DEVELOPMENT AND VALIDATION OF AN INTEGRATED MODEL FOR EVALUATING E-SERVICE QUALITY, USABILITY AND USER EXPERIENCE (E-SQUUX) OF WEB-BASED APPLICATIONS IN THE CONTEXT OF A UNIVERSITY WEB PORTAL

by

SAMUEL SSEMUGABI

Submitted in accordance with the requirements

for the degree of

DOCTOR OF PHILOSOPHY

in the subject

INFORMATION SYSTEMS

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: PROF M R DE VILLIERS

January 2019

I declare that **"Development and validation of an integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications in the context of a University web portal"** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I submitted the thesis/dissertation to originality checking software and that it falls within the accepted requirements for originality.

I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.

________________________ January 2019

S Ssemugabi

ACKNOWLEDGEMENTS

There are many people I acknowledge for their support and encouragement during my PhD studies. In particular, I extend my sincere gratitude and appreciation to the following:

- My supervisor and mentor, Prof Ruth de Villiers for the advice, effort and understanding for a number years. Even when I had challenging personal circumstances, you kept by my side and never gave up on me. I am humbled by the hospitality you and your husband, Andre, showed me.
- My wife, Judith, my daughter Vanessa Nakabba, and my sons, Bakyayita Nicholas and Sendyona James. Thank you for your love, tolerance and understanding during these times.
- Dr Filistea Naude, the College of Science, Engineering and Technology (CSET) subject librarian at UNISA, for the role she played in sourcing literature for this study.
- Mr Hennie Gerber, a UNISA statistician, for his advice and contribution.
- Mrs Sheyne Ball, for her effort in language editing of this thesis.
- My university, UNISA, for the sabbatical leave it granted me to work on this project.
- UNISA, for the financial contribution it made towards my tuition, and towards my travel and accommodation during data collection.

Sam Ssemugabi

January 2019

ABSTRACT

Developments in Internet technology and pervasive computing over the past two and half decades have resulted in a variety of Web-based applications (WBAs) that provide products and services to online users or customers. The Internet is used not only to transfer information via the web but is increasingly used to provide electronic services including business transactions, information-delivery and social networking, as well as e-government, e-health and e-learning. For such organisations, e-service quality, usability and user experience are considered to be critical determinants of their products' or services' success. Many studies to model these three concepts separately have been undertaken as part of broader studies of software quality or service quality modelling. However, to the current researcher's knowledge, none of the studies have focussed on proposing an evaluation model that integrates and combines the three of them. This research is an effort to fill that gap.

The primary purpose of this mixed-methods research was to develop a conceptual integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of WBAs and then contextualise it to evaluation of a University web portal (UWP). This was undertaken using an exploratory sequential research design. During a qualitative phase, an extensive extensive systematic literature review of 264 relevant sources relating to dimensions of e-service quality, usability and user experience, was undertaken to derive an integrated conceptual e-service quality, usability and user experience (e-SQUUX) Model for evaluating WBAs. The model was then empirically refined through a sequential series of validations, thus developing various versions of the e-SQUUX Model. First, it was content validated by a set of four expert reviewers. Second, during the quantitative phase, in the context of a University web portal, a questionnaire survey was conducted that included a comprehensive pilot study with 29 partipants, prior to the main survey. The main survey data from 174 particiapants was used to determine a validated model, using Exploratory factor analysis (EFA), followed by producing a structural model, using partial least square – structural equation modelling (PLS-SEM). This version consisted of the components of the final e-SQUUX Model. Consequently, the research enriches the body of knowledge on IS and HCI by providing the e-SQUUX Model as an evaluation tool. For designers, developers and managers of UWPs, the model serves as a customisable set of evaluation criteria and also provides specific recommendations for design.

In line with the Exploratory sequential design of mixed methods research, the findings of the qualitative work in this research influenced the subsequent quantitative study, since the potential Likert-scale questionnaire items were derived from the definitions and meanings of the components that emanated from the qualitative phase of the study. Consequently, this research is an exemplar for developing an integrated evaluation model for specific facets or domains, and of its application in a particular context, in this case, a University web portal.

Keywords: e-service quality, usability, user experience, evaluation model, integrated model, exploratory factor analysis, partial least square – structural equation modelling (PLS-SEM), mixed methods research, Exploratory sequential design, quantitative study, qualitative study, validation, Web-based applications, University web portal

Table of contents

Chapter 1: Introduction 1

1.1 Introduction 1

1.2 Background and rationale 3

1.2.1 Overview 3

1.2.2 Usability 4

1.2.3 User experience 5

1.2.4 e-Service quality 6

1.2.5 The need and justification of this research 7

1.3 Problem statement 8

1.4 Research purpose and objectives 12

1.4.1 Primary purpose 12

1.4.2 Research objectives 12

1.5 Main research question and subquestions 13

1.5.1 Main research question 13

1.5.2 Subquestions 13

1.6 Value of the research 15

1.6.1 Benefits to web portal designers, developers, evaluators and users 15

1.6.2 Potential contribution 16

1.7 Outline of the literature review 16

1.8 Research design and methodology 17

1.8.1 Research design 17

1.8.2 Research methodology 19

1.8.3 Ethical issues 22

1.9 Scope of the research 23

1.9.1 Domain and context 23

1.9.2 Delineations 23

1.9.3 Limitations 24

1.9.4 Assumptions 25

1.10 Structure of the thesis 26

Chapter 2: Literature Review 29
2.1 Introduction 29
2.2 Information Systems theories and other theories relevant to this research 31
2.2.1 DeLone and McLean IS Success model 31
2.2.2 The technology acceptance model 34
2.2.3 The unified theory of acceptance and use of technology 36
2.2.4 SERVQUAL 38
2.2.5 Main theoretical foundations of this research 41
2.3 Human Computer Interaction, interaction design, user-centred design 42
2.3.1 Human Computer Interaction 42
2.3.2 Interaction design 43
2.3.3 User-centred design/Human-centred design 45
2.4 Usability, user experience and e-service quality: an overview 48
2.4.1 Usability 48
2.4.2 User experience 56
2.4.3 Service quality and e-service quality 60
2.4.4 Benefits of high positive levels of e-service quality, usability and user experience to systems 65
2.5 Web-based applications and web portals 66
2.5.1 What are Web-based applications? 66
2.5.2 What is a web portal? 67
2.6 e-Service quality, usability and user experience evaluation and methods 70
2.6.1 e-Service quality, usability and user experience evaluation 70
2.6.2 Evaluation methods 71
2.6.3 Modelling and measurement of e-SQUUX 73
2.7 University web portal services and their evaluation 76
2.8 Conclusion 79
Chapter 3: Research design and methodology 81
3.1 Introduction 81
3.2 Research questions in the context of this study 83

3.3 Research framework, and philosophical stances and worldviews 85
3.3.1 Research framework 85
3.3.2 What is a philosophical worldview? 86
3.3.3 Philosophical stances 87
3.3.4 Main philosophical worldviews 88
3.3.5 The worldview used in this research: Pragmatism 91
3.4 Research approaches 92
3.4.1 Quantitative and qualitative approaches 93
3.4.2 Mixed methods approach 94
3.5 Research design 99
3.5.1 Research designs and methods used in related or similar studies................. 99
3.5.2 Selected research design and its justification: Exploratory sequential design..
.... 104
3.5.3 Alternative research designs that could have been used for this research .. 108
3.5.4 Application of Exploratory sequential design in this research 112
3.6 Qualitative phase: Study 1A – Systematic literature review 114
3.6.1 Background and motivation for use of a systematic literature review.... 114
3.6.2 How the literature review was conducted 116
3.7 Qualitative phase: Study 1B – Expert reviews of the conceptual model........ 119
3.8 Quantitative phase: General information for both the pilot and main
questionnaire surveys 121
3.8.1 User survey evaluation using questionnaires 121
3.8.2 Questionnaire design.. 123
3.8.3 Participants and sampling 127
3.8.4 Data collection 129
3.8.5 Data analysis and interpretation.. 129
3.8.6 Reliability and validity.. 129
3.9 Quantitative phase: Study 2A – Pilot study of the questionnaire survey........ 131
3.9.1 Overview of pilot studies 131
3.9.2 Questionnaire design.. 133
3.9.3 Participants, sampling and data collection 133

3.9.4 Data analysis and interpretation 134
3.10 Quantitative phase: Study 2B – Main study of the questionnaire survey 134
3.10.1 Questionnaire design 135
3.10.2 Participants and sampling 135
3.10.3 Data collection 136
3.10.4 Data analysis and interpretation 136
3.11 Validity, reliability and triangulation for the entire research 137
3.11.1 Validity 137
3.11.2 Reliability 138
3.11.3 Triangulation 138
3.12 Ethical considerations undertaken during this research 139
3.13 Conclusion 140
Chapter 4: Synthesis of a conceptual integrated model for evaluation of e-service quality, usability and user experience (e-SQUUX Model V1): Study 1A 142
4.1 Introduction 142
4.2 Literature sources investigated 144
4.2.1 How sources were acquired 145
4.2.2 Number of sources reviewed in the different areas 146
4.2.3 Types of sources reviewed 148
4.2.4 Analysis of sources used by year of publication 148
4.3 Dimensionality of the conceptual integrated e-SQUUX Model V1 154
4.3.1 Sources captured 155
4.3.2 First round of reduction of dimensions. 157
4.3.3 Second round of reduction of dimensions 158
4.3.4 Third round of reduction of dimensions 162
4.4 Potential application of the conceptual e-SQUUX Model V1 at different levels. 169
4.4.1 Application at Level 1 170
4.4.2 Application at Level 2 171
4.4.3 Application at Level 3 171
4.5 Conclusion 172

Chapter 5: Expert review of the conceptual e-SQUUX Model V1: Study 1B 173
5.1 Introduction 173
5.2 Experts' profiles and overview of the nature of data 176
5.2.1 Experts' profiles 176
5.2.2 Overview of the nature of data collected 176
5.3 Analysis based on the ranking of categories and dimensions by experts 178
5.3.1 Most important categories 181
5.3.2 Least important categories 183
5.3.3 Most important dimensions 186
5.3.4 Least important dimensions 188
5.3.5 Summary of ranking of categories and dimensions 190
5.4 Analysis of expert reviewers' suggestions 195
5.4.1 Combining components 196
5.4.2 Removing (deleting) components 197
5.4.3 Relocating (moving) components 199
5.4.4 Adding components 200
5.4.5 Decoupling (separating) components 200
5.4.6 Renaming of categories 201
5.4.7 Consolidation and elimination of synonyms 201
5.4.8 Dealing with miscellaneous suggestions 202
5.4.9 Categories that merged as a result of the analysis of suggestions in Sections 5.4.1 to 5.4.8 203
5.5 Merging rankings and suggestions data results to arrive at the expert-reviewed Provisional e-SQUUX Model PV2 205
5.5.1 Merging rankings and suggestions results: ranking the most important categories 205
5.5.2 Merging rankings and suggestions results: ranking the least important categories 209
5.5.3 The Provisional e-SQUUX Model PV2 as a result of expert reviews 212

5.6 Further refinement of the conceptual e-SQUUX Model due to precise definitions of its components 218
5.7 Conclusion 226
Chapter 6: Pilot study: Study 2A 229
6.1 Introduction 229
6.2 Sampling, and procedure and administration of the questionnaire 231
6.2.1 Sampling for the pilot study 232
6.2.2 Procedure and administration of the questionnaire 232
6.3 Data capturing and profile of participants 234
6.4 Reliability of the constructs in the questionnaire 236
6.5 Other changes to the questionnaire design and distribution procedure 240
6.5.1 Re-ordering of the questionnaire 240
6.5.2 Tick or crosses to use in the questionnaire? 241
6.5.3 Changes due to common problems identified during data capture 241
6.5.4 Adjustment of the questionnaire distribution procedure with respect to gender 242
6.5.5 Editing and additional modification of the questionnaire 242
6.6 An overview of the value of the pilot study 243
6.7 Conclusion 243
Chapter 7: Data analysis and results of the main study: Study 2B 245
7.1 Introduction 245
7.2 Sampling, and procedure and administration of the questionnaire 249
7.3 Data cleaning and profile data of participants 250
7.3.1 Personal information and ICT devices owned 251
7.3.2 Affiliation 253
7.3.3 Portal Access and usage 254
7.4 Reassessment of the reliability of the expert-reviewed conceptual e-SQUUX Model V2 255
7.5 Data analysis leading to the validated e-SQUUX Model V3 257
7.5.1 Validity of e-service quality: Exploratory factor analysis 259

7.5.2 Reliability of the newly formed factors of the e-service quality part of e-SQUUX Model V3 264
7.5.3 Validity of usability: Exploratory factor analysis 265
7.5.4 Reliability of the newly formed factors of the usability part of e-SQUUX Model V3 269
7.5.5 Validity of user experience: Exploratory factor analysis 270
7.5.6 Reliability of the newly formed factors of the user experience part of e-SQUUX Model V3 273
7.6 Partial least square – structural equation modelling (PLS-SEM): e-SQUUX Model estimation using SmartPLS 275
7.6.1 Round 1: Model estimation based on cross-loadings of indicators 276
7.6.2 Round 2: Model estimation based on loading of indicators on latent variables (LVs) and AVE values 276
7.6.3 Round 3: Model estimation based on average variance extracted (AVE) .. 277
7.6.4 Round 4: Model estimation based on heterotrait-monotrait (HTMT) ratio of correlation 277
7.7 e-SQUUX measurement model assessment using PLS-SEM 278
7.7.1 e-SQUUX measurement model: Loadings of indicators on latent variables 278
7.7.2 e-SQUUX measurement model: Internal consistency using composite reliability 280
7.7.3 e-SQUUX measurement model: Convergent validity using average variance extracted 280
7.7.4 e-SQUUX measurement model: Discriminant Validity using Heterotrait-Monotrait ratio of correlations 280
7.8 e-SQUUX Structural model assessment using PLS-SEM 281
7.8.1 Collinearity using variance inflation factor 282
7.8.2 Measure of variance explained (R^2) for the endogenous constructs 282
7.8.3. Measure of the strength and significance of the paths of the structural model 284
7.9 Chapter conclusion 287

Chapter 8: Discussion 290
8.1 Introduction 290
8.2 A consolidated conceptual model of e-service quality, usability and user experience (e-SQUUX) for evaluating Web-based applications 292
Answer to Subquestion 1 292
8.3 Content validity of the e-SQUUX conceptual model by means of expert reviews 294
Answer to Subquestion 2 294
8.3.1 Discussion based on rankings results 295
8.3.2 Discussion based on suggestions results 296
8.3.3 Discussion based on the merged results, and refined model – Provisional e-SQUUX Model PV2 298
8.4 Value of a pilot study in a questionnaire survey evaluation of e-service quality, usability and user experience (e-SQUUX) 301
Answer to Subquestion 3 301
8.4.1 Testing the design and feasibility of the questionnaire 301
8.4.2 Reliability of the constructs in the questionnaire 302
8.4.3 Reflection: value of a comprehensive pilot study in a survey evaluation in the discipline of HCI 303
8.5 Validation of expert-reviewed e-SQUUX Model V2 by means of a user survey 305
Answer to Subquestion 4 305
8.5.1 Comparison of the reliability of the pilot and main studies 305
8.5.2 Factor analysis of e-SQUUX and its reliability and validity 306
8.5.3 Factor analysis of e-SQUUX and its content validity 309
8.5.4 Components of a validated e-SQUUX Model V3 based on user survey 310
8.6 Proposed model: Partial least square – structural equation modelling (PLS-SEM) of e-SQUUX 313
Answer to Subquestion 5 313
8.7 Discussion of the PLS-SEM e-SQUUX Model 317

8.7.1 The relationships in the PLS-SEM e-SQUUX Model 317
8.7.2 Components of the proposed PLS-SEM e-SQUUX Model V4................. 319
Answer to Subquestion 6 319
8.7.3 Dimensions of e-service quality and recommendations 324
8.7.4 Dimensions of usability and recommendations 327
8.7.5 Dimensions of user experience and recommendations.............................. 329
8.8 Conclusion 331
Chapter 9: Conclusion.. 332
9.1 Introduction.. 332
9.2 Answering the research questions.. 333
9.2.1 How Subquestion 1 was answered.. 335
9.2.2 How Subquestion 2 was answered.. 337
9.2.3 How Subquestion 3 was answered.. 339
9.2.4 How Subquestion 4 was answered.. 341
9.2.5 How Subquestion 5 was answered.. 342
9.2.6 How Subquestion 6 was answered.. 344
9.3 Theoretical, practical and methodological contributions of the research 346
9.3.1 Theoretical contributions 346
9.3.2 Practical contributions 347
9.3.3 Methodological contributions 349
9.4 Implementations of Exploratory sequential design within this mixed methods research 351
9.5 Validity, reliability and triangulation.. 355
9.6 Recommendations... 356
9.7 Limitations and future research 358
9.8 Conclusion 360
References.. 361
Appendix A: Ethical clearance documents from UNISA 412
Appendix A-1: Ethical clearance permission letter 412

Appendix A-2: Permission to do research involving UNISA staff, student and data 413
Appendix B: Sources and dimensions in Study 1A: Systematic literature review 414
Appendix B-1: The 264 sources analysed 414
Appendix B-2: Top 70 dimensions by frequency 421
Appendix C: Documents for Study 1B: Expert review 424
Appendix C-1: Expert review: Template 424
Appendix C-2: Expert review: Introduction and instructions 440
Appendix C-3: Expert review: Consent form 444
Appendix D: Documents for Study 2A: Pilot study 446
Appendix D-1: Pilot study: Questionnaire 446
Appendix D-2: Pilot study: Consent form 458
Appendix D-3: Pilot study: Reliability of the dimensions 460
Appendix E: Documents for Study 2B: Main questionnaire survey 463
Appendix E-1: Main questionnaire survey: Questionnaire 463
Appendix E-2: Main questionnaire survey: Consent form 474
Appendix E-3: Screen plot for e-service quality (eSQ or e-SQ) 476
Appendix E-4: Screen plot for usability (UB) 477
Appendix E-5: Screen plot for user experience (UX) 478
Appendix E-6: Outer-loading of 55 indicators of the structural model 479
Appendix E-7: t-statistics values of the 39 indicators of the structural model 482

LIST OF FIGURES

Figure 1.1: Layout of Chapter 2
Figure 1.2: Structure of the thesis 28
Figure 2.1: Layout of Chapter 2 30
Figure 2.2: DeLone and McLean information systems (IS) success model (DeLone and McLean, 1992) 32
Figure 2.3: Updated DeLone and McLean IS success Model (DeLone and McLean, 2003) 33
Figure 2.4: Technology Acceptance Model (Davis, 1989) 35
Figure 2.5: UTAUT model (Venkatesh et al., 2003) 37
Figure 2.6: The four principal components in a human-machine system (Shackel, 1991)44
Figure 3.1: Layout of Chapter 3 82
Figure 3.2: A framework for research (adapted from Creswell, 2014, p. 5) 86
Figure 3.3: Sequential exploratory design applied in this research – Research process diagram ……………………. 113
Figure 4.1: Layout of Chapter 4 143
Figure 4.2: Percentage of number of all sources over the years 149
Figure 4.3: Percentage of the number of sources over the years for usability 151
Figure 4.4 Percentage of the number of sources over the years for e-SQ 152
Figure 4.5: Percentage of the number of sources over the years for UX 153
Figure 4.6: Percentage of the number of sources over the years for each and all of the facets of e-SQUUX 154
Figure 4.7: A snapshot of the spreadsheet used to capture dimensions and their sources.... 156
Figure 4.8: A photograph of the 70 dimensions pasted on a whiteboard 160
Figure 4.9: Proposed implementation framework of the conceptual e-SQUUX Model. 170
Figure 5.1: Layout of Chapter 5 175
Figure 5.2: Extract from the categories and dimensions ranking questions in the review template 179
Figure 6.1: Layout of Chapter 6 231

Figure 7.1: Layout of Chapter 7 247
Figure 7.2: Number of factors extracted from e-service quality showing the Eigen values and the percentage of variance explained 260
Figure 7.3: Number of factors extracted from usability showing the Eigen values and the percentage of variance explained 266
Figure 7.4: Number of factors extracted from user experience showing the Eigen values and the percentage of variance explained 271
Figure 7.5: The path coefficients and coefficients of determination, R^2, of the structural model of e-SQUUX 283
Figure 7.6: The t-values of the relationships between e-SQ, U and UX 285
Figure 8.1: Layout of Chapter 8 291
Figure 9.1: Layout of Chapter 9 333
Figure 9.2: Path analysis model of e-SQUUX (Figures 7.5 and 7.6 combined)............. 344

LIST OF TABLES

Table 1.1: Summary of the main research design and methodology components............ 18

Table 2.1: SERVQUAL and its relationship to website design (Parasuraman, Zeithaml and Berry, 1988; Iwaarden et al., 2004; Yilmaz, Ari and Gurbuz, 2018)......................... 39

Table 2.2: e-Service quality dimensions, models and scales 64

Table 2.3: Definitions/descriptions of a web portal... 69

Table 3.1: The research questions map for this thesis document 84

Table 3.2: Difference between qualitative and quantitative research (Synthesised by the researcher) 94

Table 3.3: Methods used in developing related instruments and their components (Synthesised by the researcher) 103

Table 3.4: Summary of evaluation categories and dimension in the questionnaire........ 126

Table 3.5: The 5-Point rating scale used in the questionnaire evaluation of items 127

Table 4.1: Summary of Chapter 4.. 142

Table 4.2: Main key terms used to search for relevant literature................................... 146

Table 4.3: The number of sources with one, two or all three facets 146

Table 4.4: Deductive statistics with respect to the number of sources identified........... 148

Table 4.5: Type of sources reviewed 148

Table 4.6: Number of sources for specific time intervals, considering all sources 149

Table 4.7: Number of usability sources for specific time intervals 150

Table 4.8: Number of e-SQ sources for specific time intervals...................................... 152

Table 4.9: Number of UX sources for specific time intervals 153

Table 4.10: Percentages of the number of sources for each and all of the areas within e-SQUUX 154

Table: 4.11: Top 20 terms used as dimensions of e-SQUUX... 157

Table 4.12: The number of sources (freq) with a given frequency (f)............................ 157

Table 4.13: Dimensions directly related to the “Learnability” dimensions as originally captured 158

Table 4.14: Top 20 of the 70 dimensions derived from the dimensions with a frequency of 5 and above 159
Table 4.15: The 70 dimensions with their corresponding frequencies (f) ranked from 1 to 70 161
Table 4.16: How the different dimensions in Table 4.15 were combined to form the 24 categories 162
Table 4.17: The actual 24 categories ranked according to the frequency 163
Table 4.18: The categories, main dimensions and associated dimensions of a conceptual integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications – The conceptual e-SQUUX Model V1 164
Table 5.1: Summary of Chapter 5 174
Table 5.2: Profile of the expert reviewers 176
Table 5.3: Extract from first part of the form used in the expert review 177
Table 5.4: The scale used for Importance (IP) 178
Table 5.5: Questions asked for each scale variable 178
Table 5.6: Top five most important categories for each expert 182
Table 5.7: Summary of rankings of most important categories 183
Table 5.8: The five least important categories for each expert 184
Table 5.9: Summary of rankings of least important categories 186
Table 5.10: Top five most important dimensions for each expert 187
Table 5.11: Summary of rankings of most important dimensions 188
Table 5.12: The five least important dimensions for each expert 189
Table 5.13: Summary of rankings of least important dimensions 190
Table 5.14: Comparison of the most important categories and dimensions 191
Table 5.15: Ranking of the most important categories and dimensions using only the rankings data 192
Table 5.16: Comparison of the least important categories and dimensions 194
Table 5.17: Ranking of the least important categories and dimensions using only the rankings data 195
Table 5.18: Experts Suggestions regarding the combining of components 196
Table 5.19: Experts' suggestions regarding removal (deletion) of components 198

Table 5.20: Experts' suggestions regarding relocation of components 199
Table 5.21: Experts' suggestions regarding addition of components 200
Table 5.22: Experts' suggestions regarding decoupling of components 201
Table 5.23: Experts Suggestions regarding renaming of components........................... 201
Table 5.24: Experts' suggestions regarding elimination of Synonyms 202
Table 5.25: Experts' miscellaneous suggestions 203
Table 5.26: Categories that merged as a result of experts' suggestions 204
Table 5.27: The remaining 19 categories, of the original e-SQUUX Model V1, as a result of experts' suggestions... 204
Table 5.28: Calculation of CatPoints, CatScore, and DimPoints values for the most important categories and dimensions.. 206
Table 5.29: Ranking the most important categories 208
Table 5.30: Calculation of CatPoints, CatScore, and DimPoints values for the least important categories and dimensions.. 210
Table 5.31: Ranking the least important categories... 212
Table 5.32: The integrated list of the revised categories ranked from 1 to 19 213
Table 5.33: Provisional e-SQUUX Model PV2, the conceptual model as a result of experts' reviews of e-SQUUX Model V1 in Chapter 4... 214
Table 5.34: Comparison of V1 and PV2 of e-SQUUX Models in terms of number of components 218
Table 5.35: Refinements made on the expert-reviewed Provisional e-SQUUX Model PV2 219
Table 5.36: The final list of the e-SQUUX dimensions after the expert review process 221
Table 5.37: The final expert-reviewed conceptual model for evaluation of e-service quality, usability and user experience (e-SQUUX Model V2)...................................... 222
Table 5.38: Comparison of the Provisional (PV2) and Final (V2) expert-reviewed e-SQUUX Models in terms of number of components.. 226
Table 6.1: Summary of Chapter 6.. 229
Table 6.2 Profile of participants... 235
Table 6.3: Reliability coefficient alpha values of the dimensions................................. 237
Table 6.4: Reliability decision table based on alpha values 237

Table 6.5: Reliability details of the dimensions that needed modifications (extracted from Appendix D-3) 238
Table 7.1: Summary of Chapter 7 246
Table 7.2: Personal information and devices ownership 252
Table 7.3: Affiliation 253
Table 7.4: Portal access and usage 254
Table 7.5: Comparison of reliability co-efficient alpha values of the pilot and main studies of the dimensions of e-SQUUX 257
Table 7.6: Summary of the questionnaire evaluation section showing its facets, dimension names, number of items and item labels 258
Table 7.7: Variance explained by each factor of e-service quality 261
Table 7.8: Factor loadings of the items of e-service quality 262
Table 7.9: Summary information of the factors of e-service quality 263
Table 7.10: Reliability of the newly formed e-service quality factors 264
Table 7.11: Variance explained by each factor of usability 266
Table 7.12: Factor loadings of the items of usability 267
Table 7.13: Summary information of the factors of usability 268
Table 7.14: Reliability of the newly formed usability factors 269
Table 7.15: Variance explained by each factor of user experience 271
Table 7.16: Factor loadings of the items of user experience 272
Table 7.17: Summary information of the factors of user experience 273
Table 7.18: Reliability of the newly formed user experience factors 274
Table 7.19: Loadings of indicators of e-SQ, U and UX 279
Table 7.20: Cronbach’s alpha and composite reliability (CR) 280
Table 7.21: Average variance extracted (AVE) of the constructs 280
Table 7.22: HTMT values of the constructs 281
Table 7.23: Collinearity statistics – the inner VIF values of the LVs. 282
Table 7.24: The coefficient of determination (R^2) of the endogenous constructs 283
Table 7.25: Path coefficient and t-values and p values 284
Table 8.1: Summary of Chapter 8 290
Table 8.2: Summary of the number of suggestions by the evaluators 297

Table 8.3: A summary of the value that was empirically realised in this pilot study..... 304
Table 8.4: Summary of exploratory factor analysis of facets of e-SQUUX: old and new factors 307
Table 8.5: Comparison of the number of the factors and of items before and after EFA308
Table 8.6: Components of the validated e-SQUUX Model V3 as a result of the user survey (see Table 8.4) 311
Table 8.7: Summary of the structural model components of e-SQUUX Model V4....... 320
Table 8.8: Components of e-service quality, usability and of user experience Model V4 based on their structural model – e-SQUUX Model V4 (see Table 8.7)........................ 321
Table 8.9: Comparison of the validated (V3) and structural (V4) e-SQUUX Models in terms of number of components 324
Table 8.10: e-Service quality (e-SQ) theorised dimensions and their corresponding items (indicators) in the PLS-SEM e-SQUUX Model 325
Table 8.11: Usability (UB) theorised dimensions and their corresponding items (indicators) in the PLS-SEM e-SQUUX Model 328
Table 8.12: User experience (UX) theorised dimensions and their corresponding items (indicators) in the PLS-SEM e-SQUUX Model 329
Table 9.1: The research questions map for this thesis document 334
Table 9.2: The main components of the conceptual e-SQUUX Model V1 – the 24 categories ranked according to their frequency and weight... 337
Table 9.3: The main components of the expert reviewed e-SQUUX Model V2 – the 16 dimensions 339
Table 9.4: The main components of the validated e-SQUUX Model V3 – the 11 factors... 342
Table 9.5: The main components of the PLS-SEM e-SQUUX Model V4..................... 345
Table 9.6: Mixed-methods research characteristics and how they were implemented in this Exploratory sequential design 352
Table 9.7: Overview of the e-SQUUX Model components evolution............................ 354
Table 9.8: How validity, reliability and triangulation were implemented in this research... 355

LIST OF ACRONYMS

Acronym	Expansion
CFA	Confirmatory factor analysis
CSR	Case study research
DL	Distance learning
EFA	Exploratory factor analysis
ESD	Exploratory sequential design
FEDS	Framework for the evaluation of design science research
HCI	Human Computer Interaction
HCI4D	Human Computer Interaction for Development
HMI	Human-Machine Interaction
HPI	Human Product Interaction
ICT	Information and Communication Technologies
ICT4D	Information and Communication Technologies for Development
ID	Interaction design
e-SQ	Electronic service quality
SQ	Service quality
TAM	Technology acceptance model
UCD	User-centred design
UTAUT	Unified theory of acceptance and use of technology
UWP	University web portal UWP.
UX	User experience
WBA	Web-based applications

Chapter 1: Introduction

1.1 Introduction

This research sets out to develop a conceptual multi-dimensional model for evaluating Web-based applications (WBAs) containing components based on theory from existing literature. The model is made up of integrated components of three important concepts of Human Computer Interaction (HCI), namely, e-service quality, usability and user experience. Hence it is termed e-SQUUX. It was empirically extended and refined in an expert review and questionnaire survey to one that is suitable for assessment of these facets in the context of a University web portal (UWP). In a sequential refinement process, the model was validated, and a structural model of the relationships between its three facets was determined. Although the phrase, 'University web portal' is used, this work is relevant to portals of other institutions of higher education.

The researcher undertook a review of literature, an expert review and a quantitative questionnaire survey, that is, it is mixed methods research. First, a model was synthesised from literature by means of an extensive systematic review. Then, by use of expert reviews, the model was inspected, enhanced and refined. Finally, using a quantitative study in the form of an extensive questionnaire survey, the model was statistically analysed, further refined and purified. The last part was achieved by empirical validation and structural modelling of e-SQUUX. The final proposed model is considered to be suitable for evaluation of e-service quality, usability and user experience of a UWP. The web portal of the University of South Africa (UNISA), called myUnisa, was used as the main target system. The participants were the portal's main users, that is, students and staff (academic and non-academic), namely stakeholders who use it for different purposes.

Figure 1.1 shows how this chapter, which is a brief introduction to the entire study, is organised. After this introduction (Section 1.1), Section 1.2 provides the background and the rationale for the research. This is followed by the problem statement in Section 1.3.

1.1: Introduction

1.2: Background and rationale

1.2.1 Overview
1.2.2 Usability
1.2.3 User experience
1.2.4 e-Service quality
1.2.5 The need and justification of this research

1.3: Problem statement

1.4: Research purpose and objectives

1.4.1 Primary purpose
1.4.2 Research objectives

1.5: Main research question and subquestions

1.5.1 Main research question
1.5.2 Subquestions

1.6: Value of the research

1.6.1 Benefits to web portal designers, developers, evaluators and users
1.6.2 Potential contribution

1.7: Outline of the literature review

1.8: Research design and methodology

1.8.1 Research design
1.8.2 Research methodology
1.8.3 Ethical issues

1.9: Scope of the research

1.9.1 Domain and context
1.9.2 Delineations
1.9.3 Limitations
1.9.4 Assumptions

1.10: Structure of the thesis

Figure 1.1: Layout of Chapter

Thereafter, the research purpose and objectives are presented in Section 1.4. In Section 1.5, the main research question and subquestions are put forward while Section 1.6 explains the value of the research and Section 1.7 outlines the literature review. Section 1.8 provides an overview of the research design and methodology used in this work. Finally, Section 1.9 presents the scope of the research and Section 1.10 depicts the structure of the thesis.

1.2 Background and rationale

1.2.1 Overview

Developments in Internet technology and pervasive computing have resulted in multiple WBAs, including business transactions, information delivery and social networking, as well as e-government, e-health and e-learning. The Internet is used not only to transfer information via the web but is increasingly used to provide electronic services to a variety of users with different characteristics, knowledge and profiles. Different websites have varying requirements and users have differing backgrounds, experiences and cultures. Users require effective, easy and enjoyable interaction, which is key to successful use and acceptance of application (Montero, Lozano and Gonzalez, 2008; Alshamayleh et al., 2015; Marchiori, Mainardes and Rodrigues, 2017). These requirements set the context of this research.

As technology of the Internet evolves, so has its use by organisations correspondingly become more advanced and complex. Over the past 20 years, institutions of higher learning have moved from provision of 'static' information via the web, such as course information, to provision of online services such as registration, payment of fees, submission of assignments, borrowing of library material and, in some cases, delivery of online courses in the form of e-learning. This has increasingly been implemented by web portals that enable the integration of these various services and information through a single frontend (Tate et al., 2007; Ali, 2018). In recent years, web portals have become popular as a way of aggregating, organising, and presenting content and interactive services in a personalised, customised and uniform manner (Calero et al., 2008; Pinho, Franco and Mendes, 2018). The growth in the provision of web portal services is mainly due to increasing needs of staff, students and other stakeholders for more and high-quality online services, with high levels of usability and user experience. From the perspective of management, there is a requirement for cost reduction and efficiency as student enrolments and staff numbers increase. While the aim of providing more services via software systems is intended to make the systems more convenient and easy to use, it frequently results in more complex user interfaces (Han et al., 2000; Jain and Chande, 2013). Web portals are not exceptions to this situation. In investigating the quality of Internet-based software, e-service quality, usability and user experience are vital aspects in the use of such systems. From traditional software to e-commerce websites and applications, usability and user experience have been recognised as key attributes of software quality (Abran et al., 2003; Khwaldeh et al., 2017). Poor usability and user experience usually result in poor software quality and complex interactions. Poor software quality is unacceptable, since one of the most important factors that influences online users in their adoption of electronic services is the quality of a system and its facilities (Rotchanakitumnuai, 2008; Jiang and Ji, 2014). Furthermore, poorly designed online systems provide unacceptable services to users, which can result in discontinued use of such systems (Chan et al., 2003; Hong, Tam and Yim, 2016).

The next subsection briefly introduces the three major facets investigated in this study, also referred to as 'facets' or 'core facets', namely, e-service quality, usability and user experience. The three facets are important aspects of HCI. HCI is a multidisciplinary approach to the design, evaluation, and implementation of interactive computer systems for human use and the related human aspects (Preece et al., 2015).

1.2.2 Usability

Usability (UB) is one of the most important factors in HCI research (Mazumder and Das, 2014). The ISO/IEC 25010:2011 (ISO/IEC 25010:11, 2011) defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context". Good usability results in increased user productivity and decreased training costs and user support (Mayhew, 2005; Gumussoy, 2016). Although much research has been done with respect to usability of general software and usability of websites, there is a lack of consistency on what exactly is entailed in usability or what its dimensions are (Chen, Germain and Rorissa, 2009; Mazumder and Das, 2014). Nielsen (1993) defines usability in terms of five dimensions – learnability, efficiency, memorability, few errors, and user satisfaction. Nielsen's classic 1993 definition or framework of usability is the most widely adopted and cited, since it provides a detailed articulation of usability aspects that can be objectively and empirically verified through different evaluation methods (Matera et al., 2008; Joo and Lee, 2011; Yahya and Razali, 2015). There is a need to determine what currently constitutes usability in terms of its components or dimensions and how it can be evaluated. Without this understanding, it is difficult to consider usability during software development or perform appropriate software usability evaluation (Abran et al., 2003; Fowdur, Hurbungs and Beeharry, 2016).

1.2.3 User experience

User experience (UX) is considered a critical determinant of product or service success for organisations that interact with online users or customers (Hsu et al., 2017). UX is a relatively new area in HCI (McNamara and Kirakowski, 2006; Moczarny, De Villiers and Van Biljon, 2012). The phrase 'user experience' was coined in 1995 by Don Norman, the renowned HCI researcher, author and practitioner, and refers to a multidimensional concept whose definition was not fully established (Agarwal, Meyer and Alto, 2009; Kujala, Roto, Väänänen-vainio-mattila, et al., 2011). The ethos and components of UX have become clearer over the years. UX attempts to go beyond traditional usability by including hedonic aspects such as beauty, fun, pleasure and personal growth associated with the use of a product. A key term for UX is 'enjoyability' (Hassenzahl and Tractinsky, 2006; Pucillo and Cascini, 2014; Sahi, 2015; Hsu et al., 2017). ISO CD 9241-210 defines UX as "all aspects of the user's experience when interacting with the product, service, environment or facility" (ISO, 2008). Preece, Rogers and Sharp (2015) describe UX as the sensations obtained by users while interacting with a product, as well as the pleasure and satisfaction (or the reverse) that they acquire during its use. Nevertheless, according to Hassenzahl (2008) and Minge and Thüring, (2018), there is a lack of a widely-accepted, shared understanding of what UX constitutes and how it can be evaluated. The main reason for this, put forward by Moczarny, De Villiers and Van Biljon (2012), is that UX is complex, context-specific, subtle and subjective in nature.

1.2.4 e-Service quality

With the rapid increase in use of the Internet to provide products and services, there is a need to deliver superior service quality over the web, referred to as e-service quality (Swaid and Wigand, 2009; Ali, 2018). e-Service quality (e-SQ), also known as website-, web-based or online service quality, is defined as the extent to which services based on web technology facilitate effective and efficient online communications, purchases and delivery of product or services (Bressolles and Nantel, 2004; Kuo et al., 2005; Sahi, 2015). Similarly, Parasuraman, Zeithaml and Malhotra (2005) and (Marimon et al., 2010) define e-service quality as the extent to which a website supports efficient and effective online transaction and delivery of products and services. This definition together with that of Ojasalo (2010) that e-service is the provision of services to customers or users through the Internet, are adopted for this research.

SERVQUAL (Parasuraman, Zeithaml and Berry, 1988), standing for 'Service quality', is the predominant instrument used for evaluating service quality offered by organisations. The concept of service quality predated pervasive electronic and online services. However, with their advent, most of the dimensions of service quality were adopted from the five dimensions of the original SERVQUAL, namely reliability, assurance, tangibles, empathy, and responsiveness (Parasuraman, Zeithaml and Berry, 1988; Parasuraman, Zeithaml and Malhotra, 2005; Cebi, 2013). These have been contextualised to WBA environments to derive corresponding e-SQ dimensions, appropriate to the web environment. For example, Parasuraman, Zeithaml and Malhotra (2005) listed efficiency, fulfilment, system quality and privacy. Cebi (2013) identified technical adequacy, content, security, communication, prestige, ease of use, ease of learning, memorability, layout, graphics, system availability, speed, accessibility, navigation, reliability, accuracy, privacy, contact information, online help, responsiveness, sustainability and currency as e-SQ dimensions. As has been indicated, many of these e-service quality dimensions also apply to usability and user experience.

To date, service quality for websites is not a fully defined construct and there is still uncertainty in defining and interpreting its meaning, mainly because there are various types of sites. As such, there is no established conceptual model for developing and evaluating service quality of websites in general (Yang et al., 2005; Mmutle and Shonhe, 2017; Corkindale, Ram and Chen, 2018).

1.2.5 The need and justification of this research

Usability is considered a key factor of software quality since it determines whether or not a system can be accepted by users (Nielsen, 1991; Gumussoy, 2016; Quinones, Rusu and Rusu, 2018). Consequently, it has been a key aspect of WBAs since the inception of the web in the mid-1990s, due to worldwide use of the web by users with different backgrounds, experiences and cultures. In the last decade the emphasis in HCI research has tended to gravitate more towards user experience than usability (Park et al., 2014; Vermeeren, Roto and Vaananen, 2016). However, the current researcher believes that usability is just as important as user experience. The point of departure in this research is that all users want a Web-based application (WBA) to be easy to use (main focus: usability) and enjoyable to use (main focus: user experience). In addition, users of WBAs need to get required services online without making telephone calls or physically visiting an organisation (main focus: e-service quality).

This work constitutes a journey towards achieving these three focus objectives. It attempts to create a model that can be used as a framework to evaluate e-service quality, usability and user experience (e-SQUUX) in an integrated manner. Though e-service quality originates from the service marketing field, and usability and user experience from HCI, the conceptualisation of each of the three constructs has been ongoing. There are varying definitions and dimensionality for each (Al-Momani, Azila and Noor, 2009; Park et al., 2014) as shown in Sections 1.2.2 to 1.2.4. However, the three constructs, though different, are closely related. For example, Alshamayleh et al. *(*2015) identified the core dimensions of e-service quality as efficiency, reliability, fulfilment and privacy. Studies by Koohang (2004) and Moumane, Idri and Abran (2016) identified the attributes of usability as including efficiency, reliability, effectiveness, learnability and satisfaction. The inclusion of efficiency and reliability in both e-service quality and usability, shows an overlap between the two. Similarly, it is widely agreed that user experience is an extension of usability. For Park et al. (2013), Vermeeren, Roto and Vaananen (2016) and Hassenzahl, Diefenbach et al. (2010), usability is the pragmatic part of UX and is related to performance.

While e-service quality, usability and user experience are indeed related, no research could be found that provides an integrated model of the dimensions of all three. Thus a gap has been identified and this research is an effort to address that gap.

1.3 Problem statement

Although there is much ongoing research, with little consensus, on how to improve service quality of e-commerce websites (Zeithaml, Parasuraman and Malhotra, 2002; Barnes and Vidgen, 2004; Rotchanakitumnuai, 2008; Jenabi and Ghanadan, 2014; Javed, 2018), little has been done to improve higher education websites or web portal service quality (Karlsson and Olsson, 2008; Ali, 2018). In order to deliver better-quality services to staff and students, university managers and portal designers need to provide usable online service offerings with a high level of positive user experience.

Though it has been argued in Section 1.2.5 that the facets of e-SQUUX, namely, e-service quality, usability and user experience, are related and are all geared towards meeting users' needs, there is a need for a consolidated integrated model that can be used as a basis for evaluating them. This is particularly the case since evaluation has been identified as a mainstream activity in HCI (Moczarny, De Villiers and Van Biljon, 2012). The most commonly used method for evaluation is employing a set of criteria for measuring constructs. According to Stake (2006) and Huang, Chen and Chiu (2016) measurement and modelling of constructs of products or services are closely related. The process usually begins with a description or definition of the constructs, including a set of attributes and sometimes sub-attributes, which can be investigated objectively or subjectively. Nonetheless, while there is agreement on objective measures or metrics such as task completion times, there is little agreement on subjective software quality measures such as satisfaction (Holzinger et al., 2008; Moumane, Idri and Abran, 2016). The focus of this research is identification of the attributes or dimensions of subjective quality measures, so that WBAs can be evaluated. Once these dimensions are established, an evaluation can identify system problems, so that solutions can be proposed to fix the problems (Winter, Wagner and Deissenboeck, 2008). As stated, while various studies have identified the dimensionality of each of the facets of e-SQUUX, little work exists on integrating two, or all three, of the constructs. These issues raise the question: *"Put together, what components or dimensions constitute each of e-service quality, usability and user experience and what corresponding dimensions and items should be considered to evaluate the three facets compositely and individually?"* This question, and its particularisation in the context of University web portals, forms the central theme of this research.

Many studies that model e-service quality, usability or user experience separately have been undertaken as part of broader studies of software quality or service quality modelling (Barnes and Vidgen, 2002; Zeithaml, Parasuraman and Malhotra, 2002; Yang et al., 2005; Karlsson and Olsson, 2008; Mandl, 2008; Moumane, Idri and Abran, 2016; Ali, 2018; Javed, 2018). A few of these studies have been conducted in the context of University web portals (Barnes and Vidgen, 2002; Karlsson and Olsson, 2008; Ali, 2018). However, to the current researcher's knowledge, none of the studies have focussed on proposing an evaluation model integrating and combining the three of them and applying it to a UWP.

In e-commerce websites, there is a need to compare service offerings for competitive advantage, e-service quality, usability and user experience. However, evaluation in the context of a University web portal should aim at improving the level of services to its users, without necessarily competing with similar portals. However, minimum quality standards should be met and some degree of competitiveness should be allowed. Provision of high-quality services by institutions results in effective and efficient services, which enrich users' experiences, impact positively on the brand of a university, and provide satisfaction to users of the portal, particularly students and staff (Shobaki and Naser, 2017; Ali, 2018).

However, there are a number of problems associated with evaluation of e-service quality, usability and user experience (e-SQUUX) in general and of University web portals in particular (Barnes and Vidgen, 2002; Zeithaml, Parasuraman and Malhotra, 2002; Yang et al., 2005; Karlsson and Olsson, 2008; Mandl, 2008; Moumane, Idri and Abran, 2016; Ali, 2018; Javed, 2018). The problems constitute part of the rationale for this research. They include the following:

- Despite widespread growth in the use and complexity of web portals, insufficient attention is paid to their quality.
- e-Service quality, usability and user experience are key components of software quality, yet they are frequently overlooked during the development of software. This results in software products with inadequate service quality, usability and user experience.
- e-Service quality, usability and user experience have not been modelled or defined concisely yet explicitly by researchers across models and standards.
- The growing complexity in the services offered to higher education students and staff using web portals has led to a greater need to have usable online service offerings with a high level of positive user experience.
- As already stated, to the researcher's knowledge, no study has been made to comprehensively model and evaluate e-service quality, usability and user experience of University web portals in a consolidated manner. Therefore, a research gap exists in respect of determining components of an integrated e-service quality, usability and user experience evaluation model in general, and for University web portals in particular.

The real-world problem addressed by this research is, therefore, the determination of appropriate components (parts) of such an integrated model for evaluating e-service quality, usability and user experience of a University web portal. This research will be conducted using as targets three main UNISA web portals, namely myUnisa, Staff and the Library portal but mainly myUnisa. These portals are explained in the next paragraph.

UNISA is a DL institution based on the open distance e-learning (ODeL) model, which recognises that, amongst others, “The appropriate use of technology is essential to the survival of the institution as a global role player. Technology makes it possible for employees, students and other stakeholders to interact with UNISA anytime and from anywhere in the world.” (UNISA-Policy, 2008:6). In 2015, of the total 293 437 registered UNISA students, 230 134 (78%) of them used myUnisa. Likewise, of the 2273 academic staff, 1 849 (81%) of them used myUnisa (Unisa-DISA, 2015). In the same year, UNISA had 3280 unique study units (modules), each of which had a website within its web portal, myUnisa. By 2017, the number of registered students had risen to 350 420 (Unisa-PowerHEDA, 2017). myUnisa offers access to a variety of services and facilities for students including student applications, registration, payment of tuition fees, submission of assignments, borrowing of library books and discussion forums. Staff members make use of myUnisa to upload student study material, communicate with students, receive students’ assignments, and lately (since 2015), carry out online marking of assignments.

The Staff portal is used as an intranet for UNISA staff members that gives them access to internal organisation information and services. They include services such as internal communication notices, applications for leave, requests for IT support services, access to students’ assignments for marking (which can be done online), monitoring students’ progress, uploading of study material and assignment solutions and many others. Staff can access the myUnisa portal independently in the same way as students or via the Staff portal. UNISA’s Library portal gives students and staff access to the usual library services. Despite all these activities for students and staff, there has not been much formal consideration of e-service quality, usability and user experience in designing myUnisa, just as is the case in other web portals of higher education (Barnes and Vidgen, 2002; Karlsson and Olsson, 2008; Ali, 2018). However, the managers of myUnisa are supportive of evaluation of their frontend web interfaces. For example, studies of the online student assignment submission, a portlet of myUnisa, identified a number of problems indicating usability and user experience issues across the entire portal (De Kock, Van Biljon and Pretorius, 2009; Pretorius, Van Biljon and De Kock, 2010; Yahya and Razali, 2015).

1.4 Research purpose and objectives

In light of the discussion in the previous section, this section provides the purpose and objectives of this research.

1.4.1 Primary purpose

The primary purpose of this mixed methods research was to develop a conceptual integrated model for evaluation of e-service quality, usability and user experience (e-SQUUX) for WBAs and then contextualise it to evaluation of a University web portal. This was undertaken by means of a systematic literature review, followed by two empirical studies. First, a qualitative expert review of the conceptual e-SQUUX Model was undertaken. Second, based on the expert-reviewed revised e-SQUUX Model, a quantitative study using a questionnaire survey of UNISA's web portal users (students and staff) was carried out. The model is 'integrated' because, while existing studies have mainly investigated e-service quality, usability and user experience separately, there is a need for a model that integrates them.

1.4.2 Research objectives

The objectives of this research are:

1. To synthesise from literature the components of a conceptual integrated model for evaluating e-service quality, usability and user experience of Web-based applications.
2. By means of expert reviews, to improve the content validity of the conceptual model for evaluating e-service quality, usability and user experience.
3. To carry out a comprehensive pilot study of the survey on the expert-reviewed model in preparation for the main study. The purpose of the pilot is not only to improve the questionnaire and its administration, but also to determine the value of a pilot in a questionnaire survey for evaluating e-service quality, usability and user experience in HCI studies. This was followed by administration of the main questionnaire survey.
4. To validate, by means of statistical analysis, the expert-reviewed model for evaluating e-service quality, usability and user experience in the context of a University web portal.

5. To determine, by means of structural modelling, the relationships between e-service quality, usability and user experience in the context of evaluating a University web portal.
6. Based on the structural model, to map out the final components of e-service quality, usability and user experience in the context of evaluating a University web portal (UWP) based on the structural model.

1.5 Main research question and subquestions

In qualitative, quantitative and mixed approaches to research, it important to formulate and state research questions, since they narrow the research purpose and objectives to specifics that will be addressed in the study (Johnson and Christensen, 2008; Creswell, 2014; Schoonenboom and Johnson, 2017). The research purpose and objectives were addressed by answering the following main research question and its subquestions. There is a relationship between the six objectives and the six research questions respectively.

1.5.1 Main research question

What are the components of a conceptual integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications, and of its validated and structural models that are suitable for evaluating a University web portal?

1.5.2 Subquestions

The main research question gives rise to the following subquestions, with the corresponding chapters where they are addressed:

1. What are the components of a *conceptual integrated model*, synthesised from the literature, for evaluating e-service quality, usability and user experience (e-SQUUX) of *Web-based applications*? (Chapter 4)
2. What are the components of the *conceptual integrated model* for evaluating e-SQUUX of Web-based applications following *an expert review*? (Chapter 5)
3. What is the *value* of a comprehensive *pilot study prior to a main questionnaire survey* on the components of an integrated model for evaluating e-SQUUX of a University web portal *(UWP)*? (Chapter 6)

4. What are the components of an *empirically validated integrated model* for evaluating e-SQUUX of a UWP? (Chapters 7 and 8)
5. What is the *structural model (relationships*) of e-service quality, usability and user experience in the context of evaluation of a UWP? (Chapters 7 and 8)
6. What are the *final components* of e-service quality, usability and user experience following the *structural modelling* of the three in the context of evaluation of a UWP? (Chapters 7 and 8)

By means of a literature review, Subquestion 1 seeks to determine an integrated set of components of the three core facets of this study, namely, e-service quality, usability and user experience, that are suitable for evaluating Web-based applications. This was undertaken by identifying the dimensions of the facets and integrating them, thus grounding the research in theory.

Subquestion 2 relates to a study that seeks to improve the content validity of the conceptual e-service quality, usability and user experience model, e-SQUUX, by requesting a set of experts to review the model.

Subquestion 3 was addressed by undertaking a comprehensive pilot study prior to the questionnaire survey of evaluation of e-SQUUX, in order to improve the questionnaire and its administration processes. The secondary objective was to determine the value of a pilot study in and of itself in the context of survey evaluation in HCI studies.

Using data from the main questionnaire survey, Subquestion 4 involved determining the reliability and validity of constructs of the facets of e-service quality, usability and user experience. The ultimate objective was to determine a set of factors and corresponding items that are suitable for evaluating e-SQUUX of a UWP.

Subquestion 5 seeks to refine the e-SQUUX evaluation model further by determining the structural model of the relationships between e-service quality, usability and user experience (e-SQUUX) in the context of evaluating a University web portal.

Subquestion 6 is closely related to the fifth one since, using the structural model in Subquestion 5, it provided a detailed breakdown of the components of the e-SQUUX Model based on the structural model. Unlike the fifth question which is about the relationships between the three facets, the focus of this subquestion was to map out the final components of the e-SQUUX Model in terms of a set of factors (dimensions) and their corresponding items that can be used for evaluation of a UWP.

By answering all the subquestions, the main research question was answered. The main research question and subquestions are addressed in the course of this study with the ultimate goal of meeting the objectives of the research.

1.6 Value of the research

The value of this work, that is, its significance, is presented in terms of the benefits of the research and potential contributions.

1.6.1 Benefits to web portal designers, developers, evaluators and users

The major envisaged value will be the benefits that can be gained from the final output, the evaluation model. A major benefit of having an integrated e-service quality, usability and user experience model is that stakeholders such as web designers, developers and evaluators can potentially be supported in their work, in particular those who are less experienced, since it should help them to understand and evaluate these concepts (Seffah et al., 2006; Montero, Lozano and Gonzalez, 2008; Moumane, Idri and Abran, 2016; Javed, 2018). Further benefits of a model of this nature (Seffah et al., 2006; Moumane, Idri and Abran, 2016; Javed, 2018), are:

- It reduces the cost of lab-based testing by providing a basis for understanding and comparing various e-service quality, usability and user experience items.
- It can be used as a basis to perform both expert-based and user-based methods synergistically.

