. The design concepts are evaluated to obtain a better understanding of user needs. To obtain valid results, the evaluation is carried out by experienced evaluators and with appropriate methods.

The activities are not strictly applied in a linear form, rather the interdependence of the human-centred design activities in Figure 5.2 illustrates that each human-centred design activity uses outputs from other activities. Also, a human-centred design activity and the preceding activity can be repeated.

5.4.3 Interaction design process

Interaction design concerns how interactive products are created to support the way people live in their everyday lives. Though a domain in the ICT world, it is overlapped by the HCI domain in scope. One of the overlapping areas is the focus on the end-user's experience and a user-centred approach with an interactive product. Similar to the human-centred design, the life cycle has an underlying philosophy on the user-centred approach. The philosophy focuses attention on the end-users, investigating their goals and opinion early in the design, and communicating the designs and potential solutions to them, in addition to the design and development team. There are four classic phases in the interaction design life cycle model, as Figure 5.3 illustrates.

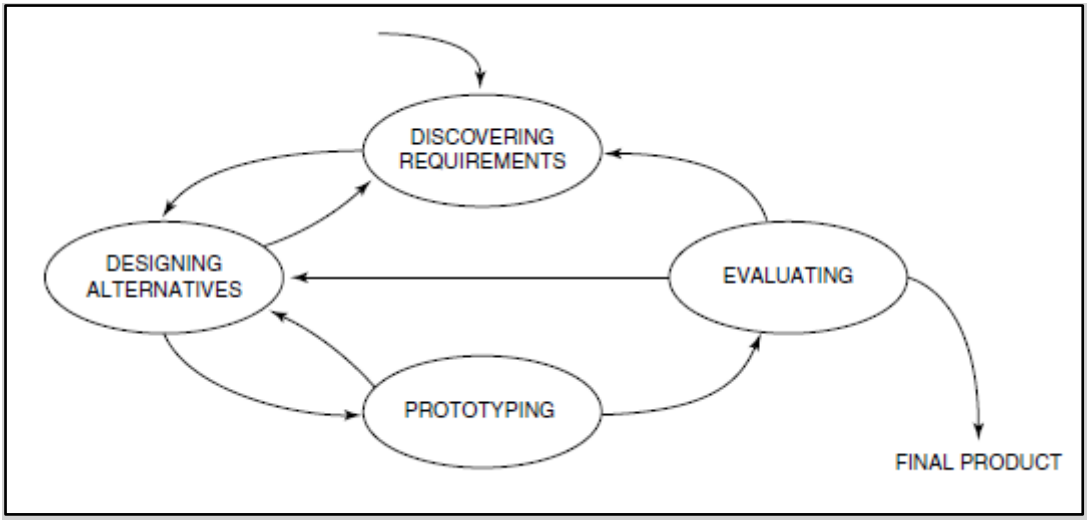


Figure 5.3: Simple interaction design life cycle model (Adapted from Preece et al., 2019)

Once the need to create a product has been determined, the life cycle commences. The first classic phase of the life cycle concerns the discovery of requirements for the interactive product. Target users are identified. The support and experience expected from the envisioned interactive product are also identified. The identification is a result of data gathering and analysis to form the product requirements such as the functional, non-functional and UX requirements.

Designing alternative product designs that meet the identified requirements happens in the second phase of the interaction design life cycle. Two main sub-phases are conceptual design and concrete design. Conceptual design involves producing an abstract outline of what the targeted users can do with the product and describing the concepts that help the team to understand how the targeted users interact with the product. The concrete design considers the details of the product characteristics, such as the visual elements, sound elements, menu design and iconographic element forms. The third phase of the interaction design life cycle concerns prototyping the alternative designs for communication and assessment. The targeted users interact with the prototypes that are made. The prototype can be paper-based or software-based. Next, the product and the UX it offers are evaluated in the fourth phase of the life cycle. The usability and acceptability of the product or design are measured in terms of usability and UX criteria. If the design meets the criteria, the final version is produced. Alternatively, the design and development teams go through an iteration of the life cycle to a phase identified during the evaluation.

5.4.4 User experience design process

Another approach to designing an interactive product is the user experience design (UXD) process. It takes the user into account every step of the product development. The UXD process makes sure that the aesthetics and functional aspects of the product's characteristics work in the context of the rest of the product and in the context of what the end-user is trying to accomplish. The UXD considers every possible action the user is likely to take and understands the user's expectations at every step of the way. The task of designing for UX is broken down into component elements across five planes in the UXD model, as Figure 5.4 illustrates. Each plane in the UXD model represents the component elements of the job of crafting UX, i.e., the compound elements of UXD. The planes are strategy, scope, structuring, skeleton, and surface.

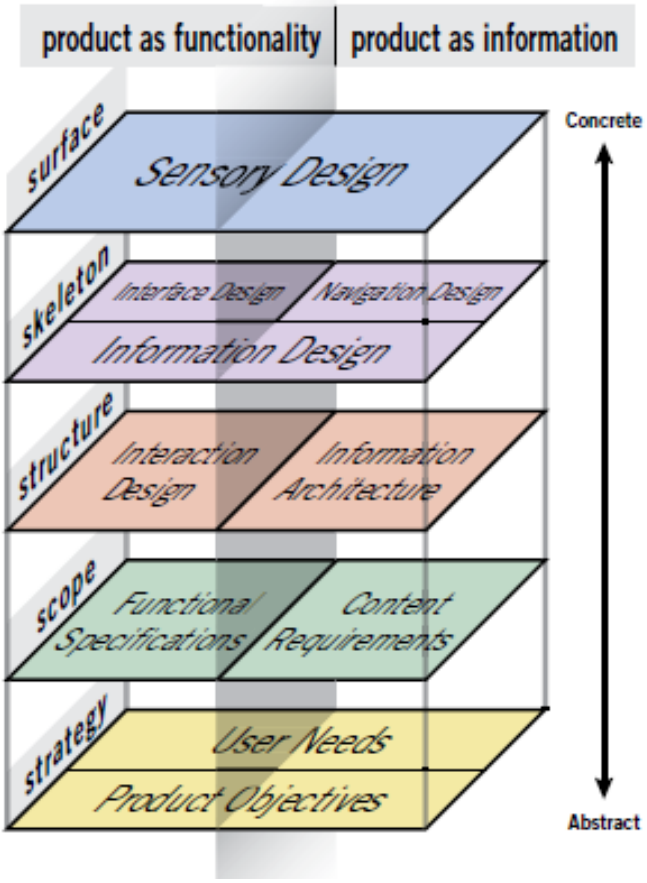


Figure 5.4: Elements of UXD (Adapted from Garrett, 2011))

The strategy plane is abstract and represents the phase in which the design/development team formulate a strategy for the interactive product. What the product owner and the intended user want from the product is incorporated into it. Component elements in this plane are the user needs and the product objectives. Next, the scope plane. The scope plane is determined by the strategy plane. The way in which the features and the functions of the interactive product fit together are defined in the scope plane. The UX component element for a functionality-oriented interactive product is a functional specification, while for the information-oriented interactive product, it is the content requirement.

The structure plane focuses on the abstract structure of the interactive product. The structure plane defines how the intended users will reach the interactive product and how they will leave it after a period of usage. It also defines the categories of items of information, interface, and navigation in the interactive product. The UX component element for the functionality-oriented interactive product is interaction design while information architecture applies to the information-oriented interactive product.

On the skeleton plane, the skeleton is a concrete expression of the abstract structure of the interactive product. It defines the placement of the interface elements and the arrangement of navigational elements for it. The arrangement and placement of the elements are optimised for maximum effect and efficiency. The UX component element for functionality-oriented interactive products is interface design, while navigation design applies to the information-oriented interactive product. In both groups of interactive products, information design is a UX component element. In the surface plane, actual items of the interactive product are created so that a person can interact with the product. The UX component element is sensory design. In addition to the component elements, the content and technology of the interactive product go into the final UX design. Valuable and available content for the users plays a big role in shaping the interactive product. As technology continues to advance, more sophisticated UX approaches could enable changes in response to how the users interact with the product.

Together, these planes form a conceptual framework for highlighting the UX problems a team or UX designer tackles as well as the tools used to solve the problems. The elements in a plane work together to reach the goal of the plane. Likewise, each plane depends on the plane below it. The use of the UX model flows from the strategy plane to the surface plane.

5.4.5 Agile UX

Design approaches that integrate UXD activities, techniques, and processes with those from Agile software development are referred to as agile user experience (Agile UX) (Sharp et al., 2019). In Agile UX, characteristics common to both UXD and the Agile approach are iteration, user involvement in the development process and a focus on measurable completion criteria. Requirements for the products are prioritised and repeated during short timeboxed implementation. This repeated reprioritisation helps to avoid wasted effort by the design and developers.

Conducting UX activities integrated with the Agile approach requires the following (Sharp et al., 2019):

- A change in the mindset of the development team because of requirements and short timeboxed implementation.
- A rethink of UXD activities such as when to perform them, how much detail to undertake and when, and when and how to feed the results back into the implementation cycles.
- A flexible point of view focusing more on the end-product as the deliverable than on the design artefacts as deliverables.
- Cross-functional teams where specialists from different disciplines work closely to evolve an understanding of both the intended users and their context, and the technical capabilities and practicalities of the technologies forming the interactive product.
- Attention to three practices, namely:
    - User research before the product development begins as well as during the ongoing development. Data collection and analysis activities are conducted to characterise the intended users, their tasks, and the context of use.

- Align work practices of UXD and Agile approaches. The Agile approach emphasises a regular delivery of a working interactive product through evolutionary development, along with the elaboration of requirements as implementation proceeds. UXD activities are conducted alongside and around the iterations of the Agile approach.
- Minimal documentation but more time on the design and development to produce value for the user via a working interactive product. This is in line with one of the key principles of the Agile approach that documentation should not replace communication and collaboration.

Further, Figure 5.5 illustrates the flow of Agile UX. UXD work is done one iteration ahead of the development work in parallel tracks.

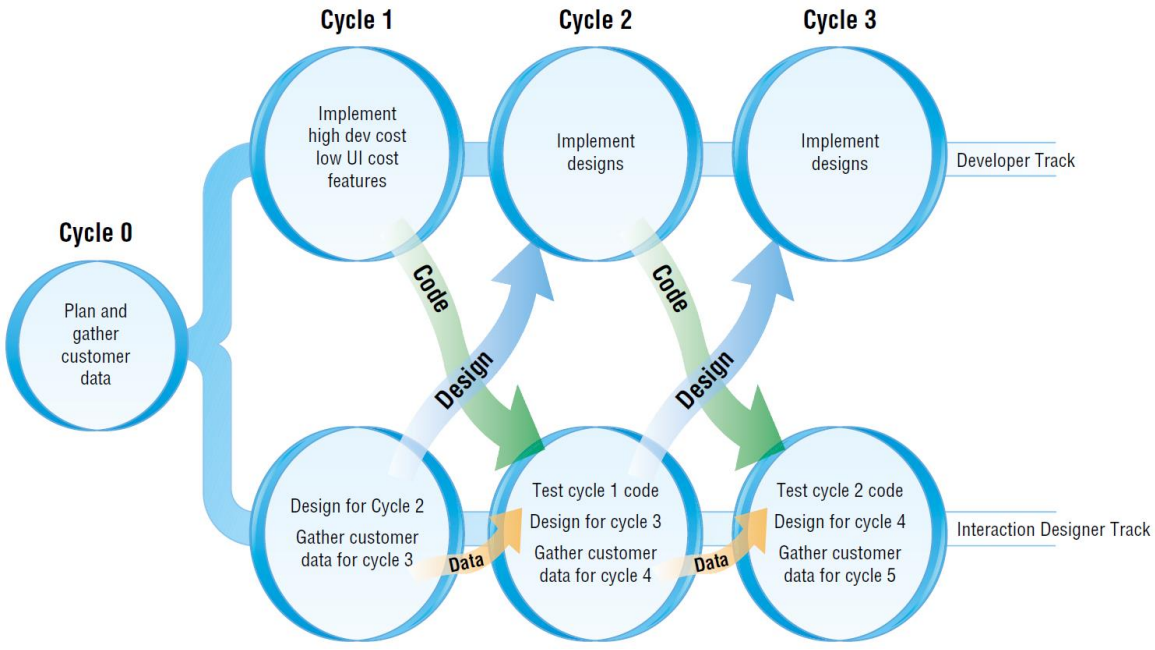


Figure 5.5: User research in Agile UX + Sy and Miller's "Staggered Sprints" model (Adapted from Preece et al., 2019))

Before any development begins, understanding the interactive product, the scope of the product and the overall technical and UXD is necessary. Also, the vision for the product needs to be defined. This is highlighted in Cycle 0 and Cycle 1 in Figure 5.5. Iteration in Agile UX is referred to as a Cycle. A UXD activity and user data collection for Cycle n+1 is performed during Cycle n. Consequently, the design work is completed just ahead of the development

work on the interactive product. Later in the Agile timeline, design work is tightly coupled to the development work as the product evolves.

5.4.6 Lean UX process model

Lean UX has Agile software development as one of its underlying philosophies, championing the importance of providing a good UX. It also builds on UXD, design thinking and Lean Startup ideas. These underlying philosophies emphasise iterative development, a collaboration between stakeholders, and cross-functional teams. The process focuses on creating (designing and developing) and deploying a product quickly. Yet, it takes a different approach to user research in that the focus is on getting the interactive product to the market and capturing user feedback on the product.

The Lean UX process has four main activities that emphasise waste reduction, the importance of experimentation to learn, and the need to articulate outcomes, assumptions, and hypotheses about a planned product. The aim of the project is first clarified, and then metrics are defined for success by moving the focus from the outputs of the process (i.e., the interactive product) to its outcomes (business goals). Expressed as a hypothesis, assumptions about the product are then put to the test either through research or by building a minimum viable product (MVP) that can be released to the intended user group. Evidence needed to confirm or refute each assumption is characterised before the testing of the hypothesis. The testing of the hypothesis is done through experimentation. Figure 5.6 illustrates the Lean UX process.

Figure 5.6: The Lean UX process/cycle (Adapted from Gothelf & Seiden, 2016))

Agile UX is an overarching term for all approaches that focus on integrating interaction design with the Agile development process. Unlike Lean UX, which uses experimentation and MVP, Agile UX can employ prototyping to answer questions and test ideas. In Lean UX projects, MVPS are released as a finished product for experimentation. However, not all MVPs may be incorporated into the final products, depending on the result of the experiment conducted.

5.4.7 Putting the life cycle in a picture

The process model for an ICT product goes through at least one iteration during its lifespan. Also, the initial SDLC cycle falls within the pre-product release. After the first release, the product's life cycle falls in the post-product release during which more iterations of the SDLC may occur.

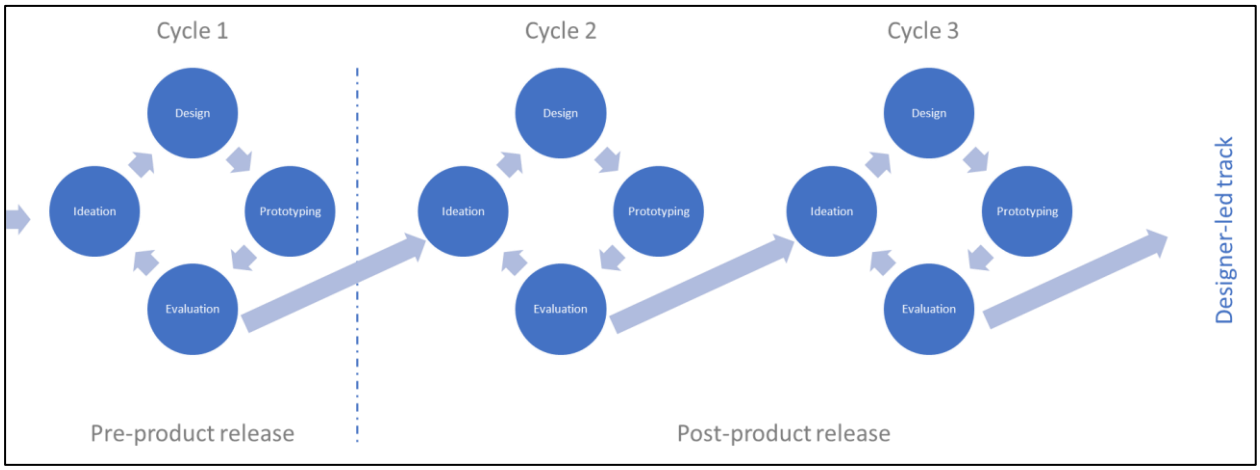


Figure 5.7: The researcher's interpretation of life cycle of an ICT product showing the designer-led track in the SDLC.

The design/development team lead the SDLC process from the pre-product release and other subsequent releases during the lifespan of the product. Figure 5.7 shows the researcher's interpretation of the designer-led track in the SDLC process. In this track, the designers elicit information and validation from the end-user. The participation of the end-user in this designer-led track is referred to as end-user involvement.

5.5 Designing social media technology for user experience

The content and user interface design aspects of social media technologies are controlled by the developers and the end-users. The developer controls the ecosystem while the end-user controls and influences the generation and sharing of content. End-users' activities contribute to the changes in the user interface of a social media technology and are seen by other end-users in the universe of the same social media technology. The generation and sharing of content are displayed on the feeds, timelines, and profiles and eventually and instantaneously changes the user interface of the social media technologies. The visibility of the social media technology user interfaces depends on the privacy settings the end-users have on their profiles and content.

5.6 Conclusion

This chapter presented a conceptualised process showing where end-user engagement fits in the design life cycle for social media technology. It is based on the discussions in the preceding sections in this chapter. Figure 5.8 illustrates the researcher's interpretation of this process.

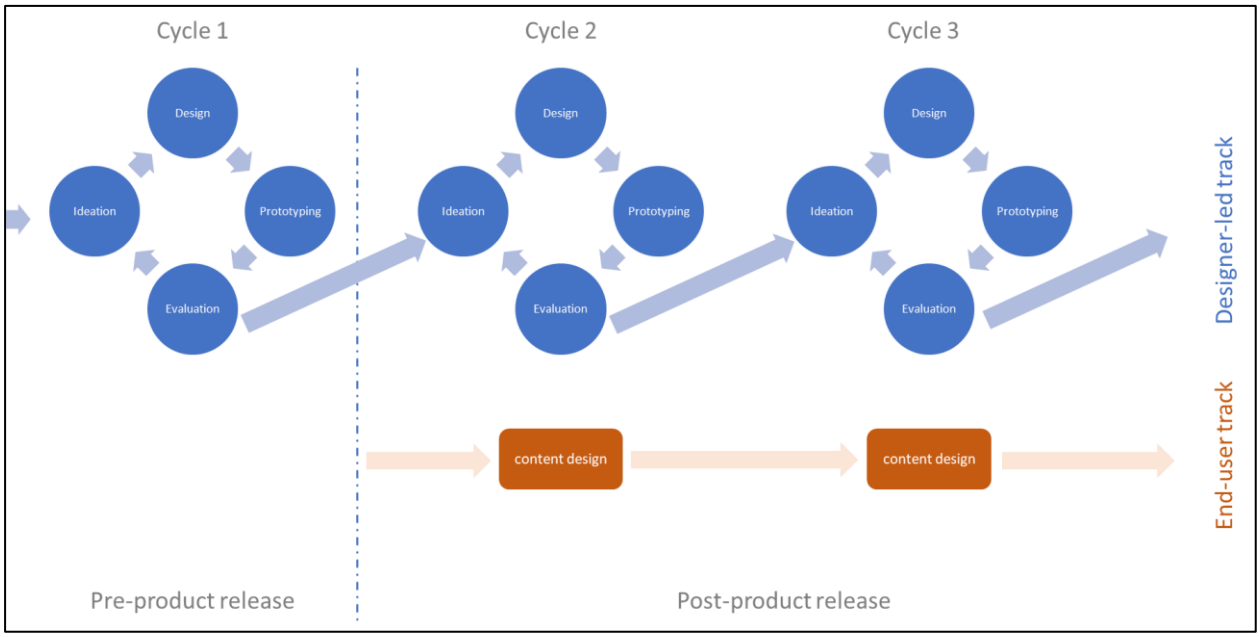


Figure 5.8: The researcher's interpretation of a process showing where the end-user's engagement fits into the SDLC of the product.

The end-users are involved in the product design process in both tracks. The content design is ongoing in the end-user's track until the product is terminated or the end-user stops using it. The end-user's engagement exists in both tracks in the life cycle. In the designer track, involvement with the product project is the end-user's engagement and assigned roles as either the elicited, the tester, or the configurator/validator.

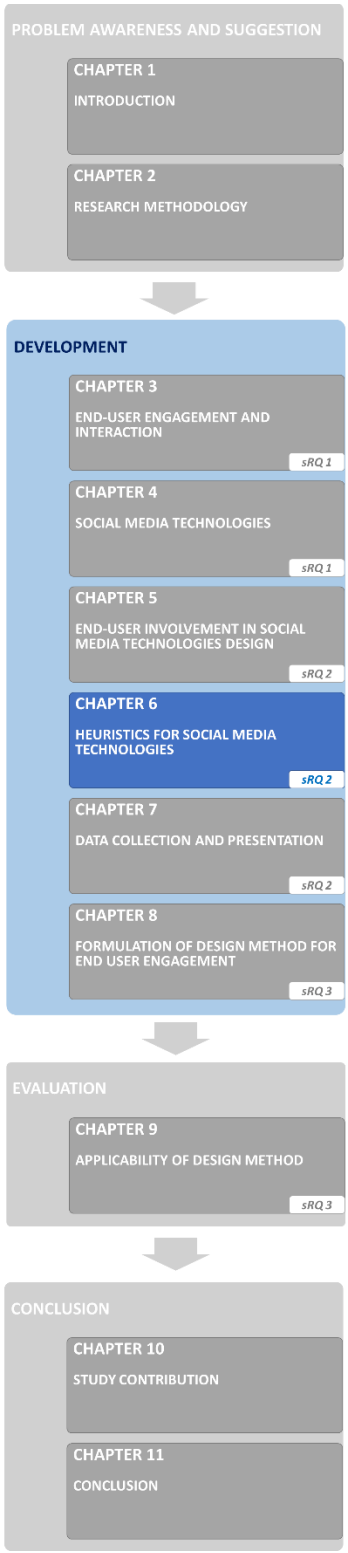
In the post-product release cycles, the two tracks run concurrently. However, the end-users involved in the designer track may not be the same as the end-users operating in the second track. Once the product is released, the intended end-users interact with it and can customise the parts they can see and generate content for the interactive product. With ICT products such as social media technology, content includes user generated content, elements of the building blocks of the social software, as well as social interactions. Consequently, the content fuels social media technology while the content design activities form part of the social media technology and are seen by its other end-users. Within the conceptualised process, the design input of the end-user into the ICT product is a result of the end-user's content design activities.

5.7 Summary

This chapter presents the findings related to the first part of the second sub-research question of this study which states: “What are the design elements that correspond to unified end-user engagement and interaction?” The objective of this question is “to identify an approach to derive some design guidelines and heuristics for unified social media technology engagement and interaction”. The involvement of the end-user in the life cycle of social media technology as an ICT product was discussed. A model of the end-user involvement at the different phases of the ICT product life cycle was presented.

The next chapter presents the steps for developing UX engagement and interaction heuristics, and the approaches for developing heuristics are reviewed as well as a general methodological approach for the development of such heuristics.

CHAPTER 6 – HEURISTICS FOR SOCIAL MEDIA TECHNOLOGIES



6.1 Introduction

This chapter presents the heuristics development process and findings related to the second sub-research question of this study, which states: “What are the design elements that correspond to unified end-user engagement and interaction?” The objective of this question is “to identify an approach to derive some design guidelines and heuristics for unified social media technology engagement and interaction”.

In the HCI domain, heuristics are design rules that are essential to understand and design the experience an ICT product is expected to bring to end-users. Few approaches are used to generate a set of heuristics, either by adopting an existing one or through a process. In describing the steps to develop UX engagement and interaction heuristics, it is essential to specify the methodological approach used followed by the output when applied.

Section 6.2 presents a description of and the uses of heuristics in the HCI domain. Section 6.3 presents three approaches for developing a set of heuristics, while Section 6.4 presents a generic process formulated for developing heuristics for an end-user’s engagement and interaction with an ICT product. Section 6 summarises the chapter.

6.2 Defining heuristics

Guiding rules are essential in the design and evaluation of ICT products. Heuristics are forms of guiding rules. These guiding rules are essential characteristics of good design and are useful for decision-making during the design and evaluation of the ICT product (Dix et al., 2004; Sharp et al., 2019).

Heuristics are used as mental shortcuts to evaluate the user interface of ICT products. High-level principles help relate heuristics to human knowledge. Examples of high-level principles are learnability, visibility, user control, and colour guidelines, to name a few. These rules are design principles and advice that are put together for a designer to understand and conform to (Dix et al., 2004; Sharp et al., 2019).