- It provides a basis for communication between software developers and software experts.
- It provides accessibility to sound evaluation practices.

If portal designers, developers and evaluators use the model in their work, they will be supported in their efforts to develop portals that meet the needs of their users. The model can thus serve as a set of design guidelines as well as a structured set of evaluation criteria. This should result in observable benefits such as improved human productivity, performance and commercial viability. Furthermore, systems that perform well with regard to the three core facets of the envisaged e-SQUUX, namely systems with good e-service quality, usability and user experience, should be more acceptable to users than those that are poorly designed (Seffah et al., 2006; Yahya and Razali, 2015; Van der Bijl-Brouwer and Dorst, 2017).

1.6.2 Potential contribution

This research intends to make theoretical, practical and methodological contributions. In summary, the main envisaged contributions will be:

- To add new knowledge and understanding to the bodies of knowledge of e-service quality, usability and user experience in terms of modelling and evaluating Web-based applications from an HCI perspective.
- To provide a model that can be used as a basis by designers and other practitioners for evaluating these three core facets of a University web portal.
- To provide a potential methodology for developing similar models in other domains.

The detailed contributions are provided in Section 9.3 of the Conclusion chapter (Chapter 9).

1.7 Outline of the literature review

Chapter 2 of this research presents the literature review. Section 2.2 gives some of the main theories relevant to this research. This is followed in Section 2.3 by an overview of how this research is contextualised in HCI, and consequently, in Information Systems (IS) in general, within the realms of interaction design and user-centred design. Sections 2.4, investigate scholastic analysis of the core focus concepts of this research, namely, usability, user experience and e-service quality, respectively. Thereafter, Section 2.5 discuses Web-based applications and web portals in detail. After that, Section 2.6 provides an overview of e-service quality, usability and user experience evaluation and methods. Section 2.7 describes University web portal services and their evaluation in terms of the three core focus concepts. It should be noted that sections 2.4 to 2.7 address aspects of the dimensionality or the components related to e-service quality, usability and user experience.

1.8 Research design and methodology

This section overviews the research design, methodology, ethical issues, validity and reliability of this research.

1.8.1 Research design

Research design involves structuring a research project in order to address a defined set of questions (Kumar and Phrommathed, 2011; Trochim, Donnelly and Arora, 2016). The proposed research design will address the main research question and subquestions provided in Section 1.5 in order to meet the main purpose and objectives of this research as listed in Section 1.4. Creswell (2014) describes a research design as the procedures and plans that guide researchers in their philosophical assumptions, which in turn determine the research paradigm and strategies to apply, and detailed methods for data collection and analysis. Table 1.1 summarises the components of the research design and methodology in line with Creswell's (2014) framework for research, and states how they were applied. Details are given in Chapter 3 (Research design and methodology).

Philosophical assumptions or research paradigms are based on varying philosophical foundations and conceptions of reality. Each paradigm has its own particular implementation of methodological approaches and strategies (De Villiers, 2005; Manzoor, 2016).

Table 1.1: Summary of the main research design and methodology components

Research design and methodology components	
Research component	**How it is applied in this research**
Research paradigm/worldview	Pragmatism
Research approach	Mixed methods
Research design	Sequential exploratory design
Research methods	**Qualitative phase** 1. Systematic literature review (Study 1A) 2. Expert reviews (Study 1B) **Quantitative phase** 3. Questionnaire survey (Study 2) a. Pilot Study (Study 2A) b. Main study (Study 2B)
Data analysis	Qualitative and quantitative techniques

Research paradigm discussions are dominated by two in particular, namely, interpretivist and positivist (Trochim, Donnelly and Arora, 2016). A positivist paradigm asserts that knowledge is absolute and objective and that a single objective reality exists independent of individuals. However, an interpretivist paradigm seeks to determine meanings and new interpretations of reality and assumes multiple realities which are time- and context-dependent (Chen and Hirschheim, 2004; De Villiers, 2005; Manzoor, 2016). In addition to the two, there is the more recent pragmatic approach (Creswell, 2014) which is concerned with what works, and solutions to problems. Instead of concentrating on the subjective/objective debate, pragmatism is concerned with how well the researchers perform in selecting, utilising and integrating various methodological tools to achieve the required research outcomes (Denzin and Lincoln, 2012). Pragmatism was used in this research since it is the most appropriate for mixed methods studies (Denzin and Lincoln, 2012; Manzoor, 2016).

A research approach can be quantitative, qualitative or a mixed-method approach. The choice of which approach to use is determined by the philosophical worldview of the researcher, and the specific research methods needed to conduct data collection, analysis and interpretation (Creswell, 2014; Manzoor, 2016). This research employs mixed methods and the design described by Creswell (2014) as a sequential exploratory design.

As shown in Table 1.1, in the present mixed-method approach, a qualitative phase was conducted first. Its results were then used during the quantitative phase. This design is appropriate for developing and testing a model (De Villiers, 2005; Creswell, 2014) as is the case in this research. The choice of mixed methods is in line with similar studies (Parasuraman, Zeithaml and Berry, 1988; Zeithaml, Parasuraman and Malhotra, 2002; Barnes and Vidgen, 2005; Caro et al., 2006; Seffah et al., 2006; Karlsson and Olsson, 2008; Yahya and Razali, 2015; Ali, 2018) for developing models for evaluating aspects such as retailing service quality and software quality. Gable (1994) and Venkatesh, Brown and Bala (2013) posit that the IS domain is suitable for mixed-method approaches such as user surveys and observations. The use of mixed methods helps to minimise the weaknesses that exist in purely positivist approaches to research and vice versa (Creswell and Clark, 2011; Venkatesh, Brown and Bala, 2013).

1.8.2 Research methodology

The aim of this research is to derive a model that can be used as a basis for evaluating e-SQUUX of a University web portal. Table 1.1 shows that this research has two phases – a qualitative phase and a quantitative phase.

Phase 1 (qualitative) incorporates:

- *Study 1A (Systematic literature review)* – A literature review from which a conceptual evaluation model, e-SQUUX, was synthesised from extant literature and theory.
- *Study 1B (Expert review)* – An empirical study in which a review and refinement of the conceptual e-SQUUX Model was performed by highly skilled expert evaluators, leading to a content-validated version of the model.

Phase 2 (quantitative) incorporates Study 2, which is a questionnaire survey. It is carried out in two parts:

- *Study 2A (Pilot study – questionnaire survey)* – The pilot study, using myUnisa as target system was used not only to refine the questionnaire and administration method, but also for limited statistical analysis to determine the initial reliability of the components of the e-SQUUX version that was the output from the expert review.
- *Study 2B (Main study – questionnaire survey)* – A comprehensive empirical study, conducting the main questionnaire survey on three of UNISA's web portals as target systems, but mainly on the one called myUnisa, with the aim of validating the conceptual model and determining the structural model that shows the relationships between the facets of e-SQUUX.

These four studies are outlined below in more detail:

1.8.2.1 Study 1A: Systematic literature review

In this phase, existing literature was used to synthesise the components that are appropriate for facets, categories and dimensions of e-SQUUX of WBAs in order to answer Subquestion 1 (see Section 1.5). In order to achieve this, a comprehensive review of relevant literature was undertaken as has been done in similar studies (Parasuraman, Zeithaml and Berry, 1988; Caro et al., 2006; Seffah et al., 2006; Yahya and Razali, 2015; Sa et al., 2016). The approach taken in this literature review is in line with Barbara Kitchenham's guidelines for a systematic literature review (Kitchenham, 2004). The systematic literature review is discussed in Chapter 3, the Research Design and Methodology chapter. According to Gough, Oliver and Thomas (2017) there is a difference between a traditional literature review and a systematic literature review. A traditional literature review summarises and presents research findings related to the topic of the study and is positioned in a literature review section or chapter of the study. On the other hand, a systematic literature is "a review of existing research using explicitly, accountable rigorous research methods" (Gough, Oliver and Thomas, 2017, p. 4). It is a method for collecting specific literature that provides primary data that is analysed to answer a research question. This makes it a research method and it is therefore discussed in Section 3.6.1 of the methodology chapter.

This study reviewed various theories and literature on e-service quality, usability and user experience in the areas of software in general, web engineering, e-commerce software, and web portals, including higher education portals. The purpose was to synthesise the first version of the conceptual e-SQUUX Model. The review included existing models, standards, definitions, principles, guidelines and criteria relating to the three core facets. As in similar studies (Churchill, 1979; Seffah et al., 2006; Zhang, Rau and Salvendy, 2010), a hierarchical model made up of facets, categories, dimensions and associated dimensions was formed. The evaluation artefact resulting from this phase was used as input to Study 1B.

1.8.2.2 Study 1B: Expert review

The aim of this study was to have a set of experts review the conceptual e-SQUUX Model in order to refine the model and improve its content validity. Expert reviews should be based on expert's knowledge (expertise) and experience (Stojmenova, Lugmayr and Dinevski, 2013; Sulaiman et al., 2016). Such reviewers should have various skills, such as domain expertise and application experience (Aziz et al., 2016). All the experts in this study were highly qualified in the fields of Information Technology and/or HCI. They were provided with a 16-page template to review the conceptual e-SQUUX Model that had emanated from Study 1A. They were asked to provide qualitative feedback in the form of suggestions and comments on the suitability of the components of the model with respect to evaluation of WBAs. In addition, they were free to remove, combine, separate or relocate components and to suggest further ones, or make any other adjustments. Furthermore, the reviewers provided certain quantitative data in terms of ranking the components from most to least important. The outcome of the study was a more refined e-SQUUX Model which was then used as input to Study 2.

1.8.2.3 Study 2: Questionnaire survey

Using the e-SQUUX Model which was the outcome of the expert review, Study 1B, an 8-page questionnaire was designed. As already shown in Table 1.1, this quantitative phase of the research included Study 2A, a pilot study of the questionnaire survey, and Study 2B, the main questionnaire survey. Even before the pilot study was undertaken, the questionnaire instrument was examined by three colleagues of the researcher to check its terminology and clarity and to comment on its suitability. The pilot study was then conducted. As stated, this was not only to test the questionnaire and refine it, but also to add value by determining the initial reliability of the components of the conceptual e-SQUUX Model. The pilot study was therefore comprehensive in nature and was conducted with a reasonably large number of participants for a pilot, namely 26, while the main questionnaire survey was conducted with 174 participants. Following data collection, both deductive and inferential statistics were used to analyse the data so as to validate the conceptual e-SQUUX instrument.

The bullets that follow, summarise the approaches of Studies 2A and 2B. They were carried out in the same way, but with differences in the outcomes. The first difference was that far more data was collected in Study 2B due to the large number of participants. The other major difference was that the data analysis performed for the main study was much more extensive than that of the pilot study. In summary, the characteristics of Studies 2A and 2B were:

- *Methodology:* questionnaire survey.
- *Sampling:* quantitative sampling techniques, specifically, stratified sampling (Fouche and Delport, 2004; Devlin, 2018).
- *Data collection*: self-administered paper-based questionnaires.
- *Data analysis methods and interpretation of results*: deductive, and inferential statistics. In addition, structural equation modelling (SEM) was done in the case of Study 2B.

1.8.3 Ethical issues

Ethical issues were considered during both the qualitative and quantitative study phases in line with the UNISA's policy on research ethics. These included vulnerability and privacy of participants, informed consent and confidentiality as discussed in Section 3.12.

1.9 Scope of the research

1.9.1 Domain and context

This work describes the iterative development-and-evaluation process of e-SQUUX, an evaluation model for web portals in the context of higher-education institutions. The study presents four versions, culminating in the final form of e-SQUUX, which comprises three core facets containing categories, dimensions, and low-level evaluation items. While the focus area is evaluation of the three facets, namely e-service quality, usability and user experience as they relate to Web-based applications, the application area is specifically the realm of University web portals. The research resides within the domain of HCI in the over-arching discipline of IS. However, the work also incorporates aspects from the fields of e-marketing, e-retailing and e-commerce.

Existing literature and models were used as the foundations of this research and thus set the context and created a general frame of reference for the rest of the research.

1.9.2 Delineations

Evaluation should occur throughout the life cycle of software or a system, that is, before, during and after its evolution. The e-SQUUX Model envisaged in this research, is intended for evaluation of functional, in-use web portals, that is, for use in evaluating post-evolution products.

The literature review was based on authoritative work, such as journal articles and other accredited studies and publications. All dimensions and items in the e-SQUUX Model are traceable to the literature sources used in this study.

As stated, this research was undertaken in a higher education context, in particular, it was conducted in an open distance e-learning (ODeL) environment. UNISA is the only dedicated DL institution in South Africa. Although other higher education institutions have started to offer DL courses, it is on a limited scale. Such institutions were therefore not selected as research sites.

The target applications used in the study when e-SQUUX was tested and refined empirically and by statistical analysis, were web portals of UNISA. In particular, participants used e-SQUUX on the myUnisa portal, which is a learning management system (LMS). However, this research is not intended to be an evaluation of the UNISA portals. Rather, it is a study of e-SQUUX itself, in its development process.

Since only students and staff of UNISA are given access to the target portals through a combination of usernames and passwords, only these two groups were used as participants in the qualitative and quantitative studies.

There is no claim that the dimensions or items in the e-SQUUX Model are fixed. New ones can be added and some can be omitted. In this sense, the model is flexible and adaptable.

Although web portals can operate on both fixed and mobile devices, the e-SQUUX Model presented in this study, focuses on evaluating web portals that operate on fixed devices.

Although the Fourth industrial revolution (4IR) is not specifically mentioned in this research, since the world is witnessing the commencement of 4IR, it is hoped that the outcome of this research will play a positive role in this era.

1.9.3 Limitations

There are a number of limitations of the present work, namely:

- The participants came from a single institution.
- The survey part of the research was undertaken in a mandatory context of use with students and staff as the participants, since they are respectively compelled to use the portals for their studies and work activities, respectively.
- The study focused only on official university websites and did not consider issues related to mobile Apps, despite the fact that the use of Apps to access content is becoming more widespread.

- The study is limited to subjective, rather than objective, evaluation of e-service quality, usability and user experience. E-SQUUX does not include scales or metrics for quantitative measurement of items evaluated.

1.9.4 Assumptions

It is assumed that a Distance learning (DL) portal provides all the usual services that portals of a contact teaching and learning institution provide, plus further features. Such additional features emerge from the particular characteristics of a DL institution, where most of the teaching and learning is delivered online, hence more online services and information are required than in a traditional contact learning institution.

A fundamental assumption is that considerably more information and services are available to official users who log onto the portals than to those with no access. This is because official users can browse and conduct transactions with password-protected content on a portal.

Since the researcher personally interpreted the meaning of data and served as an "instrument for data collection" (Johnson and Turner, 2010, p. 297) at certain stages of this research, he recognises that bias might have been present that could influence the findings and the conclusions made.

This study is exploratory, hence the use of Exploratory factor analysis (EFA) in Chapters 5 and 6, and not Confirmatory factor analysis (CFA). However, although it is conducted in the context of UNISA, it is hoped that, with little or no modification, the product of this research can be transferred to other universities or other higher education institutions, including traditional contact institutions, that is, the researcher trusts that the findings may have some generalisability (Stake, 2006; Devlin, 2018).

It was assumed that the participants had a fairly strong technological background and were competent in working with web-based systems. Furthermore, since all the participants in this mid-year study were authorised staff or students, it was taken for granted that prior to the research, they had used at least one UNISA portal at least once.

It was assumed that the participants had an adequate command of English, which is the language used in the portal design and the research instruments. However, for most of them, English was their second language.

It was assumed that the questionnaires were completed by the intended persons and that they provided authentic and honest opinions.

1.10 Structure of the thesis

Figure 1.2 provides the structure of the thesis.

Chapter 1, the *Introduction*, gives a brief overview of the content and structure of this research. The content includes the research problem, objectives and questions, scope, literature review outline, and a summary of the research design and methodology used.

Chapter 2, the *Literature review*, provides an extensive review of the body of knowledge relevant to the research problem. In this work, the literature review is far more than a background. It constitutes a vital part of primary data collection, since the concepts that constituted the building block for synthesising e-SQUUX, were acquired from the literature review.

Chapter 3 briefly discusses the *Research design and methodology* undertaken in this research, including philosophical worldviews, research approaches and designs, and methods for data collection and analysis.

Chapter 4 presents the *Synthesis of an integrated e-service quality, usability and user experience (e-SQUUX Model V1) based on Study 1A*. This is followed by Chapter 5 which describes and presents findings of the *Expert review of the conceptual e-SQUUX Model (Study 1B)*. Chapter 6 gives the result of the comprehensive *Pilot study (Study 2A)* undertaken before the main study, after which Chapter 7 sets out the *Data analysis and results of the main* questionnaire survey *study* (*Study 2B*). The sequential development of e-SQUUX through versions 1 to 4 is presented in Chapters 4, 5, 6, 7 and 8. However, Chapter 8 entails *Discussion* of the entire research. Finally, Chapter 9 provides the *Conclusion* of this work.

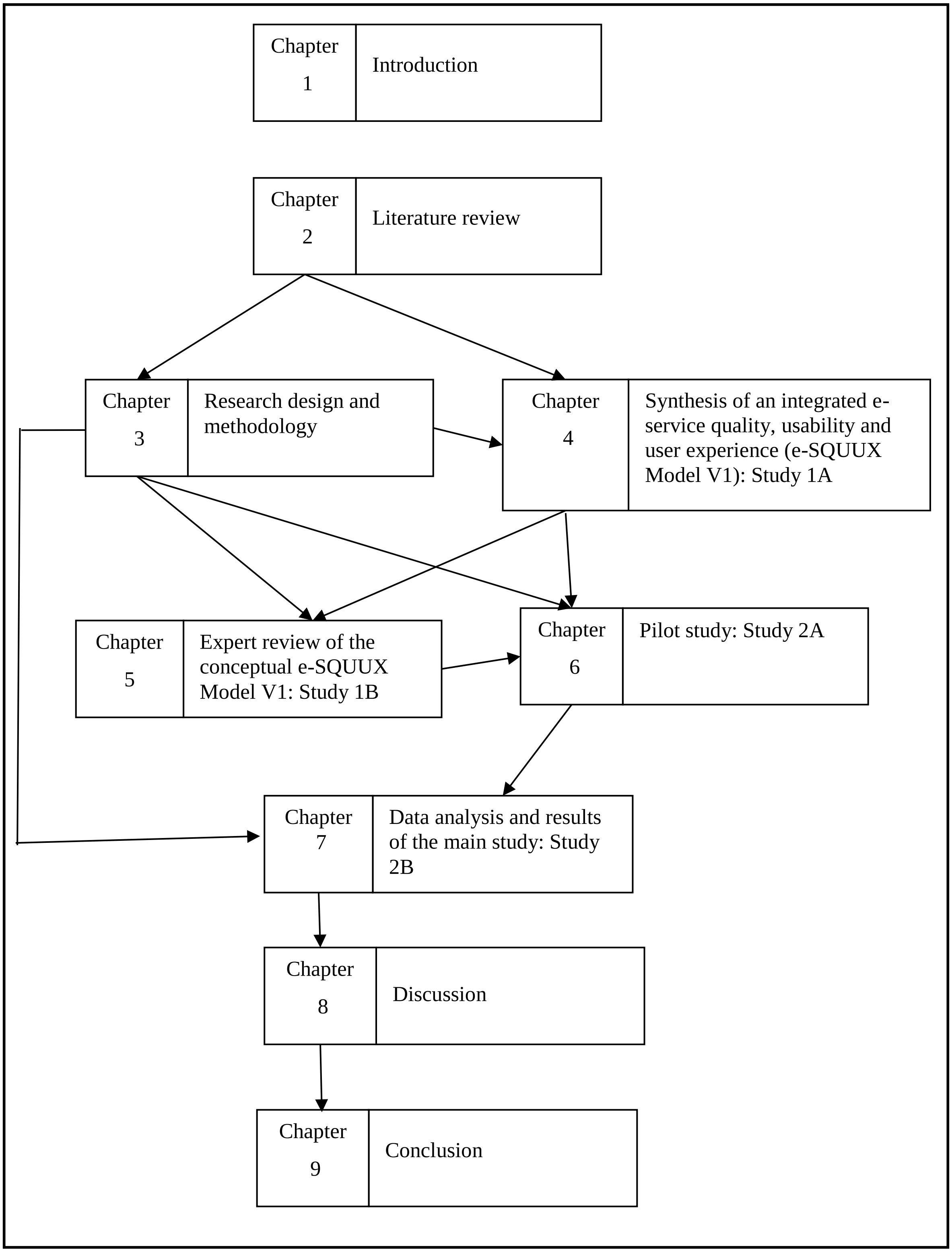


Figure 1.2: Structure of the thesis

Chapter 2: Literature Review

2.1 Introduction

Chapter 1 was the introduction to this research. It provided an overview of the entire study. The aim of this literature review chapter is to provide a context and theoretical framework for the work. This is done by critically reviewing existing literature in order to provide clear arguments of what is known or unknown about the research questions (Saunders, Lewis and Thornhill, 2016). Consequently, this chapter provides the key theories, concepts and a critical analysis of the relevant literature on which the research is based.

Figure 2.1 shows the layout of the chapter. After this introduction (Section 2.1), Section 2.2 discusses the theories relevant to this research, namely, DeLone and McLean's IS success Model (Section 2.2.1), the technology acceptance model (Section 2.2.2), the unified theory of acceptance and use of technology (Section 2.2.3), and SERVQUAL (Section 2.2.4). Lastly, Section 2.2.5 deals with the main theoretical foundations of this research. Section 2.2 is followed by Section 2.3 which overviews Human Computer Interaction (Section 2.3.1), interaction design (Section 2.3.2), and user-centred design/human-centred design (Section 2.3.3). The three main facets addressed in this work are discussed in Section 2.4, namely, usability (Section 2.4.1), user experience (Section 2.4.2), service quality and e-service quality (Section 2.4.3), and the benefits of these three (Section 2.4.4). In Section 2.5, definitions of Web-based applications (Section 2.5.2) and web portals (Section 2.5.2) are provided. Section 2.6 discusses evaluation of e-service quality, usability and user experience (e-SQUUX) and the methods used, with subsections on e-SQUUX evaluation (Sections 2.6.1), e-SQUUX evaluation methods (Sections 2.6.2) and modelling and measurement of e-SQUUX (Sections 2.6.3). Section 2.7 focuses on University web portal services and their evaluation, while Section 2.8 concludes the chapter.

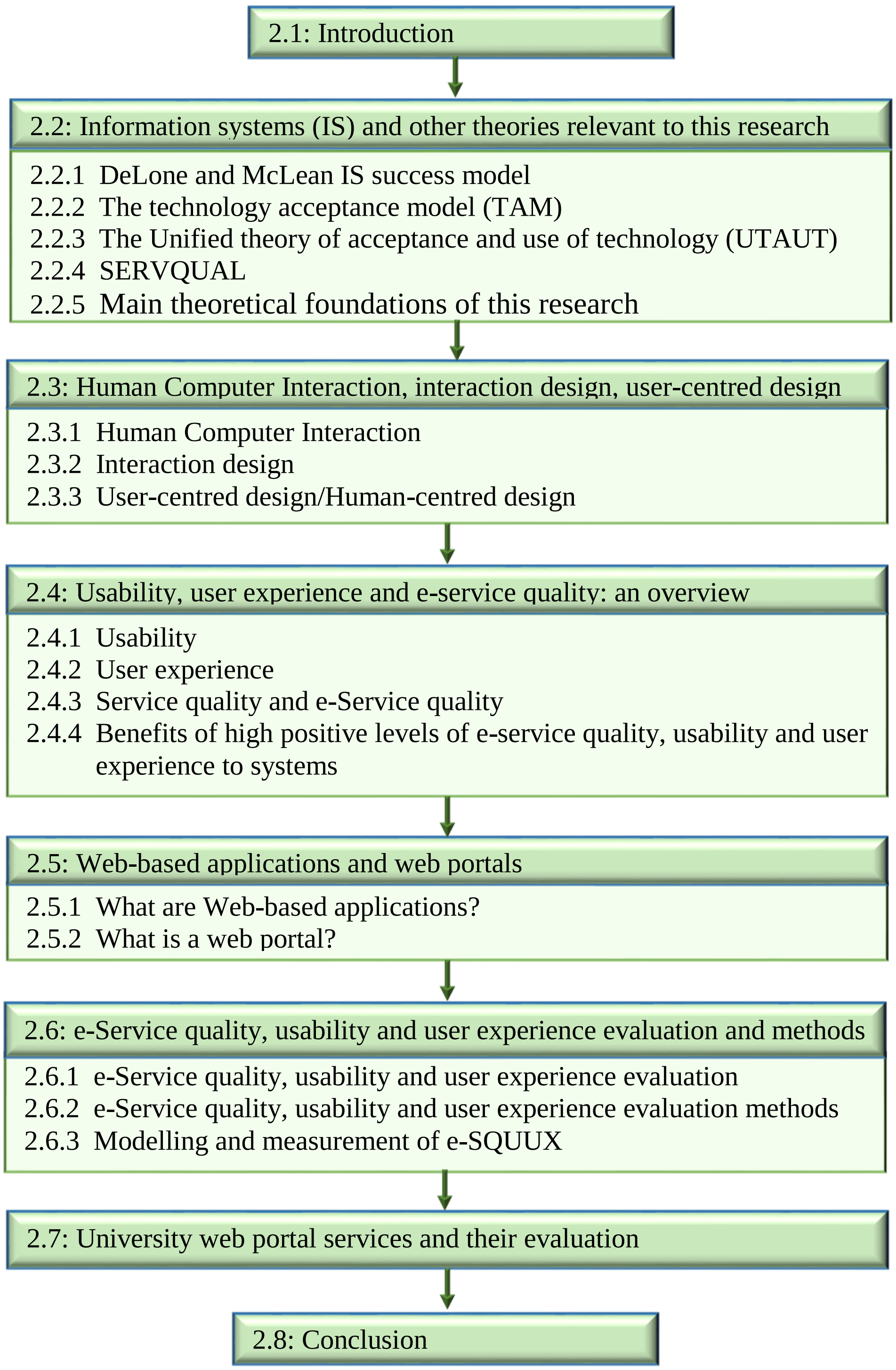


Figure 2.1: Layout of Chapter 2

2.2 Information Systems theories and other theories relevant to this research

In qualitative, quantitative and mixed methods studies, theories are frequently used. In quantitative studies, hypotheses are tested to test a theory. In qualitative studies, the theory provides a lens onto the matter to be investigated or, as in grounded theory, a theory is generated at the end of the study. Mixed methods studies may both build and test theories (Williams, 2007; Creswell, 2014). Theories influence the way researchers think, the way in which they interpret the world, and the actions they take during the research process (Walls, Widermeyer and El Sawy, 2004; Hong et al., 2014). They also play a major role in the determination of the research questions posed or hypotheses to be tested, issues to be investigated, methods to apply, and in the way in which the data is analysed and interpreted (Avgerou and Cornford, 1998; Pare et al., 2015). This section presents the four theories most relevant to this research from the fields of Human Computer Interaction and Information Systems, in which this research lies. In addition, a theory from marketing research is also included, namely SERVQUAL.

2.2.1 DeLone and McLean IS Success model

The DeLone and McLean information systems success model, known as the D&M IS success Model is a framework and model for measuring the complex dependent variables in IS research (DeLone and McLean, 1992, 2003). The model emanated from a classic study undertaken by DeLone and McLean in 1992 that synthesised previous research involving IS success to a consolidated body of knowledge and provided guidance for future research. Their findings were that IS is multidimensional and that the dimensions are interdependent. Figure 2.2 depicts their original model, which comprises six dimensions or categories.

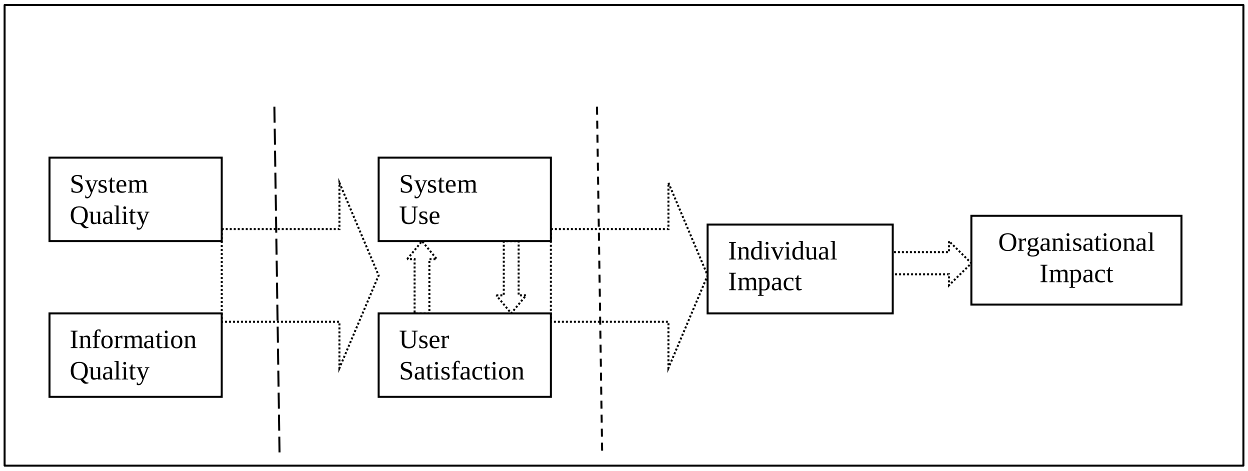


Figure 2.2: DeLone and McLean information systems (IS) success model (DeLone and McLean, 1992)

As depicted in Figure 2.2, System Quality (SQ) and Information Quality (IQ) individually, or in combination, impact on both System Use (SU) and User Satisfaction (US). Furthermore, US can affect use of a system and vice versa. SU and US individually or both have an Individual Impact (II) on a person’s performance that usually results in some Organisational Impact (OI).

Ten years after presentation of the original model, DeLone and McLean enhanced and extended the model to include the dramatic changes in IS practice, particularly due to the advent and growth of the Internet and e-commerce. The new model, Figure 2.3, includes Service Quality as an additional category and combines all ‘impact’ measures, that is, Individual Impact and Organisational Impact, to a new category named Net Benefits. Finally, System Use and Intention to Use make up a category in the new model, since they are considered to be an important measure of IS success. The new model can be adapted to evaluation and measurement of challenges of organisations with a web-presence, especially those involved in e-commerce (DeLone and McLean, 1992, 2016).

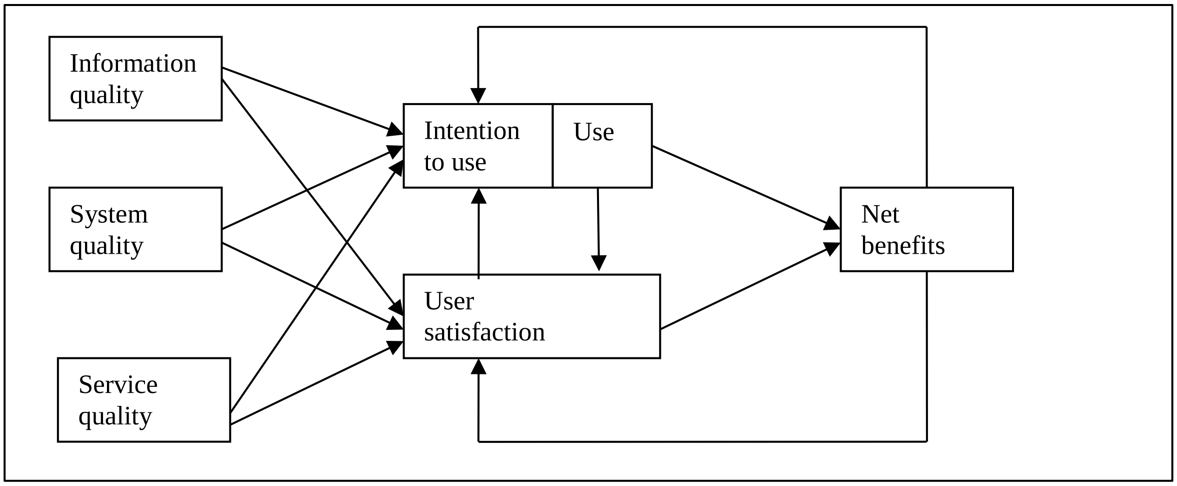


Figure 2.3: Updated DeLone and McLean IS success Model (DeLone and McLean, 2003)

The DeLone and McLean IS success Model is relevant to this research due to the following factors:

- System Quality, Intention to Use, Actual Use, User Satisfaction and, to some extent, the Net Benefit of using a system are considered by the current researcher to be critical constructs in modelling and evaluating both usability and user experience of any web-based system as undertaken in this research. For example, System Quality includes constructs such as usability, user experience, functionality, reliability and flexibility (Jamwal, 2010; Jagannathan, Balasubramanian and Natarajan, 2018).
- The model includes service quality that can be seen as the foundation of e-service quality, as investigated in this research.
- The model can be used to analyse the overall success or effectiveness of any given Information and Communication Technology (ICT) system or product (Booth, 2012) such as a web portal.
- Since the model is multidimensional and interdependent, it is important that as one emphasises and researches one aspect of on IS system, the other model constructs should not be ignored. For example, if e-SQUUX evaluation of a University web portal investigates issues related to system quality, service quality and user

satisfaction, as provided in the model, issues relating to other dimensions such as net benefit of the system should not be ignored.

Perhaps the only real criticism of the original DeLone and McLean IS Success model has been that of Seddon (1997), who points out that variance and process interpretations should not be included together in a single model, since this leads to potential confusion that can lead to a reduction in the value of the model. However, he agrees that the model makes important contributions to IS success and research. Some of the weaknesses mentioned were, however, addressed in the updated D&M IS success Model of 2003 (DeLone and McLean, 2003).

2.2.2 The technology acceptance model

The Technology acceptance model (TAM), introduced by Davis, is one of the most cited and proven IS theoretical frameworks that aims to explain why an individual accepts or rejects a new information system technology (Davis, 1989; Davis, Bagozzi and Warshaw, 1989; Venkatesh and Davis, 2000; Venkatesh and Bala, 2008; Wu and Chen, 2017).

TAM originates from the theory of reasoned action (Ajzen and Fishbein, 1980) which is used to explain and predict user behaviour across a number of domains. The theory of reasoned action postulates that a person's performance of a specific behaviour is determined by his/her behavioural intention to perform that behaviour. The associated behavioural intention is jointly determined by the person's attitude and subjective norms concerning the behaviour in question (Ajzen and Fishbein, 1980). Based on the Theory of reasoned action (TRA), the TAM investigates the factors that affect behavioural intention to use information or computer systems. Figure 2.4 is a diagrammatic representation of TAM. Two variables, *perceived usefulness (PU)* and P*erceived ease of use (PEOU),* are hypothesised to be fundamental determinants of user acceptance. *TAM* suggests a causal relationship between these two variables and user acceptance, which is sequentially made of users' *Attitude towards using* a technology*, Behavioural intention to use* it, and A*ctual system use* or (Davis, 1989; Park, Lee and Cheong, 2007; Wu and Chen, 2017). TAM suggests that actual information system adoption and use are determined by the behavioural intention to use the system, which, in turn, is jointly determined by a user's attitude towards using the system and PU.

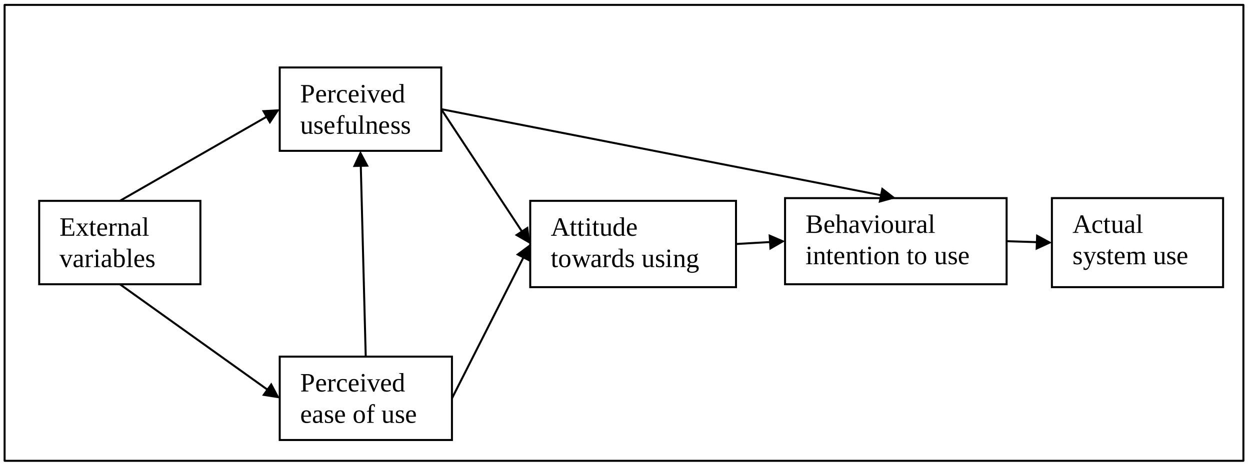


Figure 2.4: Technology Acceptance Model (Davis, 1989)

Perceived usefulness (PU) refers to "the degree to which a person believes that using a particular system would enhance his or her job performance", while Perceived ease of use (PEOU) refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis 1989, p.320). TAM suggests that PU and PEOU are the most important factors in explaining system use (Legris, Ingham and Collerette, 2003; Park, Lee and Cheong, 2007). TAM has undergone some refinements over time, such as TAM 2 (Venkatesh and Davis, 2000) and TAM 3 (Venkatesh and Bala, 2008) to incorporate newer concepts.

TAM is relevant to this research because:

- In HCI, ease of use has focused on objective measurements such as task completion rate. However, subjective ease of use is more relevant to the user's decision whether to or not to use the system (Davis, 1989). As with TAM, this research focuses on subjective measures of e-service quality, usability and user experience.
- In TAM, for each of the main variables, a number of items (subjective metrics) are used to determine user acceptance. This approach is used to model e-SQUUX, which is the main outcome of the present research.

- In the process of developing TAM, it underwent a number of refinements, validation and reliability testing to derive the final set of items. Such iterative refinement processes are also undertaken in this research.
- A number of related studies in website design and usage have been done based on TAM. For example, Mahlke (2002) identifies four website qualities: Perceived usefulness, Perceived ease of use, Perceived hedonic quality, and Perceived visual attractiveness. These qualities determine the individual's Intention to Use a website from which usage behaviour can be determined. Similarly, in the Pearson and Pearson (2008) study of the relative importance of key criteria in web usability, one of the main themes of this research, they conclude that ease of use and navigation are two critical components of website usability. These studies include not only usability but also aspects of user experience, in the form of hedonic quality.
- TAM has been identified as the most frequently used theory for IS research (Bahry, Anwar and Amran, 2012; Hornbaek and Hertzum, 2017).
- In a study by Ariffin et al. (2017) perceived enjoyment is included as one of the factors that influence attitude towards online shopping. This further confirms that TAM has been adapted to include user experience.

2.2.3 The unified theory of acceptance and use of technology

Closely related to TAM is the Unified theory of acceptance and use of technology (UTAUT) model that was developed by Viswanath Venkatesh and his colleagues in 2003 to provide factors that explain behavioural intention to use a technology and/or technology use (Venkatesh et al., 2003). It was garnered from a review of eight existing user acceptance models, namely, TRA, TAM, motivational model, theory of planned behaviour, a combined theory of planned behaviour/technology acceptance model, model of personal computer use, diffusion of innovations theory, and the social cognitive theory. Figure 2.5 shows the UTAUT model. It consists of four key constructs, namely: (i) Performance Expectancy, (ii) Effort Expectancy (iii) Social Influence, and (iv) Facilitating Conditions.

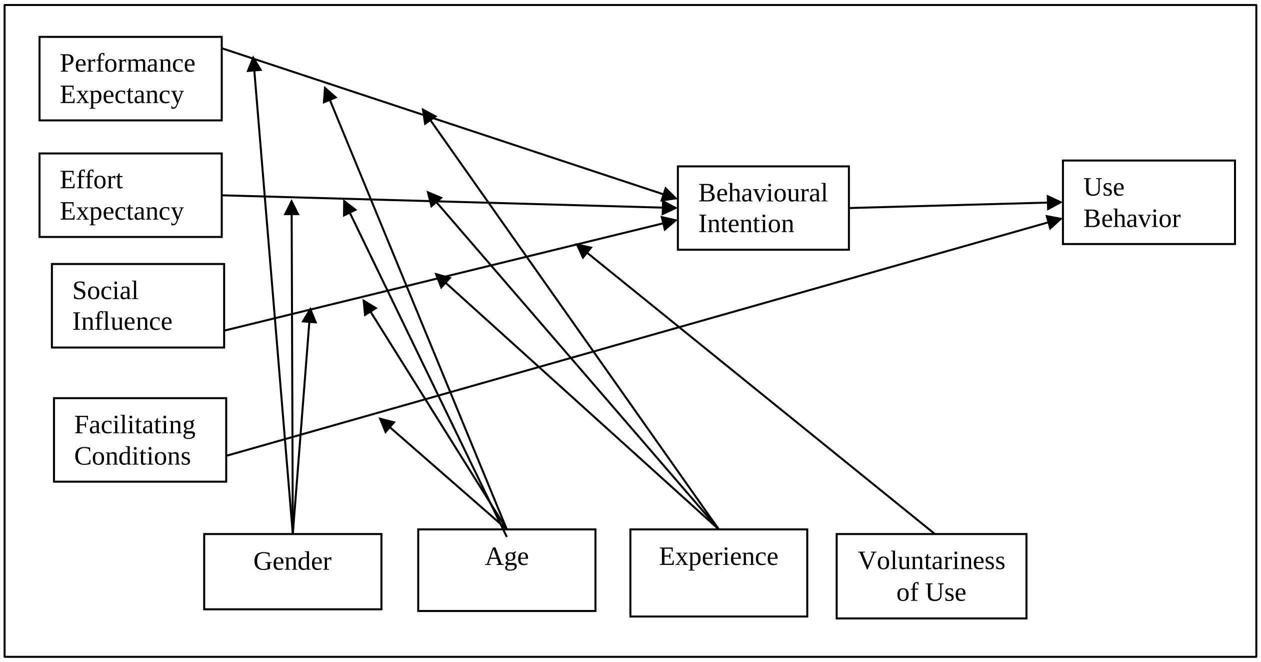


Figure 2.5: UTAUT model (Venkatesh* et al., *2003)

The first three are theorised to influence Behavioural Intention to use a technology while Behavioural Intention and Facilitating Conditions determine Use Behaviour. According to the model, Gender, Age, Experience, and Voluntariness of Use (voluntary use) moderate and influence the impact of the four key constructs on Behavioural Intention and Use Behaviour as shown in the diagram. The four key constructs are:

1. Performance Expectancy: the degree to which an individual believes that using a technology will help him/her to attain gains in job performance.
2. Effort Expectancy: the degree of ease of use of a technology.
3. Social Influence: the degree to which an individual perceives it important that others believe that he/she should use the technology.
4. Facilitating Conditions: the degree to which one believes that an organisational or technical infrastructure exists to support the use of the technology.

In 2012, the UTAUT model was modified by Venkatesh and another set of colleagues to form the UTAUT2 Model. UTAUT2 is, however, designed for use in a consumer context (Venkatesh, Thong and Xu, 2012) and is not directly relevant to the present research. In addition to the four key constructs, three others, namely Hedonic Motivation, Price Value, and Habit were incorporated into the UTAUT2 model while Voluntariness of Use was removed. The three constructs added are:

5. Hedonic Motivation: the fun or pleasure derived from using a technology.
6. Price Value: this applies to consumer settings where cost and price have an effect on a consumer's technology use.
7. Habit: the extent to which individuals tend to perform behaviours automatically as a result of learning how to use a technology.

Constructs 6 and 7 are not directly related relevant to the present work.

Like the TAM model, the UTAUT model is widely used (Mtebe, 2014; Williams, Rana and Dwivedi, 2015; Arif, Ameen and Rafiq, 2018). Since TAM was one of the models used to develop UTAUT, the reasons given in Section 2.2.2 why TAM is relevant to this research also apply to the use of UTAUT in this research. In addition, other reasons to use UTAUT and UTAUT2, are the following:

- UTAUT2 includes the Hedonic Motivation construct, which is closely related to the concept of user experience, one of the focus concepts of this research.
- Under the Habit construct, UTAUT2 considers the issue of learning to use a system automatically, in a transparent manner, after a period of use. Learning is considered a key aspect of usability, one of the focus concepts of this research.
- The Facilitating Conditions construct includes 'support', which is known to be an important factor for service provision in general and e-services quality (e-SQ) for web-based services and products in particular. e-SQ is one of the facets of this research.

2.2.4 SERVQUAL

SERVQUAL, standing for '*Serv*ice *qual*ity', originates from marketing, more specifically in service marketing research. It is the predominant instrument for measuring service quality offered by organisations, determined by assessing the gap between customer expectations and experience (Parasuraman, Zeithaml and Berry, 1988; Wolniak and Skotnicka-Zasadzien, 2012; Cebi, 2013; Javed, 2018; Sari, Alamsyah and Wibowo, 2018). It originates from the seminal conceptual model for service quality developed by A.

Parasuraman, Valarie Zeithaml and Leonard Berry (Parasuraman, Zeithaml and Berry, 1985). This original model had ten dimensions of service quality. During the development of SERVQUAL, the ten dimensions were refined to five that formed a scale with 22 items. These five are: reliability, assurance, tangibles, empathy and responsiveness (RATER). Table 2.1 shows each dimension and its description. In order to position SERVQUAL with relation to this research, a third column is included to show the dimension's relationship to website design (Iwaarden et al., 2004; Yilmaz, Ari and Gurbuz, 2018).

Table 2.1: SERVQUAL and its relationship to website design (Parasuraman, Zeithaml and Berry, 1988; Iwaarden et al., 2004; Yilmaz, Ari and Gurbuz, 2018)

Dimension	**Description**	**Relationship to website design**
Tangibles	The physical environment such as facilities, equipment and staff appearance.	It is important to have a well-functioning, aesthetically pleasing website since there is no face-to-face contact between the organisation and the user.
Reliability	The ability of service providers to offer services dependably and accurately.	Users need a website that is always available and fulfils what it promises to do.
Responsiveness	Willingness to help and respond to customer needs.	Websites should be able to provide prompt services with rapid response times.
Assurance	Ability, in terms of knowledge and courtesy, of staff to inspire confidence and trust in customers.	Users should be able to find everything they want on a website and trust the organisation to keep personal information private and confidential.
Empathy	The extent to which caring individualised service is given to customers.	Due to a lack of face-to-face interaction, users should be able to customise websites to their needs and preferences.

Although the conceptual model for service quality was developed in service marketing for the retailing industry, SERVQUAL is a generic instrument that can be adapted or supplemented to fit characteristics of a particular organisation in different domains (Parasuraman, Zeithaml and Berry, 1988; Palese and Usai, 2018; Vashishth and Chakraborty, 2018). Perceived service quality is a person's judgement about the overall excellence or superiority of an entity's or a person's attitude. This concept is related to, but not equal to, satisfaction and it results from a comparison of expectations with perceptions of performance (Parasuraman, Zeithaml and Berry, 1988; Javed, 2018). This means that service providers and website designers must identify customers' and users' needs and develop a product that meets or exceeds these needs. The SERVQUAL scale has widely been found to exhibit high validity and reliability. This is important because it is essential to measure service and software quality with an instrument that has been validated (Gorla, 2011; Javed, 2018; Malhotra, Agarwal and Shainesh, 2018).

SERVQUAL has also been widely adopted by both information system practitioners and researchers to measure software service quality (Gorla, 2011; Marchiori, Mainardes and Rodrigues, 2017) including e-service quality for e-commerce websites and web portals (Zeithaml, Parasuraman and Malhotra, 2002), and quality of websites for university students (Iwaarden et al., 2004). Based on this instrument, other instruments, such as e-SERVQUAL – a web portal service instrument (Zeithaml, Parasuraman and Malhotra, 2002; Yang et al., 2005; Javed, 2018) and E-Qual (Barnes and Vidgen, 2004), have been developed. Not only have these studies used or adapted the dimensions and items in the instrument to customise it to the digital environment, but the methodology for using it has also been widely applied. For example, Yang et al. (2005) used TAM and SERVQUAL to develop an information and service quality model consisting of 19 items with five dimensions/categories namely: usability, usefulness of content, adequacy of information, accessibility and interaction. Of late, e-SERVQUAL has been used for evaluation of e-service quality in various e-commerce domains especially in retail banking (Jenabi and Ghanadan, 2014; Javed, 2018) and in travel and hotel booking websites (Carrasco et al., 2017).

SERVQUAL is relevant to this research because of the following:

- In their study, Iwaarden et al. *(*2004) established that the quality dimensions applicable to the service sector are also applicable to websites. This was justified by the development of models such as e-SERVQUAL and E-QUAL (Zeithaml, Parasuraman and Malhotra, 2002; Barnes and Vidgen, 2004; Yang et al., 2005; Javed, 2018).
- The basis for development of SERVQUAL was that there is a need to assess customer perceptions, a subjective construct, using a quantitative instrument (Parasuraman, Zeithaml and Berry, 1988). Similarly, this research aims to determine users' perceptions of e-SQUUX using 'quantitative' measures in the form of items.

- As in the present research, the development of SERVQUAL involved first a qualitative exploratory study (Parasuraman, Zeithaml and Berry, 1985) and then a quantitative study (Parasuraman, Zeithaml and Berry, 1988).
- It is the most dominant model in evaluation of both traditional and electronic service quality (Malhotra, Agarwal and Shainesh, 2018; Narteh, 2018).

One of the criticisms of SERVQUAL is that it is industry- and context-dependent (Yang et al., 2005). Secondly, Cronin and Taylor (1992) argue that there is no real evidence to support the concept of the performance versus expectations gap as a basis for measuring service quality. They suggest that the use of performance measures alone (SERVPERF) provides a better measure for service quality. However, in their same study, they found that SERVPERF did not have better construct validity than SERVQUAL. Despite its criticism, SERVQUAL remains the most used and dominant model for measuring service quality in a variety of domains, albeit with adaptations (Wang et al., 2010; Gorla, 2011; Carrasco et al., 2017; Malhotra, Agarwal and Shainesh, 2018; Narteh, 2018).

2.2.5 Main theoretical foundations of this research

The most relevant theory used in this research is UTAUT, because:

- Its second version UTAUT2, although developed in a consumer environment, includes hedonic motivation that is very closely related to user experience (Venkatesh, Thong and Xu, 2012, 2016).
- As already stated, one of its constructs, facilitating conditions, includes support, which is known to be an important factor in service provisioning in general and e-services quality for web-based services that is one of the focus areas of this research.
- In the development of UTAUT, the TAM model was considered as one of the main inputs. This means that UTAUT incorporates concepts of TAM and others. However, a study by Hornbaek and Hertzum (2017) pointed out that most research on TAM does not cite UX, but work on UTAUT does.

- Some studies such as Chen and Chengalur-Smith (2015) and Arif, Ameen and Rafiq (2018) have applied UTAUT on library and on general web-services, respectively, in higher education institutions.

In addition to the above, SERVQUAL, and DeLone and McLean's IS Success model are also highly relevant to this research as already stated. In fact, this research was primarily motivated by three facts related to SERVQUAL, namely:

- How it was developed (the methodology used).
- How it was adapted to measure e-service quality.
- How widely it has been used across different industries.
- How dominant it has remained since its inception in 1988 up to date.

In conclusion, both UTAUT and SERVQUAL, and their variants, apply well to the theoretical foundations and the development methodology of the current research. Another reason for this stance is related to the research paradigm used in the current research, as will be pointed out in the Research Design and Methodology chapter.

2.3 Human Computer Interaction, interaction design, user-centred design

In the field of Human Computer Interaction, it is important to investigate the interaction between the computer and the human user. This interaction falls within the broader area of study of Interaction Design. One of the best approaches in designing interactive computer products is User-centred design (UCD). These three and their relationship are briefly discussed in the next three subsections.

2.3.1 Human Computer Interaction

Human Computer Interaction (HCI), also called Computer Human Interaction (CHI), Human-Machine Interaction (HMI) or Human Product Interaction (HPI), is a multidisciplinary field concerned with the design, evaluation, and implementation of interactive computer systems for human use and with the study of major phenomena surrounding them (Hassenzahl et al., 2015; Preece, Rogers and Sharp, 2015; Kocaballi and

Coiera, 2018; Ugale, 2018). The main focus in HCI is how the human uses the computer as a tool to perform, simplify or support required tasks by adapting computers to human nature (Dix et al., 2004; Hassenzahl, 2008). The discipline of HCI aims to ensure the safety, utility, effectiveness and efficiency of systems, including computer hardware and software systems (Issa and Turk, 2010; Pengnate and Sarathy, 2018). One of the initial areas that was studied in HCI was ergonomics, which is the study of work in relation to the environment where the work is carried out and with those who undertake it. The ultimate objective of ergonomics is to “adapt the job to the worker instead of making the worker adapt himself to the work place” (Montero, Lozano and Gonzalez, 2008, p. 226). In the context of human-machine interaction (HMI), the machine should adapt to human capabilities in order to accommodate his/her own needs (Sabattini et al., 2017).

One of the main activities in HCI is evaluation of computer interfaces with a view to understand and support human beings interacting with and through technology (McNamara and Kirakowski, 2006; Issa and Turk, 2010; Lazar, Feng and Hochheiser, 2017). HCI should not concentrate exclusively on effectiveness and efficiency but also consider user experience and satisfaction (Frich, Biskjaer and Dalsgaard, 2018). HCI has extended as far as trying to solve pertinent human community issues in the areas of Human Computer Interaction for Development (HCI4D), which is a derivative of Information and Communication Technologies for Development (ICT4D) but focusing on HCI technology (Ho et al., 2009; Kumar et al., 2016). ICT4D refers to the use of ICT in solving societal matters such as economic, social and political issues with emphasis on the poor and marginalised communities on a global scale (Walsham, 2017; Venkatesh, 2018).

2.3.2 Interaction design

The main focus of Interaction design (ID) is to develop usable interactive products that are easy to learn, effective to use and provide an enjoyable user experience. ID is concerned with identifying user needs and the context of their activities and using these to design usable, useful, and pleasurable interactive products. ID studies are included in a number of fields including HCI, graphic design and the film industry. Designers need to have a keen perception regarding characteristics of users, technology and interactions in order to design effective user experiences (Hartson and Pyla, 2012; Preece, Rogers and Sharp, 2015).

One of the early models in interaction design in relation to computer systems was proposed by Shackel (1991). Shackel proposed an interaction framework, depicted in Figure 2.6, consisting of four principal components that exist in any system comprising technology and human users.

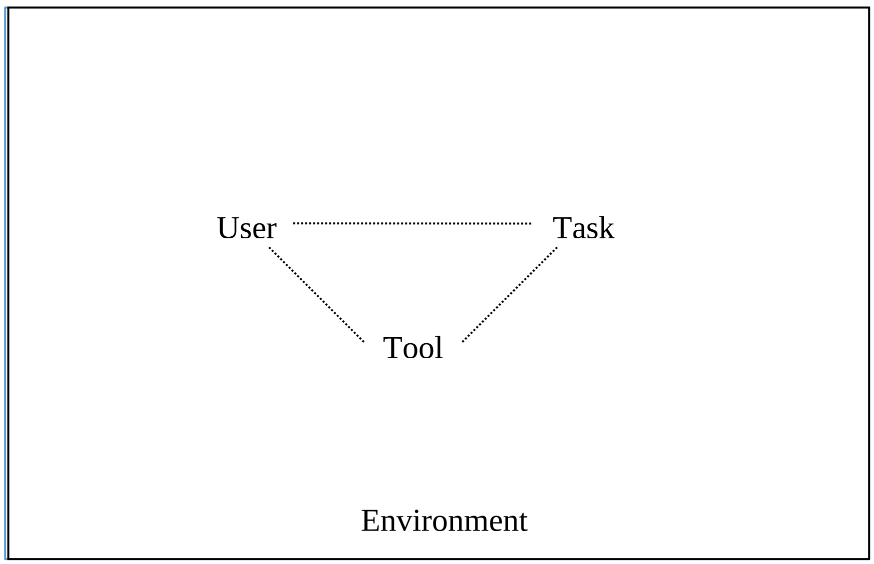


Figure 2.6: The four principal components in a human-machine system (Shackel, 1991)

The components of the framework are the *user, task, tool* and *environment*. In HCI the *tool* refers to the computer system, both hardware and software, and the *task* refers to the processes, such as writing an email that a *user* can perform with the computer system. All this is done within a particular context, the *environment* (Shackel, 1991; Kurosu, 2015).

In the framework, the tool, with respect to HCI, is a computer-based product, for example, a desktop, laptop, mobile phone or Tablet or IPad. Designing usable interactive computer products requires knowledge of who will use them (user), what they be doing (task) and where they will be used (environment). These three are discussed in the next subsections.

2.3.2.1 User analysis

User analysis, according to Shneiderman (1998), requires understanding of the intended users, including age, gender, physical abilities, education, culture, training, motivation, goals and personality. These factors can assist the designer in determining whether the user is a novice, knowledgeable or an expert. After performing user analysis, task analysis must be done.

2.3.2.2 Task analysis

Preece et al. (2015) describe task analysis as the process of eliciting descriptions of what people do, representing those descriptions, predicting difficulties and evaluating systems against criteria such as usability or functional requirements. Task analysis is concerned with what people do to get things done. Tasks should be designed so as to be meaningful and desirable to the user.

2.3.2.3 The environment

The main goal of interactive system design is to focus the design on the users, the tasks they must perform, and the environment in which they will work. Good interaction design should result in efficient and effective systems to satisfy user needs within a specified context of use.

2.3.3 User-centred design/Human-centred design

The need to involve users and fully explore their needs and desires in the context of use evolved in the field of UCD. UCD requires that users are involved from the early stages of the development of a software product through to the end. The degree to which users are involved varies from relatively low, where they are consulted about their needs or they are observed or participate in laboratory testing, through to intensive involvement where they participate throughout the development process as partners in the design. Normally, ideas are collected from a few representatives, especially during the early design of the system since it may not be possible to involve all users. The extreme end of UCD is participatory design where users are involved in the development of a product, serving as co-designers of the system (Abras, Maloney-krichmar and Preece, 2004; Giacomin, 2014; Van der Bijl-Brouwer and Dorst, 2017).

A seminal paper on UCD was written by Abras, Maloney-Krichmar and Preece in 2004. They describe UCD as “a general term for philosophy and methods which focus on designing for and involving users in the design of computerised systems” (Abras, Maloney-krichmar and Preece, 2004, p. 12). They used the terms ‘philosophy’ and ‘methods’ and the phrase ‘designing for and involving users’. These concepts indicated that there was a need for a paradigm shift for software developers to consider users as co-designers rather than just as recipients of the end product. The aim was to develop more acceptable and usable satisfying designs that result in positive user experience (Lallemand, Gronier and Koenig, 2015). Consequently, according to Lallemand, Gronier and Koenig (2015, p. 30), “usability and UX are both considered part of user-centred design”. This means that studies that seek to evaluate usability or user experience should consider the issues that underpin UCD.

The term user-centred design was popularised by Don Norman in the 1980s, particularly after the publication of his book entitled *User-centered system design: a new perspective on Human Computer Interaction* in 1986 (Norman, 1986). Norman (1986) provides the following recommendations on designing usable systems:

- Make it easy to determine what actions are possible at any moment.
- Make things visible, including the conceptual model of the system, the alternative actions and the results of actions.
- Make it easy to evaluate the current state of the system.
- Follow natural mappings between intentions and the required actions; between actions and the resulting effect; and between the information that is visible and the interpretation of the system state.

If UCD is not used, it could lead to ill thought-out designs where user-expectations are not met. This leads to frustrated system users. UCD processes emphasise the incorporation of users’ perspectives into the software development process in order to achieve usable systems with an acceptable level of user experience (Abras, Maloney-krichmar and Preece, 2004; Wilson et al., 2018).

Giacomin (2014) and Lallemand, Gronier and Koenig (2015) use the phrases user-centred design and human-centred design (HCD) interchangeably. This approach is adopted in this research. However, HCD is the preferred term in the present research, since it emphasises that the design is not based on 'just' any human being but on the individual (human) who uses the system.

ISO 13407, revised to ISO 9241-210 in 2006, is a standard framework for human-centred design for interactive systems and is complementary to ISO 9241, which is discussed in Sections 2.4.1.1 and 2.4.1.2. The key principles of HCD are (Preece, Rogers and Sharp, 2015; Van der Bijl-Brouwer and Dorst, 2017):

- The active involvement of users and a clear understanding of user and task requirements.
- An appropriate allocation of functions between users and the system.
- Iteration in the development of design solutions and ensuring that there is active involvement between users and developers during the iterations.
- Deployment of multi-disciplinary design teams.

With respect to the use of multi-disciplinary design teams, UCD teams usually have an interdisciplinary approach, recruiting experts from other disciplines such as psychology, sociology and anthropology in order to help the team in its understanding of user needs (Abras, Maloney-krichmar and Preece, 2004; Agosto et al., 2015).

This research seeks to develop a model for evaluation of e-service quality, usability and user experience (e-SQUUX). It is important to take into account the principles and processes of HCD during the determination of the dimensionality of e-SQUUX. Secondly, HCD highlights the need to involve actual users to provide their requirements during system development and evaluation. This approach should be used in determining the dimensions and items required for the e-SQUUX evaluation model.

2.4 Usability, user experience and e-service quality: an overview

The upcoming subsections provide an overview of e-service quality, usability and user experience, the three facets that comprise the main components of the e-SQUUX Model. The subsections include various definitions and/or dimensions. These, plus others from various sources, will be used in the conceptualisation of an integrated e-SQUUX Model which is described in Chapter 4.

In this study, the researcher aims to determine the components that, in turn, constitute these core facets of usability, e-service quality and user experience for Web-based applications in an integrated form. As stated in Section 1.8.2.1, these components include varying definitions, principles, guidelines and criteria of the facets. The upcoming subsections address these three core facets. It is often the custom that such sections conclude with the researcher's personal view of what that concept entails. However, due to the fact explicated above that this work sets out to determine issues such as definitions and criteria of the three, such personal consolidated definitions (which tend to be over-simplifications) are not included in this thesis document.

2.4.1 Usability

2.4.1.1 Usability definition according to ISO and other standards

Standards for HCI, usability and user experience are developed under the auspices of the International Organisation for Standardisation (ISO), the International Electrotechnical Commission (IEC) or the Institute of Electrical and Electronics Engineers (IEEE). In 1991, usability was described as one of the components of the software quality model in software engineering, ISO 9126. Later, in 1998, usability was proposed as one of the parts of the ISO/IEC 9241, which deals with ergonomics of Human Computer Interaction. The ISO 9241, ISO 9126, and other standard models are discussed in the context of usability in the next three subsections.

2.4.1.2 Usability according to ISO 9241

ISO 9241 is a multi-parts standard that was in 1998 originally named ergonomic requirements for office work with visual display terminals (VDTs) and has since 2006 been renamed ergonomics of Human Computer Interaction (ISO 9241-11, 1998; Bevan, 2006). There are slightly varying definitions of the inherent components of usability. Part 11 of this ISO specifically deals with usability and defines usability as "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." (ISO 9241-11, 1998). Effectiveness is considered to be the accuracy and completeness with which users achieve specified goals, efficiency refers to the resources expended in relation to the accuracy and completeness with which users achieve goals, and satisfaction relates to the comfort and acceptability of use. Satisfaction is usually determined after the actual use of a system (ISO 9241-11, 1998; Bevan, 2006; Toshihiro, 2008; Rasila, Rothe and Kerosuo, 2010; Bevan, Carter and Harker, 2015; Barnett, Harvey and Gatzidis, 2018; Kous et al., 2018).

The 9241-11 standard considers usability from the perspective of a product's use by describing the level with which a product adapts to the user needs and how well it can be used to achieve the goals with effectiveness, efficiency and satisfaction in a specified context of use. This approach can be described as "usability in utilisation" (Montero, Lozano and Gonzalez, 2008, p. 226) or as a process-oriented (Abran et al., 2003) definition of usability where usability provides the final goal or main design objective. The main focus of the process-oriented definition is that the software meets users' needs. From the process-oriented perspective, the three ISO 9241-11 dimensions of usability are described more specifically and in detail as follows (Abran et al., 2003; Montero, Lozano and Gonzalez, 2008; Rasila, Rothe and Kerosuo, 2010; Bevan and Raistrick, 2011; Lee, Grogan and Weck, 2012; Kous et al., 2018):

- Effectiveness means that the product has clear objectives that should be reachable. The designer must make sure that the product has explicit goals to be reached and check whether the user can accomplish the goals with a product. User-success rate during task performance is normally used to measure the effectiveness of a product.
- Efficiency is dependent on the user's skills and the software capabilities. This requires the study of different types of users. It is difficult to measure efficiency directly but it can be measured using factors such as the user's ease of learning and

remembering, resources used in the process, feedback level during interaction, control of errors, and time taken to complete tasks.

- Satisfaction is a subjective state that is reached when the user achieves the goals of his/her activities and does so in a satisfactory way.

Other aspects of the ISO 9241-11 include:

- The ISO 9241-11 view of usability can be considered as a black-box view since it focuses on what is achieved rather than how it is achieved (ISO 9241-11, 1998; Bevan, 2006; Balapour and Walton, 2017).
- According to Rasila, Rothe and Kerosuo (2010), the ISO 9241-11 standard ties usability to three aspects, namely, the user, the operating environment and the context in which a product is used. The analysis of how the three are related is very similar to that by Shackel (1991) which was discussed in Section 2.3.2 using Figure 2.6. As time passed and technology developed, the conceptualisation of context of use, as it relates to usability, emerged (Coursaris and Kim, 2006; Yahya and Razali, 2015).
- ISO 9241-11 can be used in procurement, design, development, evaluation, and communication of information about usability. This is one of the main advantages of using usability standards (Montero, Lozano and Gonzalez, 2008; Preece, Rogers and Sharp, 2015).
- The ISO 9241 was revised in 2010 to ISO 9241-210, which explicitly states that *usability* and *user experience* converge since there is an overlap between the two. This means that usability may or may not be distinguished from user experience (ISO 9241-210, 2010; Taylor and Hertzum, 2010; Hertzum and Clemmensen, 2012).
- According to Bevan, Carter and Harker (2015) there is a proposal to revise the ISO 9241-11 standard further. The intended revision emphasises that, first, the satisfaction part of usability should include aspects of user experience. Second, the word ‘products’ should be replaced by ‘products, systems and services’ since the concept of usability applies equally well to these categories. Third, the ‘context of use’ must be made clearer by specifying whether the context is according to an

individual or a group of individuals, and whether it refers to a specific environment or to general use. According to Quinones, Rusu and Rusu (2018) and Bevan et al. *(*2018) these efforts are still ongoing.

2.4.1.3 Usability according to ISO 9126

ISO/IEC 9126-1 defines a quality model that comprises six characteristics and 27 sub-characteristics of software product quality, with usability being one of the six. The other characteristics are functionality, reliability, efficiency, maintainability and portability. These five are described in various sections of this research.

The early definition of usability, the ISO 9126 standard, defines it as the capacity of a software product to be understood, learned, used and be attractive for the user when it is used under certain conditions (ISO/IEC 9126-1, 2001; Kabir and Han, 2016). Alternatively, usability is defined as a set of attributes that bear on the effort needed for use, and on the individual assessment of such use, by a stated or implied *set of users* (ISO/IEC 9126-1, 2001; Seffah et al., 2006). Abran et al. (2003) describe this definition as a product-oriented approach since usability is considered to be part of a detailed software design activity and is a component of software quality. The ISO 9126 standard specifies usability using the following measurable attributes:

- Understandability: The capability of the software product to enable the user to understand whether the software is suitable, and how it can be used for particular tasks and conditions of use.
- Learnability: The capability of the software product to enable the user to learn its application.
- Operability: The capability of the software product to enable the user to operate and control it.
- Attractiveness: The capability of the software product to be attractive to the user, for example, by use of colours during graphical design of software applications.

The ISO 9126 is sometimes considered a narrow definition of usability since it considers usability as a software quality and gives a definition in terms of attributes of a product (Bevan and Macleod, 1994). The ISO 9126 is in the process of being replaced by the

ISO/IEC 250mm standards such as the ISO/IEC 25010 that has eight quality characteristics compared to the six in 9126 and 31 sub-characteristics compared to the 27 (ISO/IEC 25010:11, 2011). If one has to choose from the existing standards, the choice should be between ISO 13407 and ISO 9241-210 as these provide high-level frameworks for usability work (Bevan, 2009).

2.4.1.4 Usability definition according to researchers and practitioners

Over and above international standard organisations, various researchers and practitioners have, over time, made efforts to define usability. The main aim has been to try to achieve a more meaningful understanding of what usability entails or to define it in such a way that it is easier to measure or quantify.

Early attempts of defining usability

Miller was one of the first researchers to define usability in terms of "ease of use' in 1971. However, the formal definition of usability was first presented by Shackel in 1981 and expanded by Bennett in 1984 (Miller, 1971; Bennett, 1984; Shackel, 1991). Shackel's definition of usability is that for a system to be usable, it should have the following dimensions (Shackel, 1991; Folmer and Bosch, 2004):

- Effectiveness: performance in accomplishment of tasks.
- Learnability: the degree of learning required in order to accomplish tasks.
- Flexibility: adaptation by users to variation in tasks.
- Attitude: the degree of user satisfaction with a system.

Nielsen's definition of usability

Perhaps the most significant definition after Shackel's in 1981, was the classic definition by Nielsen in 1993. Nielsen (1993) defined usability in terms of five dimensions:

- Learnability: how easy it is to learn the functionality and behaviour of a system.
- Efficiency: the level of attainable productivity once the user has learned how to use the system.
- Memorability: the ease of remembering and recognising the system functionality after a period of non-use.

- Few errors: capacity of a system to feature a low error rate, to minimise the number of errors and to help users recover once they have made errors.
- User satisfaction: the level at which the user finds the system pleasant to use.

The definition or framework of usability by Nielsen is the most widely adopted and cited, since it provides a detailed model in terms of usability aspects that can be objectively and empirically verified through different evaluation methods (Matera et al., 2008; Joo and Lee, 2011; Kous et al., 2018). Nielsen's model in terms of measurable constructs can be presented as (Nielsen, 1993; Matera et al., 2008; Yahya and Razali, 2015; Kous et al., 2018):

- Ease of learning – How fast can a user who has never seen the user interface before learn it sufficiently well to accomplish basic tasks?
- Efficiency of use – Once an experienced user has learned to use the system, how fast can he/she accomplish tasks?
- Memorability - If a user has used the system before, can he/she remember enough to use it effectively the next time or does the user have to relearn it?
- Error frequency and severity – How often do users make errors while using the system, how serious are these errors, and how do users recover from these errors?
- Subjective satisfaction – How much does the user like using the system?

ISO 9241 and Nielsen's definitions are the two most widely cited with Nielsen's definition being the most widely known and used, and the ISO 92412-11 definition being the most commonly accepted (Folmer and Bosch, 2004; Rasila, Rothe and Kerosuo, 2010; Kous et al., 2018).

To better understand and apply Nielsen's principles, Folmer and Bosch (2004) interpret them as follows:

- Learnability: Systems should be easy to learn. Users can rapidly start getting some work done with the system.
- Efficiency: Systems should be efficient to use. When a user has fully learned the system, productivity will be possible on a high level.

- Memorability: Ways of using the system should be easy to remember, making it possible for casual users to return to the system after some period of non-use, without having to relearn everything.
- Errors: The system should result in a low error rate, so that users make few errors during system use. When errors are made, users should be able to easily recover from them. Where possible, a system should prevent any critical or catastrophic errors.
- Satisfaction: The system should be pleasant to use, in order to subjectively satisfy users.

Shneiderman's definition of usability

Closely related to the definition of usability by Nielsen, is the definition by Shneiderman (1998) who defined usability using what he called 'five measurable factors central to evaluation of human factors goal'. The main difference between the two is that Shneiderman's usability factors are:

- Speed of performance.
- Time to learn.
- Retention over time.
- Rate of errors by users.
- Subjective satisfaction.

Other usability definitions over time

Apart from the definitions by Shackel, Nielsen and Shneiderman, certain other definitions have been put forward over time. For example:

- Bevan (1995): Usability is quality in use.
- Abran et al. *(*2003): A comprehensive model of usability, referred to as enhanced usability model, should include both process- and product-related usability attributes, the most basic being effectiveness, efficiency, satisfaction, learnability and security.

- Microsoft (2009): Usability defines how well the application meets the requirements of the user and consumer by being intuitive, easy to localise and globalise, providing good access for disabled users, and resulting in a good overall user experience.
- usability.gov (2012): Usability is the measure of the quality of a user's experience when interacting with a product or system – whether a website, a software application, mobile technology, or any user-operated device.
- Rahman and Ahmed (2013): Usability refers to an approach to make a system easy to use and learn without any requirement for training.
- Quinones (2018:109): Usability is the “capability of being used”.
- The definitions by Microsoft and by Rahman and Ahmed show that as time went by, usability started to be related to user experience.

The different definitions over time emphasise the notion that there is no single fixed definition of usability and that it can be described in several ways, as suggested by Rasila, Rothe and Kerosuo (2010) and Kabir and Han (2016). There are a number of recurring themes, such as ease of recall, ease of learning, minimal errors, high performance (speed) and user satisfaction, as well as the ability of a product or system to effectively and efficiently fulfil the needs and specifications of users. Good usability is essential to user satisfaction and user acceptance of a product or system. Fundamentally, it is the measure of the quality of interaction with a product or system (Nielsen, 1993; Dumas and Redish, 1994; Yahya and Razali, 2015; Kabir and Han, 2016). According to Coursaris and Kim (2006) even though there are numerous definitions, the central theme of usability is to determine the ease with which people can employ a particular technology artefact in order to achieve a particular goal.

Finally, in his article on the different types of usability, titled ‘Images of usability’, Taylor and Hertzum (2010) identified six types (images) of usability. He emphasised the need to consider the different types when analysing usability. These ‘images’ or types are:

- Universal usability: entails embracing the challenge of making a system that is suitable for use by everybody.

- Situational usability: usability is equivalent to the quality-in-use of a system in a specified situation with specified users for a required task in a specific context of use.
- Perceived usability: this corresponds to a user's subjective experience or satisfaction with a system.
- Hedonic usability: this refers to joy of use, task accomplishment and freedom from discomfort in using a system.
- Organisational usability: this is related to usability found in a system that is used in a collaborative situation by a group of people in an organisational setting.
- Cultural usability: usability has different meanings in different cultures.

It is important that the aspects of usability that have been described in this subsection are not ignored during usability evaluation and modelling for they influence the understanding and application of this concept. Secondly, these aspects can be used in different contexts such as when considering usability of Web-based applications or University web portals, as is the case in this research.

2.4.2 User experience

User experience (UX) is more recent in the HCI domain (McNamara and Kirakowski, 2006; McGarry and McDonald, 2017). The phrase 'user experience' was coined in 1995 by Don Norman and refers to a multidimensional concept whose definition is not yet fully established (Agarwal, Meyer and Alto, 2009; Kujala, Roto, Väänänen-Vainio-Mattila, et al., 2011; Hassenzahl et al., 2015). According to Hassenzahl et al. (2015, p.530), "We are far from a common accepted definition of what user experience could or should be". UX attempts to go beyond traditional usability by including aspects such as beauty, fun, pleasure and personal growth associated with the use of a product. A key term for UX is enjoyability (Borsci et al., 2015). ISO CD 9241-210 defines UX as "all aspects of the user's experience when interacting with the product, service, environment or facility" (ISO 9241-210, 2010). Preece et al. (2015) describe UX as the sensation obtained by users while interacting with a product, as well as the pleasure and satisfaction, or the reverse, that they acquire during its use.

For some, user experience and usability have become synonymous, but not identical. UX addresses how a user feels when interfacing with a system, while usability relates to the user-friendliness, effectiveness and efficiency of the interface (Borsci et al., 2015). User experience comprises two main dimensions, namely the pragmatic quality and the hedonic quality. Pragmatism refers to the product's perceived ability to support the achievement of 'do-goals', such as 'making a telephone call', 'finding a video on the Internet', 'creating a website' or some other tasks. On the other hand, hedonics refers to the product's perceived ability to support the achievement of enjoyability and 'be-goals', such as 'being competent', 'being social with others', and 'being highly regarded' (Hassenzahl, 2007; Park et al., 2014; Minge and Thüring, 2018; Riedmann-streitz, 2018).

UX plays a major role in contributing to experiences that are effective and pleasant, although psychology, the science of human factors, information architecture, and the application of user-centred design principles also play major roles (Gube, 2010). According to Walker (2012), usability is the ease with which people can use a particular tool or human-made object to achieve a particular goal, while UX is the experience a person has while he/she interacts with a product or service. UX focuses on well-being of the user, but not on performance, as an outcome of the interaction. Although usability emphasises the need for efficiency in order to gain time during performance of tasks, recent studies indicate that technology use in itself can be pleasurable. The feelings and the experience that individuals acquire from the use of a product or service is part of the motivation for using and reusing a specific technology (Hassenzahl et al., 2015; Kocaballi et al., 2018).

Although some efforts have been made in measuring user experience, for example, the AttrakDiff model (Hassenzahl, 2007) and the User Experience Questionnaire (Laugwitz, Held and Schrepp, 2008), to date, no comprehensive framework exists for analysing the UX of a system or application. However, UX can contribute to the following states of a person: inspired, alert, excited, enthusiastic, determined, afraid, upset, nervous, scared or distracted. Similar to 'affect', UX is associated with an individual feeling good, happy, satisfied, or the opposite, as a result of interacting with a product (Wright, Mccarthy and

Marsh, 2001; Hassenzahl, 2008; Schaik et al., 2008; Hassenzahl et al., 2015). "User experience explores how users feel about using a product, that is, the affective aspect of a product use" (Obrist et al., 2010, p. 3197).

Researchers and practitioners are seeking ways of designing interactive products that accommodate experiential qualities of technology use, rather than merely product qualities. Most agree that UX is a dynamic, highly context-dependent and subjective account of human-technology interaction (HTI) or human-product interaction (HPI), both of which are related to HCI. UX is influenced by factors such as needs, thoughts, desires and goals. It is important for users to have a positive experience and this can only be achieved if there is fulfilment of user-needs (Moczarny, De Villiers and Van Biljon, 2012). UX is dynamic because it changes over time. Human needs as described in Maslow's hierarchy of needs (physiological, safety, love/belonging, esteem and self-actualisation) (Maslow, 1943) and needs as outlined more recently in the self-determination theory (autonomy, competency and relatedness) (Deci and Ryan, 1985) play a major role in UX of a product or service (Partala and Kallinen, 2012; Lallemand, Gronier and Koenig, 2015; Partala and Kujala, 2016).

Research shows that UX is highly influenced by the context in which it occurs, since context determines how people behave in particular situations (Obrist et al., 2010; Lallemand, Gronier and Koenig, 2015). Dourish (2004) and Ardito et al. *(*2014) describe context as any information that can be used to characterise the situation of an entity, where an entity is a person, place, or object that is considered relevant to the interaction between a user and an application. Understanding of contextual experiences shapes product-developers' understanding of a user's interactions with complex interactive systems (Obrist et al., 2010; Hassenzahl et al., 2015).

Although UX is still a relatively young concept, it has a significant influence on the development of technology products. In software development, the main focus is UX design and evaluation (Partala and Kallinen, 2012). As indicated previously, UX is also related to user-centred design, since the UX software development teams usually follow a user-centred approach during the design, development and evaluation of software products (Rosenbaum et al., 2002; Lallemand, Gronier and Koenig, 2015). In fact, Moczarny et al. (2012) suggest that UX should be grounded in user-centred design practices.

In order to understand UX, one needs knowledge from other disciplines such as marketing, ethnography, interaction design, information design, technical writing and visual design (Sward, 2006; Moczarny, De Villiers and Van Biljon, 2012). For example, according to Preece et al. (2015), UX is a central concept in interaction design. However, it is important to note that "one cannot design user experience, only design for a user experience" (Preece, Rogers and Sharp, 2015, p. 15).

It is important that the aspects of user experience that have been described in this subsection (2.4.2) are not ignored during user experience evaluation and modelling, for they bear an influence on understanding and applying this concept. Secondly, these aspects can be used in different contexts such as when considering user experience of Web-based applications or University web portals as is the case in this research.

Perhaps one of the best quotations acquired in the present research on summaries of what user experience is, and how it relates to usability and functionality, is that by one of the founding gurus of user experience, Marc Hassenzahl:

> *"We currently witness a growing interest of the* Human Computer Interaction *(HCI) community in user experience. It has become a catchphrase, calling for ... concepts, such as fun, joy, pleasure, hedonic value or ludic value. ... a product should no longer be seen as simply delivering a bundle of functional features and benefits—it provides experiences. Customers want products that dazzle their senses, touch their hearts and stimulate their minds. ..., we are far from having a coherent understanding of what user experience actually is. "*(Hassenzahl, 2018, p. 1).

2.4.3 Service quality and e-service quality

Before e-service quality is considered, it is important to grasp some of the critical aspects of service quality since it is a key success factor of any organisation in providing quality services to its customers or stakeholders (Vashishth and Chakraborty, 2018). The next two subsections deal with service quality and e-service quality, respectively.

2.4.3.1 Service quality

Service quality (SQ) is the ability of an organisation to meet the needs, wants and expectations of a customer. It is therefore dependent on the customer perceptions over time based on past experience, the service process and service delivery (Strawderman and Koubek, 2008; Mmutle and Shonhe, 2017). According to Sun, Teh and Chiu (2012), the most agreed upon definition of service quality is the classic definition by Parasuraman, Zeithaml and Berry (1988) who define SQ as the measure of the difference between customers' expectations and actual service performance. Specifically, Parasuraman, Zeithaml and Berry (1988) and Zeithaml, Parasuraman and Berry (1990) define service quality from a customers' perspective as the extent of discrepancy between customers' expectations or desires, and their perceptions. This definition led to the development of SERVQUAL, the most used SQ quality model and instrument for measuring service quality. SERVQUAL is a multi-item scale developed initially to assess customer perceptions of service quality in service and retail businesses (Parasuraman, Zeithaml and Berry, 1988; Kundu and Datta, 2014). Since SERVQUAL was determined by using the difference between perceptions and expectations, it is known as the gap model. The advantages of using a gap approach is that it provides actionable information by pinpointing which areas of the service are below customer expectations (Pinhanez, 2007; Corkindale, Ram and Chen, 2018). The SERVQUAL model, one of the theoretical models on which this research is based, is discussed in detail in Section 2.2.4. A number of tools have been proposed to measure service quality, especially in the electronic commerce (e-Commerce) arena, many of which are based on SERVQUAL. These are discussed in Section 2.4.3.2.

Services consist of technical and functional outcome components. The technical outcome is that which is delivered to the consumer and is known as the "what' component of the service. The functional outcome is the 'how' component and refers to the service delivery process (Strawderman and Koubek, 2008; Marchiori, Mainardes and Rodrigues, 2017).

Some of the main characteristics of service and service quality are (Zeithaml, Parasuraman and Berry, 1990; Tate et al., 2007; Strawderman and Koubek, 2008; Kundu and Datta, 2014; Marchiori, Mainardes and Rodrigues, 2017; Vashishth and Chakraborty, 2018):

- Services are intangible since they are performances and experiences rather than objects that can be touched or held.
- Production and consumption of most services are inseparable since there is no way to make a service, inspect it, fix it and deliver it to a customer. "The customer is present while the service is being produced" (Strawderman and Koubek, 2008, p. 455).
- Services are heterogeneous since they vary from producer to producer, customer to customer, and from day to day. There are no services instances that are identical, since each instance depends on who the service provider and consumer are and what time the service is delivered.
- Service quality assessment tools need to be customised to different domains. In addition, the nature of service is continuously changing.
- Service quality is more difficult for consumers to evaluate than goods quality.
- Customers do not only base their evaluation of quality on the outcomes of a service but also consider service delivery.
- The only reliable judgment of service is by customers. Other judgements are irrelevant.

In relation to the statement that service quality assessment tools need to be customised to different domains, Owlia and Aspinwall (1996) refer to service quality in a higher education institution as serviceability. They define it as "How well an institution handles customers' complaints" (Owlia and Aspinwall, 1996, p. 14). This can be understood as how effectively an institution handles student, staff and other stakeholders' queries.

It has been suggested that superior quality yields increased savings and enables the organisation to grow, since quality efficiencies develop the organisation and create customers (Zeithaml, Parasuraman and Berry, 1990; Paschaloudis, 2014).

2.4.3.2 e-Service quality

With the seamless advances in digitised technology across the world, the Internet has become an indispensable part of many people's daily activities. This has made website quality a major area of interest for both website users and designers. Website quality, also known as web-based, online or electronic service quality (e-SQ), is defined as the extent to which services based on web technology facilitate effective and efficient online communications, purchases and delivery of product or services (Zeithaml, Parasuraman and Malhotra, 2002; Bressolles and Nantel, 2004; Stamenkov and Dika, 2015). It is also considered to be the extent to which a website supports efficient and effective online transaction and delivery of products and services (Parasuraman, Zeithaml and Malhotra, 2005; Marimon et al., 2010; Marchiori, Mainardes and Rodrigues, 2017). In this research, the phrases website quality, electronic service quality and online service quality will be used interchangeably, with electronic service quality (e-SQ) dominating frequency of use.

The biggest difference between traditional service quality and electronic service quality is the replacement of interpersonal interaction with Human Computer Interaction in the context of web-based services. Traditional service quality refers to the quality of all non-Internet-based customer interactions and experiences with companies or any other organisation. e-Service quality should take into account software-, information- and service quality, since it is not easy to differentiate website quality from these three when referring to websites or web-based services (Kelly and Vidgen, 2005; Parasuraman, Zeithaml and Malhotra, 2005; Paschaloudis, 2014; Palese and Usai, 2018).

Some of the issues about website service quality that have arisen over the years, include the following (Zeithaml, Parasuraman and Malhotra, 2002; Carrasco et al., 2017; Javed, 2018; Palese and Usai, 2018):

- Although online-service quality is a widely studied concept, its dimensions and items vary in the work of different authors.

- Website quality does not focus on technical qualities, but rather on service quality.
- Online services should not only be cost and time saving, but also superior to alternative services.
- Online service quality is a key factor for an organisation's success in the medium to long term, since it is very difficult for competitors to imitate.

Managers of organisations with web presence must first understand how customers perceive and evaluate online customer services. To do this, electronic service quality must be defined by identifying its underlying dimensions, and how it can be conceptualised and assessed (Zeithaml, Parasuraman and Malhotra, 2002; Zhou et al., 2018). Researchers and practitioners have suggested a number of dimensions that constitute e-SQ. This has resulted in a growing number of models and related instruments/scales for measurement of perceptions of e-SQ. Table 2.2 shows the e-SQ dimensions from various sources and the associated instruments or models that are part of the present research. The sources are listed sequentially according to date of publication. Most of these instruments originate from SERVQUAL developed by Parasuraman and his colleagues in 1998, as discussed in Section 2.2.4, and now one of the most adopted instruments for measuring service quality. For example, Table 2.2 shows that in 2000, Zeithaml, Parasuraman, and Malhotra developed e-SERVQUAL, comprising ten dimensions, namely reliability, responsiveness, access, flexibility, ease of navigation, efficiency, assurance/trust, security/privacy, site aesthetics, and customisation/personalisation.

Table 2.2 shows that usability (or ease of use) of the website, responsiveness (performance or speed), accessibility, and security and trust are the most frequently listed dimensions inside the table. These are therefore some of the major factors to consider in delivering excellent electronic service quality. However, according to Kincl et al. *(*2012), the highest- level quality components of any website are content and service. All the dimensions in the table are related to one or both of them.

Table 2.2: e-Service quality dimensions, models and scales

Source	**Dimensions**	**Instrument or model if any**
Barnes and Vidgen (2004)	Usability, Information Quality & Service Interaction	Webqual
Parasuraman, Zeithaml and Malhotra (2005)	Reliability, Responsiveness, Access, Flexibility, Ease of Navigation, Efficiency, Assurance/Trust, Security/Privacy, Site Aesthetics & Customisation/Personalisation	e-SERVQUAL
Parasuraman et al. (2005)	Efficiency, System Availability, Fulfilment & Privacy	E-S-QUAL
Yang et al. (2005)	Usefulness of Content, Adequacy of Information, Usability, Accessibility, Privacy/Security & Quality of Interaction	(for web portals)
Tate et al. (2007)	Usability, Information Quality, Service & Interaction Quality	E-QUAL
Matera et al.(2008)	Effectiveness Measures (Completeness And Accuracy), Efficiency Measures (For Individuals Or Group) & Satisfaction Measures	-
Kincl et al. *(*2012)	Relevance, Up-To-Datedness, Accuracy & Completeness	-
Saha et al. (2012)	Websites Should Have Search Facilities, Good Navigation & Functionality	-
Cebi (2013)	Usability, Technical Adequacy, Content, Security, Communication, Prestige, Ease of Use, Ease of Learning, Memorability, Layout, Graphics, Text, System Availability, Speed, Accessibility, Navigation, Reliability, Accuracy, Privacy, Contact Info, Online Help, Responsiveness Reputation, Sustainability & Currency	-
Chen and Chengalur-Smith (2015)	Responsiveness, Fulfilment, Usability/Intuitive Operations, Contact & Support Materials	-
Ayo et al. *(*2016)	Reliability, Responsiveness, Availability, Competence, Security/Privacy & Service Portfolio.	-
Sari, Alamsyah and Wibowo (2018)	Reliability, Personalisation, Responsiveness, Trust & Web Design	-

The table also shows that in recent years since 2013, navigation, and privacy and currency of information have become very important, emphasising the position that perceptions of quality change with time.

In investigating website quality, once dimensions are identified, evaluation or measurement of e-SQ can be undertaken. There are two main methods for measuring the quality of electronic services (Bressolles and Nantel, 2004; Zhou et al., 2018):

- Behavioural measures: these deal with measurement of technical activities such as number of clicks, number of unique visitors, and analysis of log files.
- Attitudinal measures: these use measurement scales that evaluate the perception of customers or use experts to measure the perceptions. This is normally done by questioning the customers after their interaction with the site, usually by use of interviews or questionnaires.

Just as in the case of usability and user experience, it is important the aspects of e-service quality (e-SQ) that have been described in this subsection (2.4.3.2) are not ignored during e-service quality evaluation and modelling, for they have an influence on understanding and applying this concept. Secondly, these aspects can be used in different contexts such as when considering e-service quality of Web-based applications or University web portals as is the case in this research.

2.4.4 Benefits of high positive levels of e-service quality, usability and user experience to systems

From the discussion in the last three subsections (3.4.1 – 3.4.3), the main challenges of defining each of the three facets of e-SQUUX can be summarised as follows:

- They are multi-dimensional/multi-faceted concepts that are not easy to ‘nail down’.
- They consist of both objective and subjective aspects.
- There is no uniform definition of each concept.
- Different researchers and practitioners operationalise them differently.
- The definitions evolve with technology developments and with time.

- They are context-dependent, since the manner in which they are used depends on the user and the context of use.
- There is an overlap between the three facets.

Despite the challenges, companies such as Apple, IBM, Microsoft, Nokia, Samsung and Xerox have gained advantages from designing web and mobile systems with well-considered features of e-service quality, usability and user experience. This has resulted in benefits for their customers, including increased sales, reduction in costs, boosted labour productivity, less time taken in training staff, and reduced user errors. In addition, the cost of system development, maintenance and support decreases. Another advantage is that appropriate levels of e-service quality, usability and user experience boost an organisation's corporate image and affect clients' willingness to engage with the organisation's system. For example, good usability increases the speed and accuracy of users, consequently increasing their productivity. The 'look and feel' of the software also affects the success of commercial software. On the other hand, poor usability results in user frustration, discourages exploration and wastes users' time (Matera et al., 2008; Issa and Turk, 2010; Alexander et al., 2017). Another example, according to Marchiori, Mainardes and Rodrigues (2017), is that high levels of e-service quality result in better functioning as well as improved performance of an organisation.

2.5 Web-based applications and web portals

2.5.1 What are Web-based applications?

Web-based applications are software applications that use web technologies such as browsers to run, whether on fixed or mobile computing devices (Fowdur, Hurbungs and Beeharry, 2016). In addition to software that runs on traditional (PC or Mac) computer-based web applications, the definition includes mobile applications (Apps) that run on mobile operating systems such as Android or iOS. However, in general, WBAs refer more specifically to the traditional computer-based web applications, which are the focus of this research, even though most of the e-SQUUX evaluation issues for these applications apply to mobile applications (Apps) as well. However, Apps are downloaded to the mobile device and may not need the Internet to run. Nonetheless, sometimes Apps are described as Web-based applications on mobile devices (Fowdur, Hurbungs and Beeharry, 2016). As such, the current research includes literature reviews of publications related to mobile applications. However, the present research excluded certain mobile device limitations such as those related to small screen sizes and low display resolutions as identified by Moumane et al. (2016), Nielsen (2011)and Zahra, Hussain and Mohd (2017).

There has been increasing research on Web-based applications in the field of HCI due to the need for delivering usable web products and services that provide positive user experience. Over time, website functionality has moved from static formats to transaction processing with online transactions becoming a dominant feature of organisational or business websites. The web has become a medium through which more and more people source information, communicate with each other and have fun. Internet technology, on which the web is built, has become a communication tool linking massive numbers of users by providing them access to information, business transactions such as selling and buying of goods and services, education and entertainment (Tate et al., 2007; Issa and Turk, 2010; Marchiori, Mainardes and Rodrigues, 2017).

2.5.2 What is a web portal?

During the past two decades, there has been an exponential growth in the number of organisations that have established web portals to complement, substitute or widen existing services to their clients. Web portals are among the most visited sites on the Internet. The exponential growth of the web portal is highlighted by the growth in publications relating to this topic over the years (Caro et al., 2008; Manouselis et al., 2009; Bringula and Basa, 2011; Partala and Kallinen, 2012; Aranyi and Van Schaik, 2015; Pinho, Franco and Mendes, 2018; Walker et al., 2018).

The concept ‘web portal’ or ‘Internet portal’ was originally used to refer to well-known mega-sites or search engines such as Yahoo and Excite that functioned as starting points for web users to search and access information on the web in the mid-1990s. The current equivalent of such sites is Google. The technology has matured to the extent that an increasing number of web portals are developed every year. Currently, most large to small size commercial and non-commercial organisations own web portals where customers, clients and/or employees have to log on, usually by means of usernames and passwords, to access information or services (Manouselis and Sampson, 2004; Dash and Patra, 2018).

The primary purpose of developing a portal varies from one organisation to another. This makes it difficult to define the concept of a web portal. However, the main aim is to create a working environment where users can easily and quickly navigate to find information they need in order to meet their operational and strategic objectives, to undertake decision-making, and to enable communication, transactions and integration of services for users. In general, web portals provide users with access to a variety of services as well as to online information (content) in fields such as business, education, sport, and entertainment. It is important that the services and content provided are valid, correct, believable, accessible and enjoyable (Barnes and Vidgen, 2002; Moraga, Calero and Piattini, 2006; Calero et al., 2007; Inoco, 2017; Machova, Hub and Lnenicka, 2018). Table 2.3 provides some of the definitions of a web portal and their corresponding sources, arranged in ascending date order. Most definitions in the table are supported by Tate et al. (2007) who identify the features of a web portal as follows:

- It is a single point of entry to applications and services.
- It has facilities for communication and collaboration.
- Allows personalisation.
- Enables integration of functions and data from multiple systems.

Web portals aim to create a cost-effective channel for organisations to communicate with users such as existing and potential customers and other stakeholders. Customers or users of web portals use them to explore existing information, products and services, to become acquainted with the products or services and to make inquiries. It is also important that portals cater for different language needs and for people with disabilities (Yang et al., 2005; Karlsson and Olsson, 2008; Moraga et al., 2013; Saghapour et al., 2018).

Table 2.3: Definitions/descriptions of a web portal

Source	Definition/Description
Manouselis and Sampson (2004)	Web portals are a special form of website providing a blend of information, applications and services.
Moraga, Calero and Piattini (2006)	Web portals are Internet-based applications that enable access to different sources (providers) through a single interface. They provide personalised single sign-on and content aggregation from different sources. They can help users to find the information, service or product desired from among a large number of providers without having to navigate through them all one-by-one.
Tate et al. (2007)	A web portal is a website that provides a starting point or gateway to other resources on the Internet or an intranet.
Caro et al. (2008)	A web portal aggregates, organises, presents and provides content and application functionality in a way that is highly uniform, customisable and personalised in a manner that is both useful and meaningful to the end user.
Manouselis et al. (2009, p. 1)	Web portals are "gateways to information and services from multiple sources".
Bringula and Basa (2011, p. 253)	A portal "is a gateway to information and services from multiple sources that facilitates users' access to the content in one or more repositories. …. It is a centralised access to all relevant network content and applications."
Moraga et al. (2013)	A portal is a web presence that consolidated a variety of information and services such as searching, news, email, discussion groups, and e-commerce. The main aim is to select, organise, and distribute content in order to satisfy its users/customers.
Saghapour et al.(2018), similar to Manouselis et al. (2009)	Portals, in general, are "gateways to information and services from multiple sources that facilitates users' access to content in different repositories"

The different definitions of a web portal in Table 2.3 give some indications of its functions. However, certain specific functions and features of web portals are (Caro et al., 2006; Karlsson and Olsson, 2008; Moraga et al., 2013):

1. Data-points integration and decision-making: These provide the ability to access information from a number of internal and external information sources and to display the results on a single point-of-access that can be used for decision-making.
2. Taxonomy: This provides the context of information such as organisation-specific categories that reflect and support the organisation's business processes.
3. Search capabilities: They enable users to make searches throughout the company, the web, and in search engine catalogues and indexes.

4. Help features: They offer assistance to users.
5. Content management: This function supports content creation, authorisation and inclusion in (or exclusion from) portal collections.
6. Process and action: This enables users to initiate and participate in a business process or transaction as provided by the portal owner.
7. Collaboration and communication: This facilitates discussion, the location of innovative ideas and the recognition of resourceful solutions.
8. Personalisation: This creates a working environment that is organised and customised for each user.
9. Presentation: This provides both the knowledge and the visual experience that encapsulates all of the portal's functionality.
10. Administration: This enables the deployment of maintenance activities or tasks associated with the web portal system.
11. Security: This provides a description of access levels that each user or groups of users be permitted for each portal application and function.

2.6 e-Service quality, usability and user experience evaluation and methods

2.6.1 e-Service quality, usability and user experience evaluation

From an IS or HCI perspective, the evaluation of e-service quality, usability and user experience concepts have similarities. However, the main focus of each of them is different, and the criteria to evaluate them are not the same, although there may be some criteria that relate to more than one concept. As has been stated in Chapter 1, Section 1.2.5, '…all users want a Web-based application to be easy to use (main focus: usability) and enjoyable to use (main focus: user experience). In addition, users of WBAs need to get required services online without making telephone calls or physically visiting an organisation (main focus: e-service quality).' In IS or HCI contexts, evaluation is the process of assessing the system, at any stage before, during, or after its implementation, that is, during its life cycle evolution, to ensure that it behaves as expected, meets its requirements, and is easy to use, is enjoyable to work with, and provides the required services to the user. Consequently, evaluation of e-service quality, usability and user experience is concerned with gathering information about a system in order to determine its effectiveness or potential effectiveness in terms of these three facets with the purpose of suggesting improvements to the system or product (Dix et al., 2004; Rocha, 2012; Weil et al., 2012; Hassenzahl et al., 2015; Preece, Rogers and Sharp, 2015; Zhou et al., 2018).

Organisations carry out evaluation by use of criteria, guidelines, checklist reviews or actual testing of the software (Toshihiro, 2008; Cebi, 2013; Preece, Rogers and Sharp, 2015). Evaluation during software development is sometimes neglected – not because designers feel that it is unimportant – but because they consider it too costly or think that it is common sense (Kumar, Dadhich and Shastri, 2015; Machova, Hub and Lnenicka, 2018). Evaluators should have a diverse set of knowledge, such as how to conduct evaluation, the work domain of the system, and the strategy of the organisation where the system is or will be used. In addition, they should understand: users, evaluation methods, tasks and work-domain, development conditions and business goals. However, evaluators rarely possess all of these skills. Finally, evaluators need to know the perspectives of a variety of stakeholders such as software designers, developers, clients, project managers and users (Hornbaek and Frokjaer, 2008; Weil et al., 2012; Hassenzahl et al., 2015; Kumar, Dadhich and Shastri, 2015).

2.6.2 Evaluation methods

Although there are various methodologies and models that support the design of interactive systems, there is a need to evaluate the systems. As already stated, this means that evaluation should not be considered as a single phase in the design or assessment of a system, but should, ideally, be conducted throughout the systems development life cycle (Dix et al., 2004; Preece, Rogers and Sharp, 2015; Anderson, 2018).

Certain authors use the terms methods and techniques differently. The terminology in this field tends to be loose and often confusing in that what some authors call 'techniques' others call 'methods' and vice-versa (Preece, Rogers and Sharp, 2015; Anderson, 2018; Palese and Usai, 2018). Sometimes a set of techniques is considered to be a subset of a particular method. For example, if one considers expert-review evaluation as one of the methods, one could have heuristic evaluation and cognitive walkthrough as techniques used within this method (Shneiderman, 1998). However, sometimes the method and the techniques are one and the same. For example, experimentation might be the only technique included in the experimental evaluation method. However, since a method has been defined, in the last paragraph, as 'a systematic procedure for recording data' and any technique would aim at achieving this, the terms 'methods' and 'techniques' will generally be used synonymously in the present research. This view is supported by Preece, Rogers and Sharp (2015) who suggest that in order to eliminate any confusion there should be no distinction between these two terms, that is, they should be considered synonymous.

There are a number of approaches to the classification of evaluation methods (Preece, Rogers and Sharp, 2015; Nascimento et al., 2016; Andargoli et al., 2017; Kous et al., 2018; Ledo et al., 2018). One of the approaches is according to the stage of system development, with formative methods being done during system development, and summative methods being those applied at the end. Another approach is to classify usability evaluation methods (UEMs) according to whether or not actual end users will be involved. The methods without users are referred to as inspection methods while those that involve users are called empirical methods. Inspection methods involve the use of experts' judgment or the use of principles or guidelines to evaluate a product. They include heuristic evaluation, the cognitive walkthrough, use of checklists, formal inspections, pluralistic walkthrough and GOMS (gaols, operators, methods and selection) (Nielsen, 1993; Hollingsed, Novick and Paso, 2007; Joo and Lee, 2011; Preece, Rogers and Sharp, 2015; Lazar, Feng and Hochheiser, 2017; Ledo et al., 2018). Although inspection methods are increasingly used, since they identify problems faster and are less costly, they cannot fully substitute empirical methods such as usability testing with users as participants (Hollingsed, Novick and Paso, 2007; Riihiaho, 2018). Empirical methods use actual or potential users by use of methods such as experimentations; usability testing, including eye-tracking; observations – by field work or in a laboratory; survey via interviews or questionnaires; focus groups; and verbal protocol (Preece, 1993; Zhang, Rau and Salvendy, 2010; Anderson, 2018). In short, there are user-based methods and expert-based methods. For web-based systems, more recent

UEMs include web-usage analysis, traffic analysis, navigational paths analysis, web usage mining (Oman and Velasquez, 2013; Sniegula and Glinka, 2017; Riihiaho, 2018). It should be noted that not all methods are equally suitable for e-service quality, usability or user experience. For example, while all the approaches and methods mentioned above are suitable for usability evaluation, some, such as inspection methods, are not suitable for user experience evaluation. Consequently, only empirical methods would be appropriate for UX evaluation, since it is difficult for anyone other than an actual user to evaluate "all aspects of the user's experience when interacting with the product, service, environment or facility" (ISO 9241-210, 2010) – the definition of UX (see Section 2.4.2).

Fitzpatrick (1996) defines an evaluation method as a systematic procedure for recording data relating to end-user interaction with a product or system. While some of the methods, such as usability testing, involve users directly, others such as cognitive walkthrough evaluations, call on indirect understanding of users' needs and psychology (Kujala et al., 2014; Preece, Rogers and Sharp, 2015; Anderson, 2018). Various evaluation methods exist for e-service quality, usability and user experience. The present research applied an expert-based method, namely an expert review in Study 1B to review e-SQUUX and its content validity by conducting a meta-evaluation of e-SQUUX. This research also made use of a user-based method, namely a questionnaire survey, in which actual users applied an early version of e-SQUUX to a University web portal, following which statistical analysis was conducted on the resulting data to evaluate the e-SQUUX components.

2.6.3 Modelling and measurement of e-SQUUX

Measuring a concept is one of the means of evaluating it. On the other hand modelling and measurements are associated. Normally, the model is used as the basis to design the measurement instrument that is used to evaluate a system or product (Preece, Rogers and Sharp, 2015; Yahya and Razali, 2015). Precedents of models that have been used to design measurement scales to evaluate the three core facets of this research, namely, e-service quality, usability and user experience – include:

- Quality in Use Integrated Measurement (QUIM) model for measuring usability: This is one of the most widely used consolidated models for measuring usability of interactive software systems. It comprises 10 factors and 26 sub-factors that provide a total of 127 items (Seffah et al., 2006; Yahya and Razali, 2015).

- e-SERVQUAL model for measuring e-service quality: it is based on the SERVQUAL model and is an instrument for measuring service quality as described in Section 2.2.4. SERVQUAL comprises five dimensions and 22 items (Zeithaml, Parasuraman and Malhotra, 2002; Javed, 2018).
- AttrakDiff model for measuring user experience: This is one of the most popular generic models for measuring user experience in HCI. It comprises 28 items, in the categories of pragmatic quality, hedonic quality and attractiveness (Hassenzahl, 2007; Kocaballi and Coiera, 2018).

Measurement instruments and the associated metrics are important issues in HCI and IS research (Hornbaek, 2006; Rocha, 2012; Tullis and Albert, 2013; Zhou et al., 2018). Measurement and modelling of attributes of a product or service are closely related. The process normally begins by description or definition of the concept, which includes a set of attributes and sometimes sub-attributes that can be measured objectively or subjectively. The definition and attributes aim to give an understanding of what the concept constitutes and thus provide a model for it. On the other hand, measurement aims to assign values or levels of the concept during software evaluation. For example, in terms of usability, the ISO 9241-11 (1998) and Nielsen (2000) recommend that at least one measure be assigned to each of the attributes or factors and that each factor must be fine-grained into criteria that can be measured, normally referred to as items. The factors are usually not independent of each other and have an impact on each other (Winter, Wagner and Deissenboeck, 2008; Wolski et al., 2018). What is important for any model is that the problems are identified so that solutions can be found and fixed.

Measurement of e-service quality, usability and user experience should be undertaken in order to establish the level of quality of services when a user interacts with a product or system, whether a web-based or a mobile application. Despite the recognition of the importance of software measurement in software engineering there is no single agreed-upon definition of terminology. Terms used are measurement, measure, metric, measurable attribute and others. This is the case even when definitions are used from standard software engineering bodies such as ISO, IEEE and IEC (Moraga, Calero and Piattini, 2006; Tullis and Albert, 2013). A measurement aims to establish and clarify key elements in a concept or construct. The choice of attributes used to define and measure a concept and the level of each measure depend on context and purpose of use, since different contexts require different measures (ISO 9241-11, 1998; Hornbaek, 2006; Holzinger et al., 2008; Tullis and Albert, 2013; Preece, Rogers and Sharp, 2015; Wolski et al., 2018).