The use of heuristics for evaluating ICT products can be traced back to the early 1990s when Nielsen and his team created heuristics based on usability errors discovered during ICT product tests (Dix et al., 2004; Sharp et al., 2019). The heuristics were presented as design principles for usability and have since been refined and consequently adapted in HCI and many related fields. Commonly in the HCI domain, heuristics are associated with rules of thumb for evaluating ICT products in a specific application domain. The association is done to know the extent to which the ICT product supports some aspect of usability and the user's emotional responses.

Heuristics are created either through an adaptation of existing ones or through a methodological approach (Tyllinen, Kaipio, Lääveri, & Nieminen, 2016). In the design process, heuristics help the design and developer team to choose a set of design characteristics to use. They also help to choose aspects of the product to design for a targeted experience for the end-user. Following the design process is the evaluation or testing phase. During the evaluation process, heuristics are used to find and justify problems in the user interface and/or UX of the product.

In this study, the heuristics for the user experience (UX) engagement and interaction of a generic ICT product are developed through a modified heuristics development process. The process infuses design guidelines from usability, UX, and user engagement design. The resulting heuristics are adapted and modified for a generic ICT product. Consequently, these heuristics serve as rules of thumb for decision-making during the design process for the holistic engagement an end-user has with an ICT product.

The next section presents few approaches for developing heuristics for ICT products.

6.3 Heuristic development processes

At the time of the research, a limited number of suitable approaches were found in literature and based on the requirements for the needed approach, the following methodological approaches for creating heuristics were selected and reviewed, namely:

1) Three-phase process for creating heuristics for specific application domains by van Greunen, Yeratziotis, and Pottas (2011).
2) Six-stage methodology for Heuristics development by Rusu, Roncagliolo, Rusu, and Collazos (2011).

3) Eight-stage methodology for developing usability/UX heuristics by Quiñones, Rusu, and Rusu (2018), and Quiñones and Rusu (2019)

These approaches are intended to develop heuristics to inspect the usability/UX of ICT products. Table 6.1 shows the stages, template items, and other main aspects of each of the three approaches. Sub-sections 6.3.1 – 6.3.4 present the discussion of each methodological approach for creating heuristics for UX engagement and interaction.

Table 6.1: Three methodological approaches for heuristics development.

Methodological approach		Authors	Stages/phrases	Areas of interest	Template for specifying heuristics
1)	Three-phase process for creating heuristics for specific application domains	van Greunen et al. (2011)	Three phases, namely: 1) Design high-level heuristics 2) Validation of high-level heuristics 3) Application of high-level heuristics	Usability, specific application domain online health social networking website	The theme, Opening statement, Checklist
2)	Six-stage methodology for Heuristics development	Rusu et al. (2011)	Six stages, namely: 1) Exploratory 2) Descriptive 3) Correlational 4) Explicative 5) Validation (experimental) 6) Refinement	Usability, Grid computing applications	ID, name, and definition, Explanation, Examples, Benefits, Problems
3)	Eight-stage methodology for developing usability/UX heuristics	Quiñones et al. (2018); Quiñones and Rusu (2019)	Eight stages, namely: 1) Exploratory 2) Experimental 3) Descriptive 4) Correlational 5) Selection 6) Specification	Usability, UX, specific application domain	

Methodological approach	Authors	Stages/phrases	Areas of interest	Template for specifying heuristics
		7) Validation 8) Refinement		

6.3.1 A three-phase heuristics development process

Van Greunen et al's (2011) three-phase process for creating heuristics for specific application domains is an appraised approach (Quiñones & Rusu, 2017; van Greunen et al., 2011). At the high-level of the process are the design, validation, and application/usage phases. Within and around the phases are low-level tasks through which heuristics are developed. Figure 6.1 illustrates the phases and iterations across the phases of the process.

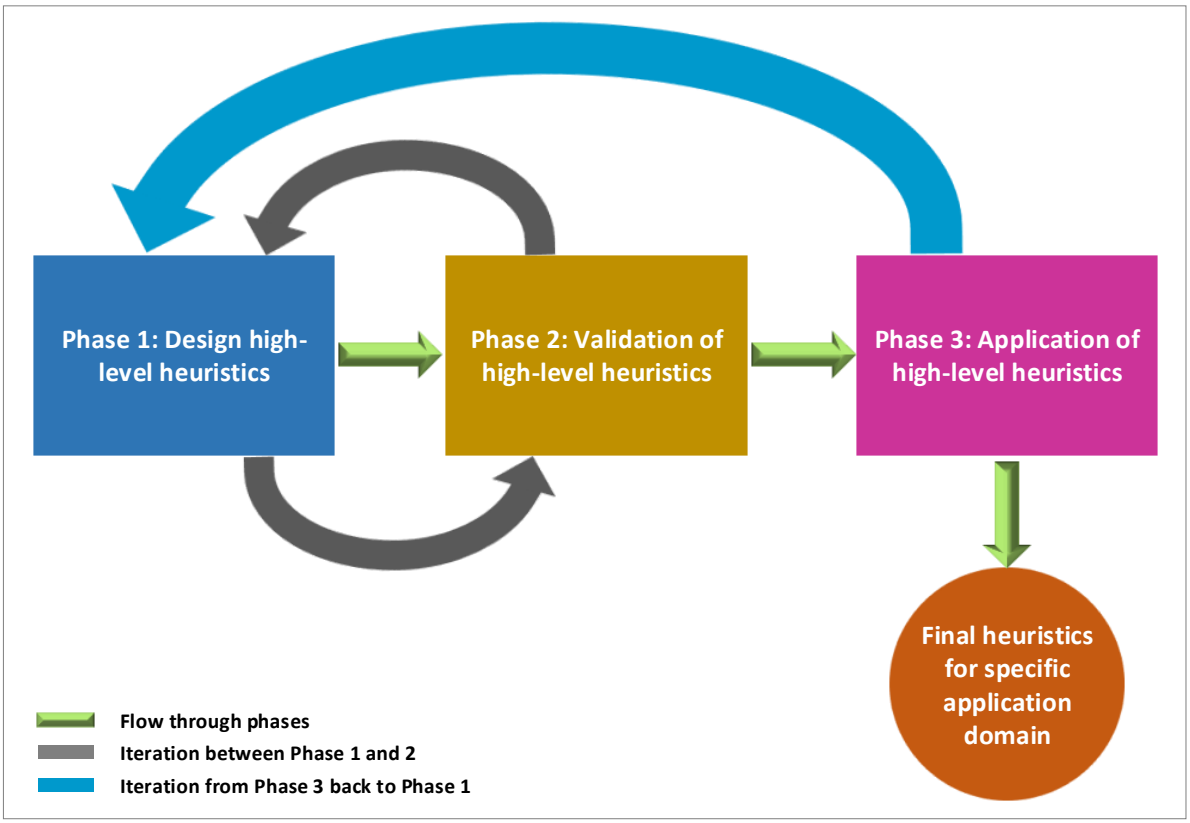


Figure 6.1: Three-phase heuristic development process (Adapted from van Greunen, et al 2011).

In the design phase, there are five tasks centred on identifying high-level heuristics. Each heuristic has a theme, opening statement, and checklist. The second phase of the three-phase

process concerns the credibility and validity of the identified high-level heuristics by experts. This phase involves identifying and selecting experts to review the listed heuristics along with their themes and checklists. Once the heuristics have been validated and possibly gone through another iteration of the validation phase, the application/usage phase commences. The validated high-level heuristics are used to evaluate a specific application domain. In the application phase, users are identified and recruited to evaluate the specific application domain using high-level heuristics. The purpose of involving the experts and users is to validate the usefulness of the heuristics and to evaluate the targeted specific application domain. The validation phase, application/usage phase, and the whole process can be iterated.

Further, this approach has been acknowledged as one of the best methodological approaches to develop heuristics that can be used to inspect an ICT product (Quiñones & Rusu, 2017; Quiñones et al., 2018). A few studies have applied the approach to developing heuristics to evaluate specific application domains related to social networking applications. Examples of the studies that developed heuristics from a review of literature related to a specific application domain, besides usability, include usable security of online health social networking sites, and deaf web user experience for a website for users with special hearing needs (Yeratziotis, Pottas, & van Greunen, 2012; Yeratziotis & Zaphiris, 2018). Concerning this study, the first two phases of the three-phase process have been adapted to inform the first-level tier of the heuristics development process to guide the design for end-user engagement and interaction with a generic ICT product such as social media technology. The specific application domain targeted is social media technology.

6.3.2 A six-stage heuristics development process

Another appraised approach for developing usability heuristics is Rusu et al's (2011) six-stage methodology for heuristics development (Quiñones & Rusu, 2017). Figure 6.2 illustrates the stages of the approach.

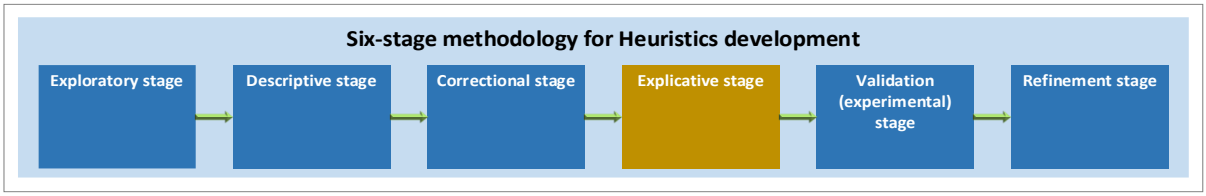


Figure 6.2: A six-stage methodology for heuristics development (Adapted from Rusu, Roncagliolo, Rusu, et al. 2011).

The methodological approach details a set of stages through which a new set of heuristics can be created to inspect the usability of user interfaces. The approach proceeds with an exploratory stage. In this stage, existing heuristics are reviewed in the literature. The identified heuristics go through the descriptive, correlational, and explicative stages. Next, the heuristics are validated through experiments during the validation stage. Then, the validated heuristics are refined in the last stage of the development cycle. Also, each heuristic is specified in a template. The template consists of the ID, name, and definition of the heuristics, along with an explanation, examples, benefits, and problems. All these stages have been applied to grid computing applications (Quiñones et al., 2018; Rusu, Roncagliolo, Tapia, et al., 2011). Interestingly, Rusu et al's (2011) methodological approach allows existing heuristics and design guidelines from related fields and application domains to be included.

6.3.3 An eight-stage heuristics development process

The methodology by Quiñones et al. (2018) and Quiñones and Rusu (2019) centres on developing usability/UX heuristics for specific domain applications. The methodology is an extended version of Rusu et al's (2011) approach, which is discussed in the previous section. The methodological approach has stages from the exploratory stage to the refinement stages, as Figure 6.3 illustrates.

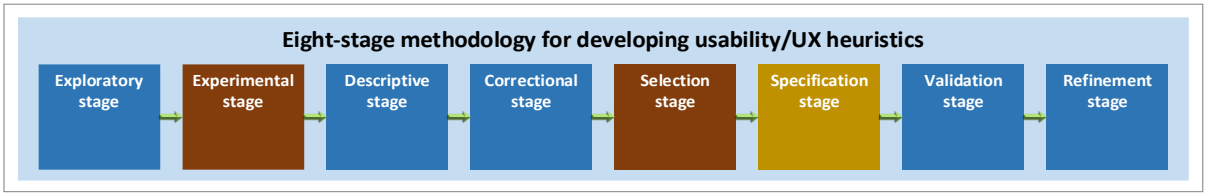


Figure 6.3: An eight-stage methodology for developing usability/UX heuristics (Adapted from Quiñones, et al (2018), Quiñones & Rusu (2019)).

The two added stages are the experiment stage and the selection stage. The approach also details the inputs, activities, and outputs for each stage. The input for each stage is the items needed before commencing with it, while the output refers to items obtained from each. Iteration could be done in any of the preceding phases and continue to the end of the

methodological approach. The methodology approach could be used to develop heuristics to evaluate the quality attributes of an ICT product besides usability (Quiñones & Rusu, 2019).

6.3.4 Reviewing the three methodological approaches

The three methodological approaches focus on heuristics related to usability and the UX of an ICT product. Each methodological approach emphasises the collection of information on the heuristics and features of the ICT product. It also emphasises the consolidation of the heuristics and features, tailoring existing heuristics to features of the ICT product, followed by the validation of the heuristics for the ICT product.

Heuristics that are not satisfactory during the validation process are refined through iteration to an earlier stage or phase in the process. The three-stage process also details the application or usage of the validated heuristics to evaluate an ICT product. The application/usage stage of this process could help show how design and developer teams could apply the heuristics to an ICT product. Furthermore, both the three-phase process and the eight-stage process for developing heuristics support the inclusion of elements from other fields, besides usability. However, the three-phase heuristic development process supports the inclusion of domain or field-related elements associated with the product goal, besides usability.

The heuristics development process for this study, through the second sub research objective, takes into consideration heuristics from UX engagement and interaction related fields such as usability, UX, and user engagement design. Given the support for inclusion and tailoring of heuristics from fields related to the area of interest and from usability, the first two phases of the three-phase process will be adopted in this study. Also, the applicability of the derived heuristics is described through a generic ICT product such as social media technology in Chapter 8. The use of a methodological approach provides a way for future researchers and developers to understand the steps for creating the UX engagement and interaction heuristics.

6.4 Conclusion

The first two phases of the three-phase heuristics development process by van Greunen et al. (2011) have been applied to this study. The methodological approach is adapted to develop UX engagement and interaction heuristics within an end-user-centred design method. Table

6.2 illustrates the design phase (Tasks 1 – 5), the validation phase (Tasks 6 – 7), and the iteration (Task 8).

The design phase focuses on gathering heuristics from fields related to the usability of the specific application domain, including usability/UX design guidelines. In other words, for this study, the Design phase focuses on gathering design guidelines from usability/UX fields, as well as from user engagement design guidelines and principles related to a specific application domain.

Table 6.2: Steps in the Design phase of the generic heuristic development process (Adapted from van Greunen, et al 2011).

Task	Description
1) Review literature	The literature for the specific application domain is extensively reviewed. In this study, literature for the specific application domain on the UX, Usability, and user engagement fields was extensively investigated.
2) Name high-level heuristics according to the themes identified	Themes from the literature findings are worded into high-level heuristic names with descriptions.
3) Tailor existing heuristics to fit the generic ICT product	The heuristics and descriptions are aligned to the dimensions of the UX engagement and interaction with the ICT product.
4) Group the high-level heuristic names based on the sub-dimensions of UX engagement and interaction	The high-level heuristics are grouped under corresponding sub-dimensions of UX engagement and interaction.

Task	Description
5) Review the grouping of the sub-dimensions	Where necessary, the high-level heuristics are moved under the different sub-dimensions of UX engagement and interaction to make sense.
6) Apply a scenario to validate the high-level heuristics	A validation tool is developed in the form of a scenario. A writing approach is used to walk through the application of the heuristics to the ICT product.
7) Analyse scenario results	The results from the applied scenario are analysed.
8) Iteration	The heuristic development process could be restarted from an appropriate task when the need for modifications of literature, themes, heuristics, a validation tool, or other parts of the process arises.

Task 1– Review literature:

A literature review can be conducted in the fields of usability, UX, and user engagement to identify relevant sources from which themes for the UX engagement and interaction heuristics could be identified. The themes may be broad and representative of usability, UX, and user engagement requirements.

For instance, during the period of study, the literature findings included four sets of guidelines and principles from UX or user engagement-related fields. The low number of sets of guidelines shows how the area of designing for end-user engagement for interaction with ICT products is still emerging. Section 3.2.5 of Chapter 3 presents the findings of the literature study. Design guidelines and principles related to UX, user engagement, user judgement were considered. The literature and findings from each field are analysed to determine the requirements that represent each field and to identify emerging themes. Each theme tests both usability, UX and user engagement as one unified entity. Once a set of guidelines and/or principles was found in the literature, each guideline and/or principle was sorted according to familiarity using their titles and descriptions. After being sorted, the guideline and/or

principle was viewed as a high-level heuristic for design. Then, each guideline and/or principle was reviewed: (i) to determine if it represents the UX engagement and interaction requirement or if the authors emphasise the guideline and/or principle as a requirement for any UX engagement and interaction components and (ii) to determine if it represents the end-user centred requirement.

Task 2 – Name high-level heuristics according to themes identified:

Descriptions of the high-level heuristic names provide a brief understanding of what the respective theme represents and addresses. The new high-level heuristics are specific to a generic ICT product.

Task 3 – Tailor existing heuristics to fit the generic ICT product:

Each high-level heuristic and description are categorised under the main UX engagement and interaction dimensions: emotional engagement, cognitive engagement, and behavioural engagement. The alignment of the heuristics to the dimensions of the UX engagement and interaction of an ICT product is based on the wording and the description of the heuristics. Also, sub-dimensions of the UX engagement and interaction are created based on the description of the heuristics.

Task 4 – Group the high-level heuristic names based on the sub-dimensions of UX engagement and interaction:

An individual high-level heuristic can be added to the populated sub-dimension.

Task 5 – Review the grouping of sub-dimensions:

For instance, four iterations of the sorting activity were done at different periods over a month. At the end of the fourth iteration, 18 groups of similar guidelines were identified.

Task 6 – Apply a scenario to validate the high-level heuristics:

A scenario about the use of heuristics can be developed. The application of the heuristics to the scenario is written out to identify areas where the heuristics may not be applicable for the ICT product. For instance, Chapter 8, Section 8.4 discusses more the description of the scenario of a social media technology as an ICT product.

Task 7 – Analyse scenario results:

The results of the applied scenario can be analysed to determine the type of modification required to improve the high-level heuristics. The determination of the type of modification may be based on the characteristics of the heuristics.

Task 8 – Iterate and re-design high-level heuristics:

From the analysis of the validation of the heuristics, the need for modifications may determine where iteration is necessary between the earlier tasks of the generic heuristics development process.

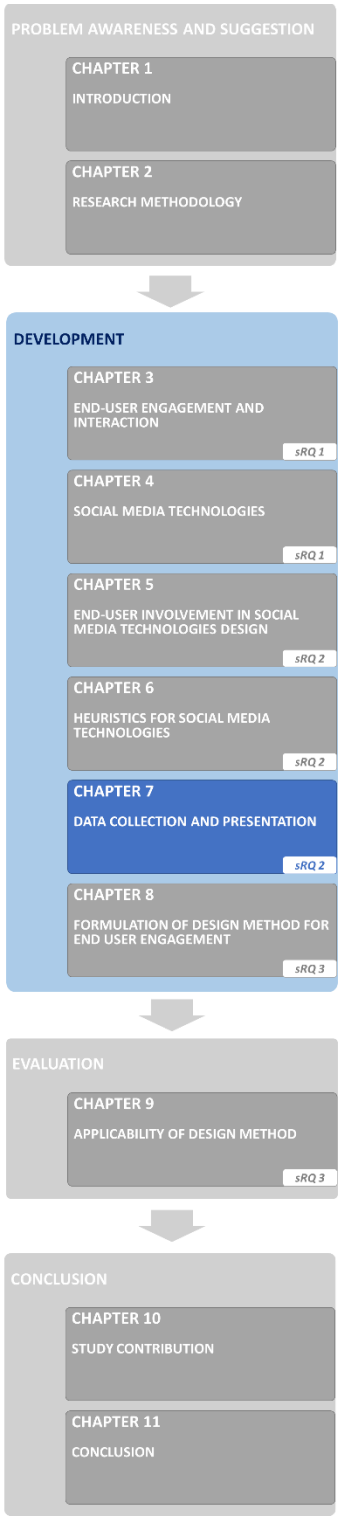
Section 7.4 in Chapter 7 discusses the result of the high-level heuristics developed for the generic ICT product.

6.5 Summary

In this chapter, the role of heuristics in the design and use of an ICT product, as well as the approaches for developing heuristics are reviewed. To describe the steps for developing heuristics, a generic methodological approach to develop the heuristics was formulated. The formulated methodological approach was aimed at developing heuristics for the UX engagement and interaction of a generic ICT product. The methodological approach centres on providing an answer to the second sub-research question formulated for this study. Following the generic heuristics development process, generic heuristics were created and presented. These heuristics and tasks in the heuristics development process form a component for the end-user engagement design method, as Chapter 8 presents.

The next chapter presents the data collection and presentation from the case study in which more elements of UX engagement and interaction are explored in the social media technology landscape and the heuristics formed through the generic heuristic development process.

CHAPTER 7 – DATA COLLECTION AND PRESENTATION



7.1 Introduction

This chapter presents the results of the case study on the UX engagement and interaction elements in social media technology, and the results of the heuristics development process. The essence of the case study findings is to provide answers to the first sub-research question of this study which states: “How can end-user engagement and interaction be defined within the context of social media technologies?” The objective of the question is “to determine which key UX elements constitute an end-user’s engagement and interaction in the social media technology context”. Whereas, the purpose of the heuristic development process is to contribute to the second sub-research question of this study, which states: “What are the design elements that correspond to unified end-user engagement and interaction?” The objective of this question is “to identify an approach to derive some design guidelines and heuristics for unified social media technology engagement and interaction”.

The results were consolidated with the literature findings. Furthermore, the interpretation of the data analysis in the case study is aligned with the generic definition model for UX engagement and interaction. The generic definition of UX engagement and interaction was presented as the foundation into which the interpreted themes were plugged. The result was a definition of UX engagement and interaction in the context of social media technology.

Social media technologies are ICT products designed to provide individual experiences and enable social interaction experience for end-users. However, the user’s view of the engagement is an important element of the whole social media technology experience. This study focused on the emotional, cognitive, and behavioural engagement elements with technology from the user’s perspective.

Section 7.2 describes the data collection methods used as well as the participants involved and Section 7.3. presents and consolidates the raw data from the case study conducted. Next, Section 7.4 presents the heuristics formed through the generic development process and Section 7.5 presents the triangulation of the results. Conclusions are presented in Section 7.6 with Section 7.7 summarising the chapter.

7.2 Procedures and materials for the case study

The data collection was done through semi-structured interviews and probing questions with social media technology users who accessed the Nelson Mandel University (NMU) Facebook page. Ethical clearance was received from the NMU ethics committee to comply with the protection of the anonymity of the persons being interviewed. The participants gave their consent to participate willingly in the interviews, knowing that they could withdraw freely should they so wish at any point. The next section briefly explains how the participants were selected and how the data was collected (c.f. Appendix A).

7.2.1 Profile of the participants

A total of 14 participants in this study were conveniently selected from followers of the Nelson Mandela University's Facebook page after an invitation to participate in the study was posted on the Facebook page. The participants were conveniently selected based on ease of access during the four-week study period between July and August 2018, of which four participants (P06, P10, P11, P12) were categorized as new users under the unmoderated remote user testing and ten participants (P01, P02, P03, P04, P05, P07, P8, P9, P13, P14) as non-new users. It is important to note that the sample size for qualitative data collection needs a minimum of 12 participants (Guest, Bunce, & Johnson, 2006). In qualitative research generally, what matters is data saturation rather than the sample size (Creswell, 2013).

The invitation included a description of the study, a link to the QuestionPro questionnaire and a clause stating that only users who were aged 18 years and older were permitted to participate in the study. Once the link in the invitation was clicked, a new browser tab was automatically opened showing the participant the home page of the online questionnaire containing more details about the study and seeking the consent of the participant before his/her participation in the study.

Moreover, during the unmoderated remote user testing section of the questionnaire completion stage, participants were further encouraged to identify and use the social media technology they had not used before, e.g., Facebook, Instagram, WhatsApp, and YouTube, with a list of basic tasks such as logging in, checking posts, sending posts to assigned users and message group, and changing profile image and theme, and logging out to be completed on the identified social media technology. The structured interview questionnaire focused on

the social media technology experience of the participants as social media technology end-users and as administrators/owners of social network groups or channels.

Figure 7.1 shows the breakdown of the participants in the study.

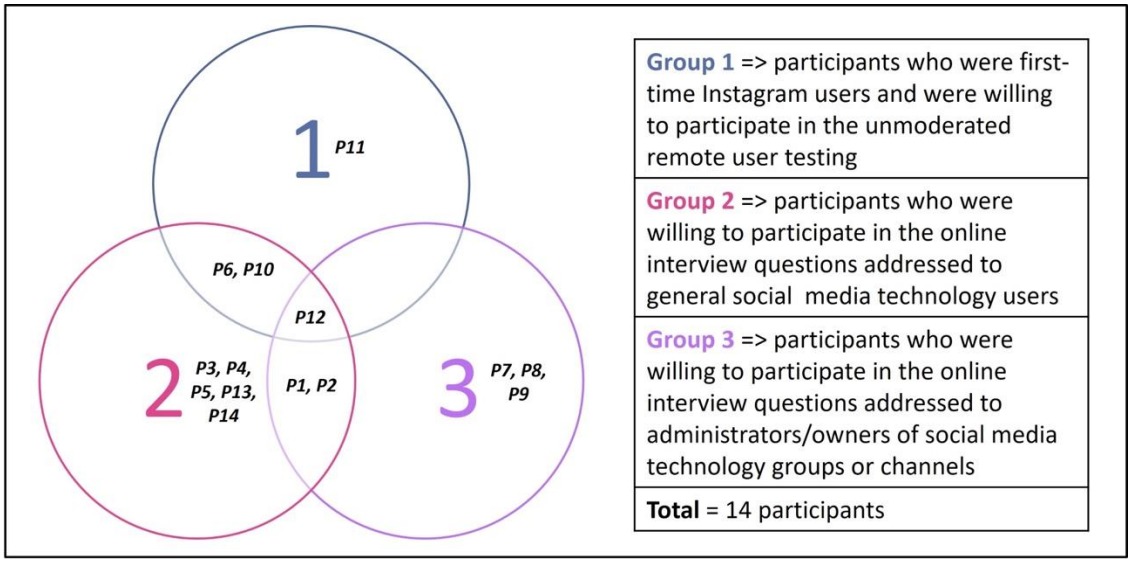


Figure 7.1: Summary of participants' role in the study

7.2.2 Data collection methods

The set-up was done differently in that it was based on a case study method utilizing an online-based Unmoderated remote user testing approach and an online-based structured interview approach to explore the user experience (UX) elements that constitute the engagement and interaction end-users have in the social media technology context. Both approaches were implemented using a web-based tool called QuestionPro, which is a platform for the creation of online questionnaires typically used for online surveys and online structured interviews (QuestionPro Survey Software, 2021). In this study, QuestionPro was used to create a single questionnaire consisting of the general background and Internet experience sections, the unmoderated remote user testing questionnaire, and the interview questionnaire.