As stated, measurement of software quality factors, can be objective or subjective. The aspects of users' interactions that are not dependent on users' perceptions that can be validated are referred to as objective measures and are usually evaluated by quantitative metrics. On the other hand, measures of users' perceptions of, or attitude towards, the system are subjective ones (Hornbaek, 2006; Rocha, 2012; Tullis and Albert, 2013). There is an on-going debate in the literature regarding whether measurements of IS evaluation concepts, such as the three core facets of this research and their constituent dimensions, should be objective or subjective. The general consensus is that both are acceptable. For example, although numerical (objective) measures of usability are common, qualitative (subjective) assessment of usability is also important. The two forms of measures present different perspectives. Despite this, some researchers suggest that evaluation of such concepts should be quantitative and objective, and solely based on metrics, for example, easily measurable software metrics such as reaction time and task completion times. However, there is less agreement on how to measure subjective metrics such as satisfaction or hedonic quality (Holzinger et al., 2008; Tullis and Albert, 2013; Law, Van Schaik and Roto, 2014; Moumane, Idri and Abran, 2016; Wolski et al., 2018).

In this study, a model to be used for subjective measurement is developed. The e-SQUUX Model incorporates evaluation by means of questionnaire items measured by Likert scaling. The refinement process of this model underwent a similar procedure during Studies 2A and 2B where early versions of the model were applied by means of subjective measurement using linked scaling.

2.7 University web portal services and their evaluation

Due to rapid growth in the usage of information technology and the web, using both fixed and mobile devices, universities are using these technologies to deliver services at all levels with a view to increasing quality of service and achieving efficiency in their operations. The primary rationale for this is to provide stakeholders anywhere, anytime access to resources and services, and to migrate from manual-based services to electronic services to improve efficiency and productivity of their systems or applications to better support internal processes and their stakeholders. In relation to the current study, as the number of online service offerings by universities increases, universities need to improve the quality of their websites. A stakeholder is any individual or group who can affect, or is affected by the actions, decisions, policies, practices or goals of an organisation. The main stakeholders of University web portals (UWPs) are current students, staff and potential students (Abran et al., 2003; Flavian, Guinaliu and Gurrea, 2006; Tate et al., 2007; Karlsson and Olsson, 2008; Jain and Chande, 2013; Khwaldeh et al., 2017; Pinho, Franco and Mendes, 2018).

Worldwide, millions of people visit UWPs seeking information or web services. Such a website should incorporate all the university's information resources and applications in a single site. It is important that users easily access the information and services they need, and that the content is easily understood (Pinho, Franco and Mendes, 2018). Before the use of the Internet, universities offered services via multiple channels including telephone, face-to-face and postal contact (Tate et al., 2007). These channels have been expanded to include the web. In some cases, these channels were replaced by the web. The initial model was for universities to use their websites as a multimedia tool to disseminate information such as contact details, course information, available courses, location, operating hours, especially library hours, available services, policies, account access, change in lecture time and lecturer contact time (Acharya et al., 2008). As users' demands for further services increased and Internet technologies developed, more services were offered via the web. This resulted in the design of complex websites that necessitated the use of portals and hence the emergence of UWPs. Currently, a majority of services and products are transactional and offer certain administrative and academic facilities such as online students' applications and registration, online submission of assignments, study material downloads and uploads including videos, podcasts, vodcasts, lecturer-student discussion forums, online courses (e-learning), borrowing books, paying of tuition fees and many others. In addition, web portals serve as gateways to teaching and learning in the form of virtual learning environments (VLEs). Examples of these are learning management systems (LMS) and massive open online courses (MOOCs) (Agarwal and Venkatesh, 2002; Bringula and Basa, 2011; Jain and Chande, 2013; Chen and Chengalur-Smith, 2015; Pinho, Franco and Mendes, 2018). Many of these services are available to official users only and are secured sections of a portal, accessed by passwords.

Web-portal quality in higher education has three high-level dimensions that should be evaluated, namely, technical or physical quality, interactive or functional quality, and corporate image quality. Physical quality dimensions are those that can be objectively measured regardless of the customer's opinion. Functional quality is concerned with the interaction between the service provider and the customer and is often measured in a subjective manner. Corporate image describes the overall picture of the organisation perceived by the customer (Owlia and Aspinwall, 1996; Matthews, Feng and Zheng, 2018).

At a lower level, the main components of a high-quality UWP that need to be evaluated include content, functionality, usability, user experience and e-service quality. First, site content should be appropriate for the students, staff and other stakeholders. Second, UWPs are successful if these stakeholders can actually use the system, therefore, it should have good functionality. Third, in terms of usability, the portal should be designed by matching the user's model of how the content should be organised within the actual portal structure. This allows users to easily navigate and use the portal. If a system is not easy to use, achieving willing adoption will be difficult. Fourth, the design of UWPs should go beyond traditional usability by providing users with enjoyable and memorable experiences. Fifth, and lastly, UWPs need to provide superior online services that are cost and time saving compared to traditional ones (Robertson, 2007; Karlsson and Olsson, 2008; Issa and Turk, 2010; Norman, 2014; Borsci et al., 2015; Hassenzahl, 2018; Palese and Usai, 2018).

Since web portals are normally complex in nature, they should exhibit a high degree of usability and user experience if they are to be acceptable to their users. At the same time, the services provided should be of a high level. In many instances, especially when the number of users is high, in order to improve a product quality and to cater for all users, more functionality is added to the portal. However, this makes the portal more complex (Robertson, 2007; Acharya et al., 2008; Karlsson and Olsson, 2008; Pinho, Franco and Mendes, 2018). Some of these issues are highlighted by (Pinho, Franco and Mendes, 2018, p. 820):

> *"In the process of creating or redesigning a website or web portal it is necessary to define clearly its purpose, the information to be obtained and the target public, as well as technical matters such as accessibility, usability, layout and style. This is a complex and detailed process. In addition, the web's exponential growth has made it necessary to rethink algorithms and processes to elaborate web portals, for them to become more efficient."*

The benefits of having a web portal with acceptable levels of e-service quality, usability and user experience include the following (Moraga, Calero and Piattini, 2006; Robertson, 2007; Jain and Chande, 2013; Pinho, Franco and Mendes, 2018):

- Training needs are reduced.
- Resistance to change is lessened.
- Content is more frequently updated.
- Cost of ownership is reduced, due to in-house maintenance management.
- The portal is used more frequently, and more successfully.
- The competitive advantage of the organisation is improved.
- The corporate image of the organisation is positively projected.
- It is easy for users to sift out unwanted information and focus on relevant material.
- Deployment is simpler and quicker.

Despite the many benefits, it is expensive and time consuming to develop and maintain web portals (Bringula and Basa, 2011).

2.8 Conclusion

This chapter presented a literature review of the pertinent issues in this research. First, an overview of theories and models for the theoretical foundations and the development methodology intended for this study, was presented. The theories were DeLone and McLean IS Success model, Technology acceptance model (TAM), Unified theory of acceptance and use of technology (UTAUT), and SERVQUAL, and their respective variants such as TAM2, and UTAUT2. Amongst these, the UTAUT and SERVQUAL were found to be the most relevant and hence adopted for this research.

Second, an overview was given of HCI, interaction design and user-centred design, considered to be the foundations on which this research is built. It was pointed out that in HCI, it is important to investigate the interaction between the computer and the human which falls within the broader area of study termed Interaction Design.

Third, the status of e-service quality, usability and user experience were analysed from their inception to the present. This included identification of the benefits if these three concepts are used in evaluating information systems.

Fourth, the chapter discussed Web-based applications and web portals. Varying definitions of the two were presented. However, it was concluded that in general, a web portal is a website that acts as gateway to information and services from multiple sources. It was also pointed out that Web-based applications can operate on both fixed and mobile devices, even though this research focuses on the former.

Fifth, an overview was undertaken of the evaluation criteria and methods for concepts inherent in this research, namely e-service quality, usability and user experience. It was noted that evaluation of the three has similarities. It was pointed out that there are many ways to classify evaluation methods, for example, whether actual users will be involved (empirical methods) or not (inspection methods). It was also concluded that although inspection methods are increasingly used, since they identify problems faster and at a lower cost, they cannot fully replace empirical methods. Evaluation methods from both categories (inspection and empirical) were addressed. However, user surveys using questionnaires, an empirical method, was discussed in more detail. In addition, it was pointed out that, as is the case with evaluation, modelling and measurements of e-service quality, usability and user experience were similar. In many cases modelling concepts lead to the creation of instruments – subjective or objective – for measuring those concepts.

Lastly, the chapter dealt with evaluation of University web portals. Since web portals are usually complex in nature, they should exhibit a high degree of usability and user experience and e-services if they are to be acceptable for use. It was noted that there is a growing demand by both students and university staff to have more and more services via web portals. Many of the services and products offered by universities are transactional and present a number of administrative and academic facilities. It was indicated that the quality of web portals in higher education should be evaluated from three different perspectives, namely, technical or physical quality, interactive or functional quality, and corporate image quality.

The role of this chapter has been to establish a theoretical foundation for most of this research. For example, definitions, principles, guidelines and criteria in this chapter will be applied in Chapter 4 during the synthesis of the e-SQUUX Model.

Chapter 3: Research design and methodology

3.1 Introduction

The previous chapter presented a literature review of the pertinent issues in this research. Research is a way of answering questions in one's profession, characterised by means of tested procedures and methods, using an unbiased and objective attitude (Kumar and Phrommathed, 2011). This chapter sets out to show how this research was conducted by providing a description of the research design and methodology. It outlines the research philosophy, approach, design, methods and ethical issues considered and applied.

Figure 3.1 shows the layout of the chapter. After this introduction (Section 3.1), Section 3.2 provides a brief overview of the research questions. Thereafter, Section 3.3 presents the research framework and philosophical worldviews, which are discussed under five subsections as seen in Figure 3.1. Immediately after the worldview that underlies this research (Section 3.3.5) is presented, there follows the research approaches that includes quantitative and qualitative studies (Section 3.4.1) and the mixed-method approach (Section 3.4.2). Section 3.5 presents details of the research design with a subsection on research designs and methods used in related/similar studies (Section 3.5.1) followed by a detailed explanation of Exploratory sequential design, which is the selected research design and its justification (Section 3.5.2). Furthermore, alternative research designs that could have been used for this research are outlined (Section 3.5.3).

Thereafter, Sections 3.6 to 3.10 discuss the four studies undertaken in this research, where the first two sections (3.6 and 3.7) deal with the qualitative phase and the last two (3.9 and 3.10) with the quantitative phase of this research. Their subsections are indicated in Figure 3.1. The middle section (Section 3.8) is also related to the quantitative phase since it provides general information that pertains to both the pilot and the main questionnaire surveys. These four studies are Study 1A – Systematic literature review (Section 3.6); Study 1B – Expert reviews of the conceptual model (Section 3.7); Study 2A – Pilot study

3.1: Introduction

↓

3.2: Research questions in the context of this study

↓

3.3: Research framework, and philosophical stances and worldviews

3.3.1 Research framework
3.3.2 What is a philosophical worldview?
3.3.3 Philosophical stances
3.3.4 Main philosophical worldview
3.3.5 The worldview used in this research: Pragmatism

↓

3.4: Research approaches

3.4.1 Quantitative and qualitative approaches
3.4.2 Mixed methods approaches

↓

3.5: Research design

3.5.1 Research designs and methods used in related/similar studies
3.5.2 Selected research design and its justification: Exploratory sequential design
3.5.3 Alternative research designs that could have been used for this research

↓

3.6: Qualitative phase: Study 1A – Systematic literature review

3.6.1 Background and motivation for use of a systematic literature review
3.6.2 How the literature review was conducted

↓

3.7: Qualitative phase: Study 1B – Expert reviews of the conceptual model

↓

3.8: Quantitative phase: General information for the pilot and main questionnaire surveys

3.8.1 User survey evaluation using questionnaires
3.8.2 Questionnaire design
3.8.3 Participants and sampling
3.8.4 Data collection
3.8.5 Data analysis and interpretation
3.8.6 Reliability and validity

↓

3.9: Quantitative phase: Study 2A – Pilot study of the questionnaire survey

3.9.1 Overview of pilot studies
3.9.2 Questionnaire design
3.9.3 Participants, sampling and data collection
3.9.4 Data analysis and interpretation

↓

3.10: Quantitative phase: Study 2B – Main study of the questionnaire survey

3.10.1 Questionnaire design
3. 10.2 Participants and sampling
3.10.3 Data collection
3.10.4 Data analysis and interpretation

↓

3.11: Validity, reliability and triangulation for the entire research (as subsections)

↓

3.12: Ethical considerations undertaken during this research

↓

3.13: Conclusion

Figure 3.1: Layout of Chapter 3

of questionnaire survey (Section 3.9); and Study 2B – Main study of questionnaire survey (Section 3.10). Section 3.11 discusses validity, reliability and triangulation as they relate to the entire study. The ethical considerations undertaken during this research are reported in Section 3.12. Lastly, Section 3.13 provides the chapter conclusion.

3.2 Research questions in the context of this study

The initial purpose of this research was to develop a comprehensive conceptual integrated evaluation model to assess the e-service quality, usability and user experience of Web-based applications. From this, a validated model and a structural model for evaluating these three core facets of University web portals was to be derived. To achieve this, a number of research questions, as given in Section 1.5.1 of Chapter 1, were put forward. Table 3.1 shows the research questions and the main chapter(s)/sections in which they are addressed. In addition to the main research question, for each of the six subquestions (numbered 1 to 6), the table shows columns giving the main chapter and version of the e-SQUUX Model that is the outcome of that chapter, the section(s) in Chapter 3 (this chapter) where the design considerations are made, the sections in the Discussion chapter (Chapter 8), and *Sections in Introduction & Conclusion Chapters* where the questions are introduced and concluded. This table serves as the index for the main chapter(s) and section(s), since the entire document is founded on the research questions. It is envisaged that Table 3.1 will work as a quick reference guide for any reader of this thesis document.

Table 3.1: The research questions map for this thesis document

Main research question (see Section 1.5.1)

What are the components of a conceptual integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications, and of its validated and structural models that are suitable for evaluating a University web portal?

		Locations				
#	**Research subquestions** (see Section 1.5.2)	**Study**	**Main Chapter & e-SQUUX Model version**	**Section(s) in Chapter 3 (Methodology)**	**Sections in Discussion Chapter (8)**	**Sections in Introduction & Conclusion Chapters**
1	What are the components of a conceptual integrated model, synthesised from the literature, for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications?	Study 1A	Chapter 4 Version 1	Section 3.6	Section 8.2	1.5.2 1.8.2.1 9.2.1
2	What are the components of the conceptual integrated model for evaluating e-SQUUX of Web-based applications following an expert review?	Study 1B	Chapter 5 Preliminary and final Version 2	Section 3.7	Section 8.3	1.5.2 1.8.2.2 9.2.2
3	What is the value of a comprehensive pilot study prior to the main questionnaire survey on the components of an integrated model for evaluating e-SQUUX of a University web portal (UWP)?	Study 2A	Chapter 6 ---NA---	Sections 3.8 & 3.9	Section 8.4	1.5.2 1.8.2.3 9.2.3
4	What are the components of an empirically validated integrated model for evaluating e-SQUUX of a UWP?	Study 2B	Chapters 7 & 8 Version 3	Sections 3.8 & 3.10	Section 8.5	1.5.2 1.8.2.3 9.2.4
5	What is the structural model (relationships) of e-SQUUX in the context of evaluation of a UWP?	Study 2B	Chapters 7 & 8 ---NA---	Sections 3.8 & 3.10	Sections 8.6 & 8.7.1	1.5.2 1.8.2.3 9.2.5
6	What are the final components of e-service quality, usability and user experience following the structural modelling of the three in the context of evaluation of a UWP?	Study 2B	Chapters 7 & 8 Version 4	Sections 3.8 & 3.10	Sections 8.7.2 to 8.7.5	1.5.2 1.8.2.3 9.2.6

3.3 Research framework, and philosophical stances and worldviews

3.3.1 Research framework

According to Creswell (2014), there are three interrelated main aspects of a research framework that should be considered in the context of any of the research approaches to a study – qualitative, quantitative or mixed methods.

Figure 3.2 depicts the three, namely, philosophical worldview, the design, and research methods (Creswell, 2014). The framework posits that an approach can be quantitative, qualitative or mixed methods. The choice of a design to use is determined by philosophical worldviews of the researcher, and by the research methods relating to how data will be collected, analysed and interpreted. In the course of this chapter, a detailed discussion of these aspects of the research framework that are relevant to this study will be discussed. It is important to note that, apart from this framework by Creswell (2014), others exist. For example, the research onion by Saunders, Lewis and Thornhill (2016, p. 154) provides a nearly-equivalent set of components to that in Figure 3.2. However, the present researcher found it simpler to refer to the Creswell framework in his discussion.

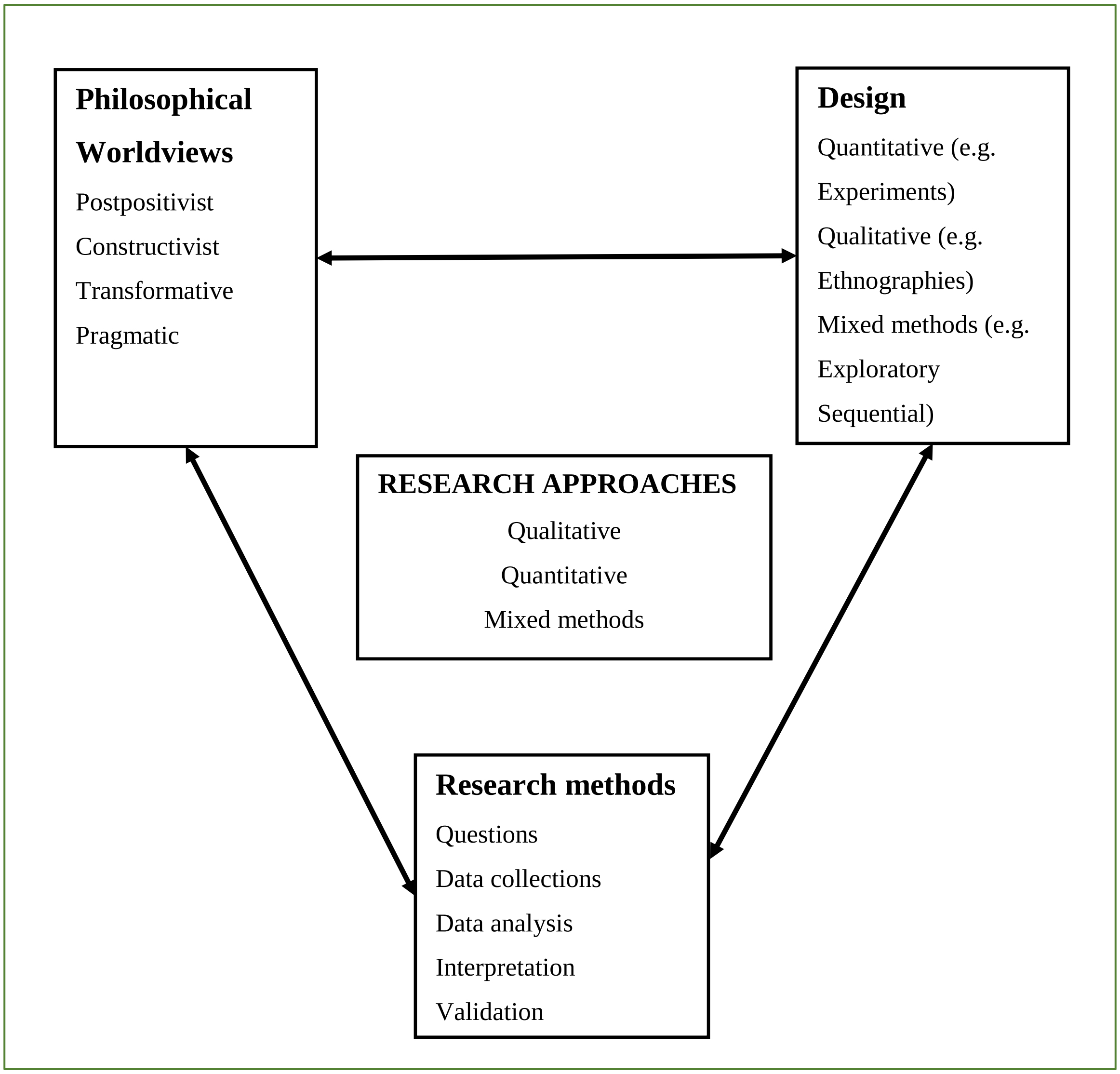


Figure 3.2: A framework for research (adapted from Creswell, 2014, p. 5)

3.3.2 What is a philosophical worldview?

In this research, the terms 'worldviews' and 'paradigms' were used interchangeably since a number of researchers such as Venkatesh et al. (2016) and Creswell and Creswell (2017) use or define them in the same manner. The term 'paradigm' has its origin in the work of Thomas Khuns, who used it in relation to the nature, growth and development of sciences, especially natural sciences. A paradigm or worldview is a basic set of beliefs that underlies a study and guides the actions that people take (Denzin and Lincoln, 2012). They are worldviews or general perspectives of what individuals or groups think about the world and a way of breaking down its complexities since they inform the researcher of what is important, legitimate and reasonable (Lincoln and Guba, 1985; Patton, 2002; Mayoh and Onwuegbuzie, 2015). A research worldview is a general framework that includes beliefs, theories and practices that are used to undertake a research (Saunders, Lewis and Thornhill, 2016). It also involves the procedure consisting of a number of steps that a researcher undertakes to answer the research questions. It is a set of fundamental beliefs and assumptions of how the world is perceived, which serves as a reflective framework that shapes the behaviour of the researcher (Jonker and Pennink, 2010; Wahyuni, 2012; Mayoh and Onwuegbuzie, 2015). Furthermore, research worldviews are based on varying philosophical foundations and conceptions of reality. Each has its own different implementation of methodological approaches and strategies (De Villiers, 2005). The main current research paradigms are positivism, postpositivism (critical realism), interpretivism (constructivism) and pragmatism (Wahyuni, 2012). Apart from a paradigm, other terms for a research worldview include, 'theoretical lens' and 'theoretical perspective' (Doyle and Brady, 2009; Venkatesh, Thong and Xu, 2016)

3.3.3 Philosophical stances

Research philosophies consist of particular stances or assumptions associated with the various research paradigms. These assumptions influence the research paradigms that a research project follows. Ontology and epistemology are the two main philosophical dimensions. In addition, axiology and methodology are two fundamental beliefs that influence how reality is investigated (Denzin and Lincoln, 2012; Wahyuni, 2012). The four are briefly described as follows:

- *Ontology* refers to the nature of the world (Oates, 2010). It raises basic questions about the nature of reality and the nature of human beings in the world. It poses questions like "What is real?; What are we looking for?; What is existence?; and What are physical objects?" (Kumar, 2014, p. 105). *Epistemology* is concerned with an individual's beliefs about how to generate, understand, use and communicate knowledge, that is, how they seek truth and what they believe as researchers. Epistemology is the way people acquire knowledge and meaning regarding the world (Oates, 2010; Saunders, Lewis and Thornhill, 2016). Epistemology asks questions like: "What is knowledge and how do we know things?; Are there different kinds of knowledge?; Are there good procedures for discovering knowledge?; and What constitutes acceptable, valid and legitimate knowledge?" (Denzin and Lincoln, 2012; Wahyuni, 2012).

- *Methodology* focuses on the best means for gaining knowledge about the world. It refers to the processes of how the individual(s) seek out new knowledge or to the model for undertaking a research within a specific paradigm (Denzin and Lincoln, 2012; Wahyuni, 2012; Saunders, Lewis and Thornhill, 2016).
- *Axiology* is concerned with the ethics of the researcher. It is concerned with the role of the researcher's values such as ethics, aesthetics and religions and how they affect the research (Denzin and Lincoln, 2012; Wahyuni, 2012; Saunders, Lewis and Thornhill, 2016).

3.3.4 Main philosophical worldviews

Different authors classify philosophical worldviews or research paradigms in different ways, for example, as depicted in Figure 3.2, Creswell (2014) categorises them as postpositivist, constructivist, transformative and pragmatic, while Denzin and Lincoln (2012) identify them as positivism, postpositivism, critical theory, constructivist and participatory action frameworks. On the other hand, Wahyuni (2012) lists them as being positivism, postpositivism, interpretivism and pragmatism. The categorisation by Wahyuni (2012) is adopted by the current researcher and discussed in Subsections 3.3.4.1 to 3.3.4.4 that follow. However, the transformative worldview will also be discussed in Subsection 3.3.4.5 since it is related to the discussion in Section 3.3.5.

3.3.4.1 Positivism

"The positivist paradigm emerged from the work of early social scientists, such as Emile Durkheim, who sought to model the social sciences on the natural sciences" (Humphrey, 2013, p. 5). A positivist paradigm asserts that knowledge is absolute and objective and that a single objective reality exists independent of individuals. It has its origin in the natural sciences but it is increasingly being used in social sciences. It relies primarily on quantitative methods such as experiments and surveys where data is mainly in the form of numbers and measurements, and analysis is done by statistical methods. The idea behind the positivist paradigm is that the results are reliable and free from biases of the researcher to the extent that those findings are replicable by other researchers. In summary, a positivist approach is concerned with hypothetic deductive testability of theories and uses objective measurements to collect research evidence (Chen and Hirschheim, 2004; De Villiers, 2005; Denzin and Lincoln, 2012; Wahyuni, 2012).

Some of the main characteristics of positivism are presented as follows (Oates, 2010; Humphrey, 2013):

- The world exists independently of humans – there is a physical and a social world that exists in real terms (objectively) but not just as a mental conception.
- Research relates to making observations and measurements and producing models such as hypotheses or theories. The researcher is neutral and objective.
- Research is based on empirical testing of theories and hypotheses that lead to confirmation or refutation.
- In most cases of data analysis, quantitative data analysis includes mathematical modelling and statistical analysis is undertaken.
- The results of research can be generalisable and hence are independent of the researcher or research context, that is, epistemologically, the results reflect the truth.

3.3.4.2 Postpositivism

Postpositivism or critical realist (Wahyuni, 2012) assumptions on reality and how to acquire it, are based on the spectrum between positivism and interpretivism. It challenges the idea of the existence of absolute truth as advocated by positivism, especially in studying human behaviour in social science (Wahyuni, 2012). Postpositivists, similarly to interpretivists, believe that social reality is created and recreated by people. However, like positivists, they believe that social reality also possesses objective properties (Oates, 2010).

3.3.4.3 Interpretivism

Interpretivism aims to understand what is being studied (Olivier, 2009). An interpretive paradigm seeks to determine meaning and new interpretation of reality and assumes multiple realities which are time- and context-dependent. It focuses on understanding phenomena that occur in natural settings, that is, reconstructed understanding of the social world. The main goal of the research is to show trustworthiness and understanding instead of internal and external validity as advocated by the positivists. It relies primarily on qualitative methods such as case studies, interviews and observations, where data is mainly verbal or textual. The researcher extracts meaning from data and is thus considered to be a research instrument himself or herself. Reliability is frequently achieved through triangulation of data using multiple data collection methods (De Villiers, 2005; Denzin and Lincoln, 2012; Rahi, 2017).

Some of the main characteristics of interpretivism are presented as follows (Oates, 2010; Humphrey, 2013):

- Multiple subjective realities exist. This means that there is no single version of truth. What individuals or groups take to be real, is the knowledge and belief of their own minds.
- Meaning is dynamically constructed. Ontologically, an individual's reality can only be transmitted to others through social constructions such as language, and shared meanings and understanding.
- Researchers are not neutral since their assumptions, beliefs and values influence the research process. Researchers must, therefore, be reflexive (self-reflective) by acknowledging their influence on the research (bias) as a result of their interaction with the participants.
- People must be studied in their natural settings, without the researchers imposing their understanding of the situation.
- Qualitative data analysis should be undertaken, for example, by analysing the language people use and metaphors they employ.

3.3.4.4 Pragmatism

Pragmatists posit that there is no need to conform to the positivist or interpretivist paradigm but rather concentrate on what works best to answer the research question(s). They believe that philosophical stances in terms of objectivity and subjectivity of reality, and how these are acquired, are not mutually exclusive and that the two can be combined. Pragmatists support the use of both qualitative and quantitative approaches to data collection for this enables them to better understand reality (Oates, 2010; Wahyuni, 2012; Humphrey, 2013; Creswell, 2014). Pragmatism is concerned with what works, and advocates that a study should be judged according to its intended purpose, available resources, procedures followed and results obtained, within a specified context and for a specific audience (Patton, 2002; Rahi, 2017).

3.3.4.5 Transformative

The transformative paradigm focuses on research that includes issues related to changes in the lives of the marginalised individuals or societies, and issues of social justice, human rights, discrimination and oppression. It holds that research should be intertwined with politics and political change agendas to address social expressions at all levels. It contends that transformative research addresses issues such as oppression, disempowerment, unemployment, inequality, domination, suppression and alienation. The research finding should include actions to be undertaken to mitigate the disparities. Sometimes, the researchers themselves need to be transformed during the study so that results include their personal experiences. Participatory action researchers, critical theorists and feminists tend to hold this worldview (Creswell, 2014; Gravem et al., 2017; Mertens, 2017).

3.3.5 The worldview used in this research: Pragmatism

As pointed out in Section 1.8.1 and as will be discussed in Section 3.5.2, a mixed-method approach was used in this research. A pragmatic approach (pragmatism) is suitable for mixed methods studies since instead of concentrating on the subjective/objective debate, its concern is how well the researcher did in selecting, utilising and integrating all the methodological tools (Denzin and Lincoln, 2012; Manzoor, 2016). Because of this, pragmatism has become the main paradigm of choice for mixed methods (Teddlie and Tashakkori, 2012; Saunders, Lewis and Thornhill, 2016; Hathcoat and Meixner, 2017). In support of this, according to Tran (2016, p. 1), "Today, the primary philosophy for mixed methods research is that of pragmatism" Consequently, this paradigm is applied in this research.

It should be noted that there are other possible choices of worldview for mixed methods research. For example, according to Tran (2016), while he considers postpositivism, constructivism, and transformative as the most commonly used worldviews, he posits that in addition to pragmatism, transformative work is also compatible with the mixed methods research.

Since the current research uses pragmatism, more than one theory, namely UTAUT and SERVQUAL, are used as reference points (see Section 2.2.5). However, in the spirit of pragmatism, the researcher concentrated on what works best without restricting himself to any of these theories as recommended by Tran (2016).

This research was done in two main phases. In line with the pragmatism paradigm, an interpretive approach was used during the first phase since this approach is appropriate when there is a need to understand the context of the information system (IS) where the context and IS influence each other (Walsham, 1993; De Villiers, 2005). In HCI studies, such as this one, the user and context of use are central to the study and have an influence on each other. In addition, the study is concerned with subjective concepts such as user satisfaction and user experience, as well as qualitative evaluation measurement, both of which make good candidates for interpretive research. In the second phase, a quantitative approach, namely a user survey, using questionnaires, was used during the refinement and validation of the model. This approach defaults to a positivist paradigm to research where it is prescribed that 'objective' data is collected to predict relationships among factors and to test theories (Chen and Hirschheim, 2004; Tashakkori and Teddlie, 2010; Tran, 2016).

3.4 Research approaches

As depicted in Figure 3.2, the three main research approaches are qualitative, quantitative and mixed methods (Creswell, 2014; Baran, 2016). Before the emergence of mixed methods, the two main research approaches were qualitative and quantitative. The two differ in terms of methods used in data collection, data processing and analysis, and style of communication of the findings. This is because they are based on different underlying philosophies, methods, models and procedures (Kumar, 2014; Hathcoat and Meixner, 2017). These three main research approaches are discussed in the next two subsections.

3.4.1 Quantitative and qualitative approaches

Up to the early 1900s, quantitative research was seen as the only research approach. Between 1900 and the 1950s the qualitative approach emerged as an alternative approach. However, around the 1960s the mixed-method approach began to emerge (Leech and Onwuegbuzie, 2009; Baran, 2016). A quantitative research approach follows a structured, rigid, predetermined methodology with the aim of quantifying phenomena and making generalisations (Tashakkori and Teddlie, 2010; Kumar and Phrommathed, 2011; Manzoor, 2016). By contrast, qualitative research follows an unstructured, flexible and open approach to enquiry, with the aim of understanding, describing or exploring perceptions and feelings rather than presenting facts and figures. Qualitative designs are generally naturalistic since the research takes place in real-world settings and the researcher does not attempt to manipulate the phenomenon of interest (Patton, 2002). It is based on empiricism that tries to answer questions through observations or personal experiences (Kumar and Phrommathed, 2011; Creswell and Creswell, 2017; Gravetter and Forzano, 2018).

Table 3.2 summarises the main differences between the two approaches (Patton, 2002; Gratton and Jones, 2010; Kumar and Phrommathed, 2011; Creswell and Guetterman, 2018; Gravetter and Forzano, 2018). It shows that the quantitative research approach originated in the natural sciences and is well-aligned with the positivist paradigm, while the qualitative approach originated in the social sciences and is aligned to the interpretivist paradigm. The concept of measuring is central to quantitative research since it provides the connection between empirical observation and mathematical expression used in describing quantitative summaries and relationships (Patton, 2002; Kumar and Phrommathed, 2011; Fetters, Curry and Creswell, 2013; Tran, 2016; Creswell and Guetterman, 2018). According to Patton (2002) and Tran (2016), though these two have different strengths and weaknesses, they are alternatives rather than mutually exclusive approaches.

Table 3.2: Difference between qualitative and quantitative research (Synthesised by the researcher)

Quantitative	**Qualitative**
Aligned to positivist approach.	Aligned to interpretivist approach.
Mainly uses quantitative data.	Mainly uses observation data.
Originated in natural science.	Has origin in social science.
Follows a deductive approach.	Follows an inductive approach.
Seeks to answer questions such as 'what', 'when', 'where' and 'how many'.	Tends to answer 'why' and 'how' questions.
Focuses on use of standardised measurements using predetermined categories to which numbers are assigned.	Focuses on the study of issues in depth and detail. Data is mainly verbal or textual description format.
There is either some form of measurement or classification. Numbers play a major role.	Seeks to form in-depth understanding of research issues. Makes extensive use of verbal and textual data.
Follows a structured, rigid, predetermined methodology.	Follows an unstructured, flexible, open methodology.
There is measurement or classification of variables.	Emphasis is on description of variables.
Research methods associated with this approach include: • Experiments • Quantitative surveys • Case studies	Methods associated with this approach include: • Ethnography • Case studies • Content analysis • Qualitative surveys • Interviews • Observations
Reliability and validity of data collected depend on the research instrument.	Reliability and validity depend on the researcher(s) since they serve as the research instruments.
Statistical analysis is normally performed to make inferences.	Subjective responses and narratives are analysed to identify patterns and themes in the data.
Results can be generalised.	Recommendations can be made.

The present research focuses mainly on the quantitative side of Table 3.2. However, the qualitative side is also pertinent since this is a mixed methods study.

3.4.2 Mixed-method approach

Mixed methods research is referred to differently by different researchers. For example, Doyle and Brady (2009) terms it 'a mixed-method approach' and 'a mixed methods paradigm' in the same paper. On the other hand, Creswell and Clark (2011) classified it as a research design. However, in recent literature such as (Creswell and Creswell, 2017) and Venkatesh et al. (2016) it has been referred to as an approach. This stance is taken by the current researcher notwithstanding that a mixed research approach includes mixed methods designs such as an Exploratory sequential design (Creswell, 2014; Baran, 2016).

There are various definitions of mixed methods, including the following, which have strong similarities:

- Mixed methods research (MMR) is an inquiry that involves collecting, analysing, and combining both qualitative and quantitative empirical material in a single study or a series of studies (Denzin and Lincoln, 2012).
- Creswell and Clark (2011) and Creswell and Guetterman (2018) define a mixed methods research design as a procedure for collecting, analysing, and mixing both qualitative and quantitative methods in a single study or more than one study to understand a research problem The aim is to get a better understanding of the research problem that would not be possible with either of the methods. Mixed methods strategies, just like action research, are a combined research design.
- Mixed methods research involves collecting, analysing, and interpreting quantitative and qualitative data in a single study or in a series of studies that investigate the same underlying phenomenon (Onwuegbuzie and Leech, 2006; Manzoor, 2016).
- The mixed methods research approach combines both quantitative and qualitative research methods in the same research inquiry (Trochim, Donnelly and Arora, 2016; Venkatesh, Brown and Sullivan, 2016; Devlin, 2018).

It should be noted that mixed methods should not be confused with multi-method since the former refers to a combination of quantitative and qualitative procedures, whereas multiple methods refer to a set of studies using different research methods but all of them being either quantitative or qualitative (Venkatesh, Brown and Sullivan, 2016).

There are no contradictions between these definitions for they all identify the key characteristics of mixed methods research as having both quantitative and qualitative approaches being used in a single or a series of studies. A fundamental strength of a mixed methods research design is that it triangulates data and approaches a phenomenon from different perspectives.

According to Venkatesh, Brown and Bala (2013), while there is growing use of mixed methods research in a number of fields, there is a lack of its use in Information Systems research. However, Gable (1994) and Venkatesh, Brown and Bala (2013) posit that the IS domain is suitable for use of mixed methods such as user surveys and observations. The use of mixed methods helps to minimise the weaknesses that exist in purely positivist approaches to research and vice versa. For example, interpretive approaches include methods that help bring richness to the data by providing a deeper understanding of the nature of the problem.

The main benefits of undertaking a mixed methods (MMs) approach are (Doyle and Brady, 2009; Creswell and Clark, 2011; Venkatesh, Brown and Bala, 2013; Manzoor, 2016; Saunders, Lewis and Thornhill, 2016; Trochim, Donnelly and Arora, 2016; Hathcoat and Meixner, 2017):

- Triangulation: this guarantees greater validity in the study due to corroboration of qualitative and quantitative data results.
- Offsetting weaknesses: using MMs, the weaknesses of one method can be neutralised by the other. This means that MMs achieve the advantages of both quantitative and qualitative approaches and mitigate the weaknesses of each of them.
- Completeness: a more comprehensive account of the areas of inquiry can be achieved when both qualitative and quantitative approaches are employed.
- Answering different research questions: MMs allow for answering of questions that would not have been adequately addressed by quantitative or qualitative methods alone.

- Explanation of findings: the findings from one method can be used to explain the results of the other method, especially when unanticipated results emerge from one of the methods. For example, insights might emerge from a quantitative study that can then be studied in detail by a qualitative study, and vice versa.
- Credibility: using the two approaches in tandem enhances the integrity of the findings.
- Hypothesis development and testing: a hypothesis can be developed during a qualitative phase that is then tested during the quantitative phase.
- A quantitative study can be conducted first, to identify issues that can subsequently be investigated in depth in a qualitative study.
- Instrument development and testing: a qualitative phase may be used to first generate items that can be used in a questionnaire during a quantitative phase.

The above benefits apply to this research. In addition, the last bullet provides one of the main rationales/reasons for using mixed methods in this research.

Despite the many benefits associated with MMs, there are important factors to consider before using this approach. They include the following (Creswell et al., 2011; Venkatesh, Brown and Sullivan, 2016):

- Available time: mixed methods research tends to take longer than purely quantitative or qualitative research.
- Skills: one should consider whether the researcher has adequate skills sets in both quantitative and qualitative research and the expertise to combine the two.
- Research problem, questions and objectives: these should be phrased in a way that naturally calls for a mixed-method approach.
- Methods to use: they should include both quantitative and qualitative data collection and analysis.

It is important that in MMs research, rigorous criteria for both qualitative and quantitative investigations should be observed. The biggest challenge to MMs studies is to articulate how the two approaches relate to each other (Doyle and Brady, 2009; Venkatesh, Brown and Sullivan, 2016).

Although others exist, the three major MMs design or integration approaches, also called MMs 'Strands' are (Creswell and Clark, 2011; Fetters, Curry and Creswell, 2013; Baran, 2016; Manzoor, 2016; Saunders, Lewis and Thornhill, 2016):

- Explanatory sequential design: in this type of integration, the researcher first collects and analyses quantitative data that is used as a basis for collecting subsequent qualitative data on pertinent aspects.
- Exploratory sequential design: This works opposite to the explanatory design above. The researcher starts by collecting and analysing qualitative data and uses this to undertake quantitative data collection and analysis where appropriate.
- Convergent parallel design: in this integration, both qualitative and quantitative data are collected at the same time and the results are triangulated.

It is important that there is coherence between the findings of both methods and that one attains an expanded insight that would not have been possible by using only one of the strands (Fetters, Curry and Creswell, 2013). The synergy in using the two methods together accrues from the way that the findings of one method identify studies that should be conducted using the other method.

To conclude this section (3.4.2). it is important to list the main characteristics of mixed methods research which, according to the current researcher, are best summarised by Mertler (2016). Mixed methods research:

- Collects and analyses rigorously both qualitative and quantitative data, based on research questions.
- Mixes by integrating or linking the two forms of data either concurrently by combining or merging them, or sequentially by having one build on the other, or embedding one within the other.
- Gives priority to one or to both forms of data, again based on the research questions.

- Uses qualitative and quantitative procedures for collecting data in a single research study or in multiple phases of a program of research.
- Frames the procedures within philosophical worldviews.
- Combines the procedures into specific research designs.

3.5 Research design

A research design is a plan or strategy used to organise the research and make it practical with the aim of answering the research questions (Cohen, Manion and Morrison, 2018). Similarly, (Kumar, 2014, p. 103) defines a research design as simply "the plan for research". A research design is a procedural plan that is used by the researcher to answer questions validity, objectively, accurately and economically. It, therefore, sets out the path that researchers take in their research journeys. A research design can also be defined as a procedure for collecting, analysing, and interpreting and reporting on data in a study that includes the following issues (Kumar and Phrommathed, 2011):

- What design was used.
- How participants were selected.
- How data was collected from respondents or participants.
- How the collected data was analysed.
- How findings were communicated.

The rest of this chapter will include a discussion of these issues in one way or another.

3.5.1 Research designs and methods used in related or similar studies

Various HCI studies have been undertaken to investigate e-service quality, usability and user experience of Web-based applications but not in a comprehensive integrated way. Rather, they are separate studies on one (or sometimes two) of these facets. In addition, a number of models and associated instruments have been developed in Information Systems and other related fields to address issues such as service interaction quality in the marketing field (Zeithaml, Parasuraman and Malhotra, 2002; Seffah et al., 2006; Yahya and Razali, 2015; Venkatesh, Brown and Sullivan, 2016; Javed, 2018; Kocaballi and Coiera, 2018).

The next subsections briefly highlight some of the studies that are related to the present work either in the methodology used or in the domain of study or both. They include the four theories that are relevant to this research as provided in Section 2.2 of Chapter 2. These four have been discussed already and reasons provided for their relevance in this research. These details will not necessarily be repeated here.

3.5.1.1 The DeLone and McLean IS Success model

The study reviewed 100 studies on the success factor for Information Systems organisations and identified six categories that were most common and possible relationships between them (DeLone and McLean, 1992, 2003). No empirical validation study was done. This study can be classified as a systematic literature review. As it has already been stated in Section 2.2, it terms of content, some of the factors such as system quality and user satisfaction are related to this research.

3.5.1.2 The Technology acceptance model (TAM)

This research undertook a review of a number of IS and non-IS studies to determine the factors that influence user acceptance of Information Technology (Davis, 1989; Davis, Bagozzi and Warshaw, 1989; Venkatesh and Bala, 2008). Initially, a relatively large number of items was identified from the literature review. For example, 14 items were identified for Perceived usefulness and 14 for Perceived ease of use. Through a number of refinement studies including user reviews, which included a ranking of items, laboratory studies with users, and surveys, the number of items was reduced. Ultimately, the final model consisted of six items for Perceived usefulness and six for Perceived ease of use. The study included a review of the literature, content validation by system users, and psychometric tests such as reliability and validity, and the structural relationships between the variables. The study thus used various qualitative and quantitative methods that fit current descriptions of mixed methods research as provided in Section 3.4.2. As has already been stated in Section 2.2, in terms of content, some of the factors such as Perceived usefulness and Perceived ease of use are related to this research.

3.5.1.3 The Unified theory of acceptance and use of technology (UTAUT)

As its name suggests, UTAUT integrated a number of existing theories, eight validated models, to determine the factors that influence user acceptance of Information Technology, similar to, and including, TAM (Venkatesh et al., 2003). An initial set of 32 effects and four moderators were sourced from the literature. Through a series of refinements, four effects were confirmed as direct determinants of intention or usage of IT, with four moderators. Similar to TAM, UTAUT was developed by means of a literature review, content validation, reliability and validity testing, and the structuring of the relationships between the variables. The study thus fits current descriptions of mixed methods research.

3.5.1.4 Quality in Use Integrated Measurement (QUIM) model

This model was developed by Ahmed Seffah and his colleagues in 2006 as a tool for measuring usability of software systems including Web-based applications, including those on mobile devices (Seffah et al., 2006). The idea was to integrate the main usability models and develop a single hierarchical model for evaluation of usability using a scale. Using a number of standardised and other models, a hierarchical model made up of 10 factors and 26 sub-factors that consisted of 127 metrics was developed. No empirical validation study was done. This study was based on an extant review of the literature. According to Yahya and Razali (2015), QUIM is one of the most widely used consolidated model for measuring usability of an interactive software system.

QUIM is relevant to this study for four reasons.

- It used an integrative approach by consolidating existing models into a single one.
- A hierarchical model was developed.
- The model dealt with one of the concepts of the present research, namely, usability.
- The model is widely used in different domains.

These factors serve as good indicators of how to start the development of a useful applicable model, not only for usability, but also for e-service quality and user experience.

3.5.1.5 AttrakDiff

AttrakDiff is a model for measuring pragmatic and hedonic quality that was developed by Marc Hassenzahl and his colleagues in 2003. It originated from a software application AttrakDiff (attrakdiff.de) that is used to evaluate the usability and design of interactive products. The instrument was validated with 28 items, in the categories of pragmatic quality, hedonic quality and attractiveness (Hassenzahl, Burmester and Koller, 2003;

Fischer et al., 2018). Apart from Fischer et al. (2018), nothing much has been published on its use. The present researcher considers this as one of the few attempts to measure user experience using a validated scale since it is a combination of pragmatic and hedonic quality. However, it is acknowledged that it has limited use and has not established itself as a formal instrument to measure or evaluate user experience. Much research still needs to be done in this area.

3.5.1.6 User Experience Questionnaire

The User Experience Questionnaire (UEQ), developed by SAP in 2008, attempts to measure both "soft (user experience) criteria and hard (usability) criteria" to determine the user experience of a product (Laugwitz, Held and Schrepp, 2008, p. 73). It consists of 26 items spread over six factors, namely attractiveness, perspicuity (clearness), efficiency, dependability stimulation and novelty. Like AttrakDiff, it evaluates both pragmatic and hedonic quality. In 2017, a short compact version of UEQ, namely, UEQ-S consisting of only 8 items, was proposed to measure UX (Schrepp, Hinderks and Thomaschewsk, 2017). However, it has limitations since it "does not allow measuring the detailed UX qualities" of UEQ (Schrepp, Hinderks and Thomaschewsk, 2017, p. 107). Even though the use of both UEQ and UEQ-S is on the rise, their practical effectiveness is still undetermined (Schrepp, Hinderks and Thomaschewsk, 2017).

3.5.1.7 SERVQUAL

As discussed in Section 2.2.2, SERVQUAL was developed in the marketing service area by Parasuraman et al. (1988) to measure service quality. First, a conceptual model of ten dimensions was developed using focus group interviews (Parasuraman, Zeithaml and Berry, 1985). This was followed, three years later, by a quantitative study, using a survey, to develop SERVQUAL, an instrument for measuring user-perceived service quality (Parasuraman, Zeithaml and Berry, 1988).

Table 3.3 provides examples of methods used in developing SERVQUAL and other instruments in areas that are similar to the focus area of this research, which is e-SQUUX of University web portals. The figure also shows the resulting components of the developed instrument. For example, in SERVQUAL, Zeithaml et al. (2002) developed an e-service quality (E-S-QUAL) model and instrument for measuring electronic service quality for e-commerce websites using extant literature, a comprehensive qualitative study and a survey. Likewise, from 2001 to 2003, Barnes and Vidgen (2001, 2002) and Bressolles and Nantel (2004) developed a series of versions of WEBQUAL, an instrument for measuring web-based service quality using quality function deployments (QFDs), focus groups, literature reviews and surveys. Quality function deployment is a "structured and disciplined process that provides a means to identify and carry the voice of the customer through each stage of

Table 3.3: Methods used in developing related instruments and their components (Synthesised by the researcher)

Instrument	**Methods used**	**Components**
SERVQUAL (Parasuraman, Zeithaml and Berry, 1988): an instrument to measure user perceived service quality	Focus group and survey	Dimensions and items
WEBQUAL (Barnes and Vidgen, 2001): an instrument for measuring web-based service quality	Used QFD, focus groups, literature review and survey	Dimensions and items
Yang et al. (2005): instrument to measure user perceived service quality	Focus group and survey	Dimensions and items
E-S-QUAL (Parasuraman, Zeithaml and Malhotra, 2005): e-service quality instrument	Extant literature, focus groups and survey	Dimensions and items
Caro et al. (2008): developed a data quality model for web portal	Literature review and survey	Attributes and definitions
Portal quality model (PQM) (Moraga, Calero and Piattini, 2004): a generic model for portal quality	Systematic literature review, conceptual model and survey	Web quality attributes and items
Zhang, Rau and Salvendy (2010): usability instrument for handset	Literature review and survey	Factors and items
Sa et al. (2016): a government e-service model	Literature review and Delphi	Domains and dimensions

product and or service development and implementation" (Barnes and Vidgen, 2001, p. 298). Like others, Yang et al. (2005) developed an instrument to measure user-perceived service quality. They too used focus groups and a survey. Other similar studies (Karlsson and Olsson, 2008; Zhang, Rau and Salvendy, 2010) have followed a similar trend as indicated in the table.

This research draws from these models/instruments and others for the methodology to use. Closely related to this research, Joo and Lee (2011) developed an instrument for evaluating usability of academic digital libraries in two stages, namely, instrument identification; and instrument confirmation. Instrument identification involves the identification of dimensions and identification of measurements items from literature. Instrument confirmation involved taking a survey and undertaking statistical analysis. This, too, is very closely related to the methodology used in this research.

3.5.2 Selected research design and its justification: Exploratory sequential design

An Exploratory sequential design (ESD) was selected and used for this research. The next two subsections define and discuss ESD, and why it was selected, respectively.

3.5.2.1 What is Exploratory sequential design?

As stated in Section 3.4.2, ESD is one of the three major research designs for mixed-method approaches, namely, explanatory sequential design, Exploratory sequential design and convergent parallel design. In ESD, a qualitative phase is conducted first. Its results are then used during the quantitative phase. This design is highly appropriate for developing and validating an evaluation model that can be used as an instrument. As a result, it is sometimes referred to as instrument development design (Creswell and Creswell, 2017).

During the first phase, the researcher explores a topic and makes findings. This involves qualitative analysis of multi-perspectives and acquisition of a deeper understanding of the research topic (Baran, 2016). According to Creswell and Creswell (2017) qualitative research is concerned with exploring and understanding the meaning people attach to a human problem. During the second phase, the findings of the first phase are used as the basis to design a quantitative data collection instrument, often in the form of a questionnaire survey. Thereafter, a plan for data collection is set out and data collected. Analysis is performed on this quantitative data and results interpreted (Manzoor, 2016).

In summary, ESD has four steps. First, the qualitative data is collected and analysed. Second, a quantitative component, for example, a survey instrument, is developed from the qualitative analysis. Third, the quantitative data is collected and analysed. Fourth, the results are interpreted to determine whether the quantitative findings generalise or provide insight into the qualitative findings (Creswell and Clark, 2011; Flick, 2018). Since this research was carried out over time, in a sequential manner, it qualifies as a longitudinal study. According to Limayem, Khalifa and Frini (2000) longitudinal studies are very appropriate when developing models that show relationships between variables, as is the case in this research.

ESD is frequently undertaken in cases where there is a lack of an existing measurement instrument, unknown research variables and/or lack of guiding frameworks or models. Consequently, it is suitable for studies that are exploring a phenomenon, developing a new research instrument or model or identifying new important but unknown variables (Manzoor, 2016).

3.5.2.2 Justification for selecting the Exploratory sequential design

In any study, the research design and methods should be suitable for answering the research questions (Baran, 2016; Creswell and Creswell, 2017). The nature of the question determines the choice of methods to use. As discussed in detail in Section 3.4.1, qualitative methodologies are applied to research when the focus of the question is to explore why or how a phenomenon occurs, to develop a theory or to describe the nature of individual experiences. On the other hand, quantitative methodologies are used to answer research questions about causality, generalisability, or magnitude of an effect. Mixed methods research draws upon the strength of both approaches to address contemporary issues (Fetters, Curry and Creswell, 2013; Trochim, Donnelly and Arora, 2016). The main research question for this research was "*What are the components of a conceptual integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications, and of its validated and structural models that are suitable for evaluating a University web portal?* This question is two-pronged and, therefore, appropriate for use of a mixed methods design (Creswell, 2014) as given in Figure 3.2.

Once a researcher has identified that a research problem requires a mixed-method approach and reflected on suitable philosophies and paradigms, the next step is to choose a specific design that best fits the problem and research question(s) (Creswell and Clark, 2011). Of the three major designs in mixed methods identified in Section 3.4.2, the researcher, as already stated made use of an Exploratory sequential design (Creswell and Clark, 2011; Fetters, Curry and Creswell, 2013; Creswell, 2014; Saunders, Lewis and Thornhill, 2016).

The choice to use a mixed-method approach and the choice of the methods to use are mostly motivated by the examples presented in Section 3.5.1 that discussed the research designs and methods used in related/similar studies as follows:

- The section shows that nearly all of them used a mixed method approach, though not explicitly stated in their papers.
- Of the six examples given in Section 3.5.1, four of them, namely, the DeLone and McLean IS Success model, TAM, UTAUT and QUIM acquired the initial conceptual model using a review of the extant literature. This justified the systematic literature review that is used in this research to synthesise a conceptual model.
- The examples demonstrate that four of the six, namely, TAM, UTAUT, AttrakDiff and SERVQUAL, validated a model using a questionnaire survey.
- Of these four, in three of them, namely, TAM, UTAUT, and SERVQUAL the model was content validated.

These examples justified the questionnaire survey and the expert review methods undertaken in this research.