The participants were requested to give consent (Appendix D) on arrival to the online questionnaire site. The logic and branching feature of QuestionPro allowed for the separation of participants into different parts of an online questionnaire. The logic and branching feature was applied after the study participants had completed the Internet experience section of the questionnaire and later used to separate the participants who were first-time social media technology users and were willing to participate in the unmoderated remote user testing from

those who were not first-time users and were willing to participate in the online interview. Also, an option was further given to the participants who were not first-time social media technology users to respond to the online interview questions addressed to general social media technology users and administrators of social media technology.

Before conducting the case study, the ethical considerations of the research methods and the research participants were done, and approval was obtained from the Nelson Mandela University's Research Ethics Committee. Afterwards, the case study was conducted. Anonymity was of high priority in the study and the QuestionPro tool proved more useful in this regard as the identities of the university's Facebook followers who clicked on the questionnaire link were not captured. Additionally, since in an unmoderated remote user testing environment the researcher does not have access to the participants and the participants' activity identities on the software that is being tested is not monitored in this current study, the identities of the participants were not monitored either. As such, the research team created five social media technology credentials for the sole purpose of this research and included them in the unmoderated remote user testing questionnaire. The credentials were randomly assigned to the participants only after the unmoderated remote user testing commenced and were deactivated after the data collection period.

7.2.3 Data analysis methods

Upon the completion of the online questionnaire, both the unmoderated remote user testing and interview data were collected and exported in Microsoft Excel format for statistical analysis. Descriptive statistics were used to summarise the findings from the unmoderated remote user testing data to the emotionally, cognitively, and behaviourally social media technology engagements of the participants. Thematic analysis was applied to the online interview responses. It was performed primarily by the researcher and cross-checked by another academician with expertise in UX research and data analysis. Then, the analysed online interview responses were cross-checked by the researcher again. Relevant statements from the online interview responses were tagged into specific codes and grouped into themes aligned with the core dimensions of UX engagement and interaction.

7.3 Consolidated Raw Data

This section presents the responses from the unmoderated remote user testing participants and the interviewees in the case study.

7.3.1 Onboarding stage in the unmoderated remote user testing session (new users)

Since the participants were further encouraged to identify and use the social media technology they had not used before during the unmoderated remote user testing section of the questionnaire completion stage, only four participants (P06, P10, P11, P12) indicated that they have not used Instagram before while the remaining participants indicated that they were frequent users of Facebook, Instagram, WhatsApp, and YouTube. Thus, the social media technology used during the unmoderated remote user testing was Instagram with the four new users. Statements about their emotional, cognitive, and behavioural engagements with this social media technology are summarised as follows:

Table 7.1 illustrates the statements concerning their emotional engagement with the social media technology (Instagram as SMT) they used. Statements 1, 2, 6 and 7 examined the new users' positive emotions based on their emotional involvement, fun, feeling of control and feeling interested, while statements 3, 4 and 5 examined their negative emotions based on their feelings of frustration, annoyance, and discouragement.

Table 7.1: Statements about their emotional engagement with a social media technology

	Statements
1	I felt involved in the experience of using the last SMT.
2	This experience of using the last SMT was fun.
3	I felt frustrated while the last SMT.
4	I felt annoyed while using the last SMT.
5	I felt discouraged while using the last SMT.
6	I felt in control while using the last SMT.
7	I felt interested in the experience of using the last SMT.

The results showed varied statements on positive emotions such as being involved, feeling in control, and feeling interested in the experience of using the social media technology when performing the tasks. Also, one user chose strongly agreed, and one agreed with the

statements on negative emotions such as feeling frustrated, annoyed, and discouraged when using the social media technology to perform the tasks in the study. Thus, after performing the assigned basic tasks (shown in Appendix D of this thesis document) on the social media technology (Instagram) that was new to the four new users, a negative emotional engagement can be observed.

Table 7.2 shows the statements concerning their cognitive engagement with the social media technology they used based on their interest [1, 4], challenges [2, 3], focused attention [7, 9, 10, 12], appeal [5, 6], sense of time [8, 11], worthwhileness [13], feeling of success [14] and rewarding [15].

Table 7.2: Statements about their cognitive engagement with a social media technology (Instagram as SMT)

	Statements
1	I was really drawn into the experience of using the last SMT.
2	Using the last SMT was mentally taxing.
3	This experience of using the last SMT was demanding.
4	I continued to use the last SMT out of curiosity.
5	The last SMT was visually appealing.
6	I liked the graphics and images used in the last SMT.
7	I lost myself in this experience.
8	I was so involved in this experience that I lost track of time.
9	When I was using the last SMT, I lost track of the world around me.
10	I was absorbed in this experience.
11	The time I spent using the last SMT just slipped away.
12	During this experience I let myself go.
13	Using the last SMT was worthwhile.
14	I consider my experience of using the last SMT a success.
15	My experience of using the last SMT was rewarding.

From the statements in Table 7.2, the results showed that the new users were not interested in continuing to use the social media technology. Also, one user strongly disagreed and three disagreed with statements [8, 9, 10, 11, 12, 13, 15] about being involved, losing track of time, being absorbed, letting go of themselves, finding the use of social media technology

worthwhile and rewarding. Two users agreed that using the social media technology in this study was mentally taxing. Based on the responses, the new users were cognitively involved to a small extent. Though the new users felt no loss of time, no absorption, no letting go, or the use of the social media technology not worthwhile and not rewarding, they were visually interested in it. The majority were interested in the visual aspects of the social media technology as could be seen in the responses about the graphics and images used in it. Others responded that using the social media technology was mentally taxing. This implied that the new users of the social media technology in this study were finding the social media technology difficult to use.

In contrast to this challenge, two new users disagreed, one neutral, while one agreed that their experience of the use of the social media technology was demanding. This implied that, although using the social media technology in this study was mentally taxing for the new users, the experience of using it was not demanding to them. This furthers showed a mixed disagreement with the cognitive challenge experiences with the social media technology used in the study. Thus, after performing the assigned basic tasks (shown in Appendix D of this thesis document) on the social media technology, which was new to the four new users, a negative cognitive engagement can be observed overall.

Table 7.3 shows the statements concerning their behavioural engagement with the social media technology that they used for the first time in this study.

Table 7.3: Statements about their behavioural engagement with a social media technology (Instagram as SMT)

	Statements
1	I completed some activities on the last SMT without any distraction.
2	I intentionally started some activities on the last SMT.
3	I accidentally started a few activities on the last SMT.
4	I intentionally ignored some activities on the last SMT.
5	I intentionally skipped a few activities on the last SMT.
6	I created contents for some activities on the last SMT.
7	I shared contents with different activities on the last SMT.
8	I am likely to do a few more activities on the last SMT later.

After performing the tasks on the SMT (Instagram), the new users were distracted when attempting to complete the activities and were unlikely to do a few more activities on it at a later stage. One user disagreed, while two were neutral and one agreed that they intentionally started some activities on the social media technology and accidentally started some other activities on the same social media technology. This implies that the activities on the social media technology could have resulted from the new users' unintended interactions as well as their intended interactions. On intentional interaction, two new users responded *Agree,* and two were *Neutral* about intentionally ignoring some activities. Three new users agreed that they intentionally skipped a few activities and disagreed that they created content for some activities on Instagram. These responses implied that the new users intentionally avoided some activities, indicating that the intention of the new users to ignore and skip some activities on the social media technology used in this study was greater than starting some activities on the SMT used in the study.

From the findings from the unmoderated remote user testing section of the case study, the UX engagement and interaction elements for the first-time end-users of a social media technology can be either positive, negative, or mixed. In this study, the elements found can be categorised into three dimensions of UX engagement and interaction as Table 7.4 illustrates.

The emotional engagement attributes to look out for among new users were both the negative and positive emotions. Three of the four new Instagram users felt that they were not involved, not having fun, not in control, and not interested in the experience of using it when performing the given study tasks to complete on this social media technology. The interest and involvement of the new users' emotions were less than satisfactory, while their negative emotions suggested that their experience with the social media technology was not always positive, especially as they were using it for the first time in research-based or non-social conditions. However, future research could examine how to improve the interest and involvement of new users in using social media technology in a remote and non-moderated online environment.

Table 7.4: UX engagement and interaction dimensions and attributes in unmoderated remote user testing.

Emotional dimension	Cognitive dimension	Behavioural dimension
• Felt uninvolved • Fun • Frustration • Annoyance • Discouragement • Felt control • Felt interested	• Not drawn in • Confusing to use • Mentally taxing • Demanding experience • Task incompletion • Curiosity • Attractiveness • Visual appeal • Perception of time (none, Loss of self, time, and space) • Worthwhileness • Success • Nonrewarding • Recommendation	• Activity completion • Intentional interaction • Accidental interaction • Dismissal of activities • No content creation • Unlikelihood of continued interaction

The cognitive engagement attributes to look out for among new users were both negative and positive perceptions. The new Instagram users liked the graphics and images used in it and found that using it was not so mentally demanding. All four new users were not drawn into or absorbed in the experience of using Instagram or continued to use it out of curiosity because they found the experience of using it unrewarding. There is a concern that the tasks in the cognitive engagement with the social media technology environment could be limiting and might require improvement. The involvement of the new end-users in terms of a sense of time, interest, absorption, and attention was less than satisfactory. It was negative and suggested that cognitive experience with the social media technology was short-term when used for the first time and under a non-social environment such as was in this current study. It is important to mention that these four new users were frequent Facebook users (in a social environment) who saw the invitational post for participation in this study (posted on the University's Facebook page) and clicked the URL, which took them out of the current social environment (to protect anonymity) to a non-social environment (the questionnaire tool). On the questionnaire tool, these new users accessed a non-social environment for the first time.

Future research could examine how to improve the cognitive engagement of research participants with social media technology, especially among new users.

The behavioural engagement attributes were intentions with actions and non-actions. The four new users were intentional in starting, ignoring, and skipping some activities when engaging with the social media technology in the study, as shown in Table 7.3. Also, all users were distracted when interacting with the social media technology and were less likely to do a few more activities on it at a later stage. There is a concern about the lengthy activities such as creating content as well as the number of activities. Reducing these might improve the behavioural engagement of the new users with Instagram. An area of focus could be to help (new users) end-users avoid or eliminate unintended actions while providing ways to capture or determine the intentions that led to their actions and non-actions.

7.3.2 Interview findings for retrospective stage (social media technology end-users)

Out of the 14 participants in this study (as illustrated in Figure 7.1), ten participants (P01, P02, P03, P04, P05, P06, P10, P12, P13, P14) who were social media technology end-users were interviewed and responded to questions related to their emotional, cognitive, and behavioural involvement with the social media technology they mostly engage with. The most used social media technology by these end-users were Facebook (P04, P05, P06, P12, P13, P14), Instagram (P01, P02, P03), and YouTube (P10).

Table 7.5: UX engagement and interaction themes from social network end-user interviews

Emotional dimension	Cognitive dimension	Behavioural dimension
• Expectations of new relevant content • Mainly excited • Mainly prompts of personal interest • Checks for new items of interest • Loss of interest	• Mainly momentary periods • Mainly attentive to visual content • Mainly attentive to visual or content of interest • Checks of items with direct relevance	• Activities of leisure • Dismissal of request/content that had no relevance • Mainly a response to request/content that is relevant • Mainly a response to content of no interest • Content generated based on own experience

Responses to emotional engagement questions:

The participants' responses to the emotional engagement questions referred to the expectations of new relevant content, feeling excited, prompts of personal interest, checking for new items of interest, and having a loss of interest, as illustrated in Table 7.5. The felt emotions identified by the participants were fear, inspiration, interest, anticipation, satisfaction, excitement/motivation, attention, and loss of interest. Furthermore, the social media technology characteristics identified by the participants regarding their emotional engagement were content of relevance, friends, Sites/Pages, notification updates, and posts.

Responses to cognitive engagement questions:

The responses of the interviewed participants to the cognitive engagement questions touched on their experiences of momentary periods, attention to visual content and content of interest, and checking of items with direct relevance, as illustrated in Table 7.5. These responses formed part of the cognitive connections end-users have with social media technology. The cognitive elements identified by the participants were the momentary period, lingering period, attention, visual appeal, interest, and the feeling of being drawn in, while the identified cognitive emotions were fun, good, and a feeling of comfort. Additionally, the social media technology characteristics identified by the participants regarding their cognitive engagement were pictures, visuals, news, newsfeeds, videos, mini videos, viewed content, friends, friends' activities and profile page, status updates, and content of interest (i.e., fashion, clothing, travel, entertainment, motivational quotes, and memes). Thus, it can be concluded that the participants' cognitive connection overlaps their emotions during the end-user interaction with social media technology.

Responses to behavioural engagement questions:

The participants' responses to the behavioural engagement questions referred to their leisure activities, dismissal of irrelevant requests or content, accidental responses to the content of no interest, and content generation based on their experience, as illustrated in Table 7.5. These responses formed part of the behavioural connection an end-user has with social media technology. The behavioural elements identified by the interviewed participants' responses were intentional leisure period (i.e., time breaks, cooking, and work), intentional modality (i.e., joining, reading, updating, finding, and looking), ignoring and skipping, responding (i.e.,

like, accept and view), posting and capturing. The behavioural emotions expressed were disinterest, annoyance, and discomfort. Moreover, the social media technology characteristics identified by the participants regarding their behavioural engagement were pictures, groups, adverts, videos, status, messages, newsfeeds, friends, posts, requests, pages, content, unknown people, photos of friends, friend requests, music sites, image capturing, video recording, and privacy. Thus, it can be concluded that the participants' behavioural connection overlaps their emotions during the end-users' interactions with social media technology.

7.3.3 Interview findings for the retrospective stage (social network group administrators)

Out of the 14 participants in this study (as illustrated in Figure 7.1), six participants (P01, P02, P07, P08, P09, P12) who were social network group administrators were interviewed and responded to questions about their emotional, cognitive, and behavioural involvement with social media technology, as social media technology administrators. These social network group administrators were administrators/owners of Facebook group (P07, P08, P12), Facebook page (P02) and WhatsApp group (P01, P09).

Table 7.6: UX engagement and interaction themes from social network administrative end-user interview.

Emotional dimension	Cognitive dimension	Behavioural dimension
• Prompts of group activities • Engagement observation via system notification • Mainly reasons of unsatisfactory events	• Period of momentary group activities • Mainly attentive to the activities of relevant people • Mainly acceptable visuals and content • Mainly checks for interactions from group members	• Proactive decisions to interact with a group • Activities of leisure or relaxation • Dismissal of mainly irrelevant content • Response to requests/content that are relevant • Mainly intentional responses • Content generated based on personal experience

Responses to emotional engagement questions:

The participants' responses to questions about their emotional engagement that social media technology administrative end-users have with their group or channel were based on their prompts for group activities, engagement observation with system notification, and reasons related to unsatisfactory events, as shown in Table 7.6. The felt emotions identified were personal interest, curiosity, motivation, attraction, dissatisfaction, and disinterest, while the behavioural elements were ghosting, responding and dismissals. Moreover, the social media technology characteristics identified from the participants' responses to questions regarding their emotional engagement were personal groups, personal adverts, notification systems, group notifications, new member requests, comments, windows, and social media technology features. Thus, it can be concluded that the emotional engagement of a social media technology administrative end-user with their administrative group channel overlaps with their behavioural connection to the group or channel.

Responses to cognitive engagement questions:

The participants' responses to questions about their cognitive engagement revealed that interest and attention were related to the period of momentary group activities, attention to activities of relevant people, acceptable visuals, content and checks for interactions from group members, as shown in Table 7.6. The cognitive elements identified by the participants were the perception of time, attention, visual appeal, and interest. The social media technology characteristics were family/personal group chat, notification pop-ups, frequency of posters, member/group content, videos, pictures, audio files, categorised features, text boxes, emojis, and content. Thus, it can be concluded that the cognitive connection a social media technology administrator end-user has with the technology has elements such as interest and visual appeal which overlap with the element from the emotional connection (that is, interest).

Responses to behavioural engagement questions:

The participants' responses to questions about their behavioural engagement were based on their proactive decisions to interact with the group, activities of leisure or relaxation, dismissal of irrelevant content, response to requests or content that is relevant, the content generated based on personal experience, and intentional responses, as shown in Table 7.6. The behavioural elements identified by the interviewed participants' responses were deleting,

read, respond/comment, ask, leave (exit), checking, ignoring, skipping, moving, joining, chatting, posting, outsourcing, typing, and researching. The social media technology characteristics identified were our member, group exit, comments, group post, meme, analytic/reporting feature, new friend request, advertisement, new page join request, video, new member request, pages, chat, pictures, and updates. These responses to these questions imply that the behavioural connection of a social media technology administrative end-user is both on the social media technology group and off the social media technology group.

7.4 Heuristics from the generic development process

This section presents the results of the generic heuristics development process for UX engagement and interaction (see Section 6.4). The guidelines from the UX and user engagement design fields were deductively analysed using attributes of the UX engagement and interaction dimensions. Most of the guidelines support at least two UX engagement and interaction dimensions. This shows that designing for an engaging experience involves the consideration of a more holistic approach. This study explores the literature on UX and user engagement from the HCI domain in this first task of the generic heuristics development process. The guidelines and principles of user engagement, and the attributes of user engagement, were found while carrying out this phase.

Guidelines and Principles: The literature findings reveal four sets of guidelines and principles from UX or user engagement fields. The low number of sets of guidelines goes to show how the area of designing for end-user engagement for interaction with ICT products is still emerging. Figure 7.2 shows a summary of the guidelines found. Details about each guideline are discussed in Section 3.2.5 in Chapter 3.

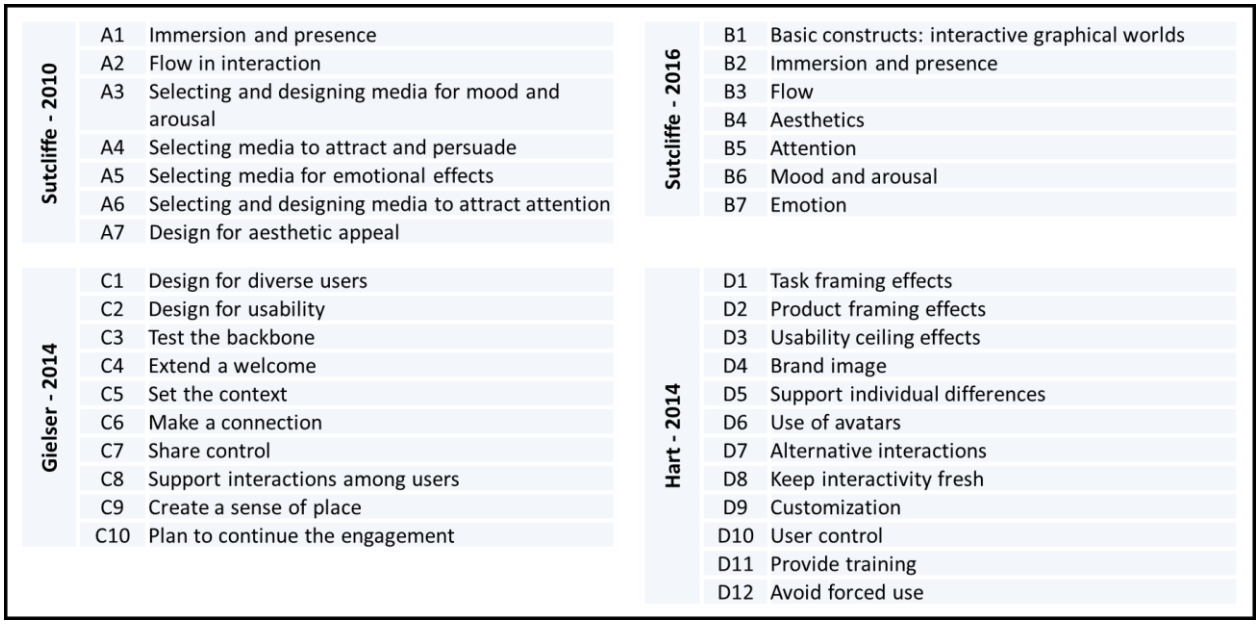


Figure 7.2: Coded design guidelines for evaluation.

Each of the guidelines and principles was coded for easy referencing in this study. The coded design guidelines were in line with the attributes of the UX engagement and interaction dimensions found in the literature review, and Chapter 3 presents these findings. Details of the alignment between the design guidelines and the UX engagement and interaction dimensions are in Appendix B of this thesis. Figure 7.3 illustrates the alignment between the guidelines and the UX engagement and interaction dimensions.

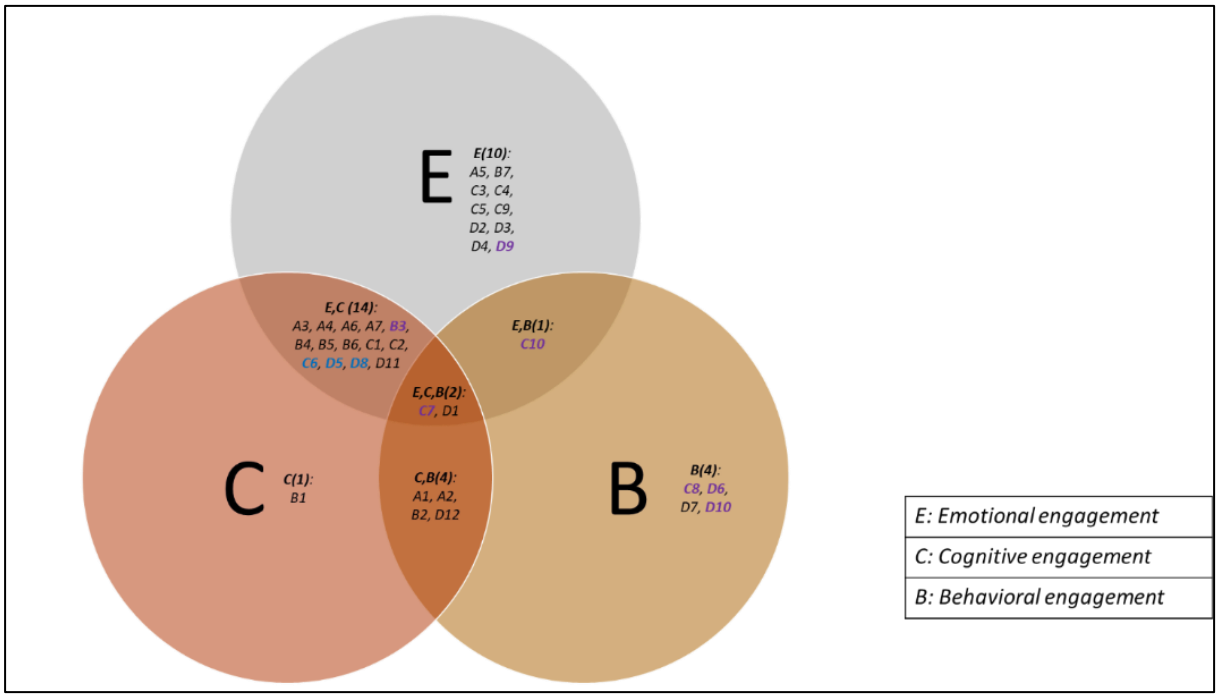


Figure 7.3: Aligning design guidelines with UX engagement and interaction dimensions.

Most of the guidelines support at least two UX engagement and interaction dimensions. This shows that designing for an engaging experience involves the consideration of a more holistic approach.

Design guidelines that fitted into the Emotional dimension are listed below:

- Only emotional engagement:

  A5 – Selecting media for emotional effects

  B7 – Emotion

  C3 – Test the backbone

  C4 – Extend a welcome

  C5 – Set the context

  C9 – Create a sense of place

  D2 – Product framing effects

  D3 – Usability ceiling effects

  D4 – Brand image

  D9 – Customisation

- Both emotional and cognitive engagement:
  A3 – Select and design media for mood and arousal
  A4 – Selecting media to attract and persuade
  A6 – Select and design media to attract attention
  A7 – Design for aesthetic appeal
  B3 – Flow
  B4 – Aesthetics
  B5 – Attention
  B6 – Mood and arousal
  C1 – Design for diverse users
  C2 – Design for usability
  C6 – Make a connection
  D5 – Support individual differences
  D8 – Keep interactivity fresh
  D11 – Provide training

- Both emotional and behavioural engagement:
  C10 – Plan to continue the engagement

Design guidelines that fitted into the *Cognitive dimension* are listed below:

- Only cognitive engagement:
  B1 – Basic constructs: interactive graphical worlds

- Both cognitive and behavioural engagement:
  A1 – Immersion and presence
  A2 – Flow in interaction
  B2 – Immersion and presence
  D12 – Avoid forced use

- Both cognitive and emotional engagement:
  Same as the listed guidelines that are categorised into the emotional dimension's *both emotional and cognitive engagement* guidelines

Design guidelines that fitted into the *Behavioural dimension* are listed below:

- Only behavioural engagement:

  C8 – Support interactions among users

  D6 – Use of avatars

  D7 – Alternative interactions

  D10 – User control

- Both behaviour and cognitive engagement:

  Same as the listed guidelines that are categorised into the cognitive dimension's both cognitive and behavioural engagement guidelines.

- Both behavioural and emotional engagement:

  Same as the listed guidelines that are categorised into the emotional dimension's both emotional and behavioural engagement guidelines.

Design guidelines that fit into all three dimensions of UX engagement and interaction are listed below:

- C7 – Share control
- D1 – Task framing effects

These guidelines are assigned to different dimensions of a UX engagement and interaction base on the subjective interpretation of the researcher.

7.5 Triangulation

As indicated in the introduction of this chapter, the essence of the case study findings was to provide answers to the first sub-research question of this study. The question states: "How can end-user engagement and interaction be defined within the context of social media technologies?" The objective of the question is "to determine which key UX elements constitute an end-user's engagement and interaction in the social media technology context". The findings for the first sub-research question were triangulated with the findings for the second sub-research question that states "What are the design elements that correspond to unified end-user engagement and interaction?". The objective of the question is to identify an approach to derive some design guidelines and heuristics for unified social media technology engagement and interaction. Figure 7.4 illustrates the triangulation process.

Sources revealed the UX engagement and interaction attributes and other elements which feed into components for the design method for end-user engagement with social media technology.

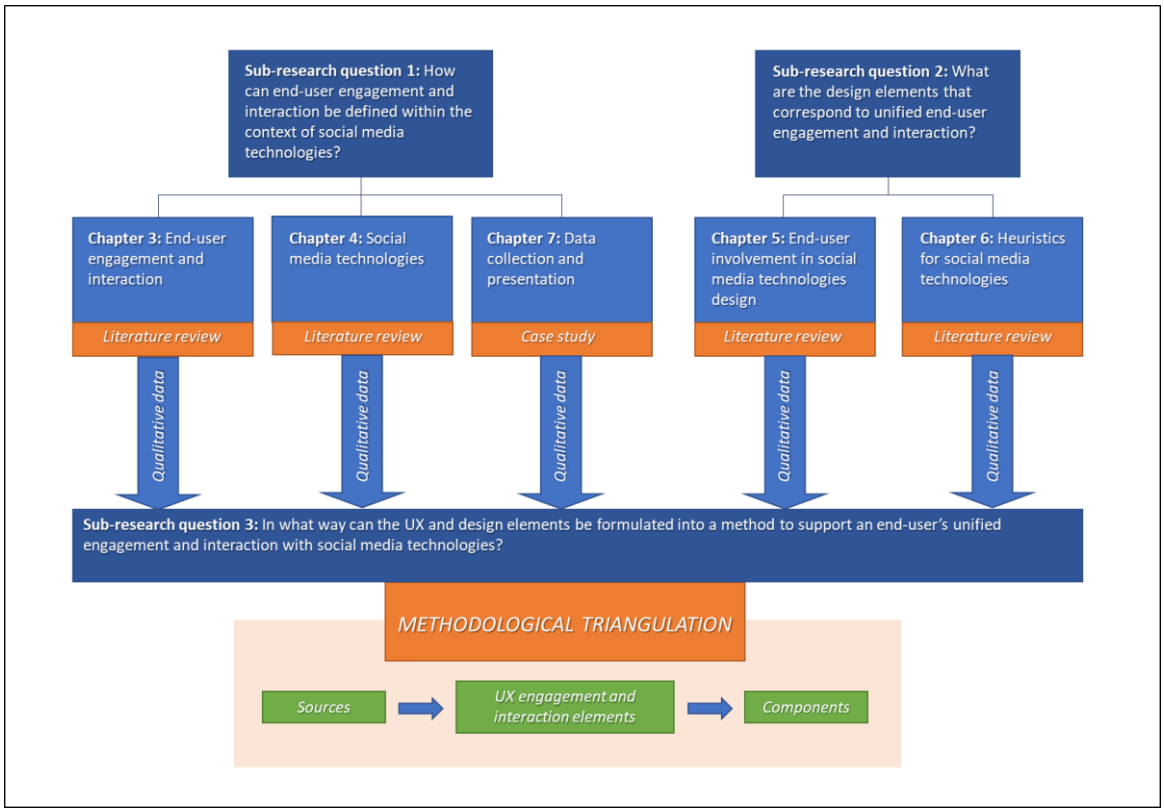


Figure 7.4: Triangulation process for research

The UX engagement and interaction attributes (see Chapter 3, Table 3.4) found in the literature were explored in the unmoderated remote user testing session of the current case study. In this study, the attributes found from the unmoderated remote user testing were categorised into three dimensions of UX engagement and interaction, namely the emotional dimension, cognitive dimension, and behavioural dimension. The responses from the participants who used social media technology for the first time in this study, in an unmoderated remote testing approach were both positive and negative with the negative responses mostly due to the technical challenges faced by the participants during their attempted use of the social media technology that they had not used before. Therefore, UX engagement and interaction can be defined as follows:

> *Definition 1: UX engagement and interaction in the social media technology context consists of a person's positive and negative subjective feelings that occur during and after using a requested social media technology.*

The themes were formed from the analysis of the interview responses of the case study conducted in this research. UX engagement and interaction is positive when all the emotional, cognitive, and behavioural engagement is positive. Findings from the interview section of the case study revealed themes that suggested a mixed engagement. Another observation finding was that the elements, from an end-user perspective as a universal social network member, were like that of their perspective as a social network group administrator. For this reason, Definition 1 for UX engagement and interaction can be redefined as follows:

> *Definition 2: UX engagement and interaction in the social media technology context consists of a person's positive emotions, thoughts, and self-driven activities that occur before, during, and after using a social media technology at both the interface interaction and the group interaction levels.*

Moreover, elements from the unmoderated remote use of the social media technology, as well as the interviews, are viewable as follows:

a) UX engagement and interaction can be either subjectively positive or negative

b) UX engagement and interaction is influenced by the circumstances of the interaction

c) UX engagement and interaction occurs at both the universal end-user and the social network administrator end-user levels

d) UX engagement and interaction is a subjective response of the end-user

Thus, Definition 2 for UX engagement and interaction can be redefined as follows:

> *Definition 3: UX engagement and interaction in the social media technology context refers to an end-user's subjective perspective of their emotional, cognitive, and behavioural involvement with technology at the interface and social levels.*

Furthermore, UX engagement and interaction elements for social media technology involve both the end-users' states of mind and actions, as well as social media technology characteristics. Figure 7.5 illustrates the connection between the overall UX engagement and interaction elements for social media technology.

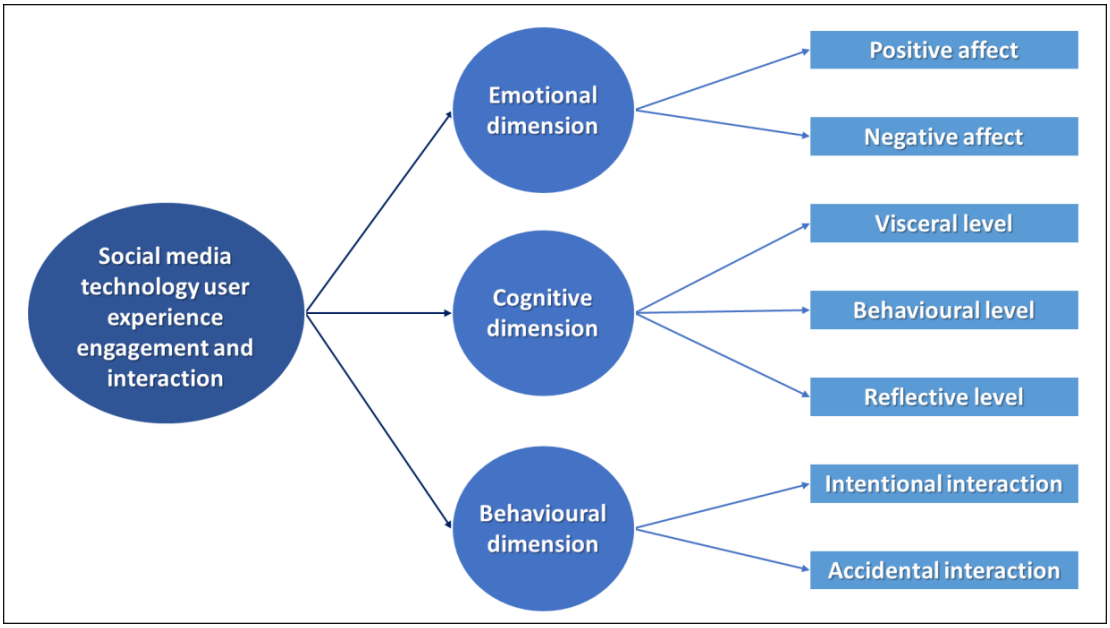


Figure 7.5: Categorisation of UX engagement and interaction attributes for social media technology end-users.

As shown in Figure 7.5, the perceptions from the emotional engagement of the end-user can be associated with their positive and negative emotions. The perceptions from the cognitive engagement can be associated with the visceral, behavioural, and reflective aspects of human interaction with ICT products, as per Norman (2004) and Komninos (2020), and as discussed in Section 3.4 of this thesis. On the other hand, the behavioural engagement constitutes the intentions, actions, and non-actions. Further, these UX engagement and interaction elements revolve around social media technology characteristics such as content, prompts and search/check options.

7.6 Conclusion

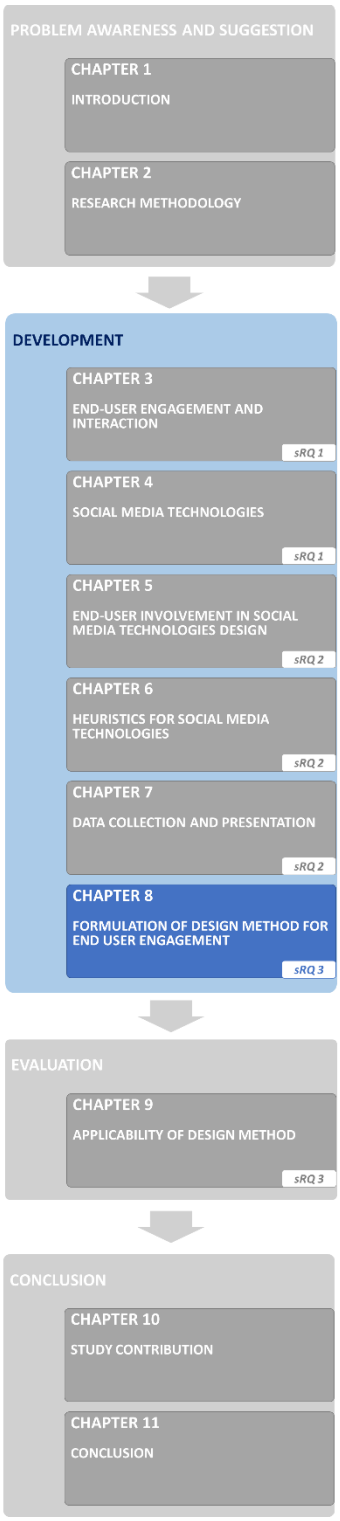
Knowledge about the engaging experience that people have with interactive technologies such as social media technology plays a vital role in their success, particularly for software developers and adopters. The engagement and interaction an end-user have with social media technology from a UX perspective are still emerging. This chapter presented the findings from a case study designed at determining the UX elements that constituted the engagement and interaction end-users have in the social media technology context. Collectively, the UX elements formed a more holistic view of the nature of the engagement and interaction that end-users have with social media technology. The term UX engagement and interaction was used to represent this holistic view of user engagement. At the

onboarding stage and the retrospective stages, the triad dimension was visible in the end-user's engagement and interaction with the social media technology. Furthermore, this chapter reasons that the elements of the emotional, cognitive, and behavioural dimensions can be combined to form a more holistic view of the nature of the engagement and interaction that end-users have with social media technology. Several UX elements were characterised based on emotional, cognitive, and behavioural dimensions. Both positive and negative affect characterised the emotional dimension of experience, while visceral, behavioural, and reflective elements characterised the cognitive dimension. Elements such as intentional interaction and accidental interaction characterised the behavioural dimension of experience. One lesson learnt from the case study was that unmoderated remote user testing together with follow-ups interviews was an appropriate approach to elicit responses from study participants. However, further research work could employ a monitorable combination of dedicated observatory approaches such as physiological techniques combined with product-oriented analytics.

7.7 Summary

This chapter began by presenting the case study, the setup, and the piloting of the tools used, followed by a summary of the activities conducted in the case study. Next, the results of the case study and their analysis and interpretation were presented, and a discussion of the UX engagement and interaction elements found in the case study followed. These elements were found by first time social media technology end-users, continual social media technology end-users and social media technology end-users with an administrative role in social networks while interacting with the social media technology. Definitions were formulated for the UX engagement and interaction for social media technology. The next chapter, Chapter 8, presents the formulation of a design method for end-user's UX engagement and interaction.

CHAPTER 8 – FORMULATION OF DESIGN METHOD FOR END-USER ENGAGEMENT



8.1 Introduction

This chapter presents a method called End-User Engagement and Interaction Design Method and the process of creating it. The method presented relates to the third sub-research question in this study, which states: "In what way can the UX and design elements be formulated into a method to support an end-user's unified engagement and interaction with social media technologies?" The objective of this sub-research question is "to determine how the UX elements and design elements can be formulated into a method". Further, this chapter presents how the concepts in Chapters 3 – 6 and the findings in Chapter 7 informed the design method. The purpose of the design method is to guide the understanding of and the design for end-user engagement and interaction with a specific ICT product such as social media technology.

Section 8.2 presents the approach that is end-user-centred to formulate the design method. Next, Section 8.3 discusses the components of the design method and Section 8.4 presents the concluding overview of it. Section 8.5 then summarises the chapter.

8.2 Process to determine the components of a design method

A process of activities based on either established approaches or through discovery determines the components of a design method. The process described in this section is based on the ISO 92410-2010 human-centred design approach (International Organization for Standardization, 2010). The purpose of adapting the human-centred design approach is to identify the activities to incorporate into the generic process for developing a design method. Further, the adapted approach can consider the end-users' perspective in defining and designing for end-user engagement. It does this by addressing the end-users' needs based on their experience of engagement and interaction in the context of an ICT product, such as social media technology.

The adapted human-centred design approach is only initiated when there is confirmation of a need to define and design end-user engagement and interaction for an ICT product. This need would occur when there is no existing definition of end-user engagement for an ICT product or when it exists, is too general or is no longer applicable. At that point, a need to create a novel set of end-user engagement and interaction elements or a novel design for end-user engagement and interaction would occur, as the entry point in Figure 8.1 indicates.

At this entry point, the activity focuses on clarifying the concern about the end-user's engagement and interaction with the targeted ICT product and planning for the adapted process.

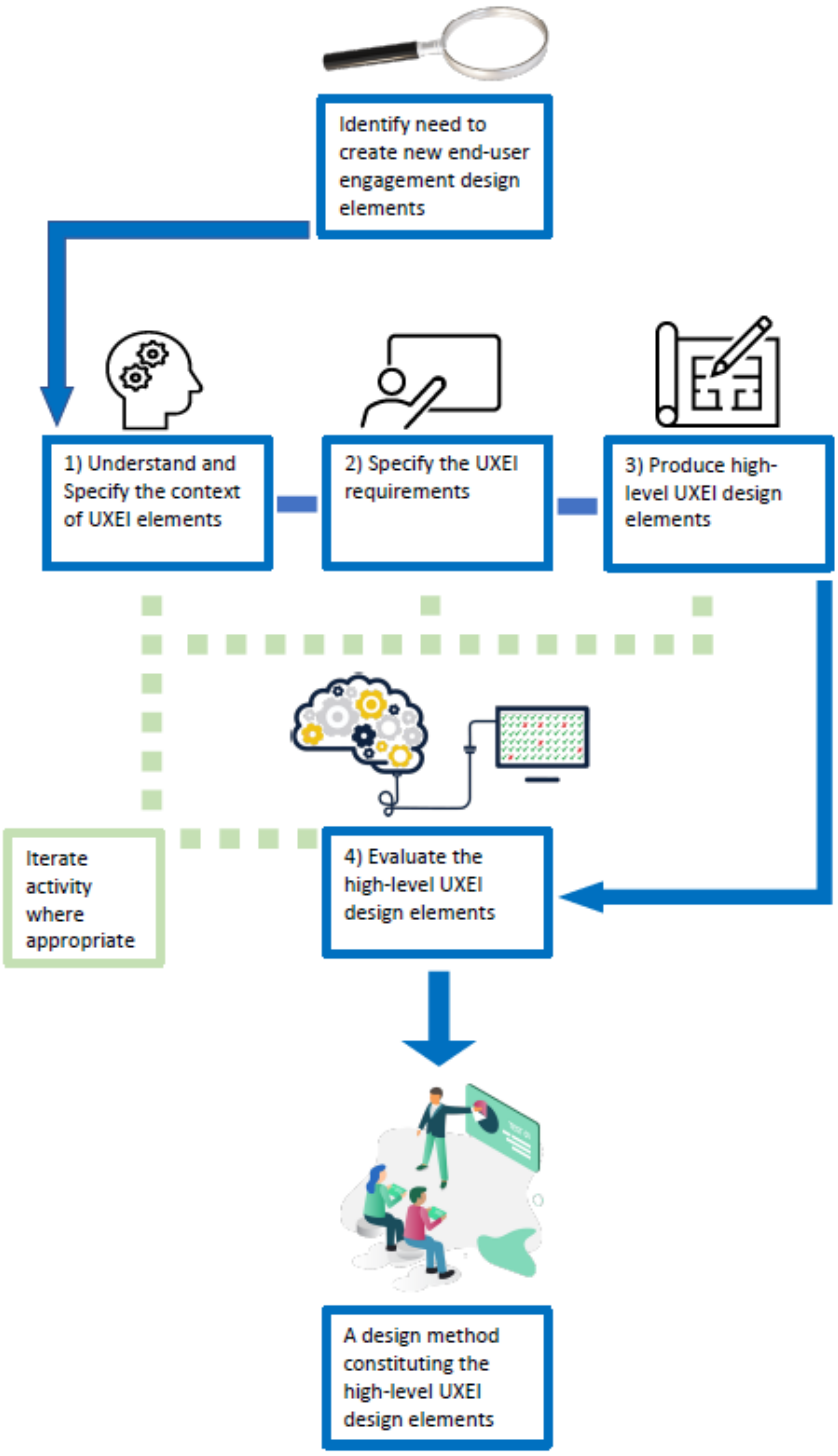


Figure 8.1: The adapted human-centred design approach.

As depicted in Figure 8.1, the adapted process also indicates that one needs to understand the context of UX engagement and interaction, specify its requirements, produce, and evaluate the design elements, and possibly revise the design elements. This is followed by a presentation of the design elements in the form of a design method, as indicated by the ending point in Figure 8.1. Therefore, the adapted process is broken down into specific phases of activities. These phases are as follows:

Phase 1: Understand and specify the context of the end-user's engagement and interaction.

Phase 2: Specify the UX engagement and interaction and social domain requirements.

Phase 3: Produce high-level UX engagement and interaction design elements for interaction with the ICT product.

Phase 4: Evaluate the high-level design elements for interaction with the ICT product.

These phases are discussed further in Sub-sections 8.2.1 – 8.2.4. The output of the adapted human-centred design process is a design method, which Section 8.3 of this chapter presents.

8.2.1 Phase 1: Understand and specify the context of the end-user's engagement and interaction

As outlined in Sections 3.2.1 and 3.3.1, the characteristics of the intended end-users define the context of the end-users. The result of this is a definition of the goal and tasks of the end-users. In addition, the organisation, technical and physical environment in which the end-user will be using the ICT product needs to be considered. Three activities guide understanding and specification of the UX engagement and interaction context.

The first activity focuses on the end-user's goals and tasks. The activity occurs if the role of the end-user in the engagement process with the ICT product has changed. The role of the end-user in the engagement and interaction are identifiable through various measurement approaches as presented in Chapter 3, Section 3.2.3. The second activity focuses on the UX engagement and interaction needs of the end-user and is performed if at least one dimension of engagement and interaction relates to the end-user's goal and task. The UX engagement and interaction needs are identified through various dimensions as presented in Chapter 3, Sections 3.2.4 and 3.4.5. The third activity focuses on the characteristics of the ICT product and is performed if the end-user's tasks relate to the interface and interaction elements of

the ICT product. The characteristics of the ICT product are identifiable through various approaches as presented in Chapter 3, Section 3.3. Once the context of the end-user's engagement and interaction has been understood, the second phase of the adapted human-centred design process commences.

8.2.2 Phase 2: Specify the UX engagement and interaction requirements

As outlined in Chapter 3, Section 3.4.5, an end-user's engagement, and interaction with an ICT product involve different dimensions, namely, the emotional, cognitive, and behavioural dimensions. Each of the dimensions has requirements and they interlace with one or two other UX engagement and interaction dimensions. Therefore, the main activity in this phase focuses on the requirements of the level of UX engagement and interaction and the social domain concerned. This involves creating an explicit statement of the requirements for the UX engagement and interaction and the social domain of the ICT product. The statements are made concerning the intended context of use and the objectives of the ICT product. Further, this activity occurs if the context of the UX engagement and interaction has been identified as outlined in Phase 1 of the adapted human-centred design process. Chapter 3, Section 3.4 identifies the different dimensions and overlap of the engagement and interactions an end-user has with an ICT product.

Once the requirements for the end-user's engagement and interaction have been specified, the third phase of the adapted human-centred design process commences.

8.2.3 Phase 3: Produce high-level UX engagement and interaction design elements

As outlined in Chapter 3, Sections 3.2.4, 3.2.5 and 3.4.5, the design elements are centred around the end-users' engagement and interaction with the ICT product. This results in defining heuristics or guidelines for potential elements in the engagement and interaction design. During this phase, potential design solutions are produced, along with the tasks and interactions between the end-users and the social media technology as an ICT product. They draw on the description of the context of use, the established state of the art in the ICT product domain, the design and usability guidelines and standards, and the experience and knowledge of the multidisciplinary design team. Also, more user requirements can emerge as potential design solutions are detailed and evaluated.

The main activity in this phase focuses on the production of high-level design elements for the ICT product, such as heuristics for engagement and interaction. This activity occurs if the UX engagement and interaction requirements have been specified and are linked to the UX engagement and interaction dimensions. Elements of UX engagement and interaction as well as the design principles for engagement and interaction have been identified in Chapter 3, Sections 3.2 and 3.4. Once the design elements for the end-users' engagement and interaction have been produced, the fourth phase of the adapted human-centred design process commences.

8.2.4 Phase 4: Evaluate the high-level design elements

As outlined in Chapter 3, Sections 3.2.3 and 3.4.5, different user-centred approaches are used to measure the attributes and elements of design for an end-user's engagement and interaction with an ICT product. User-centred evaluation (i.e., an evaluation that takes into consideration the end-user's needs and experience) is a requirement of human-centred design. The design concepts such as UX methods, heuristics, prototyping, and requirement specifications, are evaluated to obtain a better understanding of end-user needs. To obtain valid results, the evaluation is carried out by experienced evaluators and by using appropriate methods such as illustrative scenarios, self-reporting approaches, and product-oriented analytics (Sharp et al., 2019; Tullis & Albert, 2013).

The two main activities that occur are performed in the fourth phase of the adapted human-centred design process. The first activity focuses on demonstrating the application of the elements produced and how well they meet the UX engagement and interaction requirements. This activity occurs if new heuristics or guidelines are produced. The second activity focuses on refining the produced UX engagement and interaction design elements and occurs if the new heuristics or guidelines prove not to be applicable for the UX engagement and interaction with the ICT product. Iteration is prompted for any of the activities in the earlier phases of the adapted process, as indicated by the blue dashed arrows in Figure 8.1. The design elements are evaluated to see if the UX engagement and interaction requirements are met.