In the present work, a qualitative methodology was used during the first phase since this is appropriate when there is a need to understand the context of the information system (IS) where the context and IS influence each other (Walsham, 1993; De Villiers, 2005; Venkatesh, Brown and Bala, 2013). In HCI studies, such as this one, the user and context of use are central to the study and have an influence on each other as discussed in Section 2.3.4 of Chapter 2. In addition, the study was concerned with interpretations of the meanings of subjective constructs such as user satisfaction and user experience. A combination of (i) a systematic literature review to derive a conceptual model for evaluation of e-service quality, usability and user experience (e-SQUUX) and (ii) reviews of the model by experts formed the main activities during the qualitative phase of this research.

During the quantitative phase, a questionnaire survey among actual users of UNISA web portals, was undertaken in order to refine and validate the model. However, before this, a comprehensive pilot study was conducted to test the approach and the questionnaire.

The process is summarised as follows: The overall aim of this research was to derive a model that can be used for e-SQUUX evaluation of Web-based applications and to validate the model in the context of a University web portal (UWP). First, a *conceptual model* was synthesised by a systematic review of existing literature (Study 1A). Second, an expert review of the model was undertaken to *refine* and modify it (Study 1B). In the quantitative phase, empirical studies were done to validate *e-SQUUX*, using UNISA's web portals as targets for evaluation. The third step (the first part of the quantitative phase) was a comprehensive pilot study to *further refine* the questionnaire instrument (Study 2A). Fourth, the main questionnaire survey was carried out (Study 2B). The collected data was used, first, to determine a *validated model* for evaluating e-service quality, usability and user experience of a UWP. Second, based on the validated model, a *structural model of the relationships* between these three facets was built.

The process describe in the previous paragraph is in line with Exploratory sequential design where the qualitative phase provided results that were used as a basis for the quantitative phase.

The four studies will be presented in Sections 3.6 to 3.10, where Sections 3.6 and 3.7 deal with the qualitative aspects in the form of Studies 1A and 1B; Section 3.8 reports on general methodological matters applied during the quantitative phase such as questionnaire design, participants and sampling, and data collection and analysis; while Sections 3.9 and 3.10 deal with the quantitative Studies 2A and 2B. Before presenting these studies, however, attention is paid in Section 3.5.3, to other research designs that were candidates for this work.

3.5.3 Alternative research designs that could have been used for this research

Before the ESD was selected, alternative designs were considered. This section overviews two designs that could possibly have been used for the research and the reasons why they were not followed.

3.5.3.1 Design science research

One of the research designs that was seriously considered for this research is design science research (DSR) (Hevner et al., 2004; Peffers et al., 2007). DSR grew out of design science and has been used in IS research since the mid-1990s. It is termed design science research since it emphasises the creation of artefacts through innovations to solve practical IT business problem (Hevner et al., 2004; Peffers et al., 2007; Weber, 2010). The artefacts or outputs of DSR can be in the form of constructs, models, methods, instantiations or better theories (March and Smith, 1995; Gregor and Hevner, 2013; Van Biljon, Marais and Platz, 2017). IT managers and professionals are interested in the design and implementation of IT artefacts that improve business performance in an organisation (March and Storey, 2008). In IS, real problems must be identified, conceptualised and represented. Thereafter solutions must be constructed, implemented and evaluated using appropriate criteria (March and Smith, 1995; Peffers et al., 2007).

This research aims to develop a model (one of the potential outputs of DSR) that is appropriate for evaluation of e-service quality, usability and user experience (e-SQUUX). Such a model would result in the improvement of systems performance for any organisation since it supports evaluation of web-based portals and systems using appropriate criteria. This research fulfils these objectives, and in its early stages DSR was seriously considered as the research design of choice.

A three-cycle model for DSR was originally proposed by Alan Hevner (Hevner, 2007) that has since been revised to a four-cycle model by Adreas Drechsler and Alan Hevner (Drechsler and Hevner, 2016). The four cycles are: (Hevner, 2007; Drechsler and Hevner, 2016; Venable, Pries-Heje and Baskerville, 2016; Mabila, Biljon and Herselman, 2017; Baskerville et al., 2018):

- Change and impact cycle: provides the lens for the research to consider the dynamics and wider organisational and societal context within the research domain and scope.
- Relevancy cycle: bridges the contextual environment of the research with the design science activities by ensuring that the developed artefact has utility.
- Design cycle: iterates between the building and the evaluation of the artefact so that the researcher can reflect on the design.
- Rigour cycle: connects the DSR activities that have been undertaken with the knowledge base of scientific foundations (existing literature and/or theories), experience and expertise that inform the research.

This research conforms to the practices of three of these four cycles. However, it falls short in terms of the design cycle. According to Venable, Pries-Heje and Baskerville (2016) who wrote an article on a Framework for the evaluation of design science research (FEDS), there are a number of issues that should be considered in the evaluation cycle. One of them is the evaluation strategy. Venable, Pries-Heje and Baskerville (2016) argue that if a system is to be used for evaluation by real users in a real context, then a number of formative and summative evaluations should be undertaken to minimise human risks in addition to risks that the artefact would cause to the users and/or organisation. They propose that such systems should not take the 'quick and simple' approach where, for example, only one evaluation is undertaken. This assertion is echoed by Drechsler and Hevner (2016, p. 3) who recommend that "several interactions" be undertaken during DSR, which means that a number of evaluations should be conducted. Consequently, the researcher decided against using DSR as the underlying research design for the following reasons:

- The number of evaluations undertaken for the proposed e-SQUUX Model was limited to only one such evaluation, the main questionnaire survey. This means that the full evaluation process required in a DSR cycle, as sufficient to test the model, is only partially applied in this work.

- From the onset, this research was set up as an exploratory study. As a result, the Exploratory sequential design using the mixed-method approach is more suitable for the study than DSR, which requires the delivery of an artefact whose utility has been demonstrated in the real-world context. e-SQUUX has not been evaluated by stakeholders doing authentic tasks in a real-world situation.
- This work produced a conceptual model for Web-based applications, and a validated model and structural model for application to University web portals. One could argue that the expert reviews, and the questionnaire survey with actual users could qualify as forms of evaluation of the artefact. However, as suggested by Venable, Pries-Heje and Baskerville (2016), these would be considered as formative evaluations, but would not qualify as summative evaluation. Summative evaluations would require that the e-SQUUX Model is used to evaluate e-service quality, usability and user experience of a University web portal (UWP), changes be made to the portal accordingly, and then e-SQUUX reapplied to affirm that the portal has improved. Feedback would also be needed from the designer/developers/managers of the UWP on the usefulness of e-SQUUX as an evaluation tool. Such processes would demonstrate the real-world utility of the model as required in DSR (Venable, Pries-Heje and Baskerville, 2016; Mabila, Biljon and Herselman, 2017; Baskerville et al., 2018). This would have demonstrated that e-SQUUX really works. However, the present research, though statistically validated, did not undergo these forms of summative evaluation, which were beyond the scope of this study. Further work could be undertaken to fulfil these requirements.

3.5.3.2 Case study

Gillham (2000) defines a case study as an investigation to answer specific research questions that seek a range of different pieces of evidence from the case settings. This evidence can be abstracted and collated to obtain the best possible answers to the research question. Stake (1995) refers to the case as a single demarcated entity. It may be an individual, a group such as a family or class, an institution such as a university or factory, or a large-scale community such as a town. All these are single cases but multiple cases such as several groups or institutions can also be investigated. In Case study research (CSR), multiple sources of evidence should be collected, for example, what subjects say or do, and what is observed (Yin, 1984, 1989). As a consequence, multiple methods such as interviews, observations and document analysis are used in order to collect as much evidence as possible. This approach is known as triangulation (Saunders, Lewis and Thornhill, 2016). Another major characteristic of a case study is that it investigates a contemporary phenomenon within a real-life context and can provide qualitative data (Yin, 1989; Olivier, 2009). CSR is often used to explain causal links in real-life situations when it is difficult, complex or impossible to use other research methods such as experiments (Yin, 1984, 1989). In such cases, the data obtained would be more comprehensive than that obtained from a survey among a sample of the population.

Case studies are used in a number of disciplines including social science, education, health and information systems (Kaplan and Duchon, 1988; Mills et al., 2017). Since the quantitative data for this research was collected from a single entity, the University of South Africa, the current researcher considered viewing this investigation as a case study. However, it was not selected as the choice of design of choice due to the following reasons:

- Case studies should include, at least, observations, interviews and/or an analysis of participants' 'words' (Merriam, 1998; Denzin and Lincoln, 2012; Mills et al., 2017). None of these methods were used in this study.
- CSR requires that researchers examine in-depth data relating to several variables for a single demarcated entity (Cronin, 2014; Heale and Twycross, 2018). This kind of data was not collected in this study. In fact, such data normally requires qualitative data collection methods such as interviews and observations, which were not used at any stage of the research, as already stated.
- The best approach to use CSR is to explain real-life situations with the researcher being able to appreciate the subjective richness of individuals recounting their experiences in a particular context (Yin, 1989; Cronin, 2014). This was not relevant to the present study.
- In describing case studies, the three most well-known authors in case study research, according to Cronin (2014), describe CSR as being qualitative in nature (Merriam, 1998; Stake, 2006; Yin, 2014). Likewise, Creswell (2014, p.241) defines a case study as "a qualitative design in which the researcher explores in depth a program, event, activity, process, or one or more individuals". In this research,

when empirical data was collected from UNISA, it was in the form of quantitative data using a questionnaire survey. Since a quantitative rather than a qualitative method was used as the main means of data collection from UNISA, this research does not qualify as CSR. Nonetheless, the current researcher acknowledges that there are CSR endeavours where one of the methods used is quantitative.

3.5.4 Application of Exploratory sequential design in this research

Figure 3.3 demonstrates how Exploratory sequential design (ESD) was applied in this research. In line with the definition of ESD (Creswell, 2014), the figure shows that the flow (sequence) of the study was from the qualitative phase, comprising Studies 1A and 1B, to the quantitative phase which consists of Studies 2A and 2B, as depicted by the blue blocks. The blue arrows show the sequence of the longitudinal study while the four large red blocks represent the versions of e-SQUUX that were output from each individual study. The smaller red block shows the output of the pilot study. The e-SQUUX model evolved through a series of versions (1 to 4) during its development. The oval shows that the validated model from Study 2B was used for structural modelling of the core facets of the present research, by means of SEM-PLS, to produce the final e-SQUUX Model V4. In addition, Figure 3.3 shows small green circles within the version blocks, indicating where Subquestions (SQ) 1 to 6 were answered, while the larger green circle shows where the Main Research Question (MRQ) was answered. The figure thus shows the research process, depicting the sequential exploratory design applied in this research and places the research questions in the contexts where they were addressed.

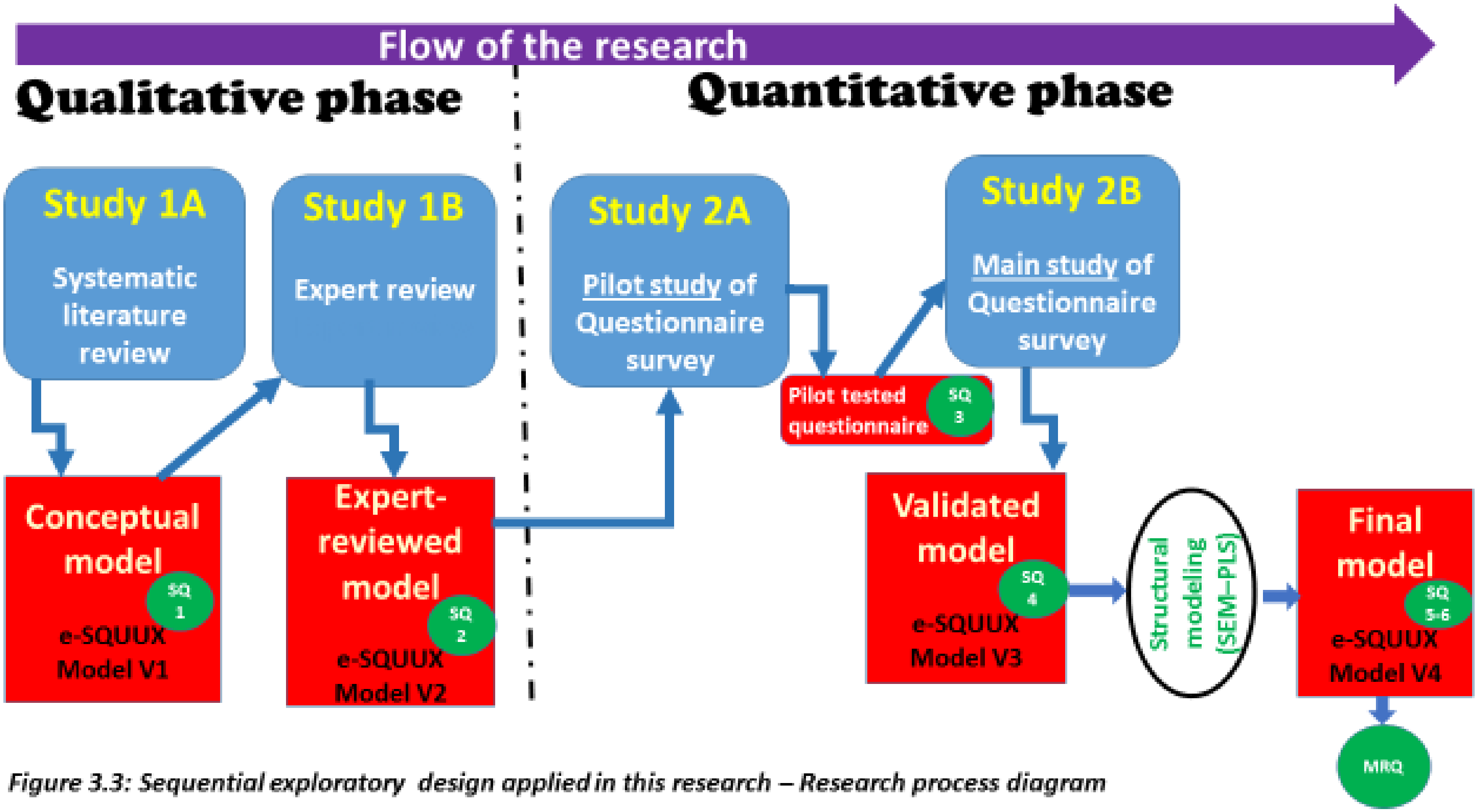


Figure 3.3: Sequential exploratory design applied in this research – Research process diagram

Sections 3.6 to 3.10 provide some detail of the different studies, as provided in the figure, on which Chapters 4 to 8 are based.

3.6 Qualitative phase: Study 1A – Systematic literature review

3.6.1 Background and motivation for use of a systematic literature review

The aim of this phase was to synthesise from existing literature the dimensionality of a conceptual model for the evaluation of e-service quality, usability and user experience (e-SQUUX) that is appropriate for assessing e-SQUUX of a University web portal in order to answer **Subquestion 1**, namely:

1. *What are the components of a conceptual integrated model, synthesised from the literature, for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications?*

According to Gough, Oliver and Thomas (2017) there is a difference between a traditional literature review and a systematic literature review. A traditional literature review summarises and presents research findings related to the topic of the study, as was done in Chapter 2. On the other hand, a systematic literature is "a review of existing research using explicitly, accountable rigorous research methods" (Gough, Oliver and Thomas, 2017, p. 4). Consequently, it is a method for collecting specific literature that provides primary data that is analysed to answer a research question, as is done in Chapter 4 of this study where literature was used to determine the dimensionality of the first version of the e-SQUUX conceptual model.

As stated previously, in 1985, Parasuraman, Zeithaml and Berry developed a conceptual model for service quality from which they later, in 1988, developed the SERVQUAL Model, used for measuring traditional service quality. Similarly, in this research, the first phase concentrated on the conceptualisation of a model for evaluating usability and user experience, as well as e-service quality of Web-based applications. However, in contrast to Parasuraman, Zeithaml and Berry (1985) who used an exploratory study with focus groups to derive the conceptual model of service quality, this research reviews existing literature to achieve the same objective. Parasuraman, Zeithaml and Berry (1985) did not use this approach because at that time there was insufficient literature in their domain of study, as expressed in the following statement: "… because the literature on service quality is not rich enough to provide a sound conceptual foundation for investigating service quality, an exploratory qualitative study was undertaken to investigate the concept of service quality." (Parasuraman, Zeithaml and Berry, 1985, p. 43). However, there is now sufficient literature in the areas of the e-SQUUX facets and categories in general and also with regard to Web-based applications, to warrant the use of a systematic literature review. But this body of literature has not yet been comprehensively synthesised, thus creating a gap which this research aims to fill. The second motivation for using a systematic literature review, as stated in Section 3.5.2, is that of the six examples discussed in Section 3.5.1, four of them took the approach of using extant literature. They serve as precedents for the present research. In addition, the use of a systematic literature review was further motivated by the following studies that also used this method in work that is similar to this phase of the present research:

- In their study, closely related to this research, to determine data quality attributes for developing a data quality model for web portals, Caro et al. *(*2008) used 55 papers published between 1995 and 2004 from which they identified data quality attributes applicable to the web context. A total of 100 attributes were identified. In their first phase, these were reduced to 41 by combining those with synonymous names. In the second phase, they used these attributes to form a matrix for data quality for web portals. Later each of the attributes was defined, and, finally, a survey was conducted to validate the attributes.
- In order to develop a portal quality model, Moraga, Calero and Piattini (2004) used the five SERVQUAL dimensions, namely tangibles, reliability, responsiveness, assurance and empathy, to conceptualise the model. They added another dimension, namely data quality, and then identified items for each dimension to conclude with 41 items in total. Finally, they conducted a questionnaire survey to evaluate the dimensions.

- Zhang, Rau and Salvendy (2010) developed a usability instrument for mobile phones. Their first step involved collecting and screening an unspecified number of literature resources related to 'usability attributes'. These included previous studies on usability frameworks, usability evaluations, usability instruments and usability testing results. The second phase was similar to the first, but considered publications on 'handset design elements'. The two phases resulted in a total of 98 items and 16 dimensions. Each item was then assigned to one of the dimensions. The dimensions and items were then given to three masters and three doctoral students who were asked to comment on their incompatibilities and to identify synonyms.

3.6.2 How the literature review was conducted

In order to define, understand and model e-SQUUX, a review of appropriate literature in the areas of software in general, web engineering, e-commerce, and web portals, including higher education portals, was undertaken. It included existing models and standards, as well as definitions, principles, guidelines, measures and criteria that were relevant to the three core facets of e-SQUUX. The works of some of the main researchers in the HCI field such as Jakob Nielsen, Jennifer Preece, Alan Dix and others were used as the foundation synthesis. This study (Study 1A) also incorporated some of the more recent work in the fields of study taking into account that context of use of technology and users' needs change over time (Abran et al., 2003; Helander, 2014). The main international standards models of usability such as ISO 9241-11 and ISO 9126 were considered, as well as the most recent standard, ISO 20282. The approach taken during this literature review was similar to that recommended by Kitchenham (2004). However, some of the recommendations by Kitchenham were not followed strictly since the aim of this phase was not to draw conclusions regarding the literature studied but rather to identify content that related to potential components of e-SQUUX.

The guidelines for a systematic literature review recommended by Kitchenham and followed in this research are (Kitchenham, 2004):

- There should be a review protocol that specifies the research question and methods to be used. A review protocol specifies the methods to be used during a specific review.
- There should be a defined search strategy, so that readers can assess the rigour and completeness of the search. This should specify what is included and excluded, where possible.
- The required information should be specified.
- Qualitative or Quantitative meta-analysis should be performed in order to make a conclusion.

Although numbers were used in the conceptualisation of the e-SQUUX evaluation model, the focus at that stage of the research was more qualitative than quantitative, since it was based on the present researcher's understanding of the publications perused – publications written by researchers or practitioners, or meaning in terms of what they considered to be the dimensions of e-service quality, usability and/or user experience. In line with the qualitative approach, there was subjectivity in this method. For example, there were certain cases where the current researcher made decisions and interpretations of what dimensions are related and how they relate to each other. For example, 'Is readability a subset of learnability or not?'

A meta-analysis approach was followed to analyse the textual data where data from primary resources was reviewed (Kitchenham, 2004; Gough, Oliver and Thomas, 2017). The main analysis approach was in line with a description by Gough, Oliver and Thomas (2017, p. 55) that 'a synthesis of 'qualitative' research which configured the results of individual studies employing aggregative logic by treating concepts that had been found in many studies as more important than those that were only found in a few". They add that aggregative logic can be quantitative when numbers from the sources are added up or qualitative when concepts, collected from the sources, in the form of text/word (s) are merged. The latter was the case in this study. Manual analysis was used; no analysis tools were employed.

In terms of the selection criteria, the following demarcation was used:

- Existing international standards such as ISO 9241 and ISO 9126.
- Literature from publications (peer-reviewed journals, conference proceedings and books) authored by those whom the present researcher considered outstanding researchers and practitioners, in the field of HCI such as Jakob Nielsen, Brian Shackel, Don Norman, Ben Shneiderman and Jared Spool. These authors were also recipients of the SIGCHI Lifetime Achievement Awards (SIGCHI Award Recipients 1998-2013, 2013).
- Literature sourced from large IT companies such as Microsoft, Apple, IBM, Xerox, Samsung and others.
- Literature from peer-reviewed scholarly academic journals and conference proceedings, and published books that do not lie in category 2 above. Although some of these publications could be directly searched from Google and Google Scholar, they had also to be listed in established electronic sources such as ISI, SCOPUS, Springer, Science Direct, and EBSCO HOST. All sources had ISBN or ISSN numbers. Each source was categorised as a Journal, Proceedings or Book. An effort was made not to consider sources from 'Predatory' journals.

In general, the aim was to find as many as possible relevant sources based on the search criteria. The search terminated when most of the terms or concepts found in new sources had already been identified. There was no limit on publication date, since the objective was to identify as many components as possible. Preference was given to the more recent sources, but many classic and seminal publications were also used.

The sources used in the literature study chapter were considered first. However, other closely related sources that satisfied the selection criteria were also studied. Terms used to search for relevant sources included one, two or three of the words/phrases e-service quality, usability and user experience, combined with any one of these words: attribute, factors, dimensions, definitions, descriptions, models, website, web portal, principles, heuristics, and measurement. For the phrase e-service quality, the ‘e-’ part was also substituted with the words: electronic, online, and web or web-based to form search-phrases such as ‘online service quality’.

Chapter 4 presents the details and results of the systematic literature review process – Study 1A. The result of this phase was a conceptual integrated model synthesised by the researcher from literature for evaluating e-service quality, usability and user experience. The conceptual model was used as the input to the next phase, Study 1B.

3.7 Qualitative phase: Study 1B – Expert reviews of the conceptual model

The objective of the expert review study was to improve the content validity of the model. Content validity seeks to get answers to questions such as (i) Is the model/instrument measuring the concepts it is intended to measure? (ii) Does the model/instrument provide an adequate sample of items or dimensions that represent the concept? (Fouche and Delport, 2004; Newman, Lim and Pineda, 2013).

According to Brod et al. (2009) and Fouche and Delport (2004), assessing content validity is usually based on collecting qualitative data from experts or actual users of the area of interest. However, according to Newman et al. (2013), content validation can be performed qualitatively, quantitatively or by a combination of both. This is because, apart from the ‘use of words’ (qualitative text format) by peer-reviewers, they can count, classify, or rate content. An expert-researcher can also determine the content validity of what they developed by critically reviewing the outcome. This means that the expert opinion of the reviewers and the prior knowledge of the researcher play a major role in the success of this method (Fouche and Delport, 2004; Brod, Tesler and Christensen, 2009).

The input to an expert review of this nature is normally a conceptual model that has been developed from a literature review or from some form of a qualitative study. The outcome of the review is normally a theoretical model made up of concepts and categories with a set of generated items. It is usually a refined model, an improved model that can be used as a basis for designing a measurement instrument (Brod, Tesler and Christensen, 2009; Oates, 2010).

Content validity is dynamic in nature since it is subject to change in time, instrument constructs or audiences (Newman, Lim and Pineda, 2013). For example, the change may be due to new literature that has emerged over time.

For this study, as recommended by Brod et al. (2009), purposive sampling was used to select the participants. It is recommended that such a sample be made up of people with knowledge (expertise) and experience in the domain of study so that expert opinion is provided (Stojmenova, Lugmayr and Dinevski, 2013; Sulaiman et al., 2016). This view is echoed by Aziz et al. *(*2016) who propose that reviewers should have a variety of skills, such as being domain experts and having application expertise. All the experts in this study were highly qualified in the fields of Information Technology (IT) and/or HCI. They were provided with a template to review the conceptual e-SQUUX Model that emerged from Study 1A, and were also asked to provide qualitative feedback in the form of comments on the suitability of the components of the model with respect to the evaluation of WBAs. In addition, they were free to add, remove, combine, separate or relocate components, or make any other adjustments. Furthermore, the reviewers provided certain quantitative data in terms of ranking the components in terms of their importance.

The aim of Chapter 5 is to answer **Subquestion 2**: *What are the components of the conceptual integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications following an expert review*? The entire Chapter 5 is dedicated to this phase of the study, including some of the methodological issues that could have been part of the present chapter. This was done because this approach will make it easier to rework the contents of this study (Study 1B), combined with certain material relating to Subquestion 1 (answered in Chapter 4), in the form of an article to be published and disseminated to the research community.

The outcome of this study was a modified e-SQUUX Model V2 (see Table 3.1) where V2 stands for ‘Version 2’.

3.8 Quantitative phase: General information for both the pilot and main questionnaire surveys

This section is the first of three sections, namely, Sections 3.8, 3.9 and 3.10, that present the methodology followed during the quantitative phase of this mixed methods research. During this phase, a pilot and the main questionnaire survey were undertaken. Section 3.8 deals with the issues that were common to both the pilot and main study. Section 3.9 covers the issues that were distinct to the pilot study while Section 3.10 provides those that were specific to the main study.

3.8.1 User survey evaluation using questionnaires

A survey is a method of collecting self-reported information from individuals about their thoughts, characteristics, feelings, perceptions, behaviour or attitude. It is the most commonly used research method in all fields including IS and HCI (Stojmenova, Lugmayr and Dinevski, 2013; Lazar, Feng and Hochheiser, 2017), which are the fields of study for this research. The instruments used are a survey questionnaire or an interview schedule. In the former, the respondents read the questions themselves and fill in the answers while in the latter the interviewer poses questions to the respondent and writes or audio-records the answers (Neuman, 2013; Saunders, Lewis and Thornhill, 2016). A questionnaire is a well-defined and well-written set of questions to which an individual is asked to respond (Lazar, Feng and Hochheiser, 2017). Questionnaires are one of the most established techniques of collecting demographic data and users’ opinions during user surveys. They generally consist of closed or open question structures. Open questions are those where the respondents can express their own answer freely, whereas closed questions require them to select answers from a choice of options provided. Although open questions provide a rich source of qualitative data, the data is more difficult to analyse than that from closed questions (Preece, Rogers and Sharp, 2015; Lazar, Feng and Hochheiser, 2017).

Before carrying out a large-scale survey, questionnaires should be prepared, reviewed with colleagues and pilot-tested with a small sample of users. To achieve a successful survey, the design of how the data will be statistically analysed and presented should also be done, before the survey is conducted, possibly in consultation with statisticians (Shneiderman and Plaisant, 2005; Saunders, Lewis and Thornhill, 2016).

When conducting questionnaire surveys, online or paper-based questionnaires can be used. The online ones should be short and brief, because online respondents rarely have the time and patience to complete them. They have the advantage of reducing the cost and minimising the effort of printing, distributing and collecting, which are characteristics of paper-based questionnaires (Shneiderman and Plaisant, 2005; Cohen, Manion and Morrison, 2018).

Ideally, questionnaires should start with general questions that require the respondent to provide basic demographic information and information about their experience. This information is useful in determining the ranges within the sample group. After the general questions, specific questions that contribute to the evaluation goal should follow. However, profile questions can sometimes be shifted to the end of the questionnaire to ensure that participants respond to the actual evaluation before fatigue sets in (Cottrell et al., 2015; Preece, Rogers and Sharp, 2015; Saunders, Lewis and Thornhill, 2016).

In general, the following guidelines should be used in designing questionnaires (Preece, Rogers and Sharp, 2015):

- Make the questions clear and specific.
- Make sure that the instructions on how to complete the questionnaire are clear.
- Try to ask closed questions, where possible, with a range of answers from which to choose.
- For questions that seek opinions, include an option for a neutral opinion.
- Give considerable thought to the way the questions are ordered, because the response to questions can be influenced by their order.

- Avoid jargon and consider whether different questionnaires will be needed for different populations.
- Because respondents are deterred by lengthy questionnaires, a balance should be kept between including large white spaces and the need to keep the questionnaire as compact as possible.
- If scales are used, make sure their ordering is consistent and intuitive. For example, in a scale of 1 to 5, 1 should indicate low agreement and 5 indicate high agreement, and this should be consistent throughout the questionnaire.

Neuman (2013) summarises the above guidelines:

> *"Three principles for writing effective survey questions are: keep it clear, keep it simple and keep the respondent's perspective in mind" (Neuman, 2013, p. 175).*

Although questionnaires are a good method of collecting information for evaluating a system, they have the disadvantage of being less flexible in comparison to some other methods, such as interviews. This is because questions are predetermined and fixed for all users, and not customised to individuals. The other disadvantage is that they can sometimes lead to biased data due to recall bias if a respondent has to respond regarding an event that took place a long time previously. However, questionnaires have the advantage of reaching a wider subject group than interviews and user testing, and are inexpensive and easy to use (Shneiderman and Plaisant, 2005; Preece, Rogers and Sharp, 2015; Saunders, Lewis and Thornhill, 2016; Lazar, Feng and Hochheiser, 2017).

3.8.2 Questionnaire design

As stated in Section 3.8.1, a questionnaire is a well-defined and well-written set of questions to which an individual is asked to respond. It is an established technique of collecting demographic data and users' opinions during surveys. An advantage of questionnaires is that they can obtain data from large numbers of respondents (Fink, 2015; Lazar, Feng and Hochheiser, 2017).

Guidelines were mentioned in Section 3.8.1 for designing quality questionnaires. In addition to those, every questionnaire should have a title and define the survey purpose. The purpose should include a description of what data should be measured, how it will be measured, from whom it will be collected, and over what periods (Stopher, 2012; Rea and Parker, 2014). Other characteristics of a good questionnaire are (Fink, 2015; Lazar, Feng and Hochheiser, 2017):

- It should draw accurate information from respondents.
- It should provide a standard format to collect facts, comments and attitudes.
- It should enable the researcher to build an overall picture in a structured, smooth and orderly manner.

The wording and structure of the questionnaire should be appropriate, relevant and free from any problems such as errors or potential misinterpretation (Kumar and Phrommathed, 2011). To ensure the validity of a questionnaire, the questions asked should be based on the research objectives and/or hypothesis of the study (Kumar and Phrommathed, 2011; Devlin, 2018). All these guidelines were applied in the design of the present questionnaire. Furthermore, the following principles that assist in formulating effective questions were applied (Kumar and Phrommathed, 2011; Trochim, Donnelly and Arora, 2016):

- Simple language, as used daily by the respondents, should be used.
- Questions should not be ambiguous. An ambiguous question is one with more than one meaning, which might be interpreted differently by different respondents.
- No question should be double-barrelled, that is, questions that refer to more than one issue but require a single answer, should be avoided.
- Leading questions or questions based on presumptions, should not be asked.

The questionnaire used in this research consisted of a number of sections which are discussed in the next subsections.

3.8.2.1 Introduction to the questionnaire

A brief introduction to the survey was provided before the main section of the questionnaire. It stated that participation was voluntary and that an individual was free to withdraw his/her consent at any time. This matter is addressed further in Section 3.12 on ethical considerations.

3.8.2.2 Demographic data

As in similar studies (Barnes and Vidgen, 2002; Bringula and Basa, 2011; Rocha, 2012), demographic information was collected on factors such as gender, age, education level, availability of Internet at home, at work or on campus, and experience in Internet usage, including the use of web portals and UNISA portals. Data on participants' general computer skills and experience was also gathered. For example, experience in using Microsoft Office packages such as Word and the extent of their use of computers in general, was required. Furthermore, participants were asked whether they had used any other University web portal and for how long. Their level of expertise in general computer applications and Internet skills was assessed, using a five-point Likert scale ranging from not skilled (1) to highly skilled (5). Commitment to the use of the University web portal was measured using a 5-point scale ranging from not committed (1) to highly committed (5).

3.8.2.3 Evaluation section and re-categorisation of components

The evaluation section of the questionnaire followed the methodology used in similar studies that focussed on the development of evaluation models and instruments. These studies were discussed in Section 3.5.1. Similar to these studies, the outcome of the qualitative phase was used as a basis for designing the questionnaire. After the development of e-SQUUX Model V2, there were 16 e-SQUUX dimensions. Each of them was assigned to one of the facets of e-SQUUX, namely, e-service quality, usability or user experience. This grouping became the norm thereafter, in this research. In the questionnaire, for the sake of the participants, the facets were labelled 'Categories'. This was done to make the questionnaire more usable and to avoid confusion with technical terms. However, in the chapters that follow, the name facets still refers to the e-service quality, usability and user experience as was the case in Section 1.1.

The use of the three main facets as the formal categories was undertaken on the advice of the statistician who was consulted at the questionnaire design stage. He believed that the questions would be answered best if the questionnaire was formally structured in that manner, rather than weaving the three facets throughout the questions. This turned out to be the case during statistical analysis including validation and structuring of the model.

A professor in Information Systems with over 25 years in HCI research, and the current researcher, performed this categorisation procedure. The result was that there were 6, 6 and 4 dimensions in e-service quality, usability and user experience categories, respectively. Apart from one dimension, the two people individually allocated the 15 other dimensions to the three categories in the same manner. There was a short debate about that one category, namely, Satisfaction. It was discussed whether to include it under the usability category where it has traditionally belonged, for example, as in the definition of the ISO 9241 (ISO 9241-11, 1998), or whether to include it under the user experience category since it was seen as the hedonic part of usability (Hassenzahl and Roto, 2004). After analysing the items that formed this dimension, a consensus was easily reached to place it under user experience. Table 3.4 shows a summary of evaluation categories and dimensions

Table 3.4: Summary of evaluation categories and dimension in the questionnaire

Category	Dimension number	Dimension	Items: Pilot	Items: Main
e-Service quality (e-SQ)	1	Information quality	4	4
	2	Availability	5	5
	3	Responsiveness and Helpfulness	4	4
	4	Security and Privacy	4	4
	5	Assurance and Credibility	4	5
	6	Support	4	4
Usability (UB)	7	Learnability	**4**	4
	8	Effectiveness	4	3
	9	Efficiency	4	4
	10	Navigation	4	3
	11	Errors	4	4
	12	Interface design	4	4
User experience (UX)	13	Suitability and Relevance	4	3
	14	Satisfaction	4	4
	15	Flexibility and Personalisation	4	5
	16	Pleasure	4	4
Total			**65**	**64**

in the questionnaire. The table includes the number of items for each dimension for both the pilot survey and the main survey. They were not identical since the questionnaire was refined and marginally changed following the pilot study.

3.8.2.4 Scales used

A five-point Likert scale ranging from Strongly disagree (1) to Strongly agree (5), shown in Table 3.5 was used to rate each of the statements in the Evaluation section of the questionnaire.

Table 3.5: The 5-Point rating scale used in the questionnaire evaluation of items

Score	**Rating**
1	Strongly disagree (SD)
2	Disagree (D)
3	Neither agree nor disagree (N)
4	Agree (A)
5	Strongly agree (SA)

3.8.3 Participants and sampling

A sample is a subset of the population, such as individuals, objects or occurrences, from which a statistical inference can be made about the population under study (Franklin, 2012; Stopher, 2012). According to Franklin (2012, p. 293), a sample can be selected "randomly or by other means". No survey can be completely free from bias. However, steps must be followed to minimise bias. Sampling must be done in a scientific manner that provides an acceptable compromise between sample cost and sample representativeness (Stopher, 2012). This means that within the available resources, there should be a trade-off when dealing with data quality and survey quality. Data quality refers to the fact that for more accurate data analysis, a larger sample is required, however, this scenario results in higher costs. The trade-offs between survey length and data quality should be considered since a limited survey, in terms of the number of respondents, cannot capture quality data, which in turn compromises survey quality.

In this research phase, a form of quantitative sampling technique known as stratified sampling was applied (Fouche and Delport, 2004; Creswell and Creswell, 2017).

Stratification occurs when an appropriate number of respondents is selected from each subset of the population of the study (Lazar, Feng and Hochheiser, 2017). A random sample of University web portal users was selected from the three target strata, namely students, academic staff and administrative staff. Between 100 and 200 respondents are required for factor analysis to be undertaken (Lenth, 2001; Barnes and Vidgen, 2002). In this study, the goal was to acquire about 150 respondents, including at least 100 students, 25 academic staff and 25 administrative staff. This number was selected as a minimum because similar studies (Parasuraman, Zeithaml and Berry, 1988; Barnes and Vidgen, 2002) used a minimum of 150 respondents. It is also the number recommended by Parasuraman, Zeithaml and Berry (1988) when developing SERVQUAL. However, due to low response-return rates in this kind of study, the goal for sample size was increased by 27.5%, as recommended by (Panach et al., 2008) to accommodate potential low return and completion rates. Consequently, a minimum of 191 participants were targeted.

The target participants were individuals who had used UNISA web portals, and who were registered students or staff employed by UNISA, and therefore had an active student number or staff number. Consequently, each participant had a username and password to login to the web portal.

Even though the University of South Africa is an ODeL institution, it has a number of sites in the form of main campuses and study centres that are used by both its staff and students. At the time the survey was undertaken, UNISA had 30 sites made up of two main campuses and 28 study centres. Since stratified sampling was applied, it was decided to target six sites including the two campuses, since most of the academic and administrative staff are based at these campuses. It was also decided that at least two of the six should be sites in the rural areas. Furthermore, since stratified sampling was used, the student to staff ratio, and male to female proportions in terms of gender were also considered, particularly during the main survey. Within the staff, the ratio of the number of academic staff and administrative staff was also taken into account.

The steps undertaken in this subsection (3.8.3) were to minimise self-selection bias, that is, to ensure that participants are selected in a manner that is representive of the population.

3.8.4 Data collection

Data was collected over a period of one month from mid-May 2017. A self-administered paper-based questionnaire was used and was handed to participants individually. Potential participants from the required groups (staff and students, ensuring a balance of male and female) were approached personally and greeted. Questionnaires and consent forms were handed to those who were willing to participate. Although the questionnaire had a brief introduction, stating who the researcher was, what he was researching and why, and the procedure to be followed, each participant was briefed on these issues in about three to four sentences. The questionnaire and the consent form were given to one to three participants at a time. In addition, a pen to complete the questionnaire was provided to each of them. Participants were informed that it would take 15-20 minutes to complete the form. The researcher or research assistant then sat about five to ten metres from the participants. The aim was to make them comfortable to fill in the questionnaire freely without any interference, although they could ask questions if anything was unclear. However, very few participants had queries. After completion, participants handed back the questionnaire and the signed consent form. As in many other studies of this nature (Ho and Lee, 2007; Cottrell et al., 2015), as a sign of appreciation, an incentive in the form of the pen was donated to the participant.

3.8.5 Data analysis and interpretation

These were handled differently for the pilot and the main surveys, since the purposes of the two were different. For the pilot study, its main purpose was to improve the quality of the questionnaire, while that of the main study was to collect quality data that was suitable for data analysis to answer the research questions. Consequently, each of these will be presented in different sections (3.9.4 and 3.10.4) later in this research document.

3.8.6 Reliability and validity

Reliability of a research instrument is its ability to produce similar results when used repeatedly under the same conditions (Kumar and Phrommathed, 2011). Reliability is a measure of the accuracy, stability and predictability of an instrument. This means that the higher the reliability of an instrument, the more accurate it is and vice versa. In a study such as the current one, the final model should also be validated since reliability and validity are very important aspects of any instrument, or model in a form of a questionnaire (Adams, Anne and Cox, 2008).

Validity in quantitative research determines whether an instrument measures what it was intended to measure, so that meaningful and useful inferences can be determined from the scores (Creswell and Creswell, 2017). When developing a model or scale, reliability and validity tests ensure that the items accurately describe the required constructs and that the results are replicable (Golafshani, 2003; Devlin, 2018).

During the analysis of both the pilot and main survey data, reliability of the constructs (dimensions) was determined using statistical techniques. An item analysis technique which uses Cronbach alpha (α) was used. The calculated alpha values were interpreted as follows (Straub and Gefen, 2004; Cordiglia and Van Belle, 2017):

- For values above 0.8, the reliability was considered to be good.
- For values from 0.6 to 0.8, the reliability was considered to be acceptable.
- For values below 0.6, the reliability was considered to be unacceptable.

In order to increase the reliability value of α, some items were removed in line with the recommended statistical techniques. This helped to reduce the number of items in the e-SQUUX model at various stages of its development and hence refined the model.

Since this research is exploratory in nature, during the analysis of the data for the main survey, only the EFA technique was used for validity testing. This was done to determine whether the items load on their respective factors (dimensions). The ideal situation is that all questions that belong to a dimension must all contribute to it. One of the advantages of EFA is that it identifies hidden factors that may or may not be apparent from the questionnaire (Tsironis, Gotzamani and Mastos, 2017).

Reliability coefficient values (Cronbach’s alpha) and EFA were thus used to determine the reliability and validity of the constructs, respectively. A number of similar studies, such as Bringula and Basa (2011), Bressolles and Nantel (2004), Barnes and Vidgen (2002) and Parasuraman, Zeithaml and Berry (1988) had used the same techniques during instrument development. A further technique that was used during data analysis of the main study was the structural modelling equation (SEM). Specifically, this study used partial least squares – structural equation modelling (PLS-SEM) (Hair et al., 2016).

The detailed application of these statistical data analysis techniques and interpretations of the result are provided in Chapters 6 and 7.

3.9 Quantitative phase: Study 2A – Pilot study of the questionnaire survey

3.9.1 Overview of pilot studies

Pilot studies are carried out by a number of researchers in survey research whether they are using existing questions items or new ones in a questionnaire (Johanson and Brooks, 2010). Piloting or pre-testing involves a limited number of participants completing a questionnaire to determine whether it works as intended (Sue and Ritter, 2012; Fink, 2015). This is important since there is a need to refine the approach and questionnaire before releasing it to the larger sample. The main purpose of a pilot study is to test whether the study design is realistic and feasible by having a critical understanding of each question and its meaning as understood by the respondents (Kumar and Phrommathed, 2011; Connaway and Radford, 2016) According to Durand and Chantler (2014) and Welman and Kruger (1999), pilot studies help to determine whether any questions are ambiguous or make respondents uncomfortable. This helps to uncover inherent problems that would otherwise be discovered too late during the main study (Lazar, Feng and Hochheiser, 2017). A focused and unambiguous questionnaire should improve the success and effectiveness of the investigation (Fouche and Delport, 2004; Adams, Anne and Cox, 2008). However, even before the pilot study, the questionnaire should be checked by one or two other people

(Yin, 1984). In this research, the questionnaire was checked by two people before the actual pilot study with 26 participants.

One of the primary interest of pilot studies is to determine if the final targeted number of participants will be reached. By finding out the response rate during a pilot study, researchers can estimate the feasibility of acquiring the necessary number of respondents during the main study (Dillman, Sinclair and Clark, 2014).

The following are some of the reasons why pilot studies should be performed (Deutschlander, 2009; Johanson and Brooks, 2010; Dillman, Sinclair and Clark, 2014; Durand and Chantler, 2014; Lazar, Feng and Hochheiser, 2017):

- Survey research questionnaires must use clear appropriate language with no obvious errors or omissions. If these occur, then revisions should be made before the questionnaire is finalised.
- In order to improve the validity of the questionnaire, the questions must not be confusing or misleading. Making questions more clear and unambiguous ensures that the content is not misunderstood which results in improvements in the reliability and validity of the questionnaire.
- Pilot studies make it possible to gauge the feasibility of the research design in terms of how participant will react to the questionnaire and in terms of response rate that is, how easy it will be to get intended respondents.
- They (pilot studies) make it possible to gauge the length of time participant will need to complete the questionnaire.
- They make possible it to get feedback from participants in terms of content and wording.
- They enable the researcher to get feedback from participants in terms of ordering of questions and sequence of the questionnaire.
- They allow for the testing of the data-capturing and analysis tools to be used for the final study and for determining if the data works as expected.

In addition to this list, according to Welman and Kruger (1999, p.146), "A pilot study allows researchers or their assistants to notice non-verbal behaviour (on part of participants) which possibly may signify discomfort or embarrassment about the content or wording of the questions". This may require the researcher to probe further on what changes need to be undertaken in the design of the questionnaire.

The entire Chapter 6 is dedicated to the pilot study that was undertaken, including certain methodological issues that could have been part of this chapter. This was done to make it easier to subsequently communicate the contents of this study (Study 2A) to the research community in the form of a published article. Chapter 6 aims to answer **Subquestion 3**: *What is the value of a comprehensive pilot study prior to the main questionnaire survey on the components of an integrated model for evaluating e-SQUUX of a University web portal (UWP)*? As indicated above, a further aim is to convert the content of that chapter to a published article, hence the inclusion of certain methodological matters in Chapter 6. Nevertheless, some of the theoretical and methodological matters are dealt with in Sections 3.9.1 to 3.9.4 following.

3.9.2 Questionnaire design

The issues related to questionnaire design were covered in Section 3.8.2. As stated there, the questionnaire consisted of three main parts. For the pilot study, after the brief introduction (see Section 3.8.2.1), the first section focused on the demographic data (see 3.8.2.2). This was followed by the actual evaluation section (see 3.8.2.3). As seen in Table 3.4, the number of items in the pilot was 65 for the 16 dimensions for which data was collected.

3.9.3 Participants, sampling and data collection

General issues related to the nature of participants and sampling technique during the questionnaire survey phase are covered in Section 3.8.3. For the pilot study, data was collected from 29 participants, of which 26 questionnaires were usable. In addition, of the six potential UNISA target sites, data was collected from two sites, one campus and one study centre.

With respect to data collection, in addition to its processes and procedure provided in Section 3.8.4, for the pilot study, five other activities occurred. First, participants were observed as they completed the questionnaire to gauge their reaction. For example, the facial expression could give an indication as to whether they were experiencing any difficulties or not. Second, they were timed to determine the approximate time they took to complete it. Third, on handing back the questionnaire, they were asked what challenges they had faced while completing it. They were also asked to provide any other feedback, for example, whether the questionnaire was clear and simple to complete. Fourth, because of the need to collect this extra research information, only the present researcher undertook this exercise without any assistance from a research assistant. Fifth, participants in the pilot study were asked not to take part in the main study, which would be conducted a few weeks later.

3.9.4 Data analysis and interpretation

This is covered in Chapter 6, specifically in Sections 6.4 (Reliability of the constructs in the questionnaire) and 6.5 (Other changes to the questionnaire design and distribution procedure). It suffices to state briefly at this point that, first, some items were modified or removed after reliability testing had been performed using Cronbach's coefficient alpha while some were added. Second, the questionnaire was modified for the main study, not only in terms of content but also in terms of the structure. Importantly, the profile data section was shifted from the beginning to the end of the questionnaire.

3.10 Quantitative phase: Study 2B – Main study of the questionnaire survey

Chapter 7 in entirety is devoted to this phase of the study, including some of the methodological issues that could have been part of the present chapter. This was done to generate holistic content in Chapter 7 that can more easily be converted to a publishable article/s that communicate the contents of Study 2B to the research community. The aim of Chapter 7 is to answer **Subquestions 4 to 6**:

4. *What are the components of an empirically validated integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of a University web portal (UWP)?*
5. *What is the structural model (relationships) of e-service quality, usability and user experience in the context of evaluation of a UWP?*
6. *What are the components of e-service quality, usability and of user experience following the structural modelling of the three in the context of evaluation of a UWP?*

Furthermore, it is hoped that two articles will be published on the main questionnaire survey, with Subquestion 4 resulting in one, and Subquestions 5 and 6, which are closely related, resulting in another. Nevertheless, certain methodological issues are dealt with in Subsections 3.10.1 to 3.10.4 that follow.

3.10.1 Questionnaire design

Most of the issues related to the questionnaire design for the main survey were covered in Section 3.8.2. As stated in Subsection 3.9.4, after the pilot study, not only was the content modified but the structure of the questionnaire was also changed. In order for participants to focus on answering the actual evaluation questions, before fatigue sets in, the section on personal profile was moved from the beginning to the end of the questionnaire. As seen in Table 3.4, the number of items in the main study was 64 for the 16 dimensions for which data was collected, compared to 65 items for the same dimensions in the pilot survey questionnaire.

3.10.2 Participants and sampling

This is addressed in Section 3.8.3. The aim was to acquire 150 participants. However, for the main survey study, data was collected from 196 participants of which 174 were usable. This is explained in Section 7.2 of Chapter 7. Data was collected from six UNISA sites comprising two campuses and four study centres. The ratio of female to male was 54% to 46% compared to 81% to 19% in the pilot study. This was very close to the UNISA's actual ratio of 60% to 40% of females to males (Van Zyl and Barnes, 2012).

3.10.3 Data collection

This was outlined in Section 3.8.4. As already stated, data was collected over a period of a month from mid-May 2017. During the main study participants took 15–20 minutes to complete the form. However, unlike the case with the pilot study where only the current researcher facilitated, three research assistants were recruited and trained by the researcher to help in the process. In addition, an appeal was made to the participants to fill in the questionnaires carefully without leaving blank spaces, as had occurred in a number of cases during the pilot study. As in the pilot study, an incentive in the form of a pen was donated to the participants on completion of the questionnaire.

3.10.4 Data analysis and interpretation

This is outlined in Chapter 7. It suffices to state briefly in this section that the following occurred in terms of data analysis and interpretation:

- Data cleaning was performed on the main survey data.
- Profile data of participants was analysed using deductive statistical techniques and conclusions made.
- Reliability of the dimensions was re-assessed using the main survey data rather than the pilot data.
- The e-SQUUX Model was validated by applying the EFA inferential statistical technique. This resulted in identification of the dimensions and their respective items for each of the facets (named categories in the questionnaire) of e-SQUUX, namely, e-service quality, usability and user experience
- By use of the SmartPLS software, a structural model was estimated and assessed by applying the PLS-SEM inferential statistical technique. Consequently, the possible relationships between e-service quality, usability and user experience were established. As already stated, such analysis was not conducted on the pilot study.

3.11 Validity, reliability and triangulation for the entire research

This section addresses the theory related to reliability, validity and triangulation for the entire research. In Chapter 9, these are revisited to show how each was implemented in this research.

3.11.1 Validity

Validity is the extent to which a data collection method(s) accurately measures what it was intended to measure, or is the extent to which the research findings reflect what they profess to be about (Fouche and Delport, 2004). In quantitative research, validity determines whether an instrument indeed measures what it was supposed to measure so that meaningful and useful inferences can be determined from the scores (Creswell and Creswell, 2017). There are different types of validity as presented in the next three subsections.

3.11.1.1 Content validity

Content validity, also known as 'definition validity' or 'logical validity', is concerned with the sampling adequacy of the content or subject of an instrument or its model. As was stated in Section 3.3, content validity seeks to get answers to questions such as: (i) Is the model/instrument measuring the concepts it is assumed to measure? (ii) Does the model/instrument provide an adequate sample of items or dimensions that represent the concept?

In essence, content validity is concerned with making judgements. The content or subject can be in the form of items, topics, dimensions or any other unit of interest. In general, content validity seeks to match the questions asked and the content or subject areas they assess (Fouche and Delport, 2004; Newman, Lim and Pineda, 2013; Saunders, Lewis and Thornhill, 2016).

3.11.1.2 Face validity

Face validity is the degree to which a measure assesses a particular construct as viewed by stakeholders such as users or customers. It is important to ascertain face validity in research, since stakeholders normally act as participants during surveys and there may be confusion or resistance from them if the instrument lacks face validity (Oates, 2010; Saunders, Lewis and Thornhill, 2016).

3.11.1.3 Construct validity

Construct validity is the degree to which a measure assesses the underlying theoretical construct, factor, skill or knowledge it is purported to measure. It includes a measure of convergence validity which seeks to determine that the individual measures assess the same construct, factor, skill or knowledge, and hence the level of correlation. On the other hand, discriminant validity seeks to demonstrate that the individual measures assess different constructs, factors, skills or knowledge (Oates, 2010; Saunders, Lewis and Thornhill, 2016).

3.11.2 Reliability

Reliability of a research instrument is its ability to produce similar results when used repeatedly under the same conductions (Kumar and Phrommathed, 2011). Reliability is a measure of accuracy, stability and predictability of an instrument. This means that the higher the reliability of an instrument, the more accurate it is and vice versa. Reliability is normally associated with consistency of an instrument, in that reliability is viewed as the extent to which independent administration of the same instrument consistently yields the same results (Adams, Anne and Cox, 2008). In some cases, reliability is achieved through triangulation of data using multiple data collection methods (De Villiers, 2005; Denzin and Lincoln, 2012; Rahi, 2017).

To conclude the discussion on validity (3.11.1) and reliability (3.11.2), it is important to state that in a study such as the present research, the final model should also be validated since reliability and validity are very important aspects of any questionnaire instrument or model (Fouche and Delport, 2004; Adams, Anne and Cox, 2008; Oates, 2010; Heale and Forbes, 2013; Saunders, Lewis and Thornhill, 2016; Turner, Cardinal and Burton, 2017).

3.11.3 Triangulation

Triangulation is the use of two or more independent sources of data or data-collection methods in the same study. Triangulation is more than validation of data or methods, for it also broadens one’s understanding of the phenomena under study. “Triangulation may be the use of multiple theories, data sources, methods or investigators within the study of a single phenomenon." (Heale and Forbes, 2013, p. 1). The four main types of triangulation are (Heale and Forbes, 2013; Turner, Cardinal and Burton, 2017):

- Data triangulation: involves using more than one set of data
- Investigator triangulation: involves multiple researchers in an investigation
- Theory triangulation: involves using more than one theory in the interpretation of results
- Methodological triangulation: involves using more than one method, for example, questionnaires, observations and interviews to collect data.

Section 9.5, in Chapter 9, provides details of how reliability, validity and triangulation issues were dealt with in this research.