8.2.5 Endpoint of the adapted process

The adapted human-centred design approach concludes when the resulting UX engagement and interaction design elements are satisfactory. The iteration between the phases ensures that any identified area of improvement is completed. The iteration also completes and confirms the transformation of the high-level end-user engagement definition and design to engagement definition for the ICT product. As depicted in the endpoint in Figure 8.1, the main activity focuses on presenting the evaluated design elements as a design method. This includes the heuristics or guidelines identified. The activity is performed when there is confirmation that the evaluated UX engagement and interaction design elements meet the UX engagement and interaction requirements. The design elements are identified in Chapter 3, Sections 3.2.4, 3.2.5 and 3.4.5.

To summarise the adapted human-centred design process, as depicted in Figure 8.2, once the need for new UX engagement and interaction elements has been identified, the process of creating the elements for design commences. The end-user's needs and goals are identified (Phase 1), the UX engagement and interaction requirements are specified (Phase 2), the UX engagement and interaction design elements are produced and evaluated (Phases 3 and 4), and the process concludes with a confirmation that the design elements match the requirements.

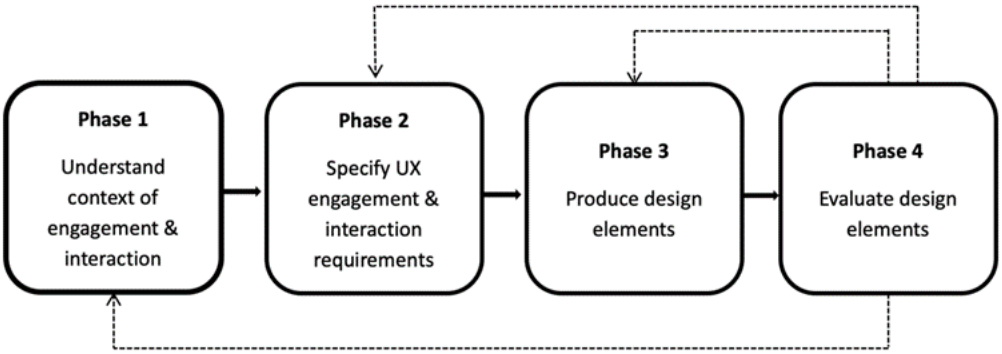


Figure 8.2: Summary of the adapted human-centred design process.

8.3 Components for the end-user engagement design method

The generic process discussed in the preceding section (Section 8.2) was applied to the end-user engagement and interaction design method for social media technologies. The components are discussed in Chapter 3 (UX engagement and interaction), Chapter 4 (Social media technology User Interaction), Chapter 5 (End-user involvement in social media

technology design), Chapter 6 (Heuristics Development), and Chapter 7 (Data Collection and Presentation).

In Chapters 3 and 5, the term UX engagement and interaction was formulated, and three interconnected dimensions were identified. These dimensions were emotional engagement, cognitive engagement, and behavioural engagement, and were explored in the social media technology landscape identified in Chapter 4. In Chapter 6, a generic heuristics development process was formulated and design guidelines as heuristics for UX engagement and interaction were identified. The 36 design guidelines were coded and mapped. Chapter 7 concerns the collection and presentation of data related to the case study findings of social media technology, the end-users' UX engagement and interaction, and the heuristics formed based on the coded design guidelines presented in Chapter 6.

In this section, four key phases are identified for the end-user engagement and interaction design method. Each of the phases is based on the adapted human-centred design process. Sub-sections 8.3.1 – 8.3.4 discuss each of the phases, with Section 8.4 presenting how they fit together to form the end-user engagement design method.

8.3.1 Phase 1 – Elements of the UX engagement and interaction context

This phase is based on the first phase of the adapted human-centred design process. It aims to understand and specify the context of end-user engagement and interaction by understanding the end-users, identified by their characteristics. In this phase, the focus is on how each of the activities fit into the levels of the UX engagement and interaction dimensions, to understand and specify the context of engagement and interaction as Figure 8.3 illustrates. The activities produce attributes and elements that describe the context of the end-user's engagement and interaction. As outlined in Chapter 3, Section 3.4.5, the UX engagement and interaction dimensions are interlaced, thereby forming different levels of engagement and interaction that reflect the end-user's experience with an ICT product. These levels of UX engagement and interaction dimensions are either singular, dual, or holistic. Hence, the need to consider them in the design process.

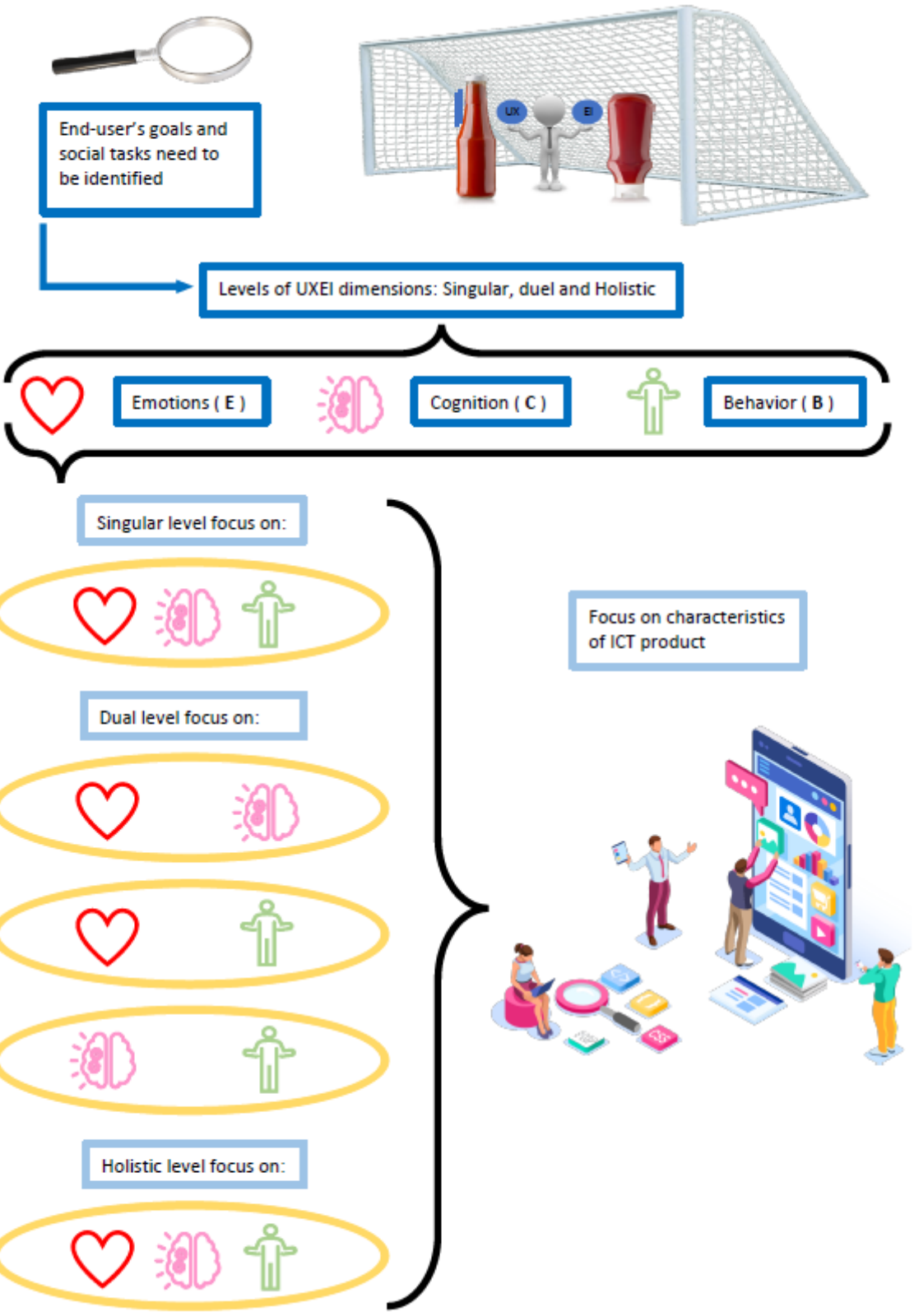


Figure 8.3: Phase 1 activities to identify and specify the UX engagement and interaction context.

As depicted in Figure 8.3, the first activity is the need to identify the end-user's goals and social tasks. Next, activities corresponding to the dimensional levels of the end-user's engagement and interaction occur. The levels of UX engagement and interaction dimensions are the Singular level, the Dual level, and the Holistic level.

At the singular level:

- Activity to focus on emotions. This activity occurs if any of the following attributes are present in the goals of the end-user: affect, motivation, interest, perceived usability, delight, reliability, adjustability, satisfaction, felt uninvolved, fun, frustration, annoyance, discouragement, felt control, felt interested. The attributes were identified in Chapter 3, Section 3.4.5 and Chapter 7, Section 7.3.2.
- Activity to focus on cognition. This activity occurs if any of the following attributes are present in the goals of the end-user: challenge, interest, focused attention, aesthetics (visual appeal), attractiveness, subjective perception of time, follow-on task performance, perceived worthiness/worthwhileness, reward/non-reward, success, not drawn in, confusion in usage, mentally taxing, demanding experience, task incompletion, curiosity, attractiveness. The attributes were identified in Chapter 3, Section 3.4.5 and Chapter 7, Section 7.3.2.
- Activity to focus on behaviour. This activity occurs if any of the following attributes are present in the goals of the end-user: interactions (intended, non-intended), number of interactions, frequency of interactions, sensory response, activity completion, intentional interaction, accidental interaction, dismissal of activities, no content creation, non-likelihood of continued interaction. The attributes were identified in Chapter 3, Section 3.4.5 and Chapter 7, Section 7.3.2.

At the dual level

- Activity to focus on emotions and cognition. This activity occurs if one attribute from emotions and one attribute from cognition are both present in the goals of the end-user.
- Activity to focus on emotions and behaviour. This activity occurs if one attribute from emotions and one attribute from behaviour are both present in the goals of the end-user.

- Activity to focus on cognition and behaviour. This activity occurs if one attribute from cognition and one attribute from behaviour are both present in the goals of the end-user.

At the holistic level

- Activity to focus on emotions, cognition, and behaviour. This activity occurs if one attribute from emotion, one attribute from cognition and one attribute from behaviour are all present in the goals of the end-user.

At the ICT product level

- Activity to focus on the characteristics of the social media technology. This activity occurs if at least one of the social media technology elements is present in the goals of the end-user: user interface, social software building blocks, content (media), technological foundation, interaction, accessibility and control, social network, and system integration. Attributes were identified in Chapter 4, Sections 4.2.1 and 4.2.3, and Chapter 5, Section 5.3.3.

To summarise, the main activities that guide the understanding and specification of the context of the end-user's engagement and interaction are as follows:

(1) Determine the end-user's main goal and social tasks. This may also include finding out if the end-user is a basic social media technology user or social network administrator.
(2) Identify the singular engagement and interaction needs of the end-user.
(3) Identify the dual engagement and interaction needs of the end-user.
(4) Identify the holistic engagement and interaction needs of the end-user.
(5) Specify the social media technology characteristics for the design elements. For instance, findings from the case study.

The next phase in the design method states the requirements for the specified context of the end-user's engagement and interaction with social media technology. Activities in this phase are discussed in Section 8.3.2.

8.3.2 Phase 2 – UX engagement and interaction requirements

In the first phase of the design method, five main activities specify the context of the UX engagement and interaction with social media technology by identifying the end-user's needs, goals, and social tasks for the social media technology. The second phase of the design method specifies the end-user's UX engagement and interaction and social domain requirements.

Phase 2 of the design method is based on the second phase of the adapted human-centred design process, which aims to specify the UX engagement and interaction requirements. The level of UX engagement and interaction dimensions for which requirements need to be specified corresponds with the interlaced UX engagement and interaction dimensions into which the end-user's needs, goals and social tasks fall, as Figure 8.4 illustrates. The phase produces a set of explicit statements about the requirements for the specified UX engagement and interaction.

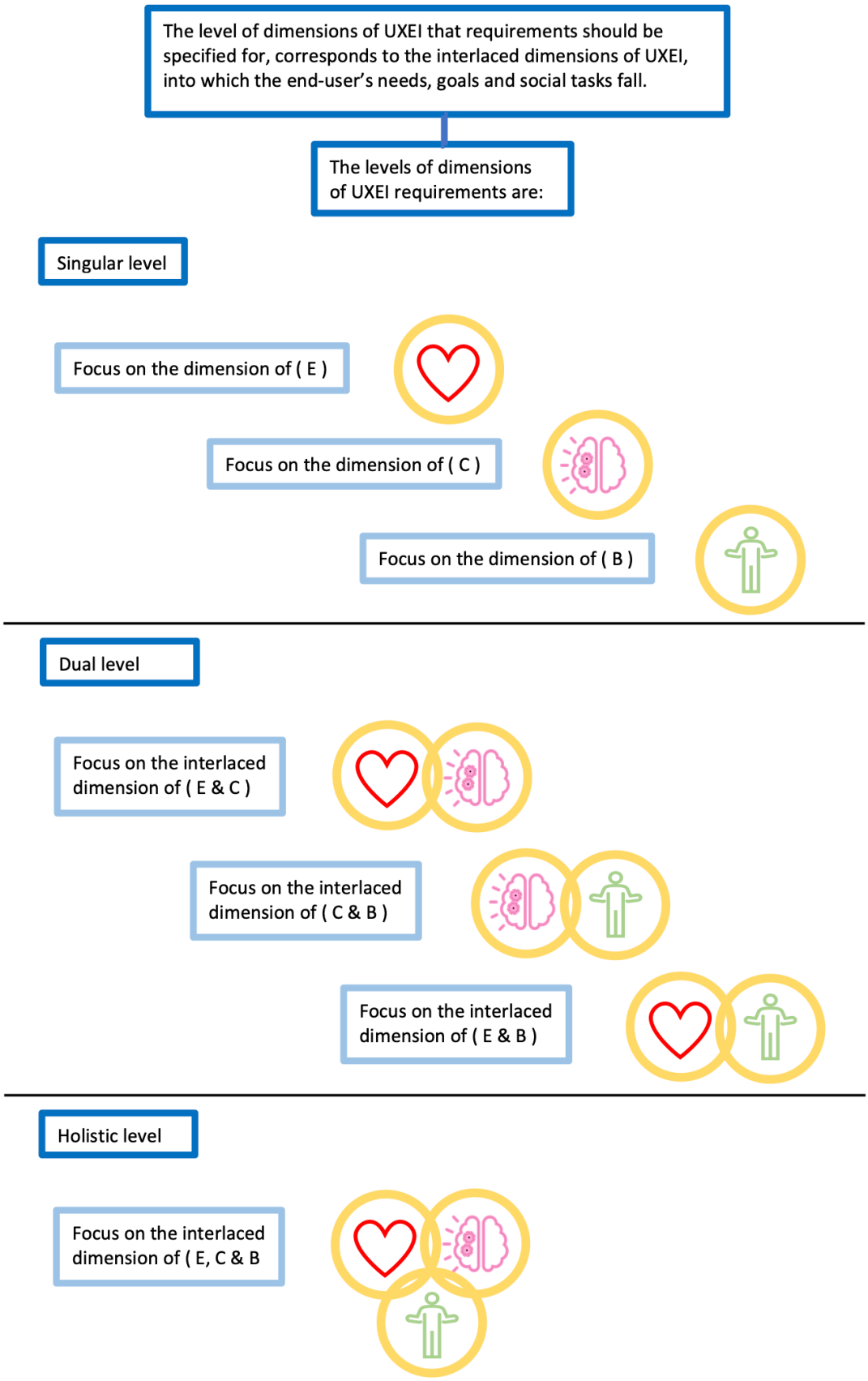


Figure 8.4: Phase 2 activities to specify the UX engagement and interaction requirements.

As depicted in Figure 8.4, Phase 2 of the design method indicates that one needs to first specify the requirements for the singular, dual, and holistic levels of UX engagement and interaction dimensions, inclusive of the ICT product level. Therefore, the phase is broken down into activities. The main activities are at the levels of the dimensions of the UX engagement and interaction requirements, namely, singular level, dual level, and holistic level.

At the singular level, there are three activities related to either the emotional, cognitive, or behavioural UX engagement and interaction dimensions. Requirement statements are formed either on the emotional, cognitive, or behavioural aspects of the end-user's engagement and interaction. The selection of the dimensions corresponds to the singular level of UX engagement and interaction dimensions identified in Phase 1 of the design method.

- Activity focuses on the dimension of emotions (E). During this activity, requirement statements are formed if the emotional dimension is at a singular level and the ICT product level is present in the end-user's needs, as specified in Phase 1 of the design method. The needs are identified in Chapter 3, Section 3.4.2 and Chapter 7, Sections 7.3 and 7.5.
- Activity focuses on the dimension of cognition (C). During this activity, requirement statements are formed if the cognitive dimension at a singular level and the ICT product level is present in the end-user's needs, as specified in Phase 1 of the design method. The needs are identified in Chapter 3, Section 3.4.2 and Chapter 7, Sections 7.3 and 7.5.
- Activity focuses on the dimension of behaviour (B). During this activity, requirement statements are formed if the behavioural dimension is at a singular level and the ICT product level is present in the end-user's needs, as specified in Phase 1 of the design method. The needs are identified in Chapter 3, Section 3.4.2, Chapter 5, Section 5.3.3 and Chapter 7, Sections 7.3 and 7.5.

At the dual level, there are three activities related to the interlacing of two UX engagement and interaction dimensions. Requirement statements are formed on any two dimensions of the end-user's engagement and interaction. The selection of the dimensions corresponds to the dual level of UX engagement and interaction dimensions, as identified in Phase 1 of the design method.

- Activity focuses on the interlaced dimension of emotions and cognition (E.C). During this activity, the requirement statements are formed if the emotional and cognitive dimensions at the dual level and the ICT product level are present in the end-user's needs, as specified in Phase 1 of the design method. The needs are identified in Chapter 3, Section 3.4.2, and Chapter 7, Sections 7.3 and 7.5.
- Activity focuses on the interlaced dimension of cognition and behaviour (C.B). Here, the requirement statements are formed if the cognitive and behavioural dimensions at the dual level and the ICT product level are present in the end-user's needs, as specified in Phase 1 of the design method. The needs are identified in Chapter 3, Section 3.4.2, Chapter 5, Section 5.3.3 and Chapter 7, Sections 7.3 and 7.5.
- Activity focuses on the interlaced dimension of emotions and behaviour (E.B). During this activity, the requirement statements are formed if the emotional and behavioural dimensions at the dual level and the ICT product level are present in the end-user's needs, as specified in Phase 1 of the design method. The needs are identified in Chapter 3, Section 3.4.2 and Chapter 7, Sections 7.3 and 7.5.

At the holistic level, there is one activity related to the interlace of three UX engagement and interaction dimensions.

- Activity focuses on the interlaced dimension of emotions, cognition, and behaviour (ECB). The requirement statements are formed if the emotional, cognitive, and behavioural dimensions at the holistic level and the ICT product level are present in the end-user's needs, as specified in Phase 1 of the design method. The needs are identified in Chapter 3, Section 3.4.2, Chapter 4, Section 4.2.3, Chapter 5, Section 5.3.3 and Chapter 7, Sections 7.3 and 7.5.

To summarise, the main activities that guide the specification of the UX engagement and interaction requirements in this phase corresponds to the interlaced UX engagement and interaction dimensions. These main activities are:

(6) Specify the end-user's requirements for singular engagement and interaction.

(7) Specify the end-user's requirements for dual engagement and interaction.

(8) Specify the end-user's requirements for holistic engagement and interaction and identify high-level engagement and interaction design guidelines.

The next phase in the design method concerns the production of high-level design elements for the requirement statements about the specified context of the end-user's engagement and interaction with social media technology. Activities in this phase are discussed in Section 8.3.3.

8.3.3 Phase 3 – High-level UX engagement and interaction design elements for social media technology

As outlined in Chapter 6, Section 6.2, design elements are forms of guiding rules for designing and evaluating ICT products. These guiding rules are typically in the form of golden rules, principles, guidelines, or heuristics. The second phase of the design method presents the activities for specifying the requirements for the end-user's needs, goals, and social tasks for social media technology, as identified in the first phase of the design method. Furthermore, the production of the design elements for the UX engagement and interaction needs and requirements falls within the third phase of the design method. Phase 3 of the design method is based on the third phase of the adapted human-centred design process and aims to produce design elements for specified UX engagement and interaction requirements. Figure 8.5 illustrates the activities to produce the UX engagement and interaction design elements. Chapter 6, Section 6.4 has detailed steps about developing heuristics for the end-user's engagement and interactions.

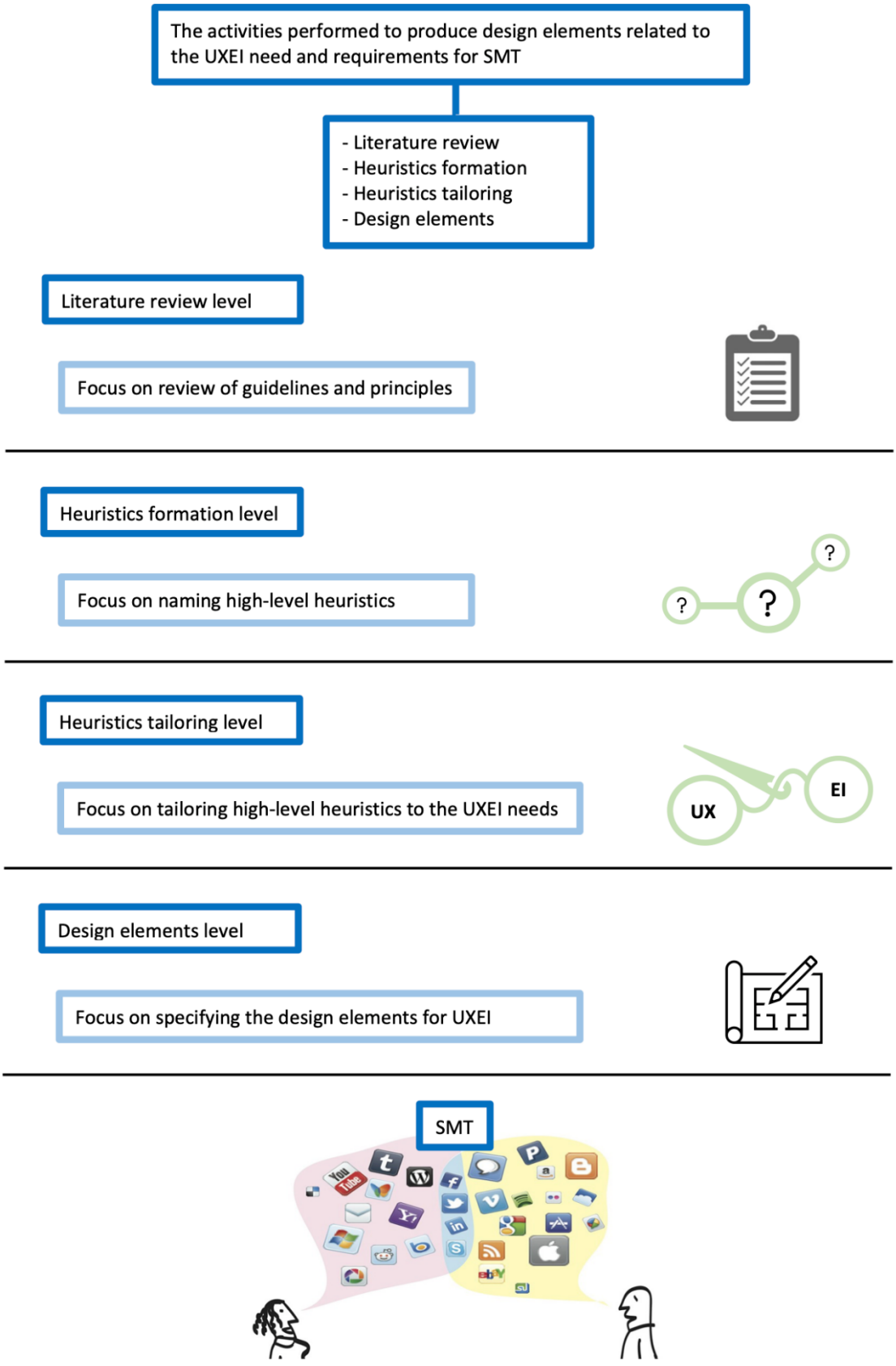


Figure 8.5: Phase 3 activities to produce high-level design elements for the UX engagement and interaction requirements.

As depicted in Figure 8.5, Phase 3 of the design method indicates that one needs to firstly review available and relevant guidelines and principles related to UX engagement and interaction. From the review results, high-level heuristics are formulated and tailored to the UX engagement and interaction needs. This is followed by specifying the design elements for UX engagement and interaction needs. Therefore, the phase is broken down into activities.

At the literature review level, activity focuses on the review of guidelines and principles related to UX engagement and interaction. The activity occurs if the UX engagement and interaction requirement statements relate to any of the UX engagement and interaction attributes and themes. The attributes and themes are identified in Chapter 3, Section 3.4.5, and Chapter 7, Sections 7.3 and 7.4. At the Heuristics formation level, the activity focuses on naming high-level heuristics. The guidelines and principles found in the literature are worded into names and a brief description of the heuristics. The description shows a brief understanding of the heuristics name and what it addresses. The activity occurs if the UX engagement and interaction requirement statements relate to any of the UX engagement and interaction attributes and themes. The attribute and themes are identified in Chapter 3, Section 3.4.5 and Chapter 7, Sections 7.3 and 7.4.

Next is the heuristics tailoring level. The activity focuses on tailoring high-level heuristics to the UX engagement and interaction needs and requirements. The activity occurs if the UX engagement and interaction requirement statements relate to any of the following: UX engagement and interaction attributes and themes, and elements of social media technology. The attributes, themes and elements were identified in Chapter 3, Section 3.4.5, Chapter 4, Section 4.2.3 and Chapter 7, Sections 7.3 and 7.4. However, a checklist is needed, based on the name of the heuristics. The items in the checklist are based on the terminology or wordings about the heuristics in literature. Then the tailoring uses a thematic analysis technique whereby the checklist items are used to modify the heuristics for the UX engagement and interaction requirements. This activity level is followed by the design element level. At the design element level, the activity focuses on specifying the UX engagement and interaction design elements. This activity occurs If the UX engagement and interaction requirement statements relate to any of the following: UX engagement and interaction attributes and themes, elements of social media technology and the involvement of the end-user in the design process. The elements are identified in Chapter 3, Section 3.4.5,

Chapter 4, Section 4.2.3, Chapter 5, Section 5.3.3 and Chapter 7, Sections 7.3 and 7.4. The activity focuses on grouping and regrouping the heuristics with the UX engagement and interaction requirements and the interlaced UX engagement and interaction concerned.

To summarise, this phase of the design method has four main activities that guide the production of high-level design elements for social media technology, as indicated by Figure 8.5. These activities are as follows:

(9) Review literature for guidelines and principles of general user engagement in the HCI domain.
(10) Name high-level heuristics.
(11) Tailor heuristics to fit the dimensions of end-user's requirements for engagement and interaction.
(12) Specify the UX engagement and interaction design elements for interaction with social media technology.

The next phase in the design method concerns the evaluation of the design elements. The evaluation is demonstrated using illustrative scenarios and is presented in Chapter 9.

8.3.4 Phase 4 – Evaluate high-level UX engagement and interaction elements for social media technology

The first phase of the design method specified the context of UX engagement and interaction, which includes the end-user's needs, followed by the second phase of the design method in which the UX engagement and interaction and social domain requirements were specified. In the third phase, the high-level design elements for the UX engagement and interaction requirements are specified. However, in the fourth phase of the design method, activities for evaluating the design elements of the UX engagement and interaction requirements for social media technology are specified, as Figure 8.6 illustrates.

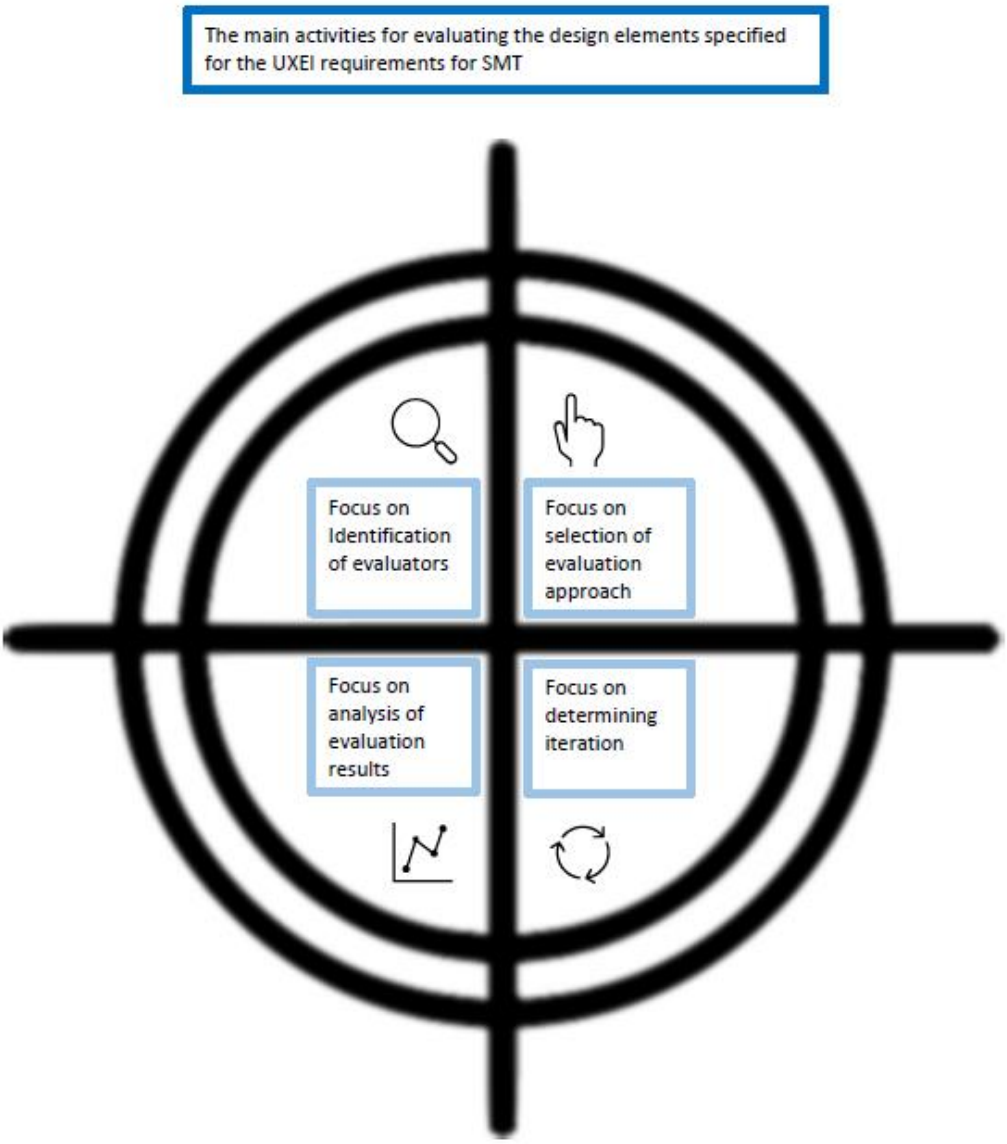


Figure 8.6: Phase 4 activities to evaluate high-level UX engagement and interaction elements.

As depicted in Figure 8.6, Phase 4 of the design method shows that one needs to first identify potential evaluators for the design elements. Thereafter, one needs to provide and apply a tool to evaluate the design method, analyse the evaluation results and possibly iterate any activity in the preceding phase. Therefore, the phase is broken down into activities.

The first activity focuses on identifying evaluators such as IT personnel or specialists. It occurs if the design elements include newly developed heuristics or known heuristics that must be applied to different aspects of the end-user's engagement and interaction with social media technology. The second activity focuses on applying an evaluation tool to the UX engagement

and interaction design elements. The activity aims to evaluate and possibly verify the design elements. The use of illustrative scenarios and online interviews are some of the tools that can be used for the evaluation.

The evaluation could be used to demonstrate the applicability of the design elements in the UX engagement and interaction context. The activity occurs if the design elements include new heuristics, which were developed, or known heuristics that need to be applied to different aspects of the end-user's engagement and interaction with social media technology. For both the first and second activity in Phase 4, the heuristics and social media technology are identified in Chapter 3, Sections 3.2.5 and 3.4.5, Chapter 4, Section 4.2.3 and Chapter 7, Sections 7.4 and 7.5.

Next, the third activity in Phase 4 of the design method focuses on analysing the evaluation results. The activity analyses the evaluation results to identify the design elements that need addition, elimination, refinement, or other modifications to the UX engagement and interaction needs and requirements. The activity occurs if the specified design elements have been evaluated. Chapter 9, Section 9.4 presents a sample of the analysis results from an illustrative scenario. The next activity in the phase is optional as it focuses on deciding whether to perform one or more activities from an earlier phase in the design method. The activity occurs if there are any modifications suggested regarding the design elements based on the evaluation findings. The activity prompts an iteration to any activity in the earlier phases of the design method.

To summarise, this phase of the design method has four main activities involved in the evaluation of the design elements, as Figure 8.6 indicates. These activities are as follows:

(13) Identify and select experts to evaluate the design outputs.
(14) Apply *an evaluation tool* to evaluate the high-level UX engagement and interaction design elements for interaction with social media technology using end-users and experts.
(15) Analyse evaluation results.
(16) Iterate the process to either Phase 1 or phase 2, depending on the findings.

The design method concludes when the design elements meet the UX engagement and interaction needs and requirements. The next section shows an overview of the design method, its phases, and its activities.

8.4 Conclusion of the design method

As outlined in the introduction section of this chapter, the purpose of the end-user engagement and interaction design method is to guide the understanding and design of an end-user's engagement and interaction with social media technology. Using an adapted human-centred design process, corresponding phases were created for the design method. Figure 8.7 shows how the phases and activities of the design method for the end-user's engagement and interaction with social media technology relate to one another.

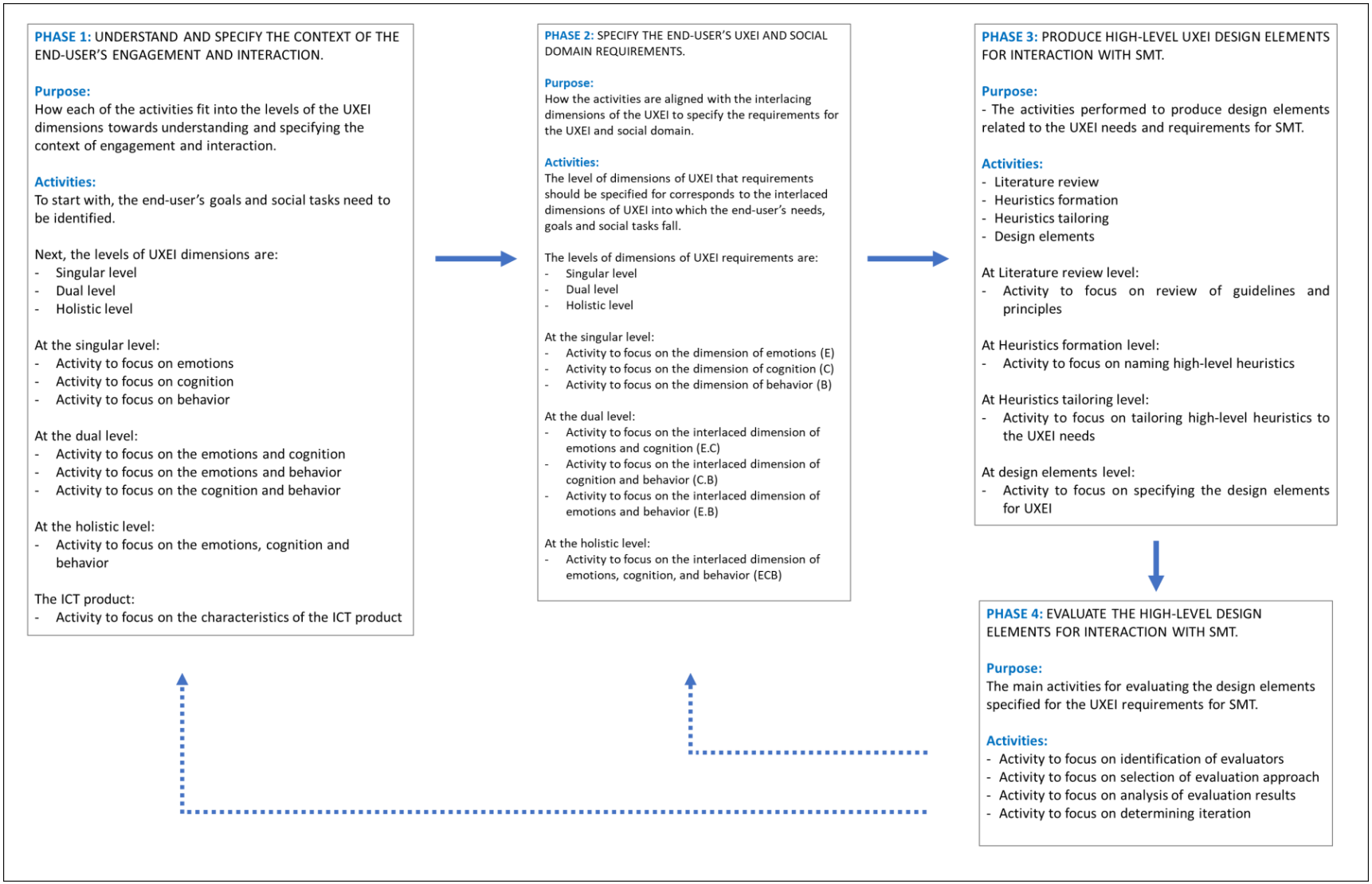


Figure 8.7: Phases and activities of the end-user engagement and interaction design method.

As depicted in Figure 8.7, the design method indicates that one needs to first specify the context of an end-user's engagement and interaction with social media technology by understanding the end-user's characteristics, needs, goals and tasks. Next, one needs to specify the requirements for the engagement and interaction with the social media technology, and then produce high-level design elements for the engagement, interaction, and evaluation of the high-level design elements. Therefore, the design method constitutes the phases and activities for designing the end-user's engagement and interaction with social media technology.

The activities in the design method phases focus on specifying the elements of the UX engagement and interaction context, the UX engagement and interaction requirements, producing the UX engagement and interaction design elements, and evaluating the high-level design elements. The flow between the phases is indicated by the bold arrows in Figure 8.7. To summarise, the activities of the phases of the design method for social media technology are:

PHASE 1: Understand and specify the context of the end-user's engagement and interaction.

(1) Determine the end-user's main goal and social tasks. This may also include finding out if the end-user is a basic social media technology user or a social network administrator.
(2) Identify the singular engagement and interaction needs of the end-user.
(3) Identify the dual engagement and interaction needs of the end-user.
(4) Identify the holistic engagement and interaction needs of the end-user.
(5) Specify the social media technology characteristics for the design elements, for example, findings from the case study.

PHASE 2: Specify the end-user's UX engagement and interaction and social domain requirements.

(6) Specify the end-user's requirements for singular engagement and interaction.
(7) Specify the end-user's requirements for dual engagement and interaction.
(8) Specify the end-user's requirements for holistic engagement and interaction.

PHASE 3: Produce high-level UX engagement and interaction design elements for interaction with social media technology.

(9) Review the literature for guidelines and principles of general user engagement in the HCI domain.
(10) Name high-level heuristics.
(11) Tailor heuristics to fit the dimensions of the end-user's requirements for engagement and interaction.
(12) Specify the UX design elements for interaction with social media technology.

PHASE 4: Evaluate the high-level design elements for interaction with social media technology.

(13) Identify and select evaluators.
(14) Apply an evaluation tool to evaluate the high-level UX engagement and interaction design elements for interaction with social media technology using end-users and/or experts.
(15) Analyse the evaluation results.
(16) Iterate the process to either Phase 1, Phase 2, or Phase 3, depending on the findings. The iteration parts are indicated by the dashed arrows in Figure 8.7.

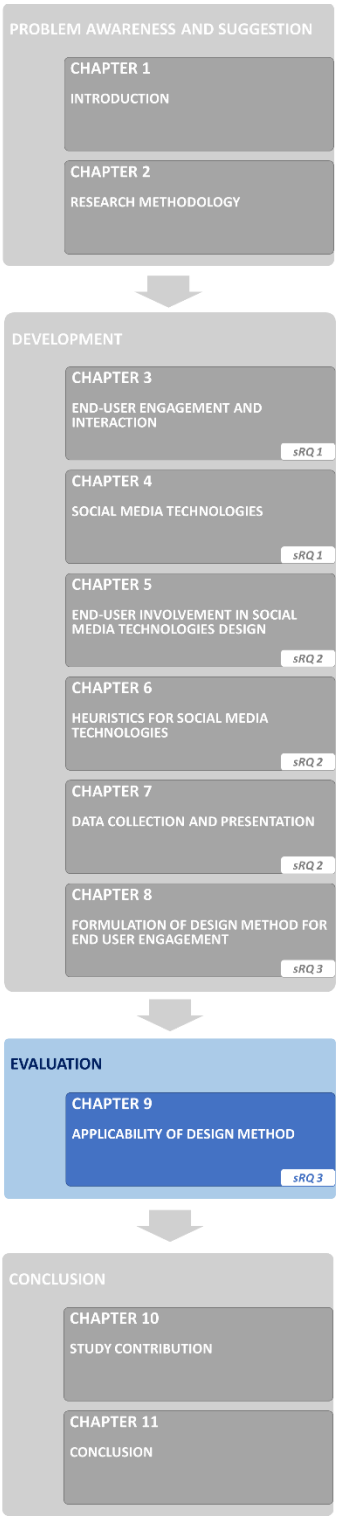
Chapter 8, Section 8.3 presents the details of the phases and activities.

8.5 Summary

This chapter detailed the process of developing a step-by-step design method for end-user engagement and interaction with social media technology. The formulation of a method that takes into consideration the end-user's perspective was presented and discussed. The components of the design method for UX engagement and interaction have four main phases. Each has been described, followed by a presentation of the flow between the design method phases.

The next chapter presents the applicability of the formulated design method.

CHAPTER 9 – APPLICABILITY OF DESIGN METHOD



9.1 Introduction

This chapter presents the applicability of the end-user engagement and interaction design method for social media technology. The essence of the applicability of the design method is to provide answers to the third sub-research question of this study. The question states: "In what way can the UX and design elements be formulated into a method to support an end-user's unified engagement and interaction with social media technologies?" The objective of this sub-research question is "to determine how the UX elements and design elements can be formulated into a method". It thus maps to the evaluation phase of the main design science research process, as Figure 2.2 describes**.** The applicability of the end-user engagement and interaction design method is shown by applying the method to a scenario that represent a simulated environment integrated with social media technology.

Section 9.2 briefly presents the high-level design principles for end-user engagement, followed by the modelling steps that include a scenario at the designer level in Section 9.3. Next, Section 9.4 presents the design implementation checklist while Section 9.5 summarises the chapter.

9.2 High-level design principles for end-user engagement and interaction

Chapter 3, Section 3.2.5 presented the principles and guidelines for designing the end-user engagement selected in this study. These principles served as input into the generic heuristic development process that Chapter 6.4 presented. In the process, the guidelines were aligned with the UX engagement and interaction dimensions, namely, the emotional, cognitive, and behavioural dimensions and their relation. Chapter 7.4 presented these high-level dimensions of the principles.

9.3 Modelling end-user engagement

9.3.1 Implementation steps of the design method

Recapping Chapter 8.2, the need for the use of the design method has to be established first. Once the need is known, then the phases of the UX engagement and interaction design method are followed with the possible iteration between the phases. The implementation steps of the design method are:

1. Understand and specify the context of the end-user's engagement and interaction. The end-user's context is defined by its characteristics.
2. Specify the end-user's UX engagement and interaction and social domain requirements. In this activity, explicit statements of the end-user's requirements are to be created.
3. Produce high-level UX engagement and interaction design elements for interaction with social media technology. Potential design elements are identified and produced during this activity.
4. Evaluate the high-level design elements for interaction with social media technology. The design elements are evaluated to obtain a better understanding of end-user needs.

Each phase has its own set of steps. For each step, inputs are identified, and outputs are generated. The next sub-section presents an illustrative scenario requiring the implementation of the design method at the designer level. Section 9.4 details the implementation of the design method and the associated input and output.

9.3.2 Scenario at designer level

The phases of the end-user engagement and interaction design method are applied to an illustrative scenario and are presented in this section. The illustrative scenario is based on the literature findings of end-user engagement and interaction with social media technology, as Chapter 4 discusses. It is also based on the case study findings, which Chapter 7 presents. Illustrative scenarios are frequently used to validate design methods. This method implements the scenario concept in an original way. The aim is to create interaction between designers and users in order to foster a shared understanding of both the problem and the solutions.

- This is a story of how the behavioural metrics did not represent true user engagement. The teacher asked learners to use a social networking platform for a class discussion. Specifically, the platform was expected to be used for videos, links, and comments.
- Three main characters:
    - Mr Tumi (social media technology end-user as group administrator): the teacher of second-year students, with more than three years of teaching experience, uses a mobile social networking platform for family conversations with family

and colleagues more than five times a day. The teacher has a vision to integrate the use of social media technology into his teaching activities and is a creator and admin of his social media technology groups.

- Ms Yolisa (Software developer familiar with social media technology): the software designer and developer in the university, uses social media technology daily, and manages the social media technology marketing platforms for the institution.
- The second-year learners (social media technology end-users): are in their late teens and early twenties, and are familiar with a different social networking platform, and use it for socialising and watching entertainment-related videos.

- On a Monday, Mr Tumi (the teacher) asked the learners to use a mobile social networking platform for a class discussion. He posted a video to the social media technology group for the class, with the expectation that the learners would view the videos and links, and comment on the posted video. Mr Tumi checks the social networking platform weekly for interaction. All the videos and links he posted a week prior on the mobile social networking platform display a metric that indicates that the posts have been either viewed or read. However, in the succeeding class session, the learners told Mr Tumi that they saw the thumbnail of the video on the social networking platform but could not watch it because of a download problem *(costly data bundle and slow network connection)*.
- Mr Tumi calls the ICT services department of the institution to ask why the learners' engagement metrics on the social networking platform reflected that the learners watched the video, yet they had not watched it. He needs to know exactly what the learners did with the posted content from his account. The ICT services department tasked one of its software designers/developers, Ms Yolisa, to help Mr Tumi design the social media technology so that the true status of the learners' engagement and interaction with the video is known. Essentially, his main need is to know whether the learners saw, downloaded, and watched the video. That is, he wants to know what the learners did with the posted content exactly: whether they clicked, skipped, saw the thumbnail, watched/downloaded/paused the video, downloaded-open-play-watched, downloaded but did not open-play-watch, etc.

- To help Mr Tumi, Ms Yolisa from the design team has decided to use the end-user engagement and interaction design method to understand the UX engagement and interaction and identify a set of design elements to support the learners' engagement and interaction with the social networking platform.

9.4 Design method implementation checklist

PHASE 1: Understand and specify the context of the end-user's engagement and interaction.

(1) Determine the end-user's characteristics, main goals, and social tasks.

a. To determine the end-user's main goals and social tasks, in the case of Scenario 1, interviews with the teacher and some of the learners would be conducted through either online questions or face-to-face. This could encourage sharing of information and screenshots of the area of concern on the social networking platform. It may also include finding out if the end-user is a basic social media technology user or social network administrator.

b. Some examples of questions that can be asked in the interview are: What are the social media technologies used for? What are the social media technologies used most often? What tasks and content are put on a social media technology? Which social media technologies are the learners familiar with? Who are the administrators of the group? What is the learners' role in the group?

c. Feedback from the interviews may be used to understand the characteristics of the end-users, the main goal for the social networking platform in the scenario, as well as the motivation for using the social platform.

d. Some examples of information that may be obtained from this step are disparity between motivation and frequency of use of the social platform, unclear tasks, cost of Internet services, uncertainty about the purpose of the social media technology.

(2) Identify the singular engagement and interaction needs of the end-user.

a. Attributes of engagement and interaction with social media technology could be emotional, cognitive, or behavioural views. Behavioural attributes form one of the single views of engagement. Other attributes are emotions and task-

related attributes. To identify singular engagement in the case of Scenario 1, interviews with the teacher and learners would be conducted through either online questions or face-to-face. This can encourage the sharing of information on the area of concern in the social networking platform. Also, platform metrics that the teacher and learners associate with the area of concern may be included.

b. Some examples of questions that can be asked in the interview are: What motivates the learners to open the social media technology? What do the learners check the social media technology for? What is it about the social media technology that drew their attention? What content did you ignore or skip? Were you involved in the experience of using the social media technology?

c. Feedback from the interviews and the elicited attributes may be used to understand the emotional, cognitive, or behavioural needs of the social media technology.

d. Some examples of information that may be obtained from this step are expectations of relevant content, prompts of personal interest, attention to visuals, momentary periods, activities of leisure.

(3) Identify the dual engagement and interaction needs of the end-user.

a. The dual view of engagement and interaction is an emotional and cognitive view when the end-user sees an element on the social media technology. The end-user feels something about the social media technology element and forms a perception of the interface but does not perform any activity. To identify the dual engagement and interaction needs, in Scenario 1, interviews with the teacher and learners would be conducted using either online questions or face-to-face. The interviews could encourage the participants to share information and screenshots or links of the area of concern on the social networking platform.

b. Some examples of questions that can be asked in the interview are: How and why did you stop checking the social media technology groups or channels? Were there actions, content, or requests that you ignored or skipped on the

social media technology? What about the visuals, content, and other parts of the social media technology that got your attention?

c. The Feedback from the interviews and elicited attributes may be used to understand the dual needs of the end-users to engage and interact with the social media technology.

d. Some examples of information that may be obtained in this step are the learners' attention to visuals or content of interest, the occurrence of accidental response to content of no interest, and unsatisfactory events.