3.12 Ethical considerations undertaken during this research

Ethical issues were considered during both the qualitative and quantitative study phases. The most important ethical issues that should be considered in research are (Stahl, 2012; Unisa, 2014; Devlin, 2018):

- *Vulnerable participants*: Advantage should not be taken of vulnerable participants such as young children or disabled persons. This was irrelevant to the present research, since only adults were targeted as participants.
- *Informed consent*: Participants should be informed in advance of the purpose of this research, what data will be collected and how it will be used. They should voluntarily agree to participate and be aware that they have the right to withdraw at any time.
- *Privacy, confidentiality and maintaining trust*: The data collected should be as anonymous as possible and kept confidential to protect the individuals' privacy. Participants or organisations should trust the researcher to use data in a way that will not impact negatively on any participant.

These recommendations were adhered to during this research. In addition, ethical clearance was sought and granted from the relevant ethical committees of UNISA in line with the university's 'Policy on Research and Ethics' (Unisa, 2014) (see the Ethical clearance certificate in Appendix A-1 and Permission to conduct research on UNISA staff and students in Appendix A-2).

3.13 Conclusion

The objective of this chapter was to clearly present the research design and methodology as undertaken in this research, so that the research questions could be answered. The chapter includes a detailed discussion of the philosophy, paradigms, approaches, design, methods and ethics as considered in this research. First, the research questions, in the context of the study, were revisited. Second, the research framework and the different philosophical worldviews were discussed. These included, amongst others, the positivist, interpretive and the pragmatic paradigms. Of these, the pragmatic worldview was found to be the most appropriate for this research.

Third, the quantitative, qualitative and mixed-method approaches were identified and discussed. A mixed method approach was adopted for this study entailing both qualitative and quantitative studies. Fifth, after due consideration of the research designs used in similar previous studies, the Exploratory sequential design (ESD) was singled out as the most appropriate for this work. However, two other research designs, namely, design science research (DSR) and case study research (CSR), were considered as possible alternatives and discussed. Reasons were provided why ESD was a better choice compared to these two.

Sixth, since this research used a mixed-method approach, the qualitative and quantitative methods applied in the two phases were highlighted. The qualitative phase included a systematic literature review (Study 1A) and an expert review of the conceptual model (Study 1B). This was followed by the quantitative phase that included a comprehensive pilot study (Study 2A) and the main questionnaire survey (Study 2B). In presenting these, issues related to questionnaire design, sampling, data collection, and proposed data analysis and interpretation of results, including reliability and validity issues were considered. Lastly, the ethical considerations undertaken during this research were overviewed.

One of the issues pointed out in this chapter is that because of the need to write academic articles emanating from this work, some of the issues related to methodology are presented, not in this chapter, but in other subsequent chapters, where data analysis is addressed. It was envisaged, and indeed found to be the case, with respect to the first study (Study 1A) on which a publication has already appeared, that this approach makes it easier to generate an academic paper from a chapter.

This chapter sets the foundation and context for presentation of the four studies, namely Study 1A, Study 1B, Study 2A and Study 2B, in chapters 4, 5, 6 and 7. Chapter 8 is devoted to discussion of the empirical work and its results.

Chapter 4: Synthesis of a conceptual integrated model for evaluation of e-service quality, usability and user experience (e-SQUUX Model V1): Study 1A

4.1 Introduction

The previous chapter showed how this research was conducted by describing the research design and methodology. The aim of this chapter, Study 1A, is to present, in detail, results of data collection from a number of publications, also termed literature sources or simply sources, of which the content was systematically analysed to synthesise an integrated multi-dimensional conceptual model to evaluate e-service quality, usability and user experience (e-SQUUX) of Web-based applications. In this situation, the literature served as primary data for the purpose of constructing a model. The ultimate objective is to answer **Subquestion 1**, which was provided in both Chapter 1 and Chapter 3 (see Sections 1.5.2 and 3.6.1):

1. *What are the components of a conceptual integrated model, synthesised from the literature, for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications?*

Table 4.1 provides a summary of this chapter, including the main objectives, data collection method and analysis and the main chapter outcome, which is the conceptual e-SQUUX Model V1.

Table 4.1: Summary of Chapter 4

Systematic literature review	
Purpose	The main objectives of this chapter are three-fold: 1. To collect as many published literature sources as possible that relate to the dimensions of e-service quality, usability and/or user experience (e-SQUUX) evaluation for WBAs. 2. To use a protocol to determine the relevant sources. 3. To build a hierarchical conceptual model that is suitable for evaluation of e-SQUUX of WBAs.
Data collected	Data in the form of published literature sources that are relevant to the evaluation of e-service quality, usability and user experience.
Data analysis	Systematic literature review
Outcome	Conceptual e-SQUUX Model V1

Figure 4.1 shows the layout of the chapter. Section 4.2 relates to the literature sources investigated, with subsections on how they were acquired (Section 4.2.1), the number of sources reviewed in the different areas (Section 4.2.2), types of sources reviewed (Section 4.2.3), and analysis of sources by year of publication (Section 4.2.4). This is followed by Section 4.3 that analyses the dimensionality of the conceptual integrated e-SQUUX Model V1 including the sources captured (Section 4.3.1), and the first (Section 4.3.2), second (Section 4.3.3) and third (Section 4.3.4) rounds of reduction of dimensions.

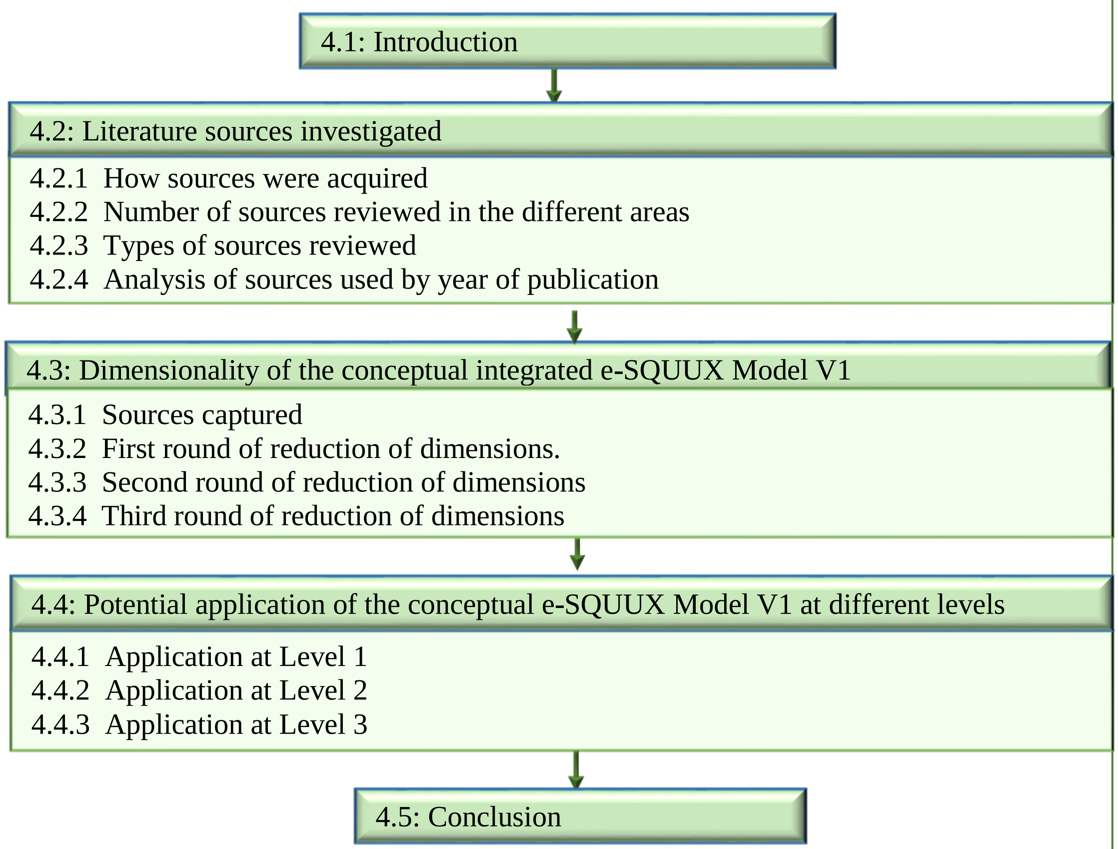


Figure 4.1: Layout of Chapter 4

Immediately after that, Section 4.4 discusses the potential application of the conceptual e-SQUUX Model V1 at different levels. Apart from Levels 0 and 4 that are described briefly, Section 4.4 focuses on Levels 1 (Section 4.4.1), 2 (Section 4.4.2) and 3 (Section 4.4.3). Section 4.5 concludes the chapter.

A paper on the initial stages of the process described in this chapter was presented at the *2016 Annual Conference of the South African Institute of Computer Scientists and Information Technologists* and was published in its proceedings (Ssemugabi and De Villiers, 2016). The paper was written to present part of this doctoral research, and has been extended in this chapter.

4.2 Literature sources investigated

In a systematic literature review (Kitchenham, 2004), numerous publications were investigated using the protocol provided in Chapter 3 Section 3.6.2 and the search process, as explained in Subsection 3.2.1. This section, 4.2, reports on how these sources were acquired and how they were analysed. The aim was to identify sources that provided dimensions of any one or a combination of the facets of this research, namely, e-service quality, usability and user experience.

A variety of domains were covered by the sources, including sectors such as retail, banking, library services, web services, web portals, travel, government, finance, marketing, e-commerce, e-government and mobile services, manufacturing, IT, telecommunication. However, some domains such as e-gaming and social media were excluded since they were outside the scope of this study.

Nearly all sources were acquired by using official electronic databases available to the University of South Africa (Unisa, 2015). UNISA library subscribes to over 300 academic databases of electronic resources for full-text access by its students and staff. They include well-known databases such as SCOPUS, ScienceDirect, IEEE Xplore, ACM and Emerald. The main database used was SCOPUS published by ELSEVIER, because “Scopus is the largest abstract and citation database of peer-reviewed literature: scientific journals, books and conference proceedings” (ELSERVIER, 2015). Moreover, the major journals which deal with issues in this study, are indexed in SCOPUS. SCOPUS provides access to over

1.5 million subject-specific databases including ACM, ScienceDirect, Springer, IEEE Xplore, Emerald and CHI publications. The databases also link to multi-disciplinary citations enhanced resources such as Web of Science. Google Scholar was also used, especially as a point of entry to access details regarding known sources, and sometimes as the point of entry before searching for a full-text article via the library resources. The books were mainly HCI texts. The websites were specifically from large private corporations that had conducted research in any of the e-SQUUX areas. They included Microsoft, Nokia, Samsung, Apple, Oracle and SAP. Many of these corporate sources included information that had been published in journals or conference proceedings. For example, Professor Virpi Roto and various colleagues have published over 50 articles (AllAboutUX, 2015) in refereed scientific journals, and full papers in refereed conference proceedings on usability and UX, many of which were based on applied research conducted at Nokia Research Centre.

4.2.1 How sources were acquired

Two techniques were used to search for relevant literature. First, key terms were used to search for what was required, based on the research question. Table 4.2 lists the main key terms. The search was done by using one or more words from two or more fields 1 to 5, for example, *usability*; user *experience and service quality; user experience and service quality attributes; web-based service quality and user experience model or dimensions*. Second, a lower-level document search process was conducted where some of the sources found in the reference lists of the identified sources, were also identified as sources themselves. This was done recursively, where the newly found sources were also subjected to the same process. This technique is recommended by Coursaris and Kim (2006) and Durand and Chantler (2014).

Table 4.2: Main key terms used to search for relevant literature

Field 1	Field 2	Field 3	Field 4	Field 5
Web	Usability	and	Model	Dimensions
Web-based	User experience	or	Framework	Attributes
Internet	UX	for	Definition	Factors
Internet-based	Service quality		Standards	Sub-factors
Online	e-service quality		Guidelines	Components
Electronic	eService quality		Heuristics	Sub-dimensions
Website			Checklist	Criteria
				Determinants

4.2.2 Number of sources reviewed in the different areas

A total of 509 sources was initially identified in the search process. Each of them was analysed to find the dimensions of one or more facets of e-SQUUX. As an example, as described in Section 2.4.1.2, the ISO 9241-11 (1998) defines usability as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context” (ISO 9241-11, 1998). The dimensions of usability, according to this source, are therefore effectiveness, efficiency and satisfaction. Only sources that had at least two dimensions of one or more of the core facets were considered. Some of these sources had the objective of determining the dimensions as outcomes during their respective studies. In such cases, the derived dimensions were listed and used in this research. Other sources provided definitions that they used as a basis of their study, while others adopted existing definitions. A critical analysis of each of these sources, as well as consolidation of synonyms and close similarities resulted in 264 sources relevant to this study. Table 4.3 shows the number of sources with one, two or all three

Table 4.3: The number of sources with one, two or all three facets

Rank	Facet(s)	Number of sources	%	Date of the oldest source
1	UB	116	44%	1988
2	eSQ	63	23%	2000
3	UX	53	20%	2000
4	UB & UX	21	8%	2000
5	UB & UX & eSQ	5	2%	2009
6	UB & eSQ	4	2%	2000
7	UX & eSQ	2	1%	2008
Total		**264**	**100%**	

facets. Usability was the most prominent facet discussed, occurring in 44% of all sources reviewed, followed by eSQ with 23% and UX with 20%.

Table 4.3 also shows that 8% of the sources dealt with a combination of usability (UB) and UX; 2% with UB and eSQ; 1% with UX and eSQ; and 2% with all three facets, namely, eSQ, UB and UX. It was observed that all the 63 articles that discussed eSQ also mentioned UB although their focus was on eSQ. And similarly, all the 53 sources that discussed UX also mentioned UB. The dominance of usability can be explained by the fact that usability research has been conducted for considerably longer than the other two facets, UX and eSQ. As discussed in Chapter 2, Section 2.4.1.2, usability studies have been conducted since the end of World War II, but were popularised in 1988. On the other hand, UX has been investigated since 1995 when it was introduced by Don Norman, and eSQ since around 2000, although SERVQUAL (SQ without the 'e' for electronic) was introduced by Parasuraman, Zeithaml and Berry in 1985 (Parasuraman, Zeithaml and Berry, 1985, 1988). The last column of Table 4.3, *Date of the oldest source*, shows the year of the first appearance of the identified sources. It demonstrates that usability research became popular in 1988 about 13 years before UX or eSQ came to the fore. Although these statistics relate to all three facets, in line with the purpose of this work to integrate evaluation via the SQUUX model, Table 4.3 shows that the most sources, 232 (116 + 63+ 53) of 264 (88%) addressed one single facet. Although the focus of this study is the three facets of e-SQUUX, several sources also discussed other issues such as software quality (33 sources – not distinguished in the table) particularly in relation to usability, and data quality (3 sources – not distinguished in the table). In addition, 16 of them discussed traditional SQ in addition to e-SQ. Another notable observation is that very few sources combined concepts: 2% (4 of 264) mentioned both UB and eSQ, 1% (only 2 of 264), mentioned both UX and eSQ, and 2% (5 of 264) mentioned all three constructs. This identifies a gap, further emphasising the need for more research. It relates closely to the aim of this work and presents a strong rationale for generating an integrated model.

Table 4.4 provides deductive statistics with respect to the number of sources identified. The table shows that the number of dimensions per source ranged from 2 to 54, with a mean of 9.6 (nearly 10 dimensions) and standard deviation (SD) of 8.3. The SD indicates a high variation in the number of dimensions different authors used or derived. The mode was 4, indicating that the most frequent number of dimensions per source was four. In addition, Table 4.4 shows that 70% (185 of 264) of all sources addressed 10 or fewer dimensions.

Table 4.4: Deductive statistics with respect to the number of sources identified

Function	**Value**
Minimum	2
Maximum	54
Mean	9.6
Standard deviation	8.3
Mode	4
More than 10 dimensions	79 or 30%
Equal or less than 10 dimensions	185 or 70%

4.2.3 Types of sources reviewed

The types of sources reviewed were academic journals (J), proceedings (P), books (B) and websites (W), as shown in Table 4.5. Of the 264 sources, more than half (51%), were academic journals, followed by conference proceedings (39%), published books (7%) and non-peer reviewed, but credible web (W) sources (3%). Together, J and P make up the majority, 90% (51+39), of the sources reviewed.

Table 4.5: Type of sources reviewed

#	**Source type**	**Frequency**	**%**
1	Journals (J)	136	51
2	Conference proceedings (P)	103	39
3	Books (B)	18	7
4	Websites (W)	7	3
Total		**264**	**100**

4.2.4 Analysis of sources used by year of publication

4.2.4.1 Number of all sources – e-SQUUX

Study 1A, the systematic literature review was undertaken in 2015. The sources reviewed originated from 1978 to 2015, which is a period of 37 years. Table 4.6 shows the number of sources for specific time intervals in descending order, commencing with the most recent period. Apart from the first and last intervals which are 6 and 11 years respectively, the rest are five years each. Nearly half of the sources (48%) were published between 2010 and 2015, and 42% (28 + 14) between 2000 and 2009. This means that 90% (48 + 42) of the 264 sources reviewed had been published since 2000, that is, in the 21st century, and only 10% dated back to earlier periods.

Table 4.6: Number of sources for specific time intervals, considering all sources

#	Interval	Frequency	Percentage (%)
1	2010 - 2015	128	48
2	2005 - 2009	73	28
3	2000 - 2004	37	14
4	1995 - 1999	14	6
5	1990 - 1994	6	2
6	1978 - 1989	6	2
Total		**264**	**100**

Figure 4.2 shows the percentage of the numbers of sources over the time intervals. Although the first and last intervals differ from the rest in duration, the general trend of the graph indicates an exponential growth in the number of publications that discussed e-SQUUX over the years.

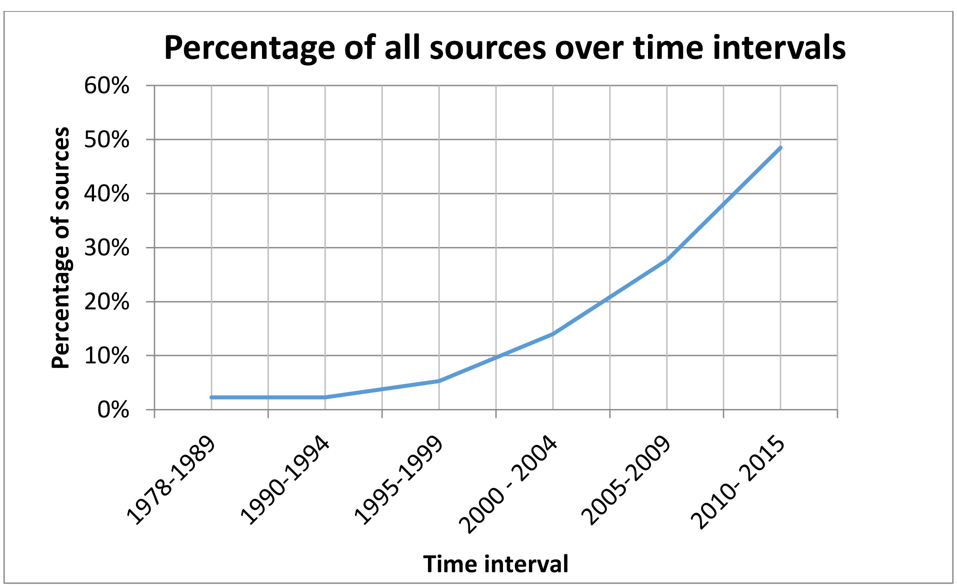


Figure 4.2: Percentage of number of all sources over the years

4.2.4.2 Number of usability sources

Table 4.3 shows that sources that discussed the dimension of Usability (UB) constituted 116 out of 264. Table 4.7 shows the number of these sources for each of the specific time intervals. Tables 4.6 and 4.7 show that the trend in the UB category in Table 4.7 varies from the general trend in Table 4.6, as can be seen from the corresponding graphs in Figures 4.3 and 4.2, where Figure 4.3 shows the percentages of the number of sources over the years for UB. Firstly, the graph for UB on its own in Figure 4.3 is not as smooth as that of the e-SQUUX graph in Figure 4.2. The second difference is that, while the trend for all sources of e-SQUUX continues to increase over the years, the trend for UB flattened out towards the end of the curve. This may mean that research that focused on UB only, was no longer increasing. This is not surprising since, as Park et al. (2013) point out, the tendency has been that the term usability has been replaced by user experience in both academia and industry.

Table 4.7: Number of usability sources for specific time intervals

#	Interval	Frequency	Percentage (%)
1	2010 - 2015	42	36%
2	2005 - 2009	38	33%
3	2000 - 2004	17	15%
4	1995 - 1999	13	10%
5	1990 - 1994	3	3%
6	1978 - 1989	3	3%
Total		**116**	**100**

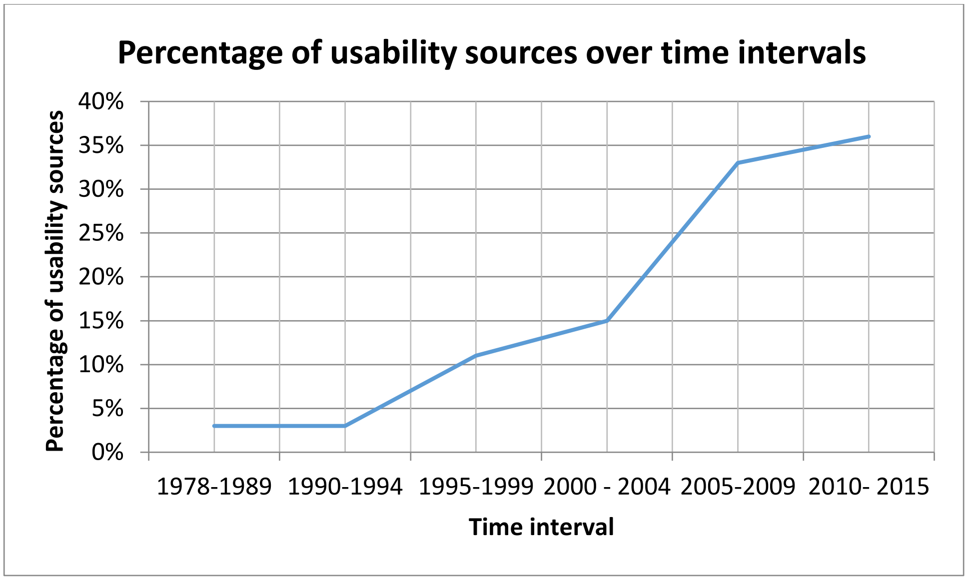


Figure 4.3: Percentage of the number of sources over the years for usability

4.2.4.3 Number of e-service quality sources

Table 4.3 shows that there were 63 (24%) out of 264 sources that discussed dimensions of e-SQ (e-SQ used interchangeably with eSQ). Table 4.8 shows the number of sources in this category for each of the same time intervals. Tables 4.6 and 4.8 show that the trend in the e-SQ category in Table 4.8, differs from the general trend in Table 4.6, as can be seen from the corresponding graphs in Figures 4.4 and 4.2 where Figure 4.4 shows the percentage of the number of sources over the years for e-SQ. However, unlike the case with UB trends, the e-SQ graph shows rapid growth since the late 1990s. There are some anomalies in the graph in relation to the frequencies of 1990-1994 and 1978-1989 intervals, each with a frequency of 3 as seen in Table 4.8. This occurs because only a few journal articles, particularly by Zeithaml, Parasuraman and Malhotra, who are the founders of service quality and consequently e-service quality, as the concept is currently termed, were published in those years. For SQ, these classical papers on traditional SQ include dimensions that are still current, such as *responsiveness*. The real e-SQ emerged around 2000 after the emergence of the World Wide Web in 1995.

Table 4.8: Number of e-SQ sources for specific time intervals

#	Interval	Frequency	Percentage (%)
1	2010 - 2015	27	43%
2	2005 - 2009	18	29%
3	2000 - 2004	13	20%
4	1995 - 1999	0	0%
5	1990 - 1994	3	5%
6	1978 - 1989	3	3%
Total		**63**	**100**

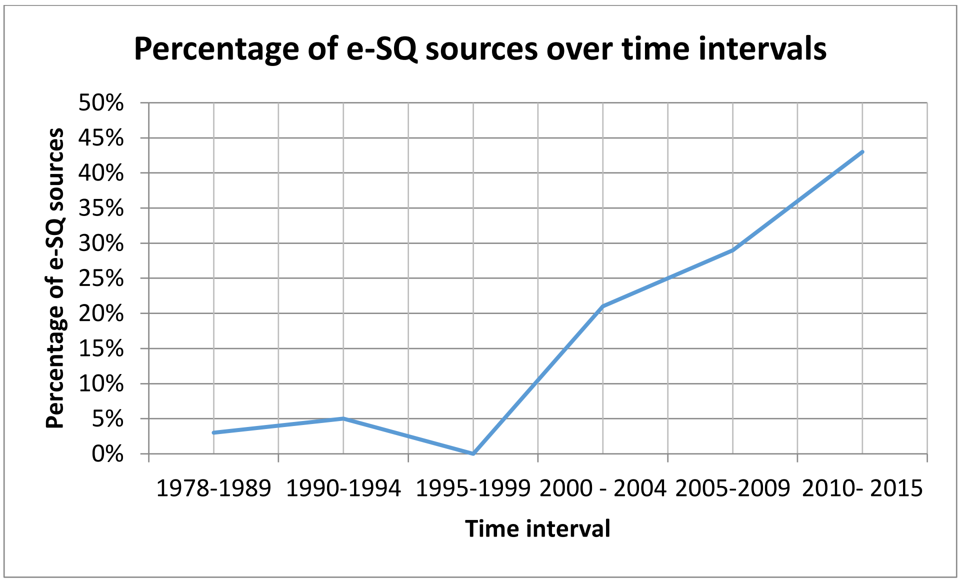


Figure 4.4 Percentage of the number of sources over the years for e-SQ

4.2.4.4 Number of user experience sources

Table 4.3 shows that 53 (20%) out of 264 sources discussed the dimension of UX. Table 4.9 shows the number of sources in this category for each of the specific year intervals. Tables 4.6 and 4.9 show that the trend in the UX category in Table 4.9, is fairly similar to that of the general trend in Table 4.6, as can be seen from the corresponding graphs in Figures 4.5 and 4.2, where Figure 4.5 shows the percentage of the number of sources over the years for UX. However, the rate of growth was notably faster than that of UB or e-SQ. This depicts more growth (almost exponential growth) in the number of articles discussing UX as compared to UB or e-SQ, though UX emerged much later than UB and e-SQ.

Table 4.9: Number of UX sources for specific time intervals

#	Interval	Frequency	Percentage (%)
1	2010- 2015	35	66%
2	2005-2009	12	23%
3	2000 - 2004	5	9%
4	1995-1999	0	0%
5	1990-1994	0	0%
6	1978-1989	1	2%
Total		**53**	**100**

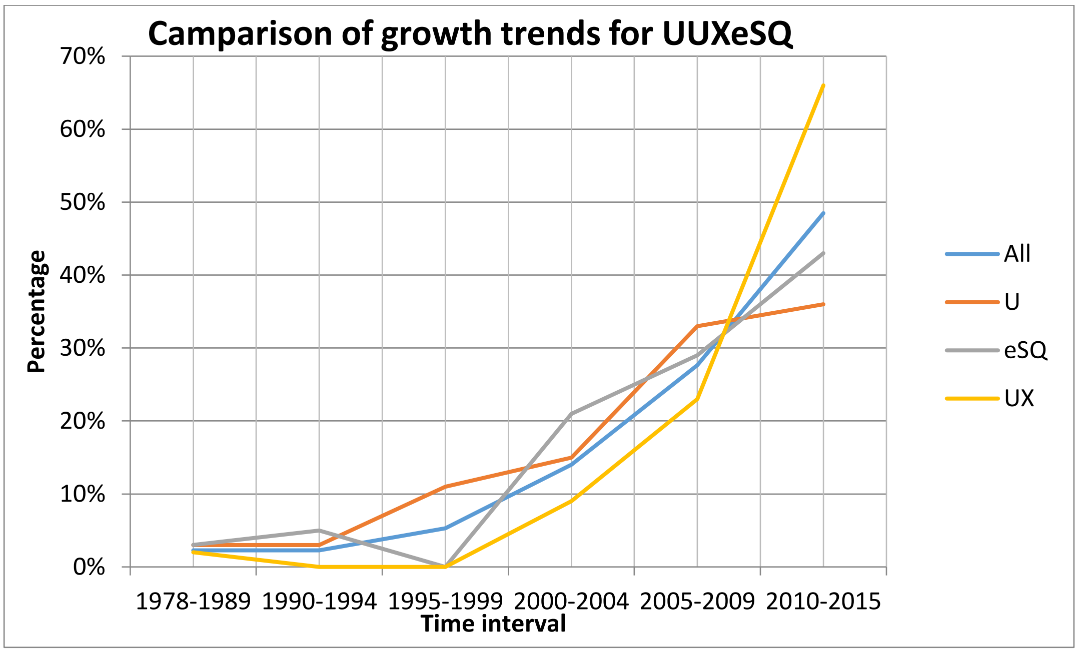


Figure 4.5: Percentage of the number of sources over the years for UX

4.2.4.5 Comparison of e-SQUUX growth trends

Table 4.10 and Figure 4.6 compare the percentage breakdown of the number of sources per time interval for each of the three facets, namely e-SQ, UB and UX. The graphs in Figure 4.6 confirm the trends that have been discussed in Sections 4.2.4.1 to 4.2.4.4 in relation to all sources (e-SQUUX), UB, e-SQ and UX, respectively. The figure shows that while the number of publications per time interval on usability is stabilising, those on UX and e-SQ are increasing with UX increasing at a faster rate.

Table 4.10: Percentages of the number of sources for each and all of the areas within e-SQUUX

	Percentages			
Interval	**Usability**	**User experience**	**e-Service quality**	**All (e-SQUUX)**
2010 - 2015	36	66	43	48
2005 - 2009	33	23	29	28
2000 - 2004	15	9	20	14
1995 - 1999	10	0	0	6
1990 - 1994	3	0	5	2
1978 - 1989	3	2	3	2
Total	**100%**	**100%**	**100%**	**100%**

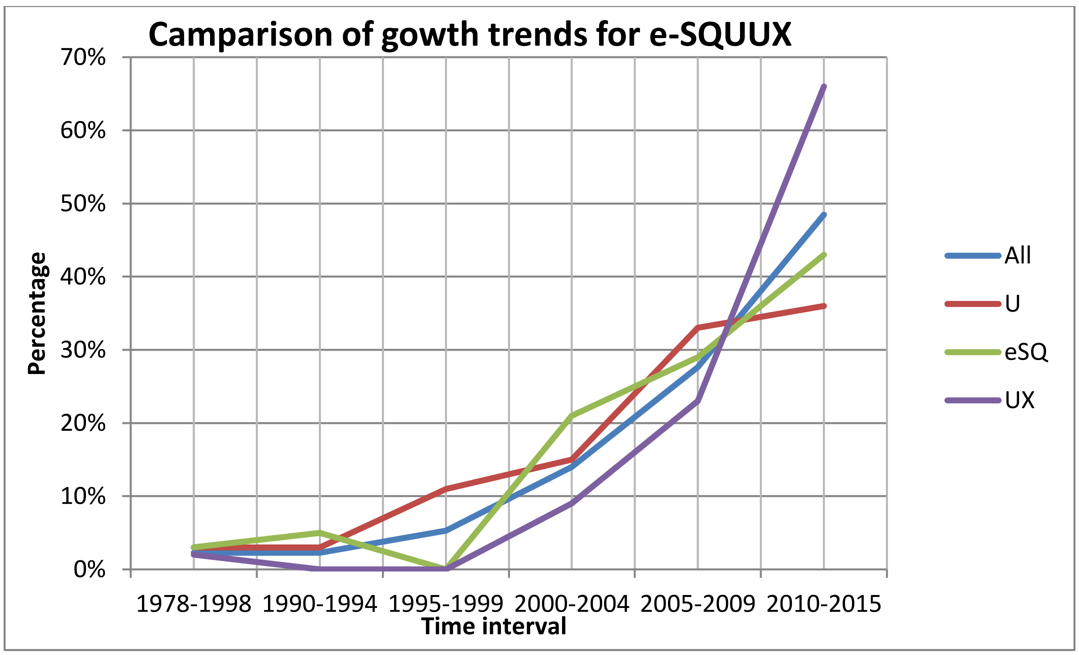


Figure 4.6: Percentage of the number of sources over the years for each and all of the facets of e-SQUUX

4.3 Dimensionality of the conceptual integrated e-SQUUX Model V1

As shown in *Field 5* of Table 4.2, the terms *dimensions* and *sub-dimensions* (Rasila, Rothe and Kerosuo, 2010) are used interchangeably in the literature with *factors* and *sub-factors* (Seffah et al., 2006), *attributes* (Olsina, Lafuente and Rossi, 2001; Rasila, Rothe and Kerosuo, 2010), *criteria* such as efficiency, effectiveness (Zhang, Rau and Salvendy, 2010; Rusu et al., 2015), *determinants* (Parasuraman, Zeithaml and Berry, 1985) and *components* (Lee et al., 2015) in e-SQUUX studies. These dimensions are the factors affecting overall e-SQUUX of a website.

4.3.1 Sources captured

As stated in Section 4.2.2, a total of 509 sources was acquired using the search methods described in 4.2.1. These were re-analysed and compressed to 264 relevant sources. A spreadsheet program was used to capture the data on the sources and dimensions. As an illustration, Figure 4.7 shows a snapshot extracted from the sheets Appendix B-1 and Appendix B-2. An extensive comprehensive list of all the 264 sources analysed is provided as Appendix B-1 while the top 70 most frequently occurring dimensions are shown in Appendix B-2. Each source was assigned a unique number (*Count*), *Source #*, *Source Type* (J, P, W, B), *Area* (eSQ, U, UX or a combination), *Year* of publication and the surname of the first *Author*. These were captured in columns in the spreadsheet. *Source #* represents the numbers that were allocated to the separate sources. *Count*, the unique number, was a sequence integer from 1 upwards that was assigned to each source as it was captured. For each of the 264 relevant sources, every dimension found in it was captured in a column, and a number '1' was inserted at the cell of the intersection of that column (Dimension) and Row of the source. For each source, a dimension was captured only once. For example, Nielsen (1993) defines usability using five dimensions, namely, learnability, efficiency, memorability, errors and satisfaction. Each of these is recorded only once even though they each appear many times in this Nielsen source. Consequently, there were five entries of '1' in the complete spreadsheet as a result of this source. This means that the number of times a dimension appeared in the source was irrelevant. This method of tallying made it possible to calculate the number of sources for each dimension and number of sources associated with each dimension. As with the sources, dimensions were each numbered from 1 upwards.

								Dimensions sub-dimensions attributes factors criteria sub-criteria metrics																	
								1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Count	**Source #**	**TypeSource**	**Group**	**Levels?**	**Diagram/Model?**	**Year**	**Author**	**Reliability**	**Responsiveness**	**Ease of use/usability**	**Privacy/security**	**Web design**	**Information quality**	**Effectiveness**	**Functionality**	**Usability**	**Efficiency**	**Navigation**	**Accessibility**	**Information/Content**	**Ease of use**	**Ease of learning**	**Memorability**	**Visual aspects**	**Technical aspect**
11	366	J	eSQ	N	N	2010	Ladhari	1	1	1	1	1	1	1											
12	304	P	UX	N	N	2009	Law													1			1		
13	301	J	eSQ	Y	Y	2011	Saha	1							1	1	1								
14	337	P	U	N	N	2015	Aparna	1								1	1				1				
15	310	P	U	Y	Y	1996	Fitzpatrick	1								1	1								

Figure 4.7: A snapshot of the spreadsheet used to capture dimensions and their sources

The review of the 264 sources resulted in an initial set of 723 dimensions. In capturing this information, the exact words from the sources were used. For example, Security, Privacy, and Privacy/Security were captured as three different dimensions and tallied individually. Likewise, Learnability and Learnable were considered to be different. As discussed later in Sections 4.3.2 and 4.3.3, the reason for this was to determine the most common terminology used to name dimensions.

The 723 dimensions were arranged alphabetically and scrutinised further. Duplicate dimensions (cases where words were identical) were merged, resulting in 697 new dimensions. This merger took into consideration the frequencies of the different occurrences, which were totalled. Table 4.11 shows the top 20 terms for the 697 dimensions before the second round commenced. The table shows that Efficiency, Reliability and Usability were the most commonly used terms. The frequency (f), the number of sources that addressed a specific dimension, ranged from 1 to 63 with a mean of 3.1, a standard deviation of 4.4 and a mode of 1. Since the mean is approximately 3, it implies that on average, sources provided three dimensions.

Table: 4.11: Top 20 terms used as dimensions of e-SQUUX

Rank	**Dimension**	**f**		**Rank**	**Dimension**	**f**
1	Efficiency	63		11	Accessibility	21
2	Reliability	47		12	Assurance	20
3	Usability	45		13	Consistency	20
4	Learnability	43		14	Memorability	20
5	Satisfaction	35		15	Functionality	18
6	Effectiveness	33		16	Information quality	18
7	Ease of use	32		17	Navigation	18
8	Responsiveness	26		18	Security	18
9	Flexibility	24		19	Service quality	18
10	Empathy	23		20	Attractiveness	17

Table 4.12 shows the number of sources (freq) with a given frequency (f). The table shows that a majority of dimensions, 55% (381 of 697), were found in only one source. Further analysis shows that 80% (55% + 15% + 10%) of the dimensions were found in only 1 to 3 different sources (see the % column in the first three rows of Table 4.12). By contrast, only 5% (34 of 697) were found in more than ten sources (see the % column in the last row of Table 4.12). The total of % column is more than 100 due to approximations.

Table 4.12: The number of sources (freq) with a given frequency (f)

#	**f**	**freq**	**%**
1	Count if f= 1	381	55%
2	Count if f= 2	105	15%
3	Count if f= 3	67	10%
4	Count if f= 4	32	5%
5	Count if f= 5	24	3%
6	Count if f= 6	19	3%
7	Count if f= 7	13	2%
8	Count if f= 8	11	2%
9	Count if f= 9	5	1%
10	Count if f= 10	6	1%
11	Count if f > 10	34	5%
	Total	**697**	**100%**

4.3.2 First round of reduction of dimensions.

The first round of reduction entailed inspection by the researcher, taking dimensions that were deemed to be similar in meaning, for example, easy to learn, ease of learning, learnability, learnable, time to learn, as given in Table 4.13 and merge them. Such sets of synonyms were reduced to one dimension, in this case to Learnability. This was done by selecting the term(s) with the highest frequency among each set. For example, in Table 4.13, Learnability has a frequency of 43 which is far higher than any of the other synonymous terms and was therefore selected to represent all the synonyms. This iterative process reduced the total number of dimensions from 697 to 431. Of these, 55 dimensions had 2 to 21 synonyms, with 'Information quality' having the highest number of 21.

Table 4.13: Dimensions directly related to the "Learnability" dimensions as originally captured

#	Dimension	Frequency
1	Ease of learning	6
2	Easy to learn	1
3	Learnability	43
4	Learnability and memorability	1
5	Learnability in use	2
6	Learnable	1
7	Suitability of learning	2
8	Time to learn	1
Total		57

4.3.3 Second round of reduction of dimensions

The second round reduced the 431 dimensions to 70 dimensions. First, the 431 dimensions were arranged in a descending order of frequency. They were then divided into two groups. The first group, 111 of them, included all those with frequencies of five and above, and the rest, 320, formed the second group. Although the cut-off number of 5 was subjective, the reason for creating the first group was to ensure that all dimensions with a relatively high frequency (five or more) would not be omitted during the formation of the final model.

The first group of 111 dimensions included terms that were considered inappropriate to view as dimensions of e-SQUUX. For example, many authors, for instance, Ladhari (2010), considered usability to be equivalent to ease of use. Though both of these dimensions had high frequencies, namely 45 and 32 for *usability* and *ease of use*, respectively, as seen in Table 4.11, they were eliminated. The reason was that, since this study aims to identify the dimensions of e-SQUUX and usability is one of the three core facets of this research, it is considered to be at the top level and it should not, therefore, appear at the lower level as a dimension. A number of other dimensions such as *System quality* were also eliminated, due to its similarity to the core facet of e-service quality.

The remaining dimensions were more critically analysed. Some which were synonyms or closely related, were combined. The allocation process was based on the current researcher's own knowledge in consultation with the literature sources from which these items were extracted. For example, ten sources out of 264, such as (Ladhari, 2010, p. 264), had "Security/Privacy" as a dimension of either UB, UX or eSQ. Using this knowledge, *Security* and *Privacy* were put into one group. In doing this, the dimension with the highest frequency was written first. For example, *Security* had a frequency of 18, and *Privacy* had 11 and *Security/Privacy* had 11. Hence, Security was written before *Privacy* since it had the highest frequency. The integration process described in this paragraph resulted in a set of 70 dimensions. Table 4.14 shows the top 20 of the 70 dimensions, arranged in descending order of frequency. The full list is given as Appendix B-2.

Table 4.14: Top 20 of the 70 dimensions derived from the dimensions with a frequency of 5 and above

Rank	**Dimension**	**f**		**Rank**	**Dimension**	**f**
1	Efficiency	63		11	Interactivity and Feedback	24
2	Reliability	47		12	Empathy	23
3	Learnability	43		13	Accessibility	21
4	Security and Privacy	40		14	Consistency	20
5	Assurance and Trust	37		15	Memorability	20
6	Satisfaction	35		16	Information quality	18
7	Effectiveness	33		17	Navigation	18
8	Attractiveness	29		18	Tangibility	17
9	Responsiveness	26		19	Understandability	17
10	Flexibility	24		20	Accuracy	16

The second process in the second round involved taking the remaining 320 of the 431 dimensions and allocating them to one of the 70 main dimensions. Firstly, the 70 main dimensions were pasted on a board and numbered from 1 to 70. Figure 4.8 shows the dimensions on the whiteboard.

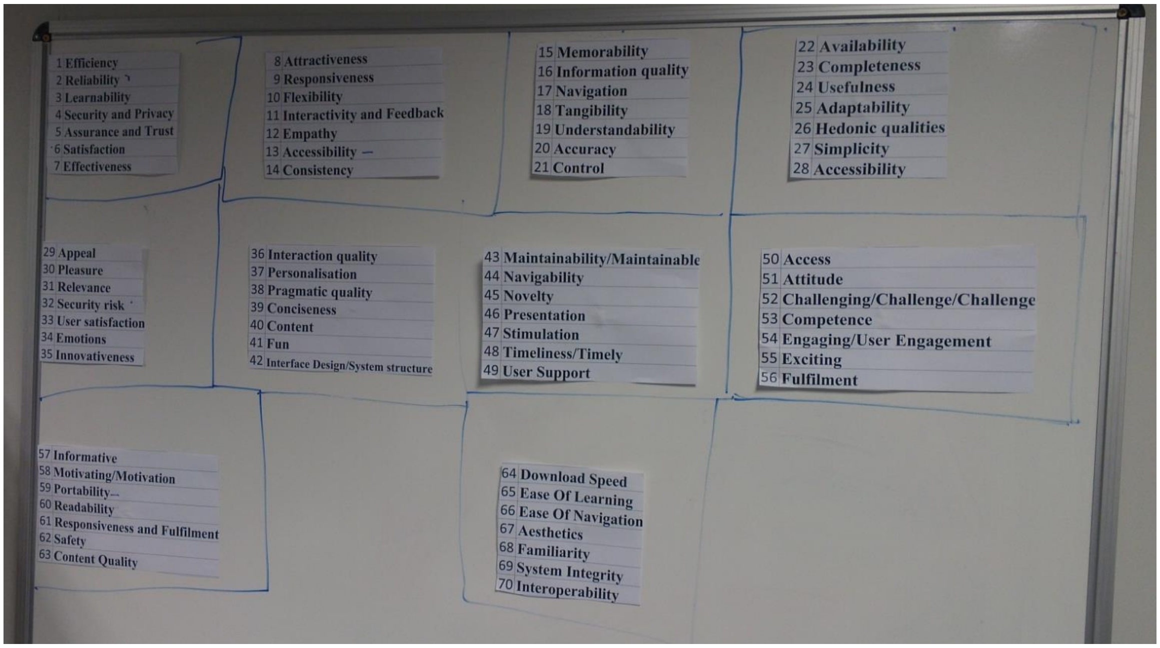


Figure 4.8: A photograph of the 70 dimensions pasted on a whiteboard

The list on the board simplified the process of identifying the most appropriate dimension of the 70, to which each of the 320 would be allocated. Similar to the merging process of the 111 dimensions to 70, the allocation process was done with the present researcher's personal knowledge in consultation with the literature sources from which these items were extracted. Some dimensions were fairly easy to allocate, for example, Findability was allocated to Searchability. In some cases, these allocations were based on definitions provided in the sources. For example, Park et al. (2013, p.3) define Flexibility as the "Extent to which a product/service can accommodate changes to tasks and environments". From this definition Accommodation and Flexibility were grouped together. Similar to the situation with the first group of 111 dimensions, this group of 320 dimensions includes terms that were considered inappropriate as dimensions of e-SQUUX, such as Usability Compliance, Anticipated use, etc. and terms that seemed irrelevant, such as Distressed and Experiential. Such terms were eliminated. By the end of this process, 130 terms had been eliminated and the remaining 190 were allocated to the 70 dimensions. Most of the 130 that were eliminated had a frequency of only 1 and appeared in only one source, as shown in Table 4.12. Table 4.15 shows the final 70 dimensions at this stage. The table is arranged according to the frequency (f) of each dimension, in a descending order.

Table 4.15: The 70 dimensions with their corresponding frequencies (f) ranked from 1 to 70

Rank	Dimension	f		Rank	Dimension	f
1	Efficiency	85		36	Functionality	21
2	Security, Confidence, Privacy	77		37	Helpfulness	21
3	Reliability	76		38	Appearance	21
4	Information Quality	69		39	Suitability, Appropriateness	21
5	Satisfaction	65		40	Tangibility	20
6	Learnability	58		41	Controllability	20
7	Interface design/structure, Graphics, Layout, Organisation	55		42	Relevance	20
8	Assurance, Trust	54		43	Conciseness	20
9	Errors, Robustness, Recoverability, Failure, Mistakes	50		44	Aesthetics	19
10	Accessibility	48		45	Support	18
11	Navigation	44		46	Searchability, Findabilility	18
12	Usefulness	44		47	Availability	17
13	Flexibility	43		48	Completeness	17
14	Effectiveness	42		49	Pragmatic	16
15	Responsiveness	42		50	Readability	16
16	Understandability	40		51	Clarity	16
17	Interactivity, Feedback	39		52	Communication, Collaboration	15
18	Consistency	37		53	Portability	14
19	Pleasure (Pleasurable), Good, Interesting, Happiness	37		54	Data Quality	14
20	Attractiveness, Desirability, Inspiring, Beauty	34		55	Adaptability	13
21	Content	33		56	Timeliness	13
22	Personalisation	32		57	Effectiveness	12
23	Memorability	31		58	Sociability	12
24	Credibility, Integrity, Authority	31		59	Presentation	11
25	Appeal	31		60	Stimulation	10
26	Hedonic	30		61	Engageability	10
27	Fun, Enjoyment, Entertainment	30		62	Motivation	10
28	Simplicity	29		63	Safety	10
29	Performance, Speed	29		64	Attitude	9
30	Accuracy	24		65	Novelty	8
31	Empathy	23		66	Fulfilment	8
32	Maintainability	23		67	Colour	8
33	Exciting	23		68	Currency, Up-To-Datedness	8
34	Emotion	22		69	Challengeability	7
35	Innovativeness	22		70	Competence	7

The next round involved merging the 70 dimensions into a smaller set of dimensions.

4.3.4 Third round of reduction of dimensions

The third round of the reduction process grouped the 70 dimensions into 24 categories. Similar to the first two rounds, the allocation was done with the current researcher's knowledge in consultation with the literature sources from which these items were extracted. To increase the rigour of the process, and since there were fewer dimensions to consider than in the first two rounds, the four main theoretical models used for this study, namely TAM, DeLone and McLean Model of IS Success, UTAUT and SERVQUAL; the ISO standards; and other classical literature sources were consulted frequently. Though frequencies were also used, for example, in determining which dimension(s) to use to name a category, the process was mainly a subjective exercise.

The process commenced by calculating the total frequency of each of the 70 categories. They were then arranged in descending order of frequency. Table 4.15 shows the 70 dimensions with their corresponding frequencies (f) ranked from 1 to 70. Table 4.16 now shows how the 70 different dimensions in Table 4.15 were combined to form 24 consolidated categories. The respective sets of dimensions that formed a category are shown under the *Dimensions members* column.

Table 4.16: How the different dimensions in Table 4.15 were combined to form the 24 categories

Category	**Dimensions members** (from Table 4.15)		**Category**	**Dimensions members** (from Table 4.15)
1	2, 20, 25		13	15, 60
2	10, 64		14	18, 39, 42, 65
3	16, 58		15	55, 69
4	6, 22, 51, 53, 61		16	11,36
5	31, 68		17	9, 24
6	17, 43, 52, 66		18	45, 70
7	5, 13, 26		19	28, 38, 30, 32, 33
8	40, 47		20	4, 48
9	1, 29, 46		21	49, 54
10	7, 8, 23, 27, 35, 56		22	44
11	3, 12, 19, 37, 57, 67		23	34, 41, 50
12	14, 21, 59		24	62, 63

Table 4.17 shows the same 24 categories, but ranked according to the frequency (f). Thereafter, Table 4.18 shows the components of e-SQUUX including all the actual categories, main dimensions and associated dimensions. This table presents the *conceptual integrated model for evaluation of e-service quality, usability and user experience (e-SQUUX) of WBAs*, named conceptual e-SQUUX Model V1, where V1 stands for ‘Version 1’, which is the outcome of Study 1A and answers **Subquestion 1**, namely:

1. *What are the components of a conceptual integrated model, synthesised from the literature, for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications?*

Table 4.17: The actual 24 categories ranked according to the frequency

Rank	**Categories**	**f**		**Rank**	**Categories**	**f**
1	Learnability and Understandability (1)	181		13	Satisfaction (13)	74
2	Flexibility and Personalisation (2)	145		14	Accessibility (14)	65
3	Efficiency (3)	143		15	Navigation (15)	62
4	Pleasure and Hedonics (4)	131		16	Errors and Robustness (16)	50
5	Responsiveness and Helpfulness (5)	120		17	Maintainability (17)	41
6	Reliability (6)	117		18	Relevance and Suitability (18)	41
7	Information Quality (7)	116		19	Consistency and Innovativeness (19)	37
8	Effectiveness and Usefulness (8)	107		20	Competence (20)	37
9	Interface design and Appearance (9)	107		21	Aesthetics (21)	27
10	Appeal and Attractiveness (10)	98		22	Sociability and Collaboration (22)	27
11	Security and Safety (11)	87		23	Timeliness (23)	21
12	Assurance and Credibility (12)	85		24	Motivation and Challengeability (24)	17

Table 4.18: The categories, main dimensions and associated dimensions of a conceptual integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications – The conceptual e-SQUUX Model V1

Rank	**Level 1** **Categories**	**Level 2** **Main dimensions**	**Level 3** **Associated dimensions**
1	Learnability and Understandability (1)	Learnability (1.1) Understandability (1.2) Memorability (1.3) Conciseness(1.4) Readability (1.5) Clarity (1.6)	----- Comprehensibility(1.2.1), Interpretability (1.2.2), Meaning (1.2.3), Nomenclature(1.2.4), Terminology(1.2.5), Wording and language (1.2.6), Text meaning (1.2.7), Use of existing knowledge (1.2.8) Brevity (1.3.1), Ease of remembering (1.3.2), Mental load (1.3.3), Recall (1.3.4), Recognition (1.3.5), Workload (1.3.6). Minimalism (1.4.1), Preciseness (1.4.2), Economy (1.4.3), Explicitness (1.4.4), Focused (1.4.5), Preference (1.4.6) Legibility (1.5.1) Granularity (1.6.1), Specific (1.6.2), Unambiguousness (1.6.3), Visibility (1.6.4), Progress indicator (1.6.5), Vividness (1.6.6)
2	Flexibility and Personalisation (2)	Flexibility (2.1) Personalisation (2.2) Empathy (2.3) Controllability (2.4) Adaptability (2.5) Portability (2.6)	Accommodation (2.1.1), Compatibility (2.1.2), Browser compatibility (2.1.3), Changeability (2.1.4), Evolvability (2.1.5), Forgiveness (2.1.6), Modifiability (2.1.7) Identification/identity (2.2.1), Exclusive (2.2.2), Individualisation (2.2.3), User centricity (2.2.4), User empowerment (2.2.5) Interoperability (2.6.1), Technology use (2.6.2)
3	Efficiency (3)	Efficiency (3.1)	Scalability (3.1.1), Integrative (3.1.2), Resources utilisation (3.1.3)

		Simplicity (3.2) Performance Speed (3.3)	Operability (3.2.1), Ease of operation (3.2.2), non-frustration (3.2.3), Effortlessness (3.2.4), non-obtrusiveness (3.2.5) Network usage (3.3.1), Technical performance (3.3.2), Throughput (3.3.3), Velocity (3.3.4)
4	Pleasure and Hedonics (4)	Pleasure (pleasurable) (4.1) Hedonics (4.2) Emotion (4.3) Fun (4.4) Enjoyment (4.5) Entertainment (4.6)	Good (4.1.1), Interesting (4.1.2), Happiness (4.1.3) Attachment (4.2.1), Be-goals (4.2.2), Continuance (4.2.3), Proud (4.2.4), Loyalty (4.2.5), Urge to use again (4.2.6) Evocation (4.3.1)
5	Responsiveness and Helpfulness (5)	Responsiveness (5.1) Helpfulness (5.2) Interactivity (5.3) Feedback (5.4) Engageability (5.5) Fulfilment (5.6)	Documentation (5.2.1), Customer service (5.2.2) Assistance (5.2.3), Explanations (5.2.4) Immersion (5.5.1)
6	Reliability (6)	Reliability (6.1) Accuracy (6.2) Completeness (6.3)	Objectivity (6.1.1), Predictability(6.1.2), Validity (6.1.3), Stability (6.1.4),Humility (6.1.5), Sustainability (6.1.6) Delicacy (6.2.1),Correctness (6.2.2)
7	Information quality (7)	Information quality (7.1) Data quality (7.2) Content quality (7.3)	Multimedia capability (7.3.1)
8	Effectiveness and Usefulness (8)	Effectiveness (8.1)	

		Usefulness (8.2) Functionality (8.3)	User value (8.2.1), User need (8.2.2),Utility (8.2.3), Value added (8.2.4), Productivity (8.2.5) Constructiveness (8.2.6), Practicality (8.2.7), Self-service(8.2.8)
9	Interface design and Appearance (9)	Interface design (9.1) Appearance (9.2) Tangibility (9.3) Presentation (9.4)	Structure (9.1.1), Graphic (9.1.2), Layout (9.1.3), Organisation (9.1.4), Format (9.1.5), Metaphors and maps (9.1.6), Texture (9.1.7), Defaults (9.1.8), Fidelity (9.1.9), Fonts (size and shape) (9.1.10), Logic (9.1.11), Orientation (9.1.12) Familiarity (9.2.1), Authenticity (9.2.2), Natural (9.2.3)
10	Appeal and Attractiveness (10)	Appeal (10.1) Attractiveness (10.2) Exciting (10.3) Stimulation (10.4)	Curiosity (10.1.1) Enthusiastic (10.3.1), Arousal (10.3.2), Delight (10.3.3), Elatedness (10.3.4), Playfulness (10.3.5), Refreshing (10.3.6), Thrill (10.3.7)
11	Security and Safety (11)	Security (11.1) Safety (11.2)	Confidence (11.1.1), Privacy (11.1.2), Financial risk (11.1.3), Perceive risk (11.1.4), Guarantee (11.1.5)
12	Assurance and Credibility (12)	Assurance (12.1) Credibility (12.2)	Trust (12.1.1), User comfort (12.1.2), Honesty (12.1.3), Courtesy (12.1.4), Maturity (12.1.5), Authority of source (12.1.6), Corporate image (12.1.7), Dependability (12.1.8), Returnability (12.1.9) Authority (12.2.1), Integrity (12.2.2), Reputation (12.2.3), Popularity (12.2.4), Brand (12.2.5), Openness (12.2.6), Transparency (12.2.7)
13	Satisfaction (13)	Satisfaction (13.1) Attitude (13.2)	
14	Accessibility (14)	Accessibility (14.1) Availability (14.2)	
15	Navigation (15)	Navigation (15.1)	Flow (15.1.1), Order (15.1.2), Paths (15.1.3)

		Searchability (15.2) Findability (15.3)	
16	Errors and Robustness (16)	Errors (16.1) Robustness (16.2)	Mistakes (16.1.1), Failure (16.1.2) Recoverability (16.2.1), Fault tolerance (16.2.2), Guidance (16.2.3), Undo (16.2.4)
17	Maintainability (17)	Maintainability (17.1) Support (17.2)	Installability (17.1.1), Replaceability (17.1.2), Reusability (17.1.3), Administration (17.1.4), Back-compatibility (17.1.5), Testability (17.1.6)
18	Relevance and Suitability (18)	Relevance (18.1) Suitability (18.2)	Applicability (18.1.1), Relatedness (18.1.2), Affordance (18.1.3), Continuance intention (18.1.4) Appropriateness (18.2.1), Compliance (18.2.2), Adequacy/Task match (18.2.3), Conformity (18.2.4), Made for the media (18.2.5), Merit (18.2.6), Technical adequacy (18.2.7), Fit for the task (18.2.8)
19	Consistency and Innovativeness (19)	Consistency (19.1) Innovativeness (19.2) Novelty (19.3)	Coherence (19.1.1) Originality (19.2.1),Self-descriptiveness (19.2.2), Intuitiveness (19.2.3)
20	Competence (20)	Competence (20.1)	
21	Aesthetics (21)	Aesthetics (21.1) Colour (21.2)	
22	Sociability and Collaboration (22)	Sociability (22.1) Collaboration (22.2) Communication (22.3)	Cooperatively (22.1.1) Universality (22.2.1)
23	Timeliness (23)	Timeliness (23.1) Currency (23.2) Up-to-datedness (23.3)	
24	Motivation and Challengeability (24)	Motivation (24.1) Challengeability (24.2)	

In Table 4.18 there are 75 main dimensions in Level 2 while in Table 4.15 there were 70 dimensions. This is because during the grouping process some of the dimensions that had more than one construct were subdivided into two or more separate main dimensions. For example, Communication and Collaboration, numbered 52 in Table 4.15, became two separate dimensions under Category 22, in Table 4.18. However, in some cases, such multi-construct dimensions had some of their constructs allocated to Level 3 as Associated dimensions. For example, the dimension for Errors, Robustness, Recoverability, Failure and Mistakes, was numbered 9 in Table 4.15, but in the final grouping of Study 1A, the Recoverability, Failure and Mistakes constructs became associated dimensions as shown in Category 16 of Table 4.18.