(4) Identify the holistic engagement and interaction needs of the end-user.

a. An instance of the holistic view is when the end-user not only connects with the social media technology emotionally and forms perceptions about it, but also performs some activities on it. To identify the holistic engagement and interaction needs in the case of Scenario 1, interviews or remote user testing with the teacher and learners would be conducted through either online questions or face-to-face. This can encourage the sharing of information and screenshots/links of the area of concern on the social networking platform.

b. Some examples of questions that can be asked in the interview are: What prompted you to check the social media technology? What about the checking of the social media technology made you continue? What about the social media technology drew your attention? Which content or action did you respond to by accident on the social media technology? Was the experience of using the social media technology demanding? What activities did you do while you were checking the social media technology?

c. Feedback from the interviews and the elicited attributes may be used to understand the holistic needs of the end-users to engage and interact with the social media technology.

d. Some examples of information that may be obtained from this step are attention to visuals, content of no interest, items with direct relevance, and leisure activities.

(5) Specify the social media technology characteristics for the design elements, E.g., findings from the case study.

a. social media technology characteristics can be extracted from the findings in Steps 1 to 4. In Scenario 1, the teacher and learners could be asked, during the interview, to mention the content on the social media technology user interface or to send screenshots to the software developer.

b. Some examples of questions that can be asked in the interview are: what were you checking for on the social media technology? What about the social media technology drew your attention? Which actions, content or requests did you respond to on the social media technology?

c. Feedback from the interviews and possibly the screenshots or log files may be used to identify the social media technology elements that are involved in the engagement and interaction.

d. Some examples of information that may be obtained from this step are visual content, friends, posts, the content generated based on their own experience, and privacy.

The output from this phase in Scenario 1 is an understanding of the context of the teacher's and learners' engagement and interaction. The understanding output could be a list of the teacher's and learners' characteristics, their engagement and interaction needs, and the social media technology elements involved. The examples of questions and feedback information are loosely based on the case study conducted during this research. They provide clarity on the type of information that can be asked and gathered. The next phase of the end-user engagement and interaction design method applies the specifics of the end-user's engagement and interaction requirements based on understanding the context of the UX engagement and interaction and related guidelines.

PHASE 2: Specify the end-user's UX engagement and interaction and social domain requirements.

Steps 6, 7, and 8 are applicable if needs information is identified in Steps 2, 3, and 4.

(6) Specify the end-user's requirements for singular engagement and interaction.

(7) Specify the end-user's requirements for dual engagement and interaction.

(8) Specify the end-user's requirements for holistic engagement and interaction.

a. First, the needs from Phase 1 are compiled and reworded into requirement statements. To specify a singular UX engagement and interaction statement, in the case of Scenario 1, the requirements are derived from the end-users' needs in Step 2.

b. Some examples of possible requirements and relevant guidelines for singular engagement and interaction in Scenario 1 that can be derived from the needs in Step 2 are:

i. The end-user (the teacher) needs a metric or status to show how many of the group members (the learners) watched the video

ii. The end-user (the teacher) needs a metric or status to show how many of the group members (the learners) skipped the video

iii. The end-user (the teacher) needs a metric or status to show how many of the group members (the learners) partially played the video

iv. The end-user (the teacher) needs a metric or status to show how many of the group members (the learners) saw the video thumbnail

v. The end-user (the teacher) needs a metric or status to show how many of the group members (the learners) had the video auto-played

PHASE 3: Produce high-level UX engagement and interaction design elements for interaction with social media technology.

In this phase, the design guidelines are formulated and aligned to the identified UX engagement and interaction requirements, after which heuristics are formed.

(9) Review the literature for guidelines and principles of general user engagement in the HCI domain.

a. There are a few guidelines and principles on user engagement and user experience that can be related to UX engagement and interaction. To determine the applicable guidelines and principles, in Scenario 1, a proposed set of design guidelines tailored for UX engagement and interaction can be used.

b. Some examples of sources of general UX and user engagement guidelines that can be used are the basic principles for designing for user engagement on the

Web by Geisler, et al (2014), design principles for user engagement by Sutcliffe (2010, 2016), and design guidelines for user experience by Hart (2014)

c. Extraction from the sources may be used to align the UX engagement and interaction requirements in the design format.

d. Some examples of information that may be obtained in this step are selecting media to attract and persuade, set the context, and extend a welcome.

(10) Name high-level heuristics

a. To determine a name for high-level heuristics in Scenario 1, the dimensions of the UX engagement and interaction can be used. The names found in Step 10 can be fitted into the dimensions and forms of UX engagement and interaction.

b. Some examples of the groups of high-level heuristics are:

i. only emotional engagement

ii. both emotional and cognitive engagement

iii. both emotional and behavioural engagement.

(11) Tailor heuristics to fit the dimensions of the end-user's requirements for engagement and interaction.

a. To determine a name for high-level heuristics in Scenario 1, the dimensions of the UX engagement and interaction can be used for either singular, dual, or holistic engagement and interaction.

b. Some examples of the groups of high-level heuristics for the dual UX engagement and interaction in the form of both emotional and cognitive engagement are:

A3 – Selecting and designing media for mood and arousal

A4 – Selecting media to attract and persuade

A6 – Selecting and designing media to attract attention

A7 – Design for aesthetic appeal

B3 – Flow

B4 – Aesthetics

B5 – Attention

B6 – Mood and arousal

C1 – Design for diverse users

C2 – Design for usability

C6 – Make a connection

D5 – Support individual differences

D8 – Keep interactivity fresh

D11 – Provide training

(12) Specify the UX design elements for interaction with social media technology.

a. To determine a name for high-level heuristics, in the case of Scenario 1, the fitted heuristics for the dimensions of UX engagement and interaction can be used. A proposed set of UX design models can be tailored for UX engagement and interaction.

PHASE 4: Evaluate the high-level design elements for interaction with social media technology.

(13) Identify and select experts

a. The objective of this step is to identify suitable IT specialists and personnel who are familiar with social media technology, as well as domain experts who are available to evaluate the design elements and heuristics. They need to have a background in UX, HCI, and/or engagement.

(14) Apply a validation tool to evaluate the high-level UX engagement and interaction design elements for interaction with social media technology using experts.

a. The objective of this step is to verify the findings in the preceding steps. This is done by conducting another round of interviews, either face-to-face or online, with a group consisting of the software developers and available IT personnel with a background in UX, HCI, and/or engagement. A scenario of the teacher and the learners can be used for the evaluation. Through the scenario, the IT specialists and domain experts can put themselves into the role of the end-user working with the social media technology, supported by checklists of the UX engagement and interaction requirements, the design guidelines, and heuristics, using a validation tool.

b. Some examples of questions to ask are: What is the importance, clarity, and relevance of the heuristics and the design guidelines.

c. Feedback from the interview may be used to understand the design requirements to meet the UX engagement and interaction needs.

d. Some examples of information to obtain from this step are comments on whether a heuristic can be eliminated, the clarity of the high-level heuristics, and the possible inclusion of more related heuristics.

(15) Analyse evaluation results

a. The results from the evaluation must be analysed to determine the kind of addition, elimination, or other forms of modifications that are needed to improve the understanding of the UX engagement and interaction design requirements and heuristics in the next iteration cycle.

(16) Iterate the process to either Phase 1 or Phase 2, depending on the findings.

a. Suggested modifications from the responses of the IT specialists and domain experts in the preceding step would determine whether an iteration is needed, and which phase of the process should be followed.

A sample of the resulting set of UX engagement and interaction and design elements could be presented in a meaningful way for both the end-users and the design team. Table 9.1 presents a sample of some of the elements resulting from the illustrated scenario.

Table 9.1: Sample elements from the applicability of the end-user engagement and interaction design method in the illustrative scenario.

	System (profile) UX engagement and interaction level		
	Emotional dimension	Cognitive dimension	Behavioural dimension
End-user attributes	Negative affect Positive affect Checks	Attention Interest Moment Visuals Checks	Responses Dismissal Content generation
social media technology characteristics	Prompts New content Group activities	Content Group activities Group members	Group activities Leisure activities
	Social (group) UX engagement and interaction level		

The elements from each of the phases should be verified against the design elements supported by the existing integrated social media technology environment to identify the required changes that the design team could make.

9.5 Conclusion

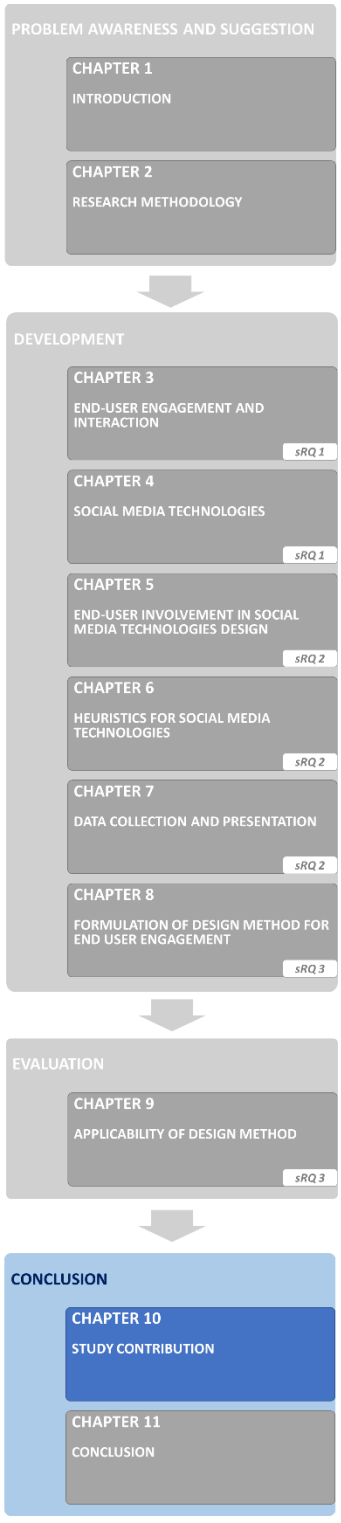
The applicability of the design method for an end-user engagement and interaction with social media technology was demonstrated to provide answer to the sub-research question 3: *"In what way can the UX and design elements be formulated into a method to support an end-user's unified engagement and interaction with social media technologies?"* This chapter looked at the high-level design principles for an end-user engagement and interaction, and how the design method could be used in a scenario whereby the actual engagements and interaction of the end-users needed to be understood and redefined. The contribution from this chapter are the steps, the results of the steps, and the sample elements of the end-user engagement and interactions

9.6 Summary

This chapter details the applicability of the design method for end-user engagement and interaction with social media technology. Using an illustrative scenario, loosely based on some of the findings in Chapters 4 and 5, the applicability of the phases and steps of the end-user engagement and interaction design method has been described. Also, a sample of the UX engagement and interaction and design elements were presented. The illustrative approach could guide social web developers, software developers and social media technology account owners/group admin to apply the design method to their integrated social media technology environment and incorporate the end-users' perspective in the process.

The next chapter presents the contributions of the study.

CHAPTER 10 – STUDY CONTRIBUTION



10.1 Introduction

This chapter presents contributions from the entire research study. The purpose of this study was to develop a design method for end-user engagement and interaction with social media technology. Issues found in the literature were low user participation in integrated social media technology environments and partial or reductive views of users' interactions with social media technologies. Other issues include UX and unclear UX design approaches that do not encourage intended users to partake in an engaging experience. Sections 1.2 and 4.4 in Chapters 1 and Chapter 4 present more details of the problem area. This research tried to find a way to guide the understanding and find a means to design for end-users' engagement within the context of social media technologies.

The chapter also responds to the main research question of the study, which states, "What are the components of a design method for unified end-user engagement and interaction with social media technology?" The main research objective of this study is "to identify the components of a design method for unified end-user engagement and interaction with social media technology". The purpose of this study was to develop a design method for end-user engagement and interaction with social media technologies.

The rest of this chapter presents an overview of the research objectives in Section 10.2. Section 10.3 summarises the study's scientific contributions to the body of knowledge and concludes the design science research process followed in the study (Section 2.4). Section 10.4 summarises the chapter.

10.2 Overview of the main research objective

Chapter 1 presented the research statements that were identified as appropriate to address the problem area for this study. These statements consist of a main research question and supporting sub-research questions, as well as corresponding research objectives.

10.2.1 Main research question

This question states: “What are the components of a design method for unified end-user engagement and interaction with social media technology?” The main research objective of this study is “to identify the components of a design method for unified end-user engagement and interaction with social media technology”. The purpose of this study was to develop a design method for end-user engagement and interaction with social media technologies. The research question was addressed by the cumulative responses to the sub-research questions and Sections 10.2.2 to 10.2.4 present these.

10.2.2 Sub-research question 1

This sub-question states: “How can end-user engagement and interaction be defined within the context of social media technologies?” The corresponding research objective is “to determine which key UX elements constitute an end-user’s engagement and interaction in the social media technology context”. Chapters 3 and 4 addressed this research question through the literature review findings and Chapter 7 through the Case Study findings. The emotional, cognitive, and behavioural aspects of a user’s engagement with technology were identified as definition elements for end-user engagement and interaction.

10.2.3 Sub-research question 2

This sub-question states: “What are the design elements that correspond to unified end-user engagement and interaction?” The corresponding research objective is “to identify an approach to derive some design guidelines and heuristics for unified social media technology engagement and interaction”. Chapters 5 and 6 answered the research question through the literature review findings and Chapter 7.4 through heuristics development. The design guidelines were obtained from UX and user engagement within the HCI domain. Then, a generic set of steps aligning the UX and design elements with social media technology end-user engagement and interaction was formulated.

10.2.4 Sub-research question 3

This sub-question states: “In what way can the UX and design elements be formulated into a method to support an end-user’s unified engagement and interaction with social media technologies?” The corresponding research objective is “to determine how the UX elements and design elements can be formulated into a method”. Chapter 8 answered the research question through the literature review findings and Chapter 9 did so through the illustrative scenario of the applicability of the design method. The scenario illustrated the generic set of steps aligning the UX and design elements with social media technology end-user engagement and interaction.

10.3 Contributions to the scientific body of knowledge

This section discusses the research contributions of this study to the scientific body of knowledge in the HCI domain, including the design science research. The importance of the end-users’ holistic engagement with technology is emphasised throughout this thesis. Gaps identified in the literature revealed the need for a design method for end-user engagement and interaction, especially in the context of social media technology, as listed in Table 10.1.

Table 10.1: end-user engagement and interaction design method contributions and gaps in literature.

Design methods for end-user engagement and interaction with social media technologies (gap identified in literature)	End-user engagement and interaction design method contribution
• No design method was found that focused on understanding and supporting the engagement and interaction that a person has with social media technologies. Likewise, no concept or method was found to integrate the dimensions of engagement in a person’s experience into the social media technology context (Chapter 4, Section 4.2.4). • Only a small number of approaches to understanding user engagement were found during the review. Some literature sources on social media technology end-users	• The end-user engagement and interaction design method provides an approach for the holistic engagement and interaction a person has with social media technology. • The design method aims to assist social media technology group owners/administrators, social media technology marketers, and

Design methods for end-user engagement and interaction with social media technologies (gap identified in literature)	End-user engagement and interaction design method contribution
focused on their interaction to represent their engagement and experience with social media technology. Examples were from Deng et al., 2013; Hung & Yuen, 2010; Keane et al., 2013; Veletsianos & Navarrete, 2012; and Wright et al., 2014. • Some of the identified UX and user engagement approaches focused on online applications and general interactive products. Examples were from O'Brien et al., 2018; O'Brien & Toms, 2010a; A. G. Sutcliffe, 2016. None of these approaches and design methods was developed for the social media technology context. • A small number of user engagement tools have been used to understand the end-user's engagement with social media technology. These mainly focus on general attributes and not on the dimensions of user engagement within an end-user's experience with social media technology. Some focused on UX-related artefacts, such as using a UX strategy of content-building for millennial end-users with no consideration of perspective and the diversity of social media technology end-users (Baird & Fisher, 2005). Others focused on using a user engagement scale to measure the attributes of engagement of social media technology end-users, not inclusive of the core dimensions of the engagement (Banhawi, Ali, & Judi, 2012).	software developers who integrate social media technology into their ICT products to understand and support the holistic engagement of their audience (social media technology end-users). • The end-user engagement and interaction design method also has a construct called UX engagement and interaction with its elements to assist in describing the holistic engagement and interaction. • The end-user engagement and interaction design method provides a list of heuristics for the UX engagement and interaction elements to assist with the design process.

As depicted in Table 10.1, this study contributes to filling up some of the gaps. The main research contribution is the step-by-step end-user engagement and interaction design method for social

media technology. It consists of steps to understand and guide the design of end-user's engagement within the context of social media technology. Next, the unique research contributions are the formulation of the UX engagement and interaction construct and its elements, the UX engagement and interaction elements within the social media technology context, and heuristics for guiding the choice of the design elements. Subsections 10.3.1 – 10.3.6 present these main contributions.

10.3.1 Contributions to understanding UX engagement and interaction elements

The UX engagement and interaction constructs and their elements developed are a synthesis of the findings on UX and engagement in this study, as illustrated in Table 10.2. The UX engagement and interaction elements are responses to the first sub-research question of this study which states: "How can end-user engagement and interaction be defined within the context of social media technologies?" The objective of this sub-research question is "to determine which key UX elements constitute an end-user's engagement and interaction in the social media technology context".

Table 10.2: UX engagement and interaction dimensions.

	Emotional dimension	Cognitive dimension	Behavioural dimension
Attributes	• Affect • Motivation • Interest • Perceived usability • Delight • Reliability • Adjustability • Satisfaction	• Challenge • Interest • Focused attention • Aesthetics (visual, audio) • Attractiveness • Subjective perception of time • Follow-on task performance • Perceived worthiness, reward, and success	• Interactions (intended, non-intended) • Amount of interactions • Frequency of interactions • Sensory responses

	Emotional dimension	Cognitive dimension	Behavioural dimension
Manifestations	• Feelings • Body responses	• Thoughts/perceptions • Completed tasks	• Body/sensory response • Modality-based actions
Measurement approaches	Self-based reports Physiological measures Product-oriented analytics		

Chapter 3 presents the details of the synthesis and the UX engagement and interaction elements. Further elements of UX engagement and interaction were explored in the social media technology context, as Section 10.3.2 illustrates.

10.3.2 Contributions to the understanding of UX engagement and interaction elements in social media technology context

Chapters 4 and 7 describe in detail the different aspects of UX engagement and interaction in the social media technology context. The UX aspects of end-user engagement in the social media technology context were developed as a synthesis of the results of the literature study and Chapter 4 presents these details. A case study of end-users in the social media technology landscape explored more of the UX engagement and interaction elements. Chapter 7 details the UX engagement and interaction elements for social media technology, which were developed as a synthesis of the findings from the case study.

The UX aspects and the UX engagement and interaction elements (Figure 10.1) are responses to first sub-research question of this study which states: “How can end-user engagement and interaction be defined within the context of social media technologies?” The objective of this sub-research question is “to determine which key UX elements constitute an end-user’s engagement and interaction in the social media technology context”.

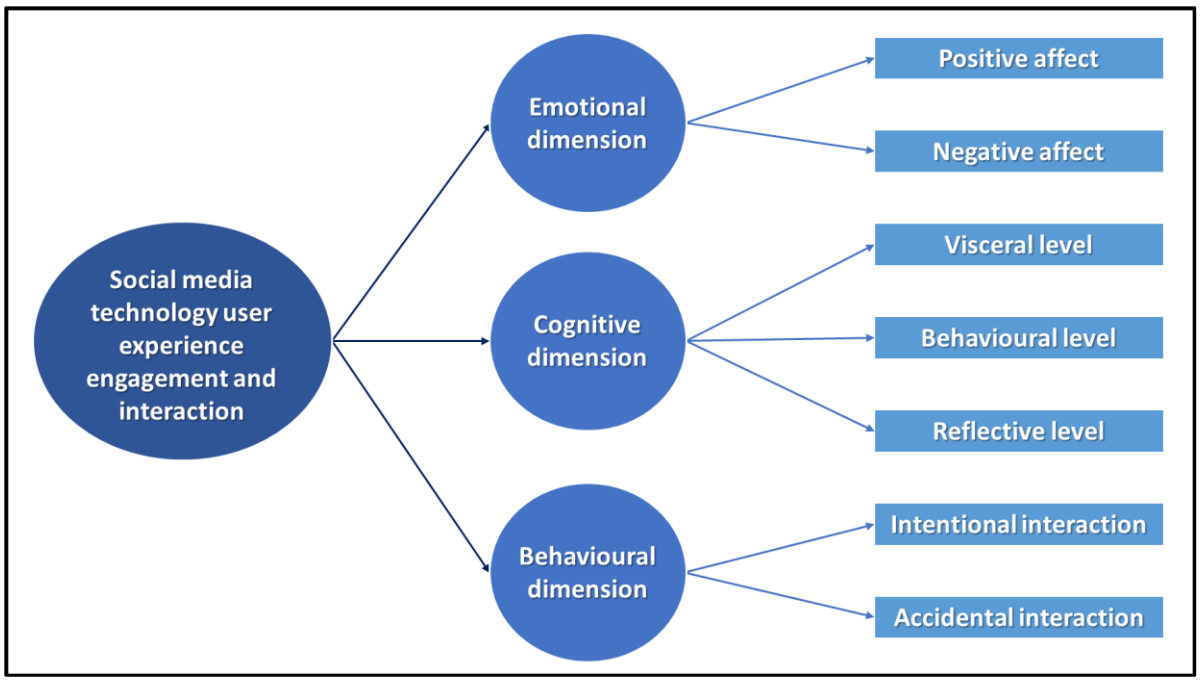


Figure 10.1: Categorisation of UX engagement and interaction attributes for social media technology end-users

Next, Section 10.3.4 illustrates the heuristics to guide the selection of design elements for UX engagement and interaction.

10.3.3 Contribution to the development of heuristics for UX engagement and interaction elements

Chapter 6 and Chapter 7, respectively, detail the heuristics as well as the heuristics development process used. Figure 10.2 illustrates the overview of the heuristics for UX engagement and interaction across its three dimensions. It is a response to the second sub-research question of this study which states: "What are the design elements that correspond to unified end-user engagement and interaction?" The objective of this sub-research question is "to identify an approach to derive some design guidelines and heuristics for unified social media technology engagement and interaction".

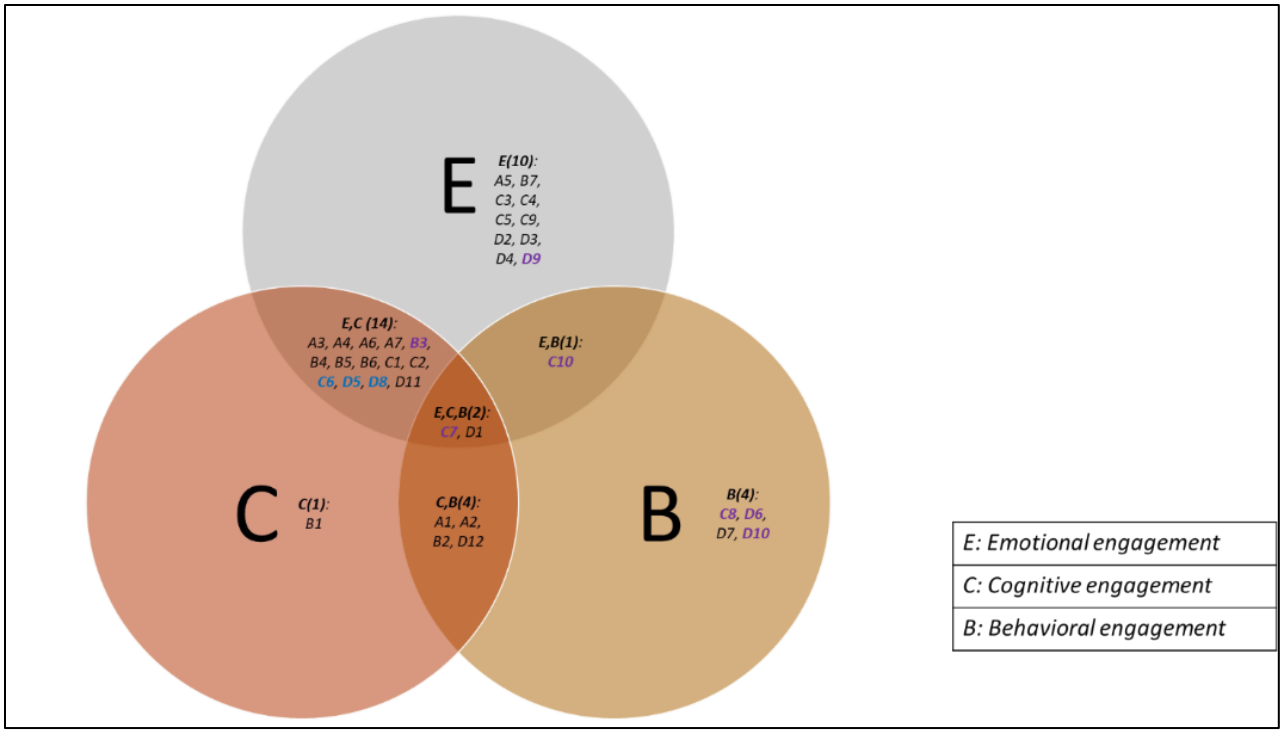


Figure 10.2: Aligning design guidelines with UX engagement and interaction dimensions.