Of the 24 categories, 14 of them are named using a combination of two dimensions. There are two reasons for this. Firstly, in some cases, their frequencies, in terms of the number of sources in which they appeared, were so close to each other that it was difficult to decide on one as the category name but not the other. The second reason is that in addition to being close in the number of occurrences, their meanings were related but not the same. A good example is Security and Safety, which is category 11 in Table 4.18. These categories can be easily turned into dimensions by converting these 14 into double-barrelled dimensions using a forward slash as the separator, for example, Learnability/Understandability, as is commonly done in e-SQUUX literature. The most common of these is Security/Privacy. As stated before, ten sources out of 264, such as Ladhari (2010) and Kundu and Datta (2014), had Security/Privacy as a dimension of eSQ, UB or UX.

Similar to a number of studies, such as (Davis, Bagozzi and Warshaw, 1989), Venkatesh, Thong and Xu (2012), Parasuraman et al. (1988), the categories are not necessarily mutually exclusive. This also applies to the main dimensions and the associated dimensions.

4.4 Potential application of the conceptual e-SQUUX Model V1 at different levels

The proposed conceptual e-SQUUX Model V1 as presented in Table 4.18 proposes 24 categories, consisting of 75 main dimensions and 163 associated dimensions. Figure 4.9 shows the hierarchical format of the e-SQUUX conceptual model. The figure distinguishes between the e-SQUUX *conceptual model* in Levels 0 to 3 and the *implementation of the conceptual model* in Level 4.

At *Level 4*, the implementation level, evaluation in the form of metrics or scale items can be undertaken, as has been done in studies such as Seffah et al. *(*2006), Moumane, Idri and Abran (2016) and Kundu and Datta (2014). The actual implementation at Level 4 can only be undertaken with reference to Levels 1 to 3, which correspond to the categories, main dimensions and associated dimensions respectively, hence the three arrows to Level 4. The xx in Level 4 stands for the varying number of metrics or items that can be generated depending on the choice of the model user and level/s implemented.

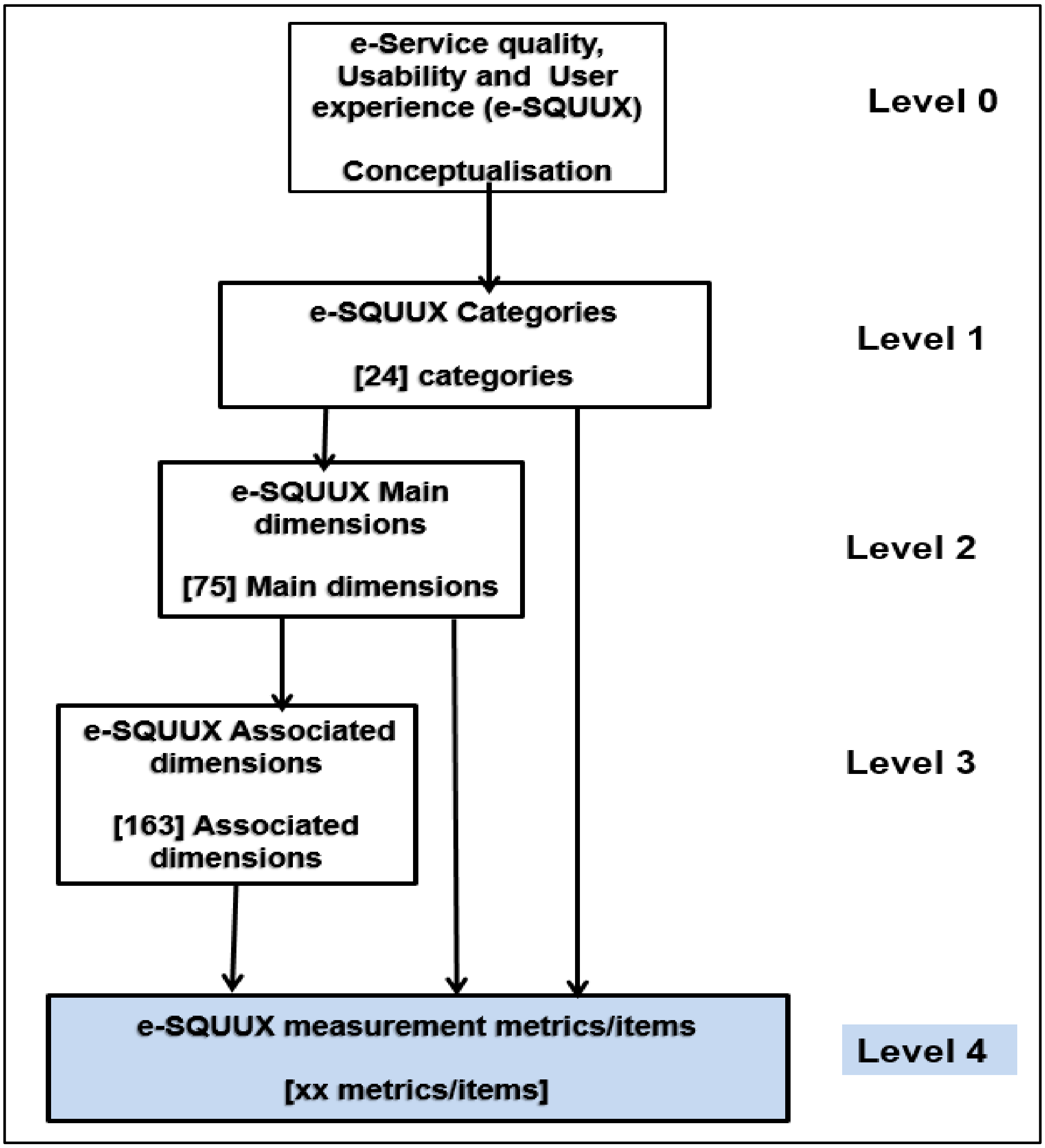


Figure 4.9: Proposed implementation framework of the conceptual e-SQUUX Model

Since *Level 0* is the actual conceptualisation of the foundation of components of e-SQUUX, and does not need further explanation, Levels 1 to 3 are explained in the next three subsections.

4.4.1 Application at Level 1

Level 1 comprises categories of the e-SQUUX dimensions. Twenty four (24) categories were identified, which can be modified, extended, increased to more categories, or reduced, hence the square brackets in Figure 4.9 for the flexible number of occurrences. If, for instance, an organisation wished to use some but not all of the 24 categories, the number would decrease. On the other hand, if a researcher identified further dimensions, the number would increase. Flexibility is built into e-SQUUX because it has been found that different industries or organisations have varying sets of context- and user-specific critical web factors (Nathan and Yeow, 2011).

Level 1 can be applied at Level 4 (note the direct arrows) by writing criteria in the form of evaluation items/statements for each category, worded appropriately for the respective target group. For Category 1, Learnability and Understandability, for example, the statement could be, "The site is easy to learn/understand" or "The site is easy to learn and understand" and for Category 3, Efficiency, it could be "The site works/operates efficiently". Using this approach, 24 statements would be made using the e-SQUUX Model V1 categories. One could also apply the varying connotations of a category as they relate to a website, say, Efficiency (Category 3) and write more than one evaluation item for the category. In terms of statistical analysis, factor analysis could be conducted on a related group of statements. Whatever technique is used, the statements to evaluate a specific Web-based application could be delivered via a questionnaire. However, one should provide at least one evaluation item for each category.

4.4.2 Application at Level 2

Level 2 provides the 75 main dimensions related to the 24 categories. This level contains all the main dimensions, including the one or two that were also used as category names. As explained in the previous paragraph on categories, the dimensions can be reduced or increased. There is an arrow from Level 2 to Level 4 since the 75 main dimensions can similarly result in 75 statements that can be used in a questionnaire. The arrow from Level 2 to Level 3 represents the fact that, in some cases, one or more associated dimensions are related to a particular main dimension.

4.4.3 Application at Level 3

Level 3 consists of 163 associated dimensions linked to the main dimensions. All the associated dimensions are listed in Table 4.18. Associated dimensions do not include the 75 main dimensions of Level 2 which are addressed in Section 4.4.2. Moreover, associated dimensions and are considered 'weaker' than the former when evaluating websites. Main dimensions carry more weight and overall meaning than associated dimensions. Nevertheless, associated dimensions are useful, since they encapsulate the detailed meaning and scope in a richer way than the main dimensions and play a valuable role in rich, detailed, fine-grained evaluation. For example, for the main dimension Understandability, some of the associated dimensions are Wording, Language, Comprehensibility, Interpretability, Terminology, and Text meaning, the combination of which can convey rich information. For example, an evaluation statement for Terminology could be "terms used are the ones that are usually applied''.

4.5 Conclusion

This chapter set out to answer the subquestion: *What are the components of a conceptual integrated model, synthesised from the literature, for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications?* This was answered in Section 4.3.3 in the form of a comprehensive table, Table 4.18, and explained further in the context of use, by the diagram, Figure 4.9, in Section 4.4. The conceptual e-SQUUX Model V1 consists of 24 categories, 75 main dimensions and 163 associated or minor dimensions. The model can be applied for evaluating WBAs as it is, but it will also serve as a framework for future empirical research and development. However, before that, the model needed to be content validated by a number of HCI/IS expert reviewers. This is in line with development procedures for evaluation of Information Systems models that have been suggested by researchers such as Burgess (2004), Parasuraman et al. (1988), Seffah et al. *(*2006), and Nathan and Yeow (2011).

The next chapter describes how the conceptual e-SQUUX Model V1 was reviewed by experts in Study 1B order to enhance its content validity.

Chapter 5: Expert review of the conceptual e-SQUUX Model V1: Study 1B

5.1 Introduction

The previous chapter dealt with the initial synthesis of the conceptual e-SQUUX Model V1 (Version 1). This chapter (Study 1B) builds on that and moves further by refining the conceptual model in order to improve the content validity of e-SQUUX as recommended in similar studies (Davis, Bagozzi and Warshaw, 1989; Parasuraman, Zeithaml and Malhotra, 2005; Venkatesh, Thong and Xu, 2012). This process is one of the steps towards the eventual objective of answering all the research subquestions and hence the main research question. Specifically, this chapter presents the results of Study 1B to answer **Subquestion 2**, namely:

2. *What are the components of the conceptual integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications following an expert review?*

Table 5.1 provides a summary of this chapter, including the main objectives, data collection method and analysis, participants that were involved in this phase, and the main chapter outcome of an expert-reviewed e-SQUUX Model V2 (version 2).

Table 5.1: Summary of Chapter 5

Expert review	
Purpose	The main objectives of this chapter are four-fold: 1. To analyse the rankings of categories and dimensions of the expert reviewers and determine their impact on the components of e-SQUUX Model V1. 2. To analyse the suggestions by the expert reviewers and determine their impact on the components of e-SQUUX Model V1 3. To combine suggestions and ranking data to form the Provisional expert-reviewed e-SQUUX Model PV2 (provisional version 2). 4. Use the definitions of the components of Model PV2 to refine the model further.
Data collection	An expert review guided by a template (see Appendix C-1)
Participants	Four experts in fields of Information Technology and/or HCI: three academics and one practitioner.
Data analysis	Rankings – ranking of categories and dimensions by experts. Suggestions – recommendations made by the expert reviewers. Definitions – application of the definitions of the components of e-SQUUX Model PV2 by the current researcher.
Outcome	Expert-reviewed e-SQUUX Model V2

Figure 5.1 shows how the chapter is organised. After this introduction (Section 5.1), Section 5.2 presents the experts' profiles (Subsection 5.2.1) and an overview of the nature of data collected (5.2.2). Thereafter, Section 5.3 provides an analysis, using the experts' rankings of e-SQUUX components, which includes ranking of the most (5.3.1) and the least (5.3.2) important categories, and the most (5.3.3) and the least (5.3.4) important dimensions. A summary of ranking of categories and dimensions is then provided in Section 5.3.5. Following on, Section 5.4 deals with analysis of the suggestions provided by the experts to modify e-SQUUX Model V1 components. This includes subsections on combining (5.4.1), removing (5.4.2), relocating (5.4.3), adding (5.4.4), decoupling (5.4.5) components, then renaming of categories (5.4.6), in addition to the consolidation and elimination of synonyms (5.4.7) and other (miscellaneous) suggestions (5.4.8). Finally, the merged results of these suggestions are provided in Subsection 5.4.9. Section 5.5 deals with the merging of the suggestions and rankings data results to arrive at the expert-reviewed Provisional e-SQUUX Model termed PV2 (provisional version 2). It includes subsections on how the most important categories (5.5.1) and least important categories (5.5.2) were used to arrive at the provisional model, which is presented in Section 5.5.3.

Thereafter Section 5.6 sets out a further refinement of the conceptual e-SQUUX Model as a result of the definitions of its components. Section 5.7 concludes the chapter.

5.1: Introduction

5.2: Experts' profiles and overview of the nature of data

5.2.1 Experts' profiles
5.2.2 Overview of the nature of data collected

5.3: Analysis based on the ranking of categories and dimensions by experts

5.3.1 Most important categories
5.3.2 Least important categories
5.3.3 Most important dimensions
5.3.4 Least important dimensions
5.3.5 Summary of ranking of categories and dimensions

5.4: Analysis of expert reviewers' suggestions

5.4.1 Combining components
5.4.2 Removing (deleting) components
5.4.3 Relocating (moving) components
5.4.4 Adding components
5.4.5 Decoupling (separating) components
5.4.6 Renaming of categories
5.4.7 Consolidation and elimination of synonyms
5.4.8 Dealing with miscellaneous suggestions
5.4.9 Categories that merged as a result of qualitative analysis in 5.4.1 to 5.4.8

5.5 Merging rankings and suggestions data results to arrive at the provisional expert-reviewed e-SQUUX Model PV2

5.5.1 Merging rankings and suggestions results: ranking the most important categories
5.5.2 Merging rankings and suggestions results: ranking the least important categories
5.5.3 Further refinement of the conceptual e-SQUUX Model as a result of the definitions of its components

5.6: Further refinement of the conceptual e-SQUUX Model due to precise definitions of its components

5.7 Conclusion

Figure 5.1: Layout of Chapter 5

5.2 Experts' profiles and overview of the nature of data

5.2.1 Experts' profiles

It has been proposed that two to three experts are sufficient for an expert review (Stojmenova, Lugmayr and Dinevski, 2013). However, to improve the content validity of this study, four of the six experts requested to participate, evaluated the conceptual e-SQUUX Model that was synthesised in Chapter 4. Their profiles are shown in Table 5.2. Three of them had PhDs in Information Systems, while the fourth had a masters degree and was doing her PhD in an HCI-related field. The four experts will henceforth be referred to as Exp A, Exp B, Exp C and Exp D, or merely A, B, C, and D respectively. Table 5.2 shows the profiles of the expert reviewers.

Table 5.2: Profile of the expert reviewers

		Experts			
#	**Expert characteristics**	**Exp A**	**Exp B**	**Exp C**	**Exp D**
1	**Qualification**	PhD	MSc	PhD	PhD
2	**Years since this qualification**	9	7 (currently doing PhD)	1	7
3	**Field of study**	Information Systems	Information Systems	Information Technology	Information Systems
4	**Area of specialisation**	HCI and mobile learning	HCI	HCI and multimedia	HCI and e-government
5	**Experience in work/teaching in HCI (in years)**	15	8	10	14
6	**Gender**	Female	Female	Male	Female

5.2.2 Overview of the nature of data collected

An expert review of a conceptual model should take into account (sic) "… familiarity with the terminologies used, relevancy of the components, looking out for errors, mistaken assumptions, lack of clarity, ascertain that the model content's conformation to acceptable standard practice, understandable, consistent and complete, and above all, readable so as to allow easy translation into development." (Sulaiman et al., 2016, p. 531).

To achieve these objectives, the four experts evaluated the overall model that had been synthesised in Study 1A (see Chapter 4) and each of its components, the 24 categories, 75 dimensions and 163 associated dimensions. Appendix C-1 provides the form (template) used to review the question and Appendix C-2 shows the instructions provided to the evaluator, while Appendix C-3 was the consent form they used. The review was divided into two main parts.

Table 5.3 shows an extract from the first part of the form. In this section, each expert was asked to comment on the components (categories, main dimensions or associated dimensions), their relationship, and to score in terms of Importance (IP), Suitability (ST), and Relatedness (RT) on Likert scales ranging from 1 to 5, with 1 indicating the lowest ranking and 5 the highest.

Table 5.3: Extract from first part of the form used in the expert review

#	**Level 1** **Category Name**	**Level 2** **Main dimensions**	***IP***	***ST***	**Level 3** **Associated dimensions**	***RT***
1	**Learnability and Understandability (1)**	Learnability (1.1)				
		Understandability (1.2)			Comprehensibility(1.2.1), Interpretability (1.2.2), Meaning (1.2.3),	
		Memorability (1.3)			Brevity (1.3.1), Ease of remembering (1.3.2), Mental load (1.3.3),	
	Dimensions	**Comment**				
	Learnability (1.1)					
	Understandability (1.2)					
	Memorability (1.3)					
	List of synonyms					
	Overall comment on category					

For example, Table 5.4 shows the scale for Importance (IP). The other two scales are similar. The questions to consider for each scale are given in Table 5.5. For example, the Importance (IP) scale required experts to consider the question “While using Web-based applications, how important is this dimension (in *Main dimension* column) to you in general?”

The second part of the form required experts to rank both the categories and then the main dimensions in terms of most and least important. In each case, they were required to list the top-most or least important categories or dimensions.

Table 5.4: The scale used for Importance (IP)

Not at all important	Slightly important	Somewhat important	Important	Very important
1	2	3	4	5

Table 5.5: Questions asked for each scale variable

Scale variable	Question asked
Importance (IP)	While using Web-based applications, how important is this dimension (in ***Main dimension*** column) to you?
Suitability (ST)	How well does this dimension (in ***Main dimension*** column) fit in with the rest of the dimensions in this category (in ***Main dimension*** column)?
Relatedness (RN)	How well is/are this/these dimension/s (in ***Associated dimensions*** column) related to the main dimension (in ***Main dimension*** column)?

5.3 Analysis based on the ranking of categories and dimensions by experts

This section provides an analysis of the results regarding the most important and least important categories and dimensions of the model. Since this was a qualitative review of the e-SQUUX Model by the experts, in the template the researcher had originally wanted to ask "What categories and dimensions do you consider most and least important?" However, it was realised that the feedback would not be sufficiently comprehensive. For example, it was possible that some would give just two important categories or dimensions and others five or more. In fact, it is possible that some would name only the most important categories and nothing else. It would then be difficult to analyse the data. Consequently, it was decided to restructure the question. Figure 5.2 shows the structure used. The figure shows page 15 of the 16-page template that was used by the experts to guide them in reviewing the questionnaire.

15

Section B: General evaluation

1. What are your top 5 most important categories? Use the **Category name** column, **Level 1,** in the given evaluation table. Rank them starting from the most important.

Ranks	Category (name or number)
1	
2	
3	
4	
5	

2. What are your 5 least important categories? Use the **Category name** column, **Level 1**, in the given evaluation table. Rank them starting from the least important.

Ranks	Category (name or number)
1	
2	
3	
4	
5	

3. What are your 5 most important individual dimensions? Use the **Main Dimensions** column, **Level 2**, in the given evaluation. Rank them starting from the most important.

Ranks	Dimension (name or number)
1	
2	
3	
4	
5	

4. What are your 5 least important individual dimensions? Use the **Main Dimensions** column, **Level 2**, in the given evaluation. Rank them starting from the least important.

Ranks	Dimension (name or number)
1	
2	
3	
4	
5	

Figure 5.2: Extract from the categories and dimensions ranking questions in the review template

The figure shows that space was provided for experts to list the most and least important categories and dimensions using four different tables. The rest of this section provides analysis of the data collected using these tables. Although this section (5.3) is lengthy, taking up 18 pages, it should be noted that:

- The aim of the section is to give an aggregated sense of what the four experts considered to be the most and the least important categories and dimensions, that is, ranking of categories and dimensions.
- Qualitative data was converted into numbers during data analysis. However, the results remain qualitative in nature, since only four experts were involved and a conclusive quantitative result could not have been made from such a low number, of four records. Sample size for a study is difficult to determine since it depends on a number of factors such as researcher's goals, population size and level of accuracy required, however, a minimum of 25 participants is generally recommended for quantitative data analysis (Durand and Chantler, 2014).
- The questions in Figure 5.2 were also motivated by the fact that the categories of the conceptual e-SQUUX Model V1 were ranked, since it was necessary to get a sense of the experts' opinions regarding relative importance.
- The researcher devised his own formulas, with explanations of how they work, to arrive at the results, in terms of ranking the categories and dimensions. These rankings contributed to the formation of the expert-reviewed Provisional e-SQUUX Model PV2 in Section 5.5.
- Interesting findings, though not conclusive, emerged from the data analysed in this section with regard to what different experts consider most and least important concepts when evaluating e-service quality, usability or user experience in an integrated manner.

These five points, particularly the first two, demonstrate that, though the researcher extensively used numbers in the analysis of the data, the end results were qualitative in nature. The rankings are subjective, but provide an aggregated sense of the opinions of the experts, thus supplementing the qualitative data from the suggestions given (see Section 5.4) in this qualitative Study 1B.

In the sections that follow, the numbering of categories, main dimensions or associated dimensions (henceforth together called *components*) will remain the same as that in the conceptual model of Chapter 4. Furthermore, some categories will be combined. The first ranked category in the conceptual model, namely, Learnability and Understandability will be referred to as Learnability and Understandability (1) where the number in the bracket (in this case '1') is the rank of the category according to the frequency of the categories as provided in Table 4.17 of Chapter 4. The '1' demonstrated that the Learnability and Understandability category was encountered most in the literature.

5.3.1 Most important categories

Each expert was asked to identify his/her top five most important categories out of the 24, starting with the most important. Table 5.6 shows the categories, rankings and scores for each of the four experts A to D. The most important category, as ranked by each expert, is allocated a score of 5 and the least important a score of 1.

Table 5.6 shows that Exp B and Exp D both identified Learnability and Understandability (1) as the most important category, but the other two experts identified different categories. For the two most important, Exp A identified Effectiveness and Usefulness (8), followed by Efficiency (3) as the two most important, while Exp C identified Accessibility (14) followed by Timeliness (23). Furthermore, Exp B selected Relevance and Suitability (18) as the second most important and Exp D selected Navigation (15) as the second. This indicates that, of the eight categories comprising the top two identified by each expert, only one, identified by B and D, was common and the other six were different. This shows an interesting diversity in what experts consider to be the top two most important e-SQUUX categories. However, when considering the top five categories identified by the four experts respectively, nine of the 20 identified were common, that is, nine of the 24 categories occurred in the top five.

Further analysis of Table 5.6 shows that while the numbering of the categories corresponds to the ranking of the categories according to the frequency with which they were encountered in literature that was reviewed in Chapter 4, some experts selected low-ranked categories as their most important. For example, for C the two most important were ranked 14th and 23rd in the literature encountered respectively named Accessibility (14) and

Table 5.6: Top five most important categories for each expert

Exp A			Exp B			Exp C			Exp D		
Rank	***Category***	***Score***	***Rank***	***Category***	***Score***	***Rank***	***Category***	***Score***	***Rank***	***Category***	***Score***
1	Effectiveness and Usefulness (8)	5	1	Learnability and Understandability (1)	5	1	Accessibility (14)	5	1	Learnability and Understandability (1)	5
2	Efficiency (3)	4	2	Relevance and Suitability (18)	4	2	Timeliness (23)	4	2	Navigation (15)	4
3	Information quality (7)	3	3	Security and Safety (11)	3	3	Relevance and Suitability (18)	3	3	Effectiveness and Usefulness (8)	3
4	Learnability and Understandability (1)	2	4	Effectiveness and Usefulness (8)	2	4	Effectiveness and Usefulness (8)	2	4	Accessibility (14)	2
5	Navigation (15)	1	5	Information quality (7)	1	5	Responsiveness and Helpfulness (5)	1	5	Efficiency (3)	1

Timeliness (23). Similarly, A selected as her first ranked category, the category that was 8th in the literature ranking, namely, Effectiveness and Usefulness (8), while D's second ranked category was 15th, namely Navigation (15). This shows that some of what was encountered less in the literature, is, in fact, viewed as important by certain expert evaluators.

Further analysis of feedback provided more insights. Table 5.7 summarises the rankings by the four experts. Given that for the sake of analysis, the most important categories were allocated a score of 5 and the least important a score of 1, the total score for each category provides an indication of its overall importance. The Position column, also referred to as CatPosM (*category position* for the *most* important categories), shows the rank or position of a given category according to the sum (Total Score) of the different scores (from List of scores) as a result of the experts' rankings and scores in Table 5.6. As shown in Table 5.7, the highest-ranked categories were Effectiveness and Usefulness (8) and Learnability and Understandability (1) with a total score of 12 points each. Since all four experts identified Effectiveness and Usefulness (8) in their top five, it has been ranked first, and category Learnability and Understandability (1) identified by three experts has been positioned second. A similar approach is used to rank the rest of the categories. To consolidate, the

24 categories that were ranked by the experts overlapped to such a degree that nine of the 24 categories were included in the top five, which is a sign of consensus among the experts. However, the experts' top five varied considerably from the frequencies that had emerged from the literature study. Only two of the categories in the five with the highest frequency, namely Learnability and Understandability, and Efficiency, appeared in the experts' top five most important. Furthermore, the present researcher determined that categories with a total of 2 or 1 should be ignored, because a score of 1 meant that only one expert identified this category and the same expert had ranked it lowest among the five; or a score of 2 would mean that one expert ranked it second lowest or two experts had both ranked it lowest. The cut-off-point of 2, results in nine of the 24 categories being viewed as most important.

Table 5.7: Summary of rankings of most important categories

Position (CatPosM)	**Categories considered most important**	**List of scores**	**Total Score**
1	Effectiveness and Usefulness (8)	5 2 2 3	12
1	Learnability and Understandability (1)	5 2 5	12
3	Relevance and Suitability (18)	4 3	7
3	Accessibility (14)	5 2	7
5	Navigation (15)	1 4	5
5	Efficiency (3)	4 1	5
7	Information quality (7)	3 1	4
7	Timeliness (23)	4	4
9	Security and Safety (11)	3	3
10	Responsiveness and Helpfulness (5)	1	1 (ignored)

5.3.2 Least important categories

Each expert was asked to identify his/her five least important categories, starting with the least important. Table 5.8 shows the categories, ranking and scores. The most important category as ranked by the each of the experts is allocated a score of 5, as explained in the last section (Section 5.3.1) and the least important a score of 1.

Table 5.8: The five least important categories for each expert

Expert A			**Expert B**			**Expert C**			**Expert D**		
Rank	***Category***	***Score***	***Rank***	***Category***	***Score***	***Rank***	***Category***	***Score***	***Rank***	***Category***	***Score***
1	Motivation and Challengeability (24)	5	1	Sociability and Collaboration (22)	5	1	Pleasure and Hedonics (4)	5	1	Consistency and Innovation (19)	5
2	Pleasure and Hedonics (4)	4	2	Interface design and Appearance (9)	4	2	Maintainability (17)	4	2	Competence (20)	4
3	Flexibility and Personalisation (2)	3	3	Motivation and Challengeability (24)	3	3	Sociability and Collaboration (22)	3	3	Motivation and Challengeability (24)	3
4	Competence (20)	2	4	Navigation (15)	2	4	Aesthetics (21)	2	4	Relevance and Suitability (18)	2
5	Consistency and Innovation (19)	1	5	Competence (20)	1	5	Appeal and Attractiveness (10)	1	5	Interface design and Appearance (9)	1

Table 5.8 shows that, apart from Exp A and Exp C who both identified Pleasure and Hedonics (4) as the one of the top two least important categories, each expert identified different categories as being least important. For example, for the top two least important, Exp B identified Sociability and Collaboration (22) and Interface design and Appearance (9), while Exp D identified Consistency and Innovation (19) and Competence (20). In addition, Exp A selected Motivation and Challengeability (24) as the least important and Exp C selected Maintainability (17) as the second. This means that, of the top two least important categories, for each expert, out of the eight, only one category was selected twice – by A and C – and the other six were different. This demonstrates the experts' diversity on the two least important e-SQUUX categories.

Further analysis of Table 5.8 shows that while the numbering of the categories themselves shows their rankings listed according to frequency encountered in the literature reviewed in Chapter 4, some experts listed highly-ranked categories among the least important. Notable among these was Pleasure and Hedonics (4) which was ranked 4th according to the literature review, but ranked least important by C and second-least important by A. This shows that some of those categories that emerged as important in an extensive literature review, are deemed unimportant in the expert review.

Further analysis of feedback gives more insights. Table 5.9 shows a summary of the rankings for the four experts. Given that, for the sake of analysis, the least important categories were allocated a score of 5 and the 5th least important a score of 1, the total score for each category provides an indication of how unimportant a category is. Similar to the case of the most important categories, the Position column, also referred to as CatPosL (*category position* for the *least* important categories), shows the rank or position of a given category according to the sum (Total Score column) of the different scores (from List of Scores column) as a result of the experts' rankings and scores in Table 5.8. As shown in Table 5.9, the worst-ranked category, at the top of the table, was Motivation and Challengeability (24) with a total score of 11 followed by Pleasure and Hedonics (4) with a total score of 9. Motivation and Challengeability (24) was selected by three different experts while Pleasure and Hedonics (4) was identified by two of them. Similar to Table 5.7, the present researcher determined that categories with a low total, a score of 2 or 1, should be ignored. This means that items ranked 9 to 12 were ignored. To consolidate, the categories that were ranked by the experts overlapped to such a degree that, in all, eight of the 24 categories were included in the five least important categories, demonstrating a degree of consensus among the experts.

Further analysis of the data in Tables 5.7 and 5.9 shows that there were no overlaps between categories that were most important and those that were least important. This shows further consensus. This data also shows that, overall, experts agreed with the conceptual model – Version 1 (V1). Furthermore, of the six lowest-ranked categories according to frequencies in Table 4.17 in Chapter 4, namely, the categories ranked 19, 20, 21, 22, 23 and 24, four of these, the categories ranked 19, 20, 22 and 24, are in the experts' five least important categories.

Table 5.9: Summary of rankings of least important categories

Position (CatPosL)	**Categories considered least important**	**List of scores**	**Total Score**
1	Motivation and Challengeability (24)	5, 3, 3	11
2	Pleasure and Hedonics (4)	5, 4	9
3	Sociability and Collaboration (22)	5, 3	8
4	Competence (20)	2, 1, 4	7
5	Consistency and Innovation (19)	1, 5	6
6	Interface design and Appearance (9)	4	4
6	Maintainability (17)	4	4
8	Flexibility and Personalisation (2)	3	3
9	Aesthetics (21)	2	2 (ignored)
9	Relevance and Suitability (18)	2	2 (ignored)
11	Appeal and Attractiveness (10)	1	1 (ignored)
11	Interface design and Appearance (9)1	1	1 (ignored)

The analysis regarding dimensions in the next two sections reports results similar to those in these two sections (5.3.1 and 5.3.2). Section 5.3.3 is very closely related to 5.3.1 and Section 5.3.4 to 5.3.2.

5.3.3 Most important dimensions

In addition to the ranking of categories, each expert was asked to identify his/her top five most important dimensions, starting with the most important. Table 5.10 shows the dimensions, rankings and scores for each of the four experts A to D. Similar to the scoring of the categories, for the sake of analysis, the most important dimension, as ranked by each of the experts, is allocated a score of 5 and the least important a score of 1.

Table 5.10 shows that apart from Exp C and Exp D who both identified Usefulness (8.2) as one of the top two most important, the experts selected a different dimension as being in the top two. For example, for the top two most important, Exp A identified Effectiveness (8.1) and Efficiency (3.1) as first and second, respectively, while Exp B identified Learnability (1.1) and Suitability (18.2). Furthermore, C selected Availability (14.2) as the most important and Exp D selected Navigation (15.1) as the second. This means that, of the top two, for each expert, only one dimension, namely Usefulness, occurred twice, while the other six were different. This shows diversity in the experts' views regarding the top two most important dimensions of e-SQUUX.

Table 5.10: Top five most important dimensions for each expert

Expert A			Expert B			Expert C			Expert D		
Rank	***Dimension***	***Score***	***Rank***	***Dimension***	***Score***	***Rank***	***Dimension***	***Score***	***Rank***	***Dimension***	***Score***
1	Effectiveness (8.1)	5	1	Learnability (1.1)	5	1	Availability (14.2)	5	1	Usefulness (8.2)	5
2	Efficiency (3.1)	4	2	Suitability (18.2)	4	2	Usefulness (8.2)	4	2	Navigation (15.1)	4
3	Information quality (7.1)	3	3	Security (11.1)	3	3	Currency (23.2)	3	3	Robustness (16.2)	3
4	Learnability (1.1)	2	4	Content quality (7.3)	2	4	Effectiveness (8.1)	2	4	Effectiveness (8.1)	2
5	Navigation (15.1)	1	5	Flexibility (2.1)	1	5	Feedback (5.4)	1	5	Aesthetics (21.1)	1

Further analysis of Table 5.10 shows that while the numbering of the dimensions shows their ranking according to the frequency in the literature that was reviewed, some experts selected low-ranked dimensions as their most important. This is similar to the situation when experts ranked the most important categories. For example, B's second-most important dimension was 18th in terms of frequency namely, Suitability (18.2). Similarly, C's most ranked dimension was 14th, Availability (14.2), and D's second ranked dimension was 15th, Navigation (15.1). This indicates that certain concepts that emerge from the literature as minor dimensions, are viewed by some experts as important.

Further analysis gives some more insights. Table 5.11 summarises the rankings of the four experts. The most important dimensions were allocated a score of 5 and the least important a score of 1, therefore the total score for each dimension provides an indication of its overall importance. The Position column, also referred to as DimPosM (*dimension position* for the *most* important dimensions), shows the rank or position of a given dimension according to the sum (Total Score column) of the different scores (from List of scores column) as a result of the experts' ranking and scores in Table 5.10. As shown in Table 5.11, the best ranked dimensions were Effectiveness (8.1) and Usefulness (8.2) with a total score of 9 each. Because three experts identified Effectiveness (8.1) as one of their top five, it has been ranked 1, and dimension Usefulness (8.2) identified by two experts is ranked 2. A similar approach is used to rank other dimensions. Furthermore, as in the case of analysis of the categories, the current researcher determined that dimensions with a total score of 2 or 1 should be ignored, as was done with categories in Sections 5.3.1 and 5.3.2.

Table 5.11: Summary of rankings of most important dimensions

Position (DimPosM)	**Category**	**List of scores**	**Total Score**
1	Effectiveness (8.1)	5, 2, 2	9
1	Usefulness (8.2)	4, 5	9
3	Learnability (1.1)	5 , 2	7
4	Availability (14.2)	5,	5
4	Navigation (15.1)	1, 4	5
6	Efficiency (3.1)	4	4
6	Suitability (18.2)	4	4
8	Information quality (7.1)	3	3
8	Security (11.1)	3	3
8	Currency (23.2)	3	3
8	Robustness (16.2)	3	3
12	Content quality (7.3)	2	2 (ignored)
13	Flexibility (2.1)	1	1 (ignored)
13	Feedback (5.4)	1	1 (ignored)
13	Aesthetics (21.1)	1	1 (ignored)

Using this cut-off-point of 2, resulted in 11 of the 75 being viewed as most important, that is , the rankings assigned by the experts demonstrated consensus to such a degree that only 11 of the 75 dimensions were included in their ‘top five’ choices.

5.3.4 Least important dimensions

Each expert was asked to identify his/her top five least important dimensions, starting with the least important. Table 5.12 shows the dimensions, rankings and scores. As previously, experts allocated a score of 5 to their selected least important dimension, 4 to the second-least important, and 1 to the 5th least important.

Table 5.12 shows that there was no common dimension in the top two least important dimensions as identified by the four experts. For example, for the two least important, Exp A identified Motivation (24.1) followed by Pleasure (4.1), while Exp B identified Stimulation (10.4) followed by Attractiveness (10.2). Table 5.12 indicates differences in the views regarding the two least important e-SQUUX dimensions.

Table 5.12: The five least important dimensions for each expert

Expert A			**Expert B**			**Expert C**			**Expert D**		
Rank	***Dimension***	***Score***	***Rank***	***Dimension***	***Score***	***Rank***	***Dimension***	***Score***	***Rank***	***Dimension***	***Score***
1	Motivation (24.1)	5	1	Stimulation (10.4)	5	1	Sociability (22.1)	5	1	Challengeability (24.2)	5
2	Pleasure (pleasurable) (4.1)	4	2	Attractiveness (10.2)	4	2	Maintainability (17.1)	4	2	Innovation (19.2)	4
3	Flexibility (2.1)	3	3	Searchability (15.2)	3	3	Colour (21.2)	3	3	Fulfilment (5.6)	3
4	Appeal (10.1)	2	4	Empathy (2.3)	2	4	Aesthetics (21.1)	2	4	Emotion (4.3)	2
5	Innovation (19.2)	1	5	Pleasure (pleasurable) (4.1)	1	5	Appearance (9.2)	1	5	Competence (20.1)	1

Furthermore, while the rankings in brackets behind the dimensions show the frequencies for each dimension's occurrences in the literature that was reviewed, some experts rated highly-ranked dimensions as their least important. Notable among these were the dimensions Flexibility (2.1) that was ranked 3rd least important by A and Empathy (2.3) that was ranked 4th least important by B. This shows that certain dimensions that emerged strongly in the literature, are viewed by some experts as unimportant.

Further analysis of feedback provides some more insights. Table 5.13 summarises the rankings of the four experts. Higher scores indicate the least important dimensions as perceived by the experts. The Position column, also referred to as DimPosL (*dimension position* for the *least* important dimensions), shows the rank or position of a given dimension according to the sum (Total Scores column) of the different scores (from List of scores column) as a result of the experts' ranking of dimensions given in Table 5.12. Table 5.13 indicates there were six worst-ranked dimensions, each with a total score of 5, namely, Pleasure (pleasurable) (4.1), Innovation (19.2), Stimulation (10.4), Sociability (22.1) Motivation (24.1) and Challengeability (24.2). Since Pleasure (pleasurable) (4.1) and Innovation (19.2) were both selected by two people, they are ranked as the top least important.

Furthermore, as in previous analyses, the current researcher ignored dimensions with a total score of 2 or 1. This resulted in 13 of the 75 dimensions being viewed as least important, indicating a consensus among the experts.

Further examination of Tables 5.11 and 5.13 shows that there were no overlaps between dimensions viewed as most important and those viewed as least important, also demonstrating consensus among the experts.

Table 5.13: Summary of rankings of least important dimensions

Position (DimPosL)	**Category**	**List of scores**	**Total Score**
1	Pleasure (Pleasurable) (4.1)	1, 4	5
1	Innovation (19.2)	4, 1	5
1	Stimulation (10.4)	5	5
1	Sociability (22.1)	5	5
1	Motivation (24.1)	5	5
1	Challengeability (24.2)	5	5
7	Attractiveness (10.2)	4	4
7	Maintainability (17.1)	4	4
9	Appeal (10.1)	2, 1	3
9	Flexibility (2.1)	3	3
9	Searchability (15.2)	3	3
9	Colour (21.2)	3	3
9	Fulfilment (5.6)	3	3
14	Empathy (2.3)	2	2 (ignored)
14	Aesthetics (21.1)	2	2 (ignored)
14	Emotion (4.3)	2	2 (ignored)
17	Competence (20.1)	1	1 (ignored)

5.3.5 Summary of ranking of categories and dimensions

5.3.5.1 Comparison of the most important categories and dimensions

The aim of this subsection is to determine how consistent experts were in ranking the most important categories and dimensions since the latter is a subset of the former. Table 5.14 shows the 11 most important dimensions and their Positions (DimPosM) as given in Table 5.11. For each dimension, the corresponding category where the dimension belongs, 'Mother' category, and category position (CatPosM), as given in Table 5.7 are also given.

Table 5.14: Comparison of the most important categories and dimensions

	Dimension rankings (see Table 5.11)			'Mother' categories and their rankings (see Table 5.7)			Differences in rankings of categories and dimensions
#	**Dimension**	**DimPosM**		**Category**	**CatPosM**		**Diff**
1	Effectiveness (8.1)	1		Effectiveness and Usefulness (8)	1		**0**
2	Usefulness (8.2)	1		Effectiveness and Usefulness (8)	1		**0**
3	Learnability (1.1)	3		Learnability and Understandability (1)	1		**2**
4	Availability (14.2)	4		Accessibility (14) [*includes Availability (14.2)]*	3		**1**
5	Navigation (15.1)	4		Navigation (15)	5		**1**
6	Efficiency (3.1)	6		Efficiency (3)	5		**1**
7	Suitability (18.2)	6		Relevance and Suitability (18)	3		**3**
8	Information quality (7.1)	8		Information quality (7)	7		**1**
9	Security (11.1)	8		Security and Safety (11)	9		**1**
10	Currency (23.2)	8		Timeliness (23)	7		**1**
11	Robustness (16.2)	8		Errors and Robustness (16)	NA		**NA**
					Mean		**1.1**
					SD		**0.83**

The *Diff* column shows the difference between the CatPosM and DimPosM for each dimension. For example, Effectiveness (8.1), which is part of the category Effectiveness and Usefulness (8), belongs to a category in position number 1 in Table 5.7 and happens to be in position 1 in the ranked-dimensions table, Table 5.11, hence the difference of zero (0) in the Diff column. The implications of the values in the Diff column are as follows.

Table 5.14 shows that the mean of the differences, in the Diff column, is 1.1, that is, the positions in the two columns, namely, CatPosM and DimPosM, differ by about 1. This means that, in general, there was little difference between the ranking of a particular category, in which a dimension is found, and the ranking of individual dimensions. The standard deviation of 0.83, approximately 1, shows that their Diff values did not vary much from one to the other.

The only extreme case was Suitability (18.2) which had a difference (Diff) of 3. In addition, Robustness (16.2) has a position of 8 in the Dimensions summary table, Table 5.11, but it does not occur in any of the identified top categories in Table 5.11. Consequently, this dimension was placed at the bottom of the list of the most important dimensions. However, as shown in Table 5.11 and Table 5.14, it is already positioned there. Notably, all categories listed as most important had associated dimensions identified as most important, hence the list remains unchanged. A combination of these two results shows that there was high consistency in the rankings of dimensions and consequently in the rankings of categories in which the dimensions reside. Table 5.15 shows the final rankings of the most important nine categories and of the most important 11 dimensions.

It is of interest that attributes that relate to traditional usability, for example, Effectiveness, Learnability, Navigation and Efficiency, as well as same attributers of service quality, are ranked highly by experts.

Table 5.15: Ranking of the most important categories and dimensions using only the rankings data

#	**Most important categories**		#	**Most important dimensions**
1	Effectiveness and Usefulness (8)		1	Effectiveness (8.1)
2	Learnability and Understandability (1)		1	Usefulness (8.2)
3	Relevance and Suitability (18)		3	Learnability (1.1)
3	Accessibility (14) [*includes Availability (14.2)]*		4	Availability (14.2)
5	Navigation (15)		4	Navigation (15.1)
5	Efficiency (3)		6	Efficiency (3.1)
7	Information quality (7)		6	Suitability (18.2)
7	Timeliness (23)		8	Information quality (7.1)
9	Security and Safety (11)		8	Security (11.1)
			10	Currency (23.2)
			11	Robustness (16.2)

5.3.5.2 Comparison of the least important categories and dimensions

Similar to the previous section, 5.3.5.1, the aim of this subsection is to determine how consistent experts were in ranking the least important categories and dimensions. Table 5.16 shows the 13 least important dimensions and their Positions (DimPosL) as given in Table 5.13. For each dimension, the corresponding category where the dimension belongs, 'Mother' category, and category position (CatPosL), as given in Table 5.9, are also given.

As in Section 5.3.5.1, The *Diff* column shows the difference between the CatPosL and DimPosL for each dimension. The implications of the values in the Diff column are as follows.

First, Table 5.16 shows that the mean of the differences of the two columns, namely, CatPosL and DimPosL, in the Diff column, is 1.1, that is, the positions in the two columns differ by about 1. This means that, in general, there was little difference between the ranking of a particular category, in which a dimension is found, and the ranking of individual dimensions.

Second, the standard deviation (SD) of 1.4, shows that position values of least important categories (CatPosL) and dimensions (DimPosL) differ between each other slightly more than in the case of the most important dimensions which had a SD of 0.83 (Table 5.14). One of the extreme values is Innovation (19.2) which has a difference (Diff) of 4.

Third, while the most important dimensions table (Table 5.14) has only one NA value in the diff column, in Table 5.16 there are six of them: Stimulation (10.4), Attractiveness (10.2), Appeal (10.1), Searchability (15.2), Fulfilment (5.6) and Colour. As in Table 5.14, NA means that a component listed as one of the least important dimensions is not associated with any of least important categories. For this reason, these dimensions are placed at the bottom of the least important dimensions list, consisting of 13 items, as depicted in Table 5.17, which shows the ranking of the least important categories and dimensions using only the rankings by experts.

Table 5.16: Comparison of the least important categories and dimensions

	Dimension rankings (see Table 5.13)		'Mother' categories and their rankings (see Table 5.9)		Differences in rankings of categories and dimensions
#	**Dimension**	**DimPosL**	**Category**	**CatPosL**	**Diff**
1	Innovation (19.2)	1	Consistency and Innovation (19)	5	4
2	Pleasure (pleasurable) (4.1)	1	Pleasure and Hedonics (4)	2	1
3	Motivation (24.1)	1	Motivation and Challengeability (24)	1	0
4	Stimulation (10.4)	1	Appeal and Attractiveness (10)	NA	NA
5	Sociability (22.1)	1	Sociability and Collaboration (22)	3	2
6	Challengeability (24.2)	1	Motivation and Challengeability (24)	1	0
7	Attractiveness (10.2)	7	Appeal and Attractiveness (10)	NA	NA
8	Maintainability (17.1)	7	Maintainability (17)	6	1
9	Appeal (10.1)	9	Appeal and Attractiveness (10)	NA	NA
10	Flexibility (2.1)	9	Flexibility and Personalisation (2)	8	1
11	Searchability (15.2)	9	Navigation (15)	NA	NA
12	Colour (21.2)	9	Aesthetics (21)	NA	NA
13	Fulfilment (5.6)	9	Responsiveness and Helpfulness (5)	NA	NA
				Mean	**1.1**
				SD	**1.4**

Fourth, there are two categories, namely Competence (20) and Interface design and Appearance (9), listed as least important but have no dimensions identified as least important related to them. These two are also placed at the bottom of the least important categories list, consisting of 8 items, as seen in Table 5.17.

Table 5.17: Ranking of the least important categories and dimensions using only the rankings data

#	Category		#	Dimension
1	Motivation and Challengeability (24)		1	Innovation (19.2)
2	Pleasure and Hedonics (4)		2	Pleasure (Pleasurable) (4.1)
3	Sociability and Collaboration (22)		3	Motivation (24.1)
4	Consistency and Innovation (19)		4	Sociability (22.1)
5	Maintainability (17)		5	Challengeability (24.2)
6	Flexibility and Personalisation (2)		6	Maintainability (17.1)
7	Competence (20)		7	Flexibility (2.1)
8	Interface design and Appearance (9)		8	Stimulation (10.4)
			9	Attractiveness (10.2)
			10	Appeal (10.1)
			11	Searchability (15.2)
			12	Colour (21.2)
			13	Fulfilment (5.6)

In summary, a combination of these four results shows that, in general, there was little consistency by the set of the four experts in identifying and ranking the least important categories and dimensions. Secondly, there was less agreement on which items were least important compared to agreement on those that were most important.

It is of interest that attributes that relate to user experience, for example, Motivation, Hedonics, Innovation and Pleasure, are viewed by some experts as being among the least important categories and dimensions.

5.4 Analysis of expert reviewers' suggestions

As discussed in Section 5.2, each expert evaluator was asked to give their opinion on the e-SQUUX Model and comment on its components (categories, main dimensions, or associated dimensions), their interrelationships, and to rate them in terms of Importance (IP), Suitability (ST), and Relatedness (RT).

Importantly, the experts were asked to add, remove, combine, separate, and relocate components or make any adjustments they felt appropriate. This section provides the analyses of this exercise by reporting the suggestions, the evaluators who made them, and whether the researcher accepted or rejected them. Reasons are provided where rejections were followed through and implemented. The researcher took into consideration his knowledge and experience in deciding whether to implement a suggestion or not. The rationale for acceptances is not provided in the tables in order not to overload this chapter.

5.4.1 Combining components

Some evaluators suggested that certain categories should be combined. For example, Exp C suggested that Category 21, Aesthetics – henceforth to be written as Aesthetics (21) (where the figure in brackets represents the original category number [rank from the literature] in the e-SQUUX conceptual model of Chapter 4) – should be combined with Category 10, Appeal and Attractiveness (10) since he felt that the two are closely related. This is provided as entry number 3 in Table 5.18 where the full list of suggestions to combine components is provided.

Table 5.18: Experts Suggestions regarding the combining of components

#	Suggestions	Expert(s)	Y/N
1	Combine Interface design and Appearance (9), and Aesthetics (21).	B, D	Y
2	Combine Reliability (6), and Information quality (7).	C	Y
3	Combine Aesthetics (21), and Appeal and Attractiveness (10).	C	N

The *Expert(s)* column indicates which expert(s) made the suggestion. The *Y/N* column represents the decision taken by the researcher whether or not to implement the change. The researcher applied his knowledge and experience in making the decision. For example, unlike A, B and D, C suggested that Aesthetics (21) should be combined with Appeal and Attractiveness (10). This was not implemented by the researcher, since sources such as Ladhari (2010) and Kundu and Datta (2014) relate aesthetics to Interface design or Appearance. In line with this, Entry 1 in Table 5.18 suggests that Aesthetics (21) should be combined with Interface design, which was implemented. Of the three suggestions by the experts, only one was rejected by the researcher.