Most of the guidelines support at least two UX engagement and interaction dimensions. This shows that designing for an engaging experience involves consideration not only for a single dimension but for a dual or more holistic approach. Section 10.4 presents the scientific contributions from this study to the body of knowledge.

10.3.4 Contribution to design science research

In this study, a Design science research paradigm is followed. One of its guidelines concerns research contributions (Section 2.4) as proposed by Hevner et al. (2004) and is echoed by Viashnavi and Kuechler (2016). In line with this guideline, the contribution from this study to the body of knowledge in design science research is an artefact called a method (End-user engagement and interaction design method for social media technology) and attached to a construct called UX engagement and interaction. Table 10.3 shows the guideline, descriptions, and relevance of this study.

Table 10.3: Contribution to design science research.

Guideline	Description and Relevance of this study
1. Research contributions	Effective design science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies. Contributions of design science research are based on the novelty, generality, and significance of the design artefact (Hevner et al., 2004). A design method for end-user engagement and interaction with social media technology is the primary contribution. Also, a UX engagement and interaction construct is contributed to the existing knowledge base.

Table 10.4 presents the design method for end-user engagement and interaction with social media technology as a generic method to guide the understanding and design of the holistic engagement that a person has with social media technology. The end-user engagement and interaction design method, as an artefact, adds to the pool of design science research outputs, thereby fitting into the prescriptive knowledge contributions.

10.3.5 Contributions of the design method to an end-user's engagement and interaction in the social media technology context

The end-user engagement and interaction design method phases and steps (Figure 10.3) are responses to the main research question since they represent the components of a design method for end-user engagement and interaction with social media technologies. The generic approach to create the design method in a way that the end-user's perspective is taken into consideration during the design was formulated in response to the second sub-research question of this study which states: "What are the design elements that correspond to unified end-user engagement and interaction?" The objective of this sub-research question is "to identify an

approach to derive some design guidelines and heuristics for unified social media technology engagement and interaction". Next, the formulated generic approach was applied to create a design method for end-user engagement and interaction. This also serves as part of a response to the third sub-research question of this study which states: "In what way can the UX and design elements be formulated into a method to support an end-user's unified engagement and interaction with social media technologies?" The objective of this sub-research question is "to determine how the UX elements and design elements can be formulated into a method". Chapter 8 presents the details of the generic approach to create both the design method and the design method.

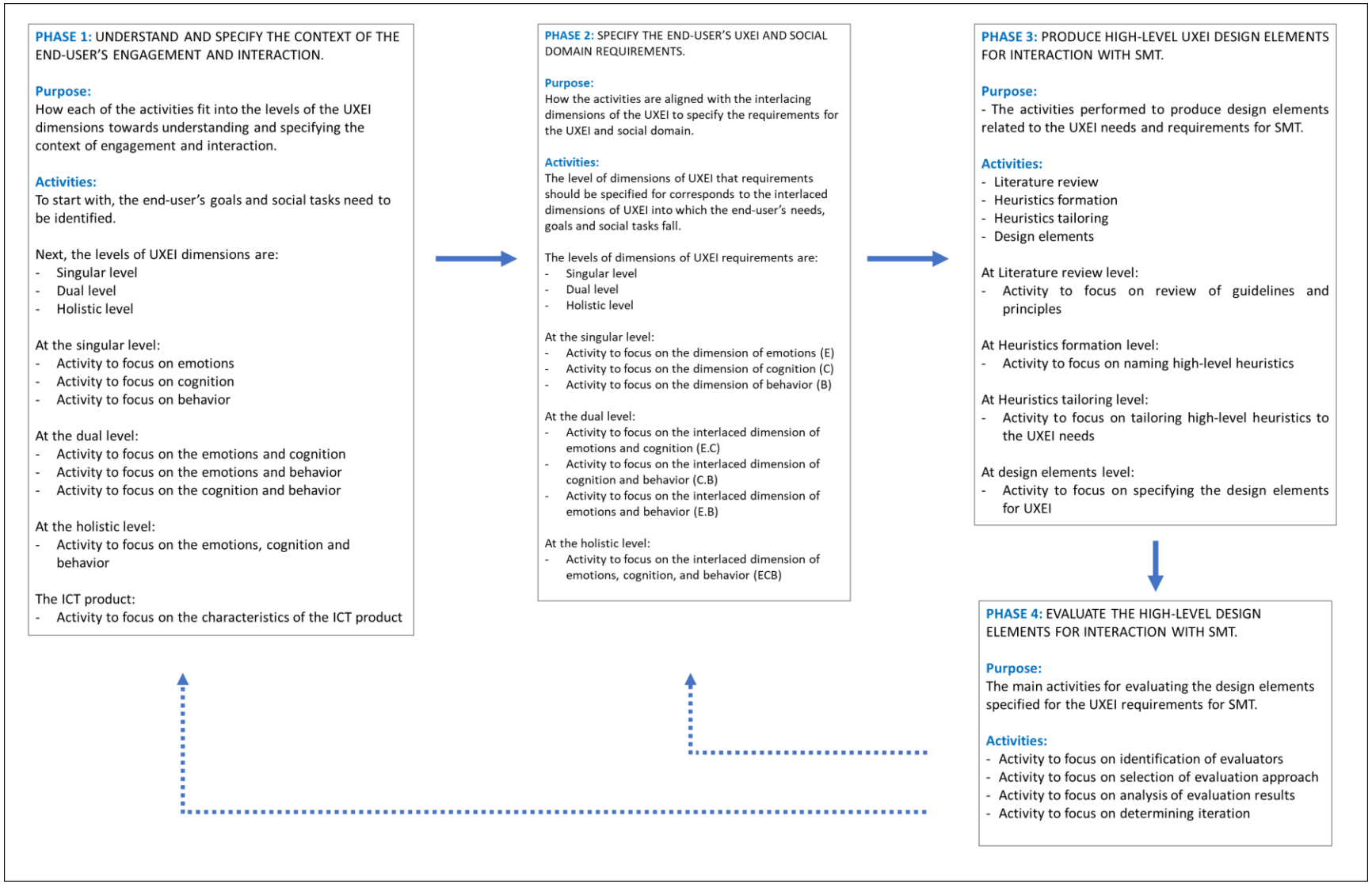


Figure 10.3: Phases and activities of the end-user engagement and interaction design method.

Figure 10.3 illustrates the phases and activities in the end-user engagement and interaction design method as follows:

PHASE 1: Understand and specify the context of the end-user's engagement and interaction.

(1) Determine the end-user's main goal and social tasks. This may also include finding out if the end-user is a basic social media technology user or social network administrator.
(2) Identify the singular engagement and interaction needs of the end-user.
(3) Identify the dual engagement and interaction needs of the end-user.
(4) Identify the holistic engagement and interaction needs of the end-user.
(5) Specify the social media technology characteristics for the design elements. For instance, findings from the case study.

PHASE 2: Specify the end-user's engagement and interaction and social domain requirements.

(6) Specify the end-user's requirements for singular engagement and interaction.
(7) Specify the end-user's requirements for dual engagement and interaction.
(8) Specify the end-user's requirements for holistic engagement and interaction.

PHASE 3: Produce high-level UX engagement and interaction design elements for interaction with social media technology.

(9) Review the literature for guidelines and principles of general user engagement in the HCI domain.
(10) Name high-level heuristics.
(11) Tailor the heuristics to fit the dimensions of the end-user's requirements for engagement and interaction.
(12) Specify the UX design elements for interaction with social media technology.

PHASE 4: Evaluate the high-level design elements for interaction with social media technology.

(13) Identify and select evaluators.

(14) Apply an evaluation tool to evaluate the high-level UX engagement and interaction design elements for interaction with social media technology using end-users and experts.

(15) Analyse the evaluation results

(16) Iterate the process to either Phase 1 or Phase 2, depending on the findings.

The applicability of the step-by-step end-user engagement and interaction design method was demonstrated by following the adapted human-centred design approach and the responses to the second part of the third sub-research question of this study which states: "In what way can the UX and design elements be formulated into a method to support an end-user's unified engagement and interaction with social media technologies?" The objective of this sub-research question is "to determine how the UX elements and design elements can be formulated into a method". Chapter 9 presents the details of its applicability.

10.3.6 Contribution to steps on how to go about understanding and designing for end-user experience and engagement.

Few publications are available on understanding the experience and engagement of the interaction that people have with social media technology. This thesis contributes to the body of knowledge in the academic and research domains by focusing on the UX aspects of engagement and interaction, the three engagement dimensions and interactions, and the end-user's perspective. The knowledge contribution is conceptual and prescriptive.

10.4 Conclusion

The research questions and objectives were formulated for this study based on the problem statement which states that: "*There are limited methods and approaches for understanding and designing a unified measure of an end-user's engagement and interaction with* social media technology*."* Some parts of this problem were presented in Chapters 1 and Chapter 4 which presented the issues on the understanding of UX engagement and interaction in the context of

social media technologies. This chapter looked at the research questions and answers found, as well as the contributions from the study to the scientific body of knowledge.

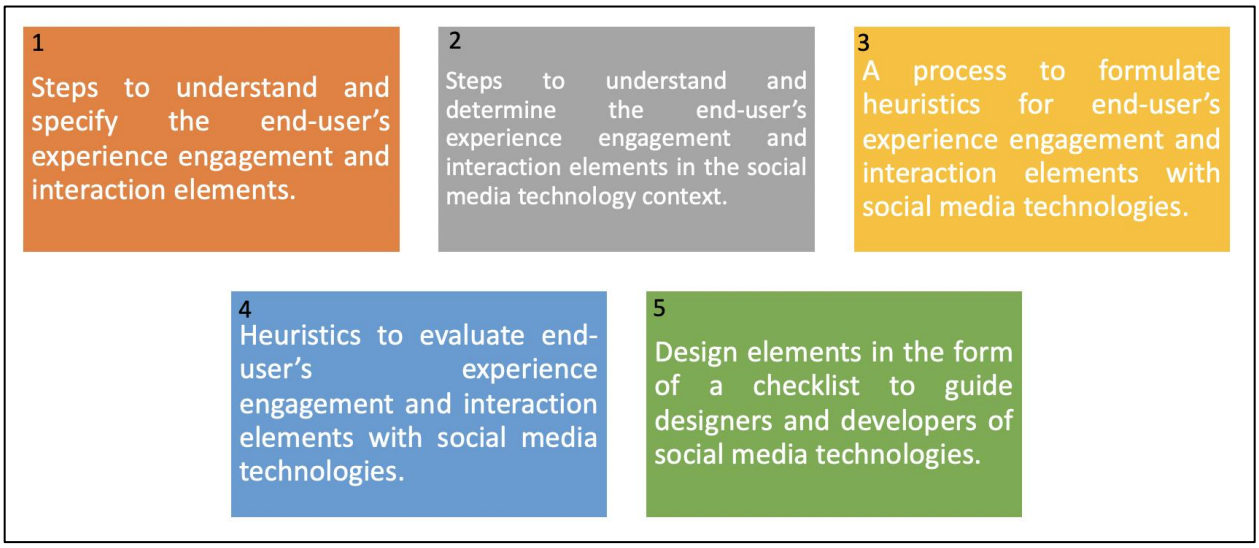
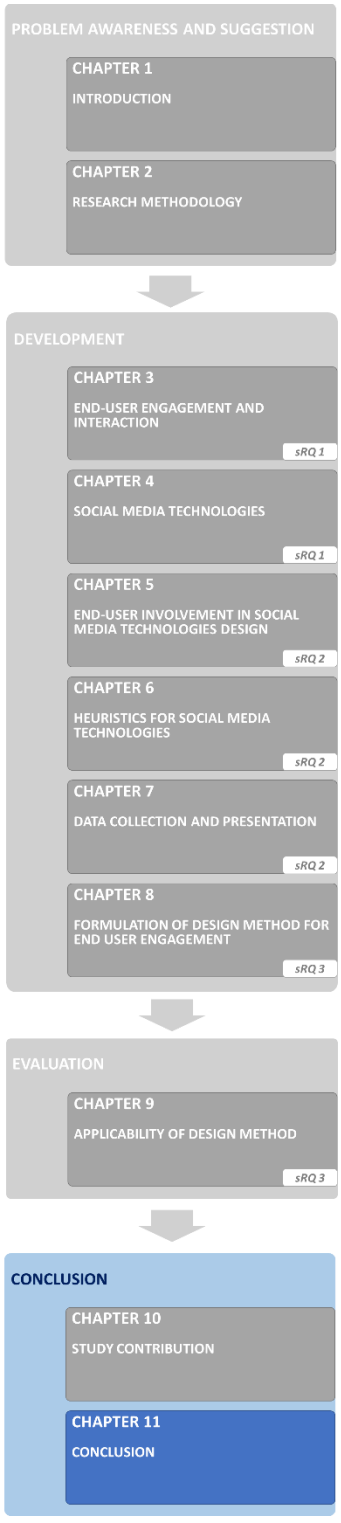


Figure 10.4: Contributions resulting from research study.

10.5 Summary

This chapter discusses a summary of the contributions made in this thesis. It addressed the gap in the need for an approach to understand and guide the design for the holistic engagement and interaction a person has with social media technology. The next chapter discusses the conclusion of the research and highlights possible future research areas.

CHAPTER 11 – CONCLUSION



11.1 Introduction

This final chapter of this thesis presents a summary of the entire research study. The main research question and objective, as well as the sub-research questions and objectives, are revisited. The thesis consists of eleven chapters.

Chapter 1 introduces the thesis by giving a brief background to the study and the main and sub-research questions and objectives. It also describes the scope of the study and summarises its research approach. Chapter 2 presents the philosophical assumptions and the methodology.

Chapter 3 provides the findings of the exploration of the concepts that define end-user engagement and interaction and describes how they apply to the context of UX for the end-users. Chapter 4 discusses the concepts that constitute social media technology and presents the views of end-user interaction and participation in the social media technology context. It also presented the need for a holistic view of the end-user's engagement and interaction with social media technology. It is followed by Chapter 5, which presents the involvement of end-users in the design process of ICT products such as social media technology and the roles the end-users play during the process. Chapter 6 presents the formulation of a heuristics development process to identify the heuristics to guide the UX engagement and interaction design.

Chapter 7 presents the results of a case study undertaken in this research to identify the UX engagement and interaction elements in the social media technology context. It also discusses the heuristics formulated in the heuristic development that Chapter 6 describes. Next, Chapter 8 presents how the concepts and findings together form a step-by-step design method for end-user engagement and interaction with social media technology. This is followed in Chapter 9 with a demonstration of how the design method can be applied. Chapter 10 presents an overview of the research objectives, as well as the contributions made by the research. Chapter 11 provides a revisitation of the research questions and objectives, limitations of the study and possible further research. Seven Appendices are included in this thesis.

In the rest of this chapter Section 11.2 reflects on the research from a few different perspectives while Section 11.3 outlines the research limitations. Section 11.4 presents some areas of possible future research and Section 11.5 concludes the study.

11.2 Reflections

The research objectives for this study were founded on the problem area presented in Chapter 1. A main research question and supporting sub-research questions, as well as corresponding research objectives were derived. The personal and methodological reflections of the researcher are discussed in Sections 11.2.1 and 11.2.2, respectively.

11.2.1 Personal reflections

The study presented in this thesis provided the researcher with an opportunity to integrate her knowledge from the HCI domain, as a university lecturer and user experience researcher, with her knowledge and experience in using social platforms for lectures and administration. The researcher also manages social media platforms for a church. As a lecturer, the researcher became aware of the importance of engaging people through social platforms for both formal and leisure reasons. This engagement enhances the experience they all have with both the technology and its goals. The observation was that many people enrolled to use the social platform at the onboarding stage and had many interactions. During the period of adoption, however, the number of interactions on the social platform reduced. As a user experience designer, the researcher constantly sought ways to implement the benefits offered by user experience principles. These benefits are to understand and enhance the engagement that people have with social platforms within a given context of use. The analytics of a group on the mobile social platform WhatsApp initially sparked the researcher's interest in the research presented in this thesis. One of the group administrators sent a video message to everyone, and the analytics showed that everyone had seen it. Yet, the video had not been downloaded on the devices of some of the members of the group. This meant that not all the members in that WhatsApp group had engaged with the video and its content, which was sent by the group administrator. In the months and years that followed, the researcher read different publications on social media technology end-users and social media experience and engagement and then decided to embark on the research.

11.2.2 Methodological reflections

Design science research aims to provide an artefact to solve identified real-world research problems (Hevner et al., 2004). At the beginning of the research, the design science paradigm was considered as it had the potential to both answer complex problems and to create an artefact as a potential solution for the problem. A design science research approach is applicable because this study aimed to generate an artefact consisting of steps to support the understanding and design of end-user engagement and interaction with social media technology. Also, the generated artefact could guide software developers and social media technology managers towards social media technology integration to engage end-users. The methodological approach that was used to develop and evaluate the artefact is unique in comparison to the approaches reported in the literature.

Hevner et al. (2004) suggested seven guidelines for evaluating or determining effective design science research. Table 2.2 indicates the adherence to the guidelines. Also, the guidelines show that this study is effective as an example of a design science research approach.

Table 11.1: Design science research guidelines.

Guideline	Description and Relevance for this study
1. Design as an artefact	Design science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation. This study developed a UX-based method as an artefact to support the design for end-user engagement and interaction with social media technologies.
2. Problem relevance	The objective of design science research is to develop technology-based solutions for important and relevant business problems. The need for a UX-based method to support the design for end-user engagement and interaction with social media technologies is argued.
3. Design evaluation	The utility, quality, and efficacy of a design artefact must be demonstrated rigorously via well-executed evaluation methods.

Guideline	Description and Relevance for this study
	Evaluation methods available from the knowledge base, and established requirements from the business environment, were adapted to evaluate the artefact. A scenario demonstration approach was used to evaluate the design method. The UX engagement and interaction construct was presented in a conference paper that was peer-reviewed. The design artefact was considered applicable when it met the requirements and constraints of the problem it was meant to solve. The utility (applicability) of the artefact was evaluated appropriately.
4. Research contributions	Effective design science research must provide clear and verifiable contributions for the design artefact, design foundations, and/or design methodologies. Contributions of design science research are based on the novelty, generality, and significance of the design artefact (Hevner et al., 2004). A *design method for end-user engagement and interaction with social media technologies* is the primary contribution of this research. Also, a UX engagement and interaction construct has been contributed to the existing knowledge base.
5. Research rigour	Design science research relies upon the application of rigorous methods in both constructing and evaluating the design artefact. Appropriate research methods were applied to the design and evaluation of the artefact. This implies using the proposed methods in the research process, the triangulation of findings, and the review of the artefact.
6. Design as a search process	The search for an effective artefact requires utilising available means to reach desired ends while satisfying laws in the problem environment.

Guideline	Description and Relevance for this study
	The study followed a systematic research process and the triangulation of findings iteratively to design the artefact. The iterative refinement of the artefact continued until it was deemed an effective solution to support the understanding and design for end-user engagement and interaction with social media technologies.
7. Communication of research	Design science research must be presented effectively to both technology-oriented and management-oriented audiences. The developed artefact was communicated to academic audiences through publication.

11.3 Limitations of this study

The following limitations were encountered during the journey of this research:

- Literature related to guidelines supporting the design of end-user engagement from a UX perspective was limited. Consequently, there was limited evidence of the use of guidelines for end-user engagement and interaction. Though there are many materials on gamification to improve end-user engagement with ICT products, the gamifying approach was beyond the scope of this study. The primary focus of the study is to understand UX engagement and interaction and provide a way to design for it within a social media technology context, not a gamified context.
- The outcomes of the case study were influenced by the nature of the target population as well as the climate of the social media technology landscape. The case study was conducted a few months after the Facebook-Cambridge Analytica data and privacy scandal had taken place in which the end-users' information was used without their knowledge during an in-Facebook survey. This is also reflected by the low number of responses to the invitation to participate in the case study. It should be noted that the anonymity of the participants was given the highest priority and that the participants were referred to an online questionnaire tool used outside the social media technology.

- A limitation in the case study of this thesis is that the data collection was done before the COVID-19 pandemic era and the discussions presented are based on those findings. The COVID-19 pandemic irreversibly changed how people interact and engage with one another, consequently changing how people use social media technologies and mobile technologies.
- This study aimed to explore the UX engagement and interaction in the social media technology context, particularly the big five social media technologies, namely, Facebook, WhatsApp, YouTube, Twitter, and Instagram, using a remote user testing approach for first-time users. However, only Instagram was considered for the unmoderated remote user testing and its data analysis. This is due to the prohibition of fictitious accounts on Facebook and the requirements for physical elements (phone and SIM card number) for profile creation on WhatsApp. It is also due to the limited opportunity to protect YouTube accounts linked to the Google system and the inconclusive responses from the participants that used Twitter during the user testing. It should be noted that unmoderated remote user testing is a part of the data collection methods used in the case study and that the five social media technologies were considered during the interview parts of the case study.
- As a result of the change of usage of social media technologies during the time of the COVID-19 pandemic, it was not possible to test the method in a real-life design and development environment.

11.4 Future research

The engagement and interaction a person has with social media technology from a UX perspective, and support for the design of holistic engagement, are still emerging. This study explored this perspective. Further studies on this perspective may result in improved understanding and design of the holistic engagement and interaction an end-user has with social media technologies. A few avenues to research the end-users' perspective of their engagement and interaction and design for UX engagement and interaction further are presented below:

- Explore the UX engagement and interaction elements of social technologies used in the COVID-19's new normal era with a large sample size of participants.

- Increase the number of social media technologies to review the end-user's perspective of their engaging experience in a controlled environment to understand holistic UX engagement and interaction.
- Apply the design method in a real-life context for other ICTs such as mobile technologies and online educational platforms.
- Conduct a study on the attributes of a model for each interlinked dimension.
- Integrate aspects from other domains that deal with human engagement into the end-user engagement design method, such as player and citizen engagement, and gamification.

11.5 Conclusion

The adoption of social media technologies continues to increase. The nature of the holistic engagement and interaction that end-users have with social media technologies requires understanding the end-users' perspective and identifying design elements that support it. This study culminated in the development of a design method to understand and guide the design of holistic engagement and interaction with social media technologies for end-users. In the end, solutions that leverage this design method focus on the end-users' perspective of true engagement and interaction with social media technologies.

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LIST OF APPENDICES

Appendices listed here are available in the included DropBox link.

A) NMU ethics clearance
B) UX engagement and interaction attributes and categorisation of design guidelines
C) Social media engagement concepts and relation to UX engagement and interaction
D) Online questionnaire tool - Sections
E) Interview data collection and analysis
F) Interpretation of interview data analysis
G) Paper published on UX engagement and interaction.

APPENDIX A – NMU ETHICS CLEARANCE

Appendix A contains a copy of the ethics clearance obtained from the Nelson Mandela University. The Appendix is available in the included DropBox link.

APPENDIX B – UX ENGAGEMENT AND INTERACTION ATTRIBUTES AND CATEGORISATION OF DESIGN GUIDELINES

Appendix B contains a copy of the following:

- List and definitions of UX engagement and interaction attributes
- Description and categorisation of the design guidelines for UX engagement and interaction

The appendix is available as a Microsoft Excel workbook file in the included DropBox link.

APPENDIX C – SOCIAL MEDIA ENGAGEMENT CONCEPTS

Appendix C contains the thematic coding and analysis of the social media engagement concepts found in the literature, as well as the relationship of the findings to the UX engagement and interaction construct. The Appendix is available as a Microsoft Excel workbook file in the included DropBox link.

APPENDIX D – ONLINE QUESTIONNAIRE TOOL - SECTIONS

Appendix D contains a copy of the questionnaire tool used in the case study carried out during this research. The Appendix is available in the included DropBox link.

APPENDIX E – INTERVIEW DATA COLLECTION AND ANALYSIS

Appendix E contains a copy of the collected interview data and the data analysis on the following areas:

- The end-user background of all the interview participants in the case study
- The responses of the participants from the interview sessions
- The analysis of the responses of the participants from the interview sessions.

The appendix is available as a Microsoft Excel workbook file in the included DropBox link.

APPENDIX F – INTERPRETATION OF INTERVIEW DATA ANALYSIS

Appendix F contains a copy of the detailed interpretation of the data analysis, which is available in the included DropBox link. The summary of the analysis is presented in Chapter 7 of the thesis document.

APPENDIX G – PAPER PUBLISHED ON UX ENGAGEMENT AND INTERACTION

Appendix G contains a copy of the publication on the UX engagement and interaction construct. The Appendix is available in the included DropBox link.