The approach described in the last paragraph re-occurs in the next sections, 5.4.2 to 5.4.8.

5.4.2 Removing (deleting) components

Removal of some components was suggested. For example, Expert B suggested that Happiness (4.1.3) should be removed since “Happiness describes a person using the website, but not the website.” This was accepted by the current researcher as seen in the first entry of Table 5.19 that shows the full list of the suggestions and the actions taken for each. In some instances, in this and subsequent sections, the evaluators provided reasons why actions needed to be taken.

As in Section 5.4.1 some recommendations were not implemented. For example, according to B (row 21 of the table), Accessibility (14.1) is the same as Availability (14.2) and therefore one of them should be removed. This was rejected by the current researcher, based on his knowledge that was supported by definitions given by (García-Zubia et al., 2009; Karolic, 2013). They defined availability as how often the technology is available in the client system, and accessibility as how accessible the technology is for disabled people.

Of the 21 suggestions by the experts, only three were rejected by the researcher. As depicted in Table 5.3 in Section 5.2.2 of this chapter, Level 3 refers to the Associated dimensions, since Level 1 describes the categories and Level 2 the Main dimensions of e-SQUUX.

In fact, although mentioned here, as stated in Section 4.4.3 in Chapter 4, Level 3 components, named Associated dimensions, were considered ‘weaker’ than the Main dimensions of e-SQUUX Model V1. That is why they have a header of their own in Table 5.19, and subsequent tables where applicable. The leftmost column numbers 21 suggestions, but these numbers do not represent any ranking or sequence.

Table 5.19: Experts' suggestions regarding removal (deletion) of components

#	Suggestions	Expert(s)	Y/N
1	Happiness (4.1.3) should be removed, since "Happiness describes a person using the website but not the website."	B	Y
2	Satisfaction (13) should be removed, since "Satisfaction comes from several items already mentioned in other categories."	A	N
3	Delete Empathy (2.3), since it is associated more with people rather than systems.	A, B, C	Y
4	Remove Tangibility (9.3), since the term is unclear in the context of system design and evaluation.	D	Y
5	Sociability and Collaboration (22) are not very important for e-SQUUX.	A, C	N
	Level 3 (Associated dimensions)		
6	Delete Nomenclature (2.2.4) or rename it Labelling of components.	D	Y
7	Delete Text Meaning (1.2.7), since Meaning (1.2.3) already exists.	B, D	Y
8	Delete Ease of remembering (1.3.2), since it is the same as Memorability (1.3).	D	Y
9	Delete Preference (1.4.6), Granularity (1.6.1), Changeability (2.1.4), Forgiveness (2.1.6), Exclusive (2.2.2), User centricity (2.2.4), User empowerment (2.2.5), Technology use (2.6.2), Throughput (3.3.3), Velocity (3.3.4), Good (4.1.1), Be-goals (4.2.2), Immersion (5.5.1), Constructiveness (8.2.6), Curiosity (10.1.1), Returnability (12.1.9) and Failure (16.1.2). It is not clear what they mean in this research context.	D	Y
10	Delete Scalability (3.1.1) and Integrative (3.1.2) since they are not linked to Efficiency.	C, D	Y
11	Delete Ease of operation (3.2.2) and Cooperatively (22.1.1) since they mean the same as Operability (3.2.1).	D	Y
12	Delete Happiness (4.1.3) and Enthusiastic (10.3.1) since these refer more to a person rather than a system.	B, D	Y
13	Delete Evocation (4.3.1) since it is not clear what it means in this research context.	C, D	Y
14	Delete Immersion (5.5.1) since it is not clear what it means in this research context.	C	Y
15	Delete Explanations (5.2.4) since it should not be part of Helpfulness (5.2).	C	Y
16	Delete Humility (6.1.5) and Delicacy (6.2.1) since it is not clear what they mean in this research context.	A, B, C	Y
17	Delete Multimedia capability (7.3.1) and Guidance (16.2.3) since it is not clear what they mean in this research context.	B, C	Y
18	Delete Affordance (18.1.3) since it is not clear what it means in this research context.	A, C	Y
19	Delete Continuance intention (18.1.4), Conformity (18.2.4), Merit (18.2.6) and Technical adequacy (18.2.7) since it is not clear what they mean in this research context.	A, D	Y
20	Delete Made for the media (18.2.5), since it is not clear what it means in this research context.	A, B	Y
21	Accessibility is the same as Availability hence remove one.	B	N

5.4.3 Relocating (moving) components

All four experts made suggestions to move categories, main dimensions or associated dimensions from one location to another. For, example, according to Exp A, the dimension, Fulfilment (5.6), should be moved from Category 5, Responsiveness and Helpfulness (5), to Category 4, Pleasure and Hedonics (4). The full list of such suggestions is given in Table 5.20. In each case, the reason given was that the component would fit better elsewhere.

Table 5.20: Experts' suggestions regarding relocation of components

#	Suggestions	Expert(s)	Y/N?
1	Fulfilment (5.6) should be moved from the category Responsiveness and Helpfulness (5) to Pleasure and Hedonics (4).	A	Y
2	Adaptability (2.5) should be moved to Level 3 under (a subset of) Flexibility (2.1).	D	Y
3	Simplicity (3.2) should be moved to Category 1, Learnability (1)	D	Y
4	Make Pleasure (4) a subset of Hedonic (4).	C	N
5	Feedback (5.4) should be under Errors (16).	D	Y
6	Engageability (5.5) should be under Pleasure and Hedonics (4).	D	Y
7	Fulfilment should be under Pleasure and Hedonics (4).	A	Y
8	Move Reliability (6) to Level 2, under Information quality (7).	A	Y
9	Move Presentation (9.4) to Level 3, under Appearance (9.2)	D	Y
10	Move Stimulation (10.4) to Level 3, under Exciting (10.3)	B	Y
11	Move Innovation (19.2) to Level 2, under Pleasure and Hedonics (4).	D	Y
12	Move Competence (20) to Level 2, under Effectiveness and Usefulness (8)	C	Y
13	Move Motivation and Challengeability (24) to Level 2, under Pleasure and Hedonics (4).	C	Y
14	Move Novelty (19.3) to Level 2, under Pleasure and Hedonics (4)	C	Y
15	Move Consistency (19.1) to Level 2, under Information quality (7)	D	Y
	Level 3		
16	Move Universality (22.2.1) from Collaboration (22.2) to Level 2, under Flexibility (2.1)	C	Y

Suggestion 4 in the table to "Make Pleasure (4) a subset of Hedonic (4)" was given by Exp C. The reason put forward was that hedonics includes pleasure. As a result of this suggestion, the researcher further investigated the issue of hedonic quality. According to various sources (Diefenbach, Hassenzahl and Diefenbach, 2011; Diefenbach, Kolb and

Hassenzahl, 2014; Taylor and Hassenzahl, 2011), user experience (UX) involves both pragmatic and hedonic qualities. Hedonic quality includes a wide number of affective dimensions such as excitement, innovation, enjoyment, and interesting (Diefenbach, Kolb and Hassenzahl, 2014). Due to the broad meaning of hedonic, a number of other components within the conceptual model can fall under it due to their meanings. This makes 'hedonics' a high-order concept. For this reason, the current researcher decided not to implement "Make Pleasure (4) a subset of Hedonic (4)" and to remove hedonic from the model. Using a similar reasoning, 'ease of use' was removed as described in Section 4.3.3 of Chapter 4. All other suggestions were implemented.

5.4.4 Adding components

There were suggestions regarding dimensions or associated dimensions that should be added. For example, Exp B advised the inclusion of 'familiarity' as one of the associated dimensions of Memorability (1.3). The full list of such suggestions is given in Table 5.21.

Table 5.21: Experts' suggestions regarding addition of components

#	Suggestions	Expert(s)	Y/N
1	Add a new dimension, Familiarity to Level 3, under Memorability (1.3).	B	Y
2	Add a new dimension, Discoverability to Level 3, under Searchability (15.2).	B	Y
	Level 3		
3	Add Slips under Errors (16.1) since errors are made up of slips and mistakes.	D	Y

5.4.5 Decoupling (separating) components

There were suggestions that some of the categories named by two dimension names, such as category 19, Consistency and Innovation (19), should be separated into two distinct categories. For example, Exp A felt that Consistency and Innovation (19) should not be together, since they are contradictory. The full list of such suggestions is given in Table 5.22, also indicating that four of the six suggestions were implemented.

Table 5.22: Experts' suggestions regarding decoupling of components

#	Suggestions	Expert(s)	Y/N
1	Separate Consistency and Innovation (19) since they contradict each other.	A	Y
2	Effectiveness and Usefulness (8) should be separated as they conflict with each other since "Effectiveness and Usefulness can be different for a site".	A	N
3	It is a problem to have Flexibility and Personalisation (2) together since "the choice may be different for different sites."	A	N
4	Responsiveness and Helpfulness (5) should be separated since they mean very different things.	C, D	Y
	Level 3		
5	Separate Wording and Language (1.2.6).	B	Y
6	Separate Adequacy/Task match (18.2.3).	B	Y

5.4.6 Renaming of categories

There were suggestions that a single dimension should be used to name a category. For example, A would prefer a single name to represent a category in all cases. As an illustration, the category called, "Learnability and Understandability (1) should be renamed Learnability (1)". Table 5.23 presents the renaming suggestions. All six suggestions were accepted.

Table 5.23: Experts Suggestions regarding renaming of components

#	Suggestions	Expert(s)	Y/N
1	Learnability and Understandability (1) should be renamed Learnability (1).	A	Y
2	Emotion (4.3) should be renamed Emotionality (4.3).	B	Y
3	Rename Stimulation (10.4) to Stimulating (10.4).	B	Y
4	Appeal and Attractiveness (10) should be renamed Appeal (10).	A	Y
	Level 3		
5	Rename Ability to evolve (2.1.5) to Upgradeable (2.1.5)	B	Y
6	Rename Self-service (8.2.8) to Self-service capabilities (8.2.8).	B	Y

5.4.7 Consolidation and elimination of synonyms

A section in the template, used by the experts for evaluating e-SQUUX (see Appendix B-1) and appearing in Table 5.3, required the expert reviewers to consider synonyms. Table 5.24 shows synonyms specifically identified. In fact, all of them came from D.

Table 5.24: Experts' suggestions regarding elimination of Synonyms

#	List of Synonyms	Expert(s)	Action taken
1	Understandability (1.2), Comprehensibility (1.2.1), Interpretability (1.2.2)	D	None
2	Meaning (1.2.4), Text meaning (1.2.7).	D	Text meaning (1.2.7) deleted
3	Mental load (1.3.3), Workload (1.3.5)	D	Workload (1.3.5) deleted
4	Minimalism (1.4.1), Preciseness (1.4.2), Economy (1.4.3).	D	Economy (1.4.3) deleted
5	Adaptability (2.5) Accommodation (2.1.1), Compatibility (2.1.2), Modifiability (2.1.7)	D	None
6	Attachment (4.2.1), Continuance (4.2.3), Loyalty (4.2.5), Urge to use again (4.2.6)	D	Continuance (4.2.3) and Urge to use again (4.2.6) deleted
7	User value (8.2.1), User need (8.2.2), Utility (8.2.3), Value added (8.2.4), User value (8.2.1), Value added (8.2.4).	D	User value (8.2.1) and Value added (8.2.4) deleted and replaced by Adds Value (8.2.1)
8	Delight (10.3.3), Elatedness (10.3.4), Thrill (10.3.7).	D	Elatedness (10.3.4) and Thrill (10.3.7) deleted
9	Flow (15.1.1), Order (15.1.2), Paths (15.1.3).	D	Paths (15.1.3) deleted
10	Applicability (18.1.1), Relatedness (18.1.2).	D	Applicability (18.1.1) deleted

The *Action taken* column indicates the researcher's response, based on his own judgement and discernment. The comment, 'None', means that no changes were made to the relevant components. Of the ten suggestions, action was taken in eight of them.

5.4.8 Dealing with miscellaneous suggestions

There were miscellaneous suggestions that did not fall into any of the previous types in Sections 5.4.1 to 5.4.7. Some were implemented by the researcher and others not. For example, Exp A suggested that each category should be represented by one dimension only. Except for one case of the four such suggestions, this was rejected. Table 5.25 lists the miscellaneous suggestions and the actions taken.

Table 5.25: Experts' miscellaneous suggestions

#	Suggestions	Expert(s)	Action taken
1	Each category should be represented by one dimension.	A	Accepted only in case of Learnability and Understandability (1) that has been renamed Learnability (1)
2	Some associated dimensions, Level 3 dimensions, should belong to more than one dimension. For example, B suggests that "Attractiveness" should be an associated dimension falling under each of the following. • Readability (1.5) • Interface design (9.1) • Appearance (9.2) • Appeal (10.1)	B	Rejected since the purpose of the model is to identify components suitable to e-SQUUX evaluation and assessment. The proposed restructuring would increase complexity.
3	Security and Safety (11) apply mainly to e-commerce sites.	C	The statement is correct but no change was made since the model is intended to be generic
4	Motivation and Challengeability (24) apply more to learning and gaming applications.	C	The statement is correct, but no change was made since the model is intended to be generic

In addition to the miscellaneous suggestions presented in Table 5.25, it was pointed out that the importance of a category or dimension depends on the domain to be evaluated. Two of the experts, B and C, stated that it was sometimes difficult to rate the importance of a category or dimension without knowing the application domain of the target website. For example, C stated: "I do, however, find it difficult to do the above-mentioned ranking if the type of website application is not known. For example, for an e-commerce application, safety and security would be my No 1 in importance but it would be much less important for other types of web application."

Likewise, Exp A commented that "the importance of the dimensions depends on the type of website e.g. time critical and entertainment sites have different priorities".

5.4.9 Categories that merged as a result of the analysis of suggestions in Sections 5.4.1 to 5.4.8

As a result of the suggestions in Sections 5.4.1 to 5.4.8, five of the original 24 categories of e-SQUUX Model V1 in Chapter 4 were merged with others and hence 'disappeared' as stand-alone categories. These are shown in Table 5.26. They are listed in the column

Original rank according to the rank they had in the original e-SQUUX Model V1. The *Reference table* and *Suggestion number* columns respectively refer to the table name where the suggestion was made, and the label number in that table. It is noted that most of these suggestions were made in Table 5.20. It should be noted that the *Action taken* column refers to the situation as it was stated in the *Reference table* column, that is, before any changes were made to e-SQUUX V1.

Table 5.26: Categories that merged as a result of experts' suggestions

Original rank	Categories	Action taken (*as provided in the reference table*)	Reference table	Suggestion number
6	Reliability (6)	Moved to Information Quality (7)	5.20	8
19	Consistency and Innovativeness (19)	Consistency moved to Information quality (7)	5.20	15
		Innovativeness moved to Pleasure and Hedonics (4) and renamed Innovation	5.20	11
20	Competence (20)	Moved Competence (20) to Effectiveness and Usefulness (8)	5.20	12
21	Aesthetics (21)	Moved to Interface design (9)	5.18	1
24	Motivation and Challengeability (24)	Both Motivation and Challengeability moved to Pleasure and Hedonics (4).	5.20	13

Since five categories of 24 were merged into others, 19 categories remained, as shown in Table 5.27.

Table 5.27: The remaining 19 categories, of the original e-SQUUX Model V1, as a result of experts' suggestions

Original rank	Category		Original rank	Category
1	Learnability (1)		12	Assurance and Credibility (12)
2	Flexibility and Personalisation (2)		13	Satisfaction (13)
3	Efficiency (3)		14	Accessibility and availability (14)
4	Pleasure (4)		15	Navigation (15)
5	Responsiveness and Helpfulness (5)		16	Errors and Robustness (16)
7	Information quality (7)		17	Maintainability (17)
8	Effectiveness and Usefulness (8)		18	Relevance and Suitability (18)
9	Interface design (9)		22	Sociability and Collaboration (22)
10	Appeal (10)		23	Timeliness (23)
11	Security and Safety (11)			

As in the case of Table 5.26, they are listed according to the rank they had in the original e-SQUUX Model V1. However, due to suggestions in Sections 5.4.1 to 5.4.8, some of them have different names. For example, because of implementing the first suggestion of Table 5.23, namely “Learnability and Understandability (1) should be renamed Learnability (1)”, the name has changed to Learnability (1).

5.5 Merging rankings and suggestions data results to arrive at the expert-reviewed Provisional e-SQUUX Model PV2

Section 5.3 focused on the results of the ranking of the most important and least important categories and dimensions. Tables 5.7 and 5.15 provide the nine most important categories out of 24, while Tables 5.11 and 5.14 provide the 11 most important dimensions out of 75. With respect to the least important dimensions and categories, Tables 5.9 and 5.17 provide the eight least important categories of the 24, while Tables 5.13 and 5.17 provide the 13 least important dimensions out of 75. Since the categories of e-SQUUX Model V1 were ranked from 1 to 24 in an ascending level of importance, this section of the study will use a combination of this information to rank the 19 categories by experts from most to least important. To achieve this, two major processes were undertaken:

1. Ranking the most important categories using (i) the 9 most important categories out of 24, and (ii) the 11 most important dimensions out of 75. This is done in Section 5.5.1.
2. Ranking the least important categories using (i) the 8 least important categories of the 24, and (ii) the 13 least important dimensions out of 75. This is done in Section 5.5.2

During the process of determining these rankings, the original ranking of each of the categories in E-SQUUX V1 as provided in Table 4.18 will also be taken into account.

The researcher who was a mathematician before he became a computer scientist, determined the formula applied in Sections 5.5.1 and 5.5.2.

5.5.1 Merging rankings and suggestions results: ranking the most important categories

In order to re-rank the categories a number of factors were used. These factors included the original e-SQUUX Model V1 rankings/numbering as provided in Table 4.18 of Chapter

4 where there were 24 categories and 75 main dimensions; the results of the analysis of suggestions as provided in Section 5.3; and the rankings of the most important categories and dimensions as provided in Tables 5.14 and 5.15. Table 5.28 shows the most important categories and is followed by an explanation of how they were determined.

Table 5.28: Calculation of CatPoints, CatScore, and DimPoints values for the most important categories and dimensions

CatPosM	CatPoints	Category	CatScore		DimPosM	DimPoints	Dimension
1	9	Effectiveness and Usefulness (8)	17		1	11	Effectiveness (8.1)
1	9	Learnability and Understandability (1)	24		1	11	Usefulness (8.2)
3	7	Relevance and Suitability (18)	7		3	9	Learnability (1.1)
3	7	Accessibility (14) (*includes Availability (14.2)*)	11		4	8	Availability (14.2)
5	5	Navigation (15)	10		4	8	Navigation (15.1)
5	5	Efficiency (3)	22		6	6	Efficiency (3.1)
7	3	Information quality (7)	18		6	6	Suitability (18.2)
7	3	Timeliness (23) (includes (Currency)	2		8	4	Information quality (7.1)
9	1	Security and Safety (11)	14		8	4	Security (11.1)
					8	4	Currency (23.2)
					8	4	Robustness (16.2)

The values in Table 5.28 are calculated as follows:

- **CatPosM** (Category Position – most important): As already discussed, CatPosM represents the position of a specific category as given in Table 5.7 (Section 5.3.1), where the most important categories were ranked by experts.
- **CatPoints** (Category Points): Since nine categories were ranked, CatPoints is calculated by awarding a 9 to the category in position 1 and awarding a 1 to a category in position 9. The formula used is:

  $$CatPoints = (9 - CatPosM) + 1.$$

  This means that the higher the category points (CatPoints) the more important the category is and vice versa.

- **DimPosM** (Dimension Position – most important): As already discussed, DimPosM represents the position of a specific dimension as in Table 5.11 (Section 5.3.3) where the most important dimensions were ranked by experts.
- **DimPoints** (Dimension points): Since 11 dimensions were ranked, DimPoints is calculated by awarding an 11 to the dimension in position 1 and awarding a 1 to a dimension in position 11. The formula used is:

  DimPoints = (11 – DimPosM) + 1.

  This means that the higher the dimension points (DimPoints) the more important the category is and vice versa since dimension(s) make up a category. When both dimensions of a category are part of the list of the ranked dimensions, the DimPoint of that category is the average of the scores of the two dimensions. This was done because each dimension whether made up of one (e.g. Learnability) or two dimension names (e.g. Effectiveness and Usefulness) is considered a single unit.
- **CatScore** (Category Score): CatScore shows a score calculated for each category as a result of its original position in the e-SQUUX Model V1 in Chapter 4, where e-SQUUX contained 24 categories ranked from 1 to 24 in descending order of the frequency with which they were encountered in literature. Similar to the calculation of CatPoints and DimPoints, the formula used is:

  CatScore = [24 – (original position of the category) + 1].

  The original positions in E-SQUUX V1, in Chapter 4, for each category are carried through and are shown in the brackets after the category name. For example, Effectiveness and Usefulness (8), means that this category was ranked 8^{th} out of 24 categories in the original model. This means that its CatScore is [24 – 8 + 1] = 17. This formula means that the higher the CatScore value, the more important the category is and vice versa.

It should be noted that there are no dimension score values since dimensions were not ranked in the original e-SQUUX V1.

Using the value of the variables of CatScore, CatPoints and DimPoints, the total values of each category, CatTotal, were calculated by summing up these three variables as shown in

Table 5.29 in the *Total* column. The formula used is:

CatTotal = CatScore + CatPoints + Dim Points.

Table 5.29: Ranking the most important categories

Rank	**Category**	**CatScore**	**CatPoints**	**DimPoints**	**Total (CatTotal)**
1	Learnability (1)	24	9	9	42
2	Effectiveness and Usefulness (8) (made up of two dimensions)	17	9	(11+ 11 = 22)/2 = 11	37
3	Efficiency (3)	22	5	6	33
4	Information quality (7)	18	3	4	25
5	Availability and *Accessibility* (14) (*includes dimension Availability (14.*2))	11	5	8	24
6	Navigation (15)	10	5	8	23
7	*Responsiveness and Helpfulness (5)*	20	NA		20
8	Security and Safety (11)	14	1	4	19
9	Suitability and Relevance (18)	7	7	4	18
10	*Errors and Robustness (16)*	9	NA	4	13
11	*Assurance and Credibility (12)*	13	NA		13
12	*Satisfaction (13)*	12	NA		12
13	Timeliness (23)	2	3	4	9

(The italicised categories are explained at the end of the subsection)

For each of the values used to calculate CatTotal, namely CatScore, CatPoints and DimPoints in Table 5.29, the higher the values of each of these three variables, the more important the category should be in the next version of e-SQUUX. Consequently, each of their sums for a category, CatTotal, in Table 5.29, is directly related to its new rank shown in the first column, namely, Rank. The points and scores of the dimensions were used to calculate the CatTotal (category total) of each category, which is the value used to re-rank the categories. That is to say, the higher the total for the category, the more important it is and hence the better its position in Table 5.29.

Furthermore, the use of these three variables shows that the new ranking of the categories is influenced by two factors:

1. The results of the literature review from which the first model was synthesised, because of the use of the CatScore variable.
2. The review of the experts, due to the use of CatPoints and DimPoints.

A further point is that Table 5.28 not only includes the nine most important categories but also four other new categories which are italicised and were included in Table 5.27 (in Section 5.4.9), but are not included in the list of the least important categories, described in Section 5.5.2. These are categories which are neither in the list of the most important categories, in Table 5.7, nor in the least important categories, in Table 5.9. There are four of them, namely, Responsiveness and Helpfulness (5), Errors and Robustness (16), Assurance and Credibility (12) and Satisfaction (13). They are shown in italics. For each of these four, there are no CatPoints, since this variable is only applicable to the most important (and in Section 5.5.2, to the least important) categories ranked by experts.

5.5.2 Merging rankings and suggestions results: ranking the least important categories

This section forms the second part of ranking the 19 remaining categories as discussed at the beginning of Section 5.5. The process followed is very similar to that as for Section 5.5.1. However, in some cases the method of calculating values is different, so the two sections could not be integrated.

Table 5.30 shows points and scores of the least important categories and dimensions that were used to calculate the CatTotal (category total) of each category and is followed by a description of how they were determined.

Table 5.30: Calculation of CatPoints, CatScore, and DimPoints values for the least important categories and dimensions

CatPosL	CatPoints	Category	CatScore		DimPosL	DimPoints	Dimension
1	1	Motivation and Challengeability (24)	1		1	1	Innovation (19.2)
2	2	Pleasure and Hedonics (4)	21		1	1	Pleasure (pleasurable) (4.1)
3	3	Sociability and Collaboration (22)	3		1	1	Motivation (24.1)
4	4	Competence (20)	5		1	1	Stimulation (10.4)
5	5	Consistency and Innovation (19)	6		1	1	Sociability (22.1)
6	6	Interface design and Appearance (9)	16		1	1	Challengeability (24.2)
6	6	Maintainability (17)	8		7	7	Attractiveness (10.2)
8	8	Flexibility and Personalisation (2)	23		7	7	Maintainability (17.1)
					9	9	Appeal (10.1)
					9	9	Flexibility (2.1
					9	9	Searchability (15.2)
					9	9	Colour (21.2)
					9	9	Fulfilment (5.6)

In Table 5.30, CatPosL represents the position of a specific category as in Table 5.9 where the least important categories were ranked by experts. Similarly, DimPosL represents the position of a specific dimension as in Table 5.13 where the least important categories were ranked by experts.

The values in Table 5.30 are calculated as follows:

- **CatPosL** (Category Position – least important): As already discussed with respect to the least important categories, CatPosL represents the position of a specific category as given in Table 5.9 (Section 5.3.2), where the least important categories were ranked by experts.

- **CatPoints** (Category Points): Unlike Section 5.5.1 where the most important category was allocated the highest points, CatPoints value for the least important categories is equal to the CatPosL value (see Table 5.9). The formula used is:

  CatPoints = CatPosL.

  This is because the categories were ranked/positioned with least important category at the top. For example, the least important category has a category position (CatPosL) of 1 (one). This means that the higher the category points (CatPoints) the more important the category is and vice versa.
- **DimPosL** (Dimension Position – least important): As already discussed, DimPosL represents the position of a specific dimension as in Table 5.13 (Section 5.3.4) where the least important dimensions were ranked by experts.
- **DimPoints** (Dimension points): Similar to determining the value of CatPoints, the values of DimPoints are the same as DimPosL. The formula used is:

  DimPoints = DimPosL.

  This means that the lower the dimension points (DimPoints), the less important the category is and vice versa since dimension(s) make up a category.
- **CatScore** (Category Score): The calculation of CatScore in this section, is similar to that in Section 5.5.1 since its value is based on the ranking of categories in e-SQUUX V1 in Chapter 4. This means that the formula used is:

  CatScore = [24 – (original position of the category) + 1].

  This means that the lower the CatScore value, the less important the category is and vice versa.

Table 5.31 shows the calculation done to determine the CatTotal, the last column of the table. Similar to Section 5.5.1, using the value of the variables of CatScore, CatPoints and DimPoints, the total values of each category, CatTotal, were calculated by summing up these three variables as shown in Table 5.31 under the Total column. The formula used is:

CatTotal = CatScore + CatPoints + Dim Points.

Table 5.31: Ranking the least important categories

Rank	Category	CatScore	CatPoints	DimPoints	Total (CatTotal)
19	Sociability and Collaboration (22)	3	3	1	7
18	Maintainability (17)	8	6	7	21
17	Appeal (10)	15	-	9	24
16	Pleasure (4)	21	2	1	24
15	Interface design (9)	16	6	9	31
14	Flexibility and Personalisation (2)	23	8	9	40

Similar to the most important dimensions in Section 5.5.1, for each of the values used to calculate CatTotal, namely CatScore, CatPoints and DimPoints, in Table 5.31 of the least important categories, the higher the value of any of these variables, the more important the dimension. Consequently, the sum of these values, CatTotal, represents a reasonable position of a specific category in a decreasing order, that is, the higher the value, the better its position. For example, Flexibility and Personalisation (2) with a CatTotal of 40 is on the top of the least important list and Sociability and Collaboration (22) with a value of 7 goes to the bottom of the list, making it the least important category of all. In summary, CatTotal, in Table 5.31, is directly related to its new rank of e-SQUUX – shown under the column *Rank*. However, since the most important categories, listed in Table 5.29, are numbered up to 13, the ranking of the least important items starts from 14 (bottom row), and ends at 19 (top row). It should be noted that, since the CatTotal values are not calculated in the same manner for the most and for the least important categories, the CatTotal in the two tables cannot be compared.

5.5.3 The Provisional e-SQUUX Model PV2 as a result of expert reviews

The output of Section 5.5.1, which was a process of merging the results of the reviewers' rankings and suggestions, was a list of 13 most important categories in the form of Table 5.29. Similarly, Section 5.5.2, resulted in a list of 6 least important categories in the form of Table 5.31. A combination of these two tables resulted in Table 5.32. It shows the integrated list of the new categories ranked from 1 to 19.

Table 5.32: The integrated list of the revised categories ranked from 1 to 19

Rank	**Category**	**Rank**	**Category**
1	Learnability (1)	11	*Assurance and Credibility (12)*
2	Effectiveness and Usefulness (8)	12	*Satisfaction (13)*
3	Efficiency (3)	13	Timeliness (23)
4	Information quality (7)	14	Flexibility and Personalisation (2)
5	Availability and Accessibility (14) (*includes Availability (14.2)*	15	Interface design (9)
6	Navigation (15)	16	Pleasure (4)
7	*Responsiveness and Helpfulness (5)*	17	Appeal (10)
8	Security and Safety (11)	18	Maintainability (17)
9	Suitability and Relevance (18)	19	Sociability and Collaboration (22)
10	*Errors and Robustness (16)*		

Table 5.32 shows that not only have categories been re-ranked but some of them have been renamed, compared to those in the original e-SQUUX Model V1. The original rankings (see Table 4.17 of Chapter 4) are in parentheses. For example, the category Effectiveness and Usefulness (8) which was ranked 8th has moved to the 2nd position, and Accessibility and availability (14) has not only moved from 14th to 5th position but it has been renamed Availability and Accessibility (14). The reason for renaming is that Availability was identified by experts to be among the most important dimensions but Accessibility was not. Other changes follow a similar argument.

As was mentioned previously, an impact, at this stage, of the expert review, is that traditional attributes of usability are prioritised over the more human user experience attributes.

Table 5.33 shows the full model of categories, main dimensions and associated dimensions that resulted from the expert review of the conceptual e-SQUUX Model V1 which was synthesised in Chapter 4. The new model is the outcome of combining both the rankings and suggestions results of the expert reviews. The model was named Provisional e-SQUUX Model PV2, where PV2 indicates provisional version 2. The final version 2 (V2) will be provided in Section 5.6 towards the end of this chapter. While the original e-SQUUX

Model V1 in Table 4.18 of Chapter 4, consisted of 24 categories, 75 main dimensions and 163 associated dimensions, PV2 consists of 19 categories, 64 main dimensions and 125 associated dimensions. Table 5.34 is a comparison of the two models, V1 and PV2 in terms of the number of components.

Table 5.33: Provisional e-SQUUX Model PV2, the conceptual model as a result of experts' reviews of e-SQUUX Model V1 in Chapter 4

Rank	**Level 1** **Categories**	**Level 2** **Main dimensions**	**Level 3** **Associated dimensions**
1	Learnability (1)	Learnability (1.1)	
		Understandability (1.2)	Comprehensibility (1.2.1), Interpretability (1.2.2), Meaning (1.2.3), Labelling (1.2.4), Terminology (1.2.5), Wording (1.2.6), Language use (1.2.7), Use of existing knowledge (1.2.8).
		Memorability (1.3)	Brevity (1.3.1), Mental load (1.3.2), Recall (1.3.3), Recognition(1.3.4)
		Conciseness (1.4)	Minimalism (1.4.1), Preciseness (1.4.2), Explicitness (1.4.3), Focused (1.4.4)
		Readability (1.5)	Legibility (1.5.1)
		Clarity (1.6)	Specific (1.6.1), Unambiguousness (1.6.2), Visibility (1.6.3), Progress indicator (1.6.4), Vividness (1.6.5)
2	Effectiveness and Usefulness (2)	Effectiveness (2.1)	Productivity (2.1.1)
		Usefulness (2.2)	Value added (2.2.1), User need (2.2.2), Utility (2.2.3), Practicality (2.2.4), Self-service capabilities (2.2.5)
		Functionality (2.3)	
		Competence (2.4)	
3	Efficiency (3)	Efficiency (3.1)	Resources utilisation (3.1.3)
		Simplicity (3.2)	Operability (3.2.1), Non-frustrating (3.2.3), Effortlessness (3.2.4), Non-obtrusiveness (3.2.5)

		Performance Speed (3.3)	Network usage(3.3.1), Technical performance(3.3.2)
4	Information quality (4)	Information quality (4.1) Reliability (4.2) Consistency (4.3)	Data quality (4.1.1), Content quality (4.1.2) Accuracy (4.2.1), Completeness (4.2.2), Correctness (4.2.3), Objectivity (4.2.4), Predictability (4.2.5), Validity (4.2.6), Stability (4.2.7), Sustainability (4.2.8) Coherence (4.3.1)
5	Availability and Accessibility (5)	Availability (5.1) Accessibility (5.2)	
6	Navigation (6)	Navigation (6.1) Searchability (6.2) Findability (6.3)	Flow (6.1.1), Order (6.1.2) Discoverability (6.2.1)
7	Responsiveness and Helpfulness (7)	Responsiveness (7.1) Helpfulness (7.2) Interactivity (7.3) Feedback (7.4)	Communication (7.1.1) Documentation (7.2.1), Customer service (7.2.2) Assistance (7.2.3), Explanations (7.2.4)
8	Security and Safety (8)	Security (8.1) Safety (8.2)	Confidence (8.1.1), Privacy (8.1.2), Financial risk (8.1.3), Perceive risk (8.1.4), Guarantee (8.1.5)
9	Suitability and Relevance (9)	Suitability (9.1) Relevance (9.2)	Appropriateness (9.1.1), Compliance (9.1.2), Adequacy (9.1.3), Task Match (9.1.4), Fit for the task (9.1.5) Relatedness (9.2.1), Affordance (9.2.2)
10	Errors and Robustness (10)	Errors (10.1) Robustness (10.2)	Mistakes (10.1.1), Slips (10.1.2) Recoverability (10.2.1), Fault tolerance (10.2.2), Undo (10.2.3)
11	Assurance and Credibility (11)	Assurance (11.1)	Trust (11.1.1), User comfort (11.1.2), Honesty (11.1.3), Courtesy (11.1.4), Maturity (11.1.5), Authority of source (11.1.6),

		Credibility (11.2)	Corporate image (11.1.7), Dependability (11.1.8) Authority (11.2.1), Integrity (11.2.2), Reputation (11.2.3), Popularity (11.2.4), Brand (11.2.5), Openness (11.2.6), Transparency (11.2.7)
12	Satisfaction (12)	Satisfaction (12.1) Attitude (12.2)	
13	Timeliness (13)	Timeliness (13.1) Currency (13.2) Up-to-datedness (13.3)	
14	Flexibility and Personalisation (14)	Flexibility (14.1) Personalisation (14.2) Controllability (14.3) Portability (14.4)	Accommodation (14.1.1), Compatibility(14.1.2), Upgradability (14.1.3), Modifiability (14.1.4), Adaptability (14.1.5) Identification/identity (14.2.1), Individualisation (14.2.2) Interoperability (14.4.1)
15	Interface design (15)	Interface design (15.1) Appearance (15.2) Presentation (15.3) Aesthetics (15.4)	Structure (15.1.1), Graphic (15.1.2), Layout (15.1.3), Organisation (15.1.4), Format (15.1.5), Metaphors and maps (15.1.6), Texture (15.1.7), Defaults (15.1.8), Fonts (size and shape) (15.1.9), Logic (15.1.10) Familiarity (15.2.1), Authenticity (15.2.2) Colour (15.4.1)
16	Pleasure (16)	Pleasure (pleasurable) (16.1) Emotion (16.2) Fun (16.3) Enjoyment (16.4)	Interesting (16.1.1) Attachment (16.2.1), Proud (16.2.2), Loyalty (16.2.3), Urge to use again (16.2.4)

		Entertainment (16.5) Innovation (16.6) Novelty (16.7) Fulfilment (16.8) Engageability (16.9) Motivation (16.10) Challengeability (16.11)	 Originality(16.6.1), Self-descriptiveness (16.6.2), Intuitiveness (16.6.3)
17	Appeal (17)	Appeal (17.1) Attractiveness (17.2) Exciting (17.3)	 Stimulation (17.3.1), Arousal (17.3.2), Delight (17.3.3), Refreshing (17.3.4)
18	Maintainability (18)	Maintainability (18.1) Support (18.2)	Installability (18.1.1), Replaceability (18.1.2), Reusability (18.1.3), Administration (18.1.4), Back-compatibility (18.1.5), Testability (18.1.6)
19	Sociability and Collaboration (19)	Sociability (19.1) Collaboration (19.2)	

Table 5.34 shows that, in general, there was consolidation and a decrease in the number of components, with the greatest decrease being 23% for the Associated dimensions, followed by Categories with a decrease of 21% and by Main dimensions that decreased by 15%, resulting in an average of 20%. This is in line with the methodological approach taken in this study whereby each sequential stage of the study aims to reduce the number of components in the model and consequently improve its reliability. This approach has precedents. It has been used in popular Information Systems Models such as DeLone and McLean's Information Systems Success Model (DeLone and McLean, 1992, 2003) and the service quality model, SERVQUAL (Parasuraman, Zeithaml and Berry, 1988).

Table 5.34: Comparison of V1 and PV2 of e-SQUUX Models in terms of number of components

Model name	**Categories**	**Main dimensions**	**Associated dimensions**
Original e-SQUUX Model V1	24	75	163
Provisional e-SQUUX Model PV2	19	64	125
% decrease	21%	15%	23%

5.6 Further refinement of the conceptual e-SQUUX Model due to precise definitions of its components

Once the provisional model was achieved (see Table 5.33), the researcher embarked on the process of describing each of the 19 categories. The descriptions were in the form of statements derived mainly from the definitions of the Main dimensions (Level 2) of each category, although the Associated dimensions (Level 3) were also considered. For example, for the category Learnability (1), the definitions of its main dimensions namely, Learnability (1.1), Understandability (1.2), Memorability (1.3), Conciseness (1.4), Readability (1.5) and Clarity (1.6) were taken from literature. Then, one or more statements were made using these definitions. For example, one of the most common definitions of learnability was found to be the ease with which users can accomplish basic tasks the first time they work with a system (Nielsen, 1993, 2012). Consequently, after looking at this and similar definitions, two statements emerged, namely:

1. It is easy to learn how to use the system the first time, and
2. It is easy to get work done the first time.

These are the first two statements (Descriptors) in Table 5.37 that is presented later in this section. These statements lead themselves to forming a bank of potential questionnaire items.

During the description process, it was found that certain changes and refinements to the model were necessary because of the definitions and resulting descriptions. The researcher returned to the literature to investigate the precise meanings of the revised, replaced and adapted terms to maintain the grounding of this work in accepted theory. Table 5.35 shows these refinements to the expert-reviewed Provisional e-SQUUX Model PV2. This resulted in e-SQUUX V2, the main outcome of Study 1B, where V2 stands for ‘Version 2’.

Table 5.35: Refinements made on the expert-reviewed Provisional e-SQUUX Model PV2

	Change	Reason	Implication
1	Eliminated Usefulness (2.2)	In TAM2 (Venkatesh and Davis, 2000), usefulness, specifically Perceived Usefulness (PU), is described in terms of systems performance, productivity, effectiveness and utility, which make it very generic to the extent that it is at a more abstract level than, for example, usability, one of the facets of e-SQUUX. For this reason, Usefulness (2.2) was removed from category Effectiveness and Usefulness (2). However, it was found that in many definitions, usefulness related to usefulness of Information quality (4.1). For example, according to Jiang and Ji (2014, p. 2182), "the system information is useful". Due to this, usefulness was moved to Information quality (4).	The category Effectiveness and Usefulness (2) was renamed Effectiveness.
2	Eliminated Accessibility (5.2)	The most common definition of accessibility was that it refers to "the degree of effectiveness; efficiency, safety and satisfaction when persons with the widest range of capabilities use a system" (ISO 9241-11, 1998; Herrera et al., 2010). It commonly refers to people with special needs, especially those with disabilities or older people (Petrie and Bevan, 2009; Herrera et al., 2010). However, the issue of 'special needs' that is equated to accessibility is outside the scope of this study. Consequently, Accessibility (5.2) was removed.	The category Availability and Accessibility (5) was renamed Availability.
3	Moved the Timeliness (13.1), Currency (13.2), Up-to-datedness (13.3) to category Information quality (4)	Definitions of timeliness dimensions were all related to information quality according to most definitions in the literature. For example, according to DeLone and McLean (1992) and (Petter, DeLone and McLean, 2008), information quality refers to the generation of accurate, precise, current, timely and concise information on e-commerce websites. As a result, the content of category Timeliness (13) was moved to the category Information quality (4).	Category Timeliness (13), as a stand-alone category, disappeared.
4	Moved Appeal (17.1), Attractiveness (17.2) and Exciting (17.3) to the category Pleasure (16).	According to the different definitions encountered, such as Hedegaard and Simonsen (2013), they posit that appeal, attractiveness, excitements and others such as enjoyment, belong to the hedonic quality. Consequently, they were moved to Pleasure (16) since it best describes aspects of hedonic quality, which is an important part of user experience. Furthermore,	Category Appeal (17), as a stand-alone category, disappeared

		all features of a system that are appealing, attractive or exciting bring pleasure to individuals (Bron et al., 2017). The content of the category Appeal (17) was therefore moved to the category Pleasure (16).	
5	Eliminated both Sociability (19.1) and Collaboration (19.2)	Category Sociability and Collaboration (19) was eliminated for three reasons. First, of the 19 categories remaining, this was ranked lowest by the experts. Second, sociability is defined as the degree to which a product or service satisfies the user's desire of being sociable, such as being friendly and entertaining (Lin, Chen and Kuan-Shun-Chiu, 2010). The issues of 'being sociable' in terms of being 'friendly and entertaining' were deemed to be beyond the scope of this research, especially due to the emergence of social media research in recent times, where these belong. Third, similar to sociability, collaboration was found to be out of the scope of this research. Fourthly, most literature encountered, referred to it in terms of collaborative software that allows two or more remote users to work jointly on a task or project at the same time, and is considered part of wider areas of computer-supported cooperative work (CSCW) that has the primary purpose of supporting remote group work on the same task (Koch, Schwabe and Briggs, 2015; Mills, 2017). For these three reasons, the contents of the category Sociability and Collaboration (19) were removed.	Category Sociability and Collaboration (19) was eliminated.
6	Replaced the category Maintainability (18) with Support	Maintainability (18.1) and Support (18.2) formed category 18. On defining the two, it was found appropriate that only the Support (18.2) should be retained. Software maintenance is a back-end process performed by the vendor or in-house system developers with the purpose of modifying and updating software applications after installation to correct faults and improve performance. However, for end users, what is needed is support when they encounter any problems (Tilley and Rosenblatt, 2017). This is more so in the case of Web-based applications. Maintainability (18) was therefore replaced by Support, which is normally provided to WBA users in the form of online support (Zhu et al., 2012).	The term Support was used instead of Maintainability in Category 18.
7	Removed 'Robustness' from the	According to Robertson (2007), a system is robust if it copes with errors. However, 'errors' refers to minimising the number of errors,	The category Errors and Robustness (10) was renamed Errors

	category Errors and Robustness (10)	prevention of serious errors, and ability to recover from errors (Nielsen, 1993). Since 'errors' incorporates 'robustness', and is more clearly defined in HCI, the term 'Robustness' was removed.	but Robustness (10.2) retained under this category.
8	Replaced the term 'Security' with 'Privacy' in category Security and Safety (8)	In most of the definitions related to online security, privacy and security were bundled together in that, even though they are not the same, they go hand-in-hand (Flavian, Guinaliu and Gurrea, 2006; Lowry, Dinev and Willison, 2017). On the other hand, safety is used to describe the security of a system. For example, Parasuraman, Zeithaml and Malhotra (2005, p. 7) state "Security/privacy: Degree to which the customer believes the site is safe from intrusion and personal information is protected." For these reasons, instead of using the phrase 'Security and Safety', the term 'Security and Privacy' was used.	The category Security and Safety (8) was renamed Security and Privacy

After implementing the changes in Table 5.35, involving removal of three categories and some renaming, the final model for this study (Study 1B) resulting from the expert review, was compiled. Table 5.36 shows the final list of the 16 resulting dimensions, while Table 5.37 shows the final expert-reviewed conceptual model for evaluation of e-service quality, usability and user experience (e-SQUUX Model V2). The term *Dimensions* replaces what were named *Categories* in e-SQUUX Model V1 (see Chapter 4, Table 4.18) and the Provisional e-SQUUX Model 2 (see Table 5.33).

Table 5.36: The final list of the e-SQUUX dimensions after the expert review process

Rank	Dimension		Rank	Dimension
1	Learnability		9	Suitability and Relevance
2	Effectiveness		10	Errors
3	Efficiency		11	Assurance and Credibility
4	Information quality		12	Satisfaction
5	Availability		13	Flexibility and Personalisation
6	Navigation		14	Interface design
7	Responsiveness and Helpfulness		15	Pleasure
8	Security and Privacy		16	Maintainability

Table 5.37 shows the 16 numbered *Dimensions*, and the *Defining dimensions* and the *Descriptors* for each of the dimensions. The *Defining dimensions* are equivalent to what were the *Main dimensions* in Model V1. These changes to the naming of components were done to make the model simpler and easier to understand compared to the previous Model V1. This new naming structure is used in the chapters that follow.

Table 5.37: The final expert-reviewed conceptual model for evaluation of e-service quality, usability and user experience (e-SQUUX Model V2)

		1. Learnability
Defining dimensions	**#**	**Descriptors**
1. Learnability 2. Understandability 3. Memorability 4. Conciseness 5. Readability 6. Clarity	1.1	The site is easy to learn to use the first time.
	1.2	Minimal effort and time are required to learn how to use the site.
	1.3	I understand how to use the site.
	1.4	It is easy to interpret the meaning of the site contents.
	1.5	The site uses simple language.
	1.6	The use of jargon is minimal.
	1.7	The site caters for different languages.
	1.8	The site content is legible (easy to read).
	1.9	When I return to the site after some time of non-use, I find it easy to use without having to relearn how to use it.
	1.10	The site provides only the minimum information needed to carry out required tasks.
		2. Effectiveness
1. Effectiveness 2. Functionality 3. Competence	2.1	The site works correctly.
	2.2	The site enables me to complete my tasks.
	2.3	I can achieve my goals using the site.
	2.4	The site is coherent since it is logical in the way it functions.
	2.5	Using the site improves my job performance.
	2.6	The site's content is useful.
		3. Efficiency
1. Efficiency 2. Simplicity 3. Performance speed	3.1	Once I have learned how to use the site, I take minimal time and energy to complete tasks successfully.
	3.2	The site is simple to use.
	3.3	The site is quick to load.
	3.4	It is fast to move back and forth through the pages of the site.
		4. Information quality
1. Information quality 2. Reliability 3. Consistency 4. Timeliness 5. Currency 6. Up-to-datedness	4.1	The site's information is accurate.
	4.2	The site's information is clear in its meaning.
	4.3	The site's information is current since it is continuously updated.
	4.4	The site's information is appropriate (suitable for its intended use).
	4.5	The site's information is adequate.
	4.6	The site works in a predictable manner since future actions are based on the way it acted in the past.

5. Availability		
1. Availability	5.1	It is fast to access the site.
	5.2	The site can be accessed from anywhere the Internet is available.
	5.3	The site quickly recovers from its failures.
	5.4	I can easily contact the people I need by means of the site.
	5.5	It is easy to access content (things I need) on the site.
6. Navigation		
1. Navigation 2. Searchability 3. Findability	6.1	The site has a logical (intuitive) navigation structure.
	6.2	The navigation is consistent throughout the site.
	6.3	The site has an effective search facility since it consists of multiple search options such as a search engine, back and forward buttons, and menu bars.
	6.4	It is quick to find what I want on the site.
	6.5	At any time, I know where I am on the site.
	6.6	At any time, I know where I want to go next on the site.
	6.7	The site provides suggestions or clues on how it should be used.
	6.8	It is easy to recognise linked and unlinked text.
7. Responsiveness and Helpfulness		
1. Responsiveness 2. Helpfulness 3. Interactivity 4. Feedback	7.1	The site provides me with prompt services.
	7.2	The responses I get for queries submitted via the site are satisfactory since they help me to solve the problem at hand.
	7.3	The site provides me with feedback where I require it.
	7.4	Queries submitted via the site are responded to promptly.
	7.5	The site asks me whether I am satisfied with the feedback I receive for my queries.
	7.6	The site provides me with solutions to problems and errors that I encounter on the site.
	7.7	I can easily find answers to frequently asked questions (FAQs)
	7.8	The site provides me with mechanisms to interact with the organisation.
8. Security and Privacy		
1. Security 2. Privacy 3. Safety	8.1	I feel safe to make transactions on the site.
	8.2	The site protects my personal information.
	8.3	I have confidence in the organisation that owns the site.
	8.4	The organisation is reputable.
	8.5	The site has access control mechanisms to allow only authorised users to perform authorised tasks.
	8.6	The site has mechanisms to prevent malicious attacks.
9. Suitability and Relevance		
1. Suitability 2. Relevance	9.1	The site is fit for the purposes it is intended to fulfil.
	9.2	The site provides me with only the necessary information or features to perform the tasks I require.
	9.3	The site provides added-value to me.
	9.4	The services provided by the site match my current requirements.
	9.5	The facilities on the site are in line with current information technology developments.

10. Errors		
1. Errors 2. Robustness	10.1	The site is built in such a way that it prevents me from committing many errors.
	10.2	The site does not allow me to commit serious errors.
	10.3	If I commit errors, I can easily recover from them.
	10.4	Fault tolerance: the site is robust since it does not fail to function due to system-generated errors.
	10.5	Fault tolerance: the site is robust since it does not fail to function due to user errors.
11. Assurance and Credibility		
1. Assurance 2. Credibility	11.1	The site provides promised services within a reasonable time.
	11.2	The site provides promised services accurately.
	11.3	I have trust and confidence since its organisation has a good reputation.
	11.4	The site clearly provides the source of the information on it.
	11.5	The site has information on how to contact the people in the organisation if I require to do so.
	11.6	The process for carrying out transactions, such as making a payment, is transparent.
	11.7	The site is technically reliable since it remains operational over time.
	11.8	The site gives me a sense of loyalty in the sense that I will reuse it in the future.
	11.9	I can recommend this site to other people.
12. Satisfaction		
1. Satisfaction 2. Attitude	12.1	I quickly accepted the use of this site.
	12.2	The portal inspires a positive attitude in me.
	12.3	The portal enables me to achieve my goals satisfactorily.
13. Flexibility and Personalisation		
1. Flexibility 2. Personalisation 3. Controllability 4. Portability	13.1	The site works well in different environments.
	13.2	The site is portable since it can work well in different browsers.
	13.3	The portal is interoperable since it can exchange and communicate information with other sites.
	13.4	The site accommodates changes to the way specific tasks are performed.
	13.5	The site allows me to personalise (customise) it according to my preferences (personal needs).
	13.6	When I use the site, I feel that I am in control.
14. Interface design		
1. Interface design 2. Appearance 3. Presentation 4. Aesthetics	14.1	The site has a logically well-organised structure and layout.
	14.2	The site has a simple intuitive navigation structure.
	14.3	The site has an attractive appearance.
	14.4	The site uses colours appropriately.
	14.5	The site is consistent since similar parts of the interface mean the same thing.
	14.6	The site's information output is well presented.
	14.7	The site's design portrays the corporate image of the organisation that owns it.

	14.8	The site has an innovative design since the way it is presented is new and unique.
15. Pleasure		
1. Pleasure 2. Enjoyment 3. Emotion 4. Fun 5. Fulfilment 6. Engaging 7. Motivation 8. Appeal 9. Exciting	15.1	The site provides a pleasurable experience that invokes positive emotions in me.
	15.2	The site is enjoyable to work with since it is interesting, stimulating, motivating, exciting, gratifying, fulfilling and fun to use.
	15.3	I feel emotionally attached to the site.
	15.4	The site appeals to me
16. Support		
1. Support	16.1	The site offers support to problems that arise.
	16.2	The support provided to me is informative.
	16.3	The support I receive is timely.
	16.4	The support I receive meets my needs.
	16.5	I receive support from the beginning to the end of any transaction I perform on the site.
	16.6	The site provides me with options for online self-service.
	16.7	I receive support from the beginning to the end of any service I receive via the site.
	16.8	I receive support from the beginning to the end of any product I acquire via the site.
Total: 55		**Total: 101**

The table consists of a set of descriptions in the form of statements, named *Descriptors*, for each dimension. As discussed at the beginning of this section (5.6), they were derived from the definitions of, mainly, the *Main dimensions* (Level 2) of each category of the Provisional Model 2, although the Associated dimensions (Level 3) were also considered. The descriptors were introduced in this version since it is a practical evaluation model. As such, the intention is that these statements should make it easy to design an evaluation or a measurement instrument from the Model by selecting the most appropriate items to use for a specific Web-based application in a specific context.

Table 5.38 shows a comparison of the Provisional e-SQUUX Model (PV2) and the Final expert-reviewed e-SQUUX Model V2 in terms of the number of components. While the Provisional expert-reviewed e-SQUUX Model PV2 in Table 5.33 consisted of 19 categories, V2 consists of 16 dimensions (named categories in PV2) which is a 15.8% reduction in the overall number of dimensions to consider for evaluation of e-service quality, usability and user experience. This shows that this stage (Study 1B), of the qualitative phase contributed greatly to the refinement of the e-SQUUX Model. Once again, this is in line with the methodological approach taken in this research whereby each sequential stage of the study aims to reduce the number of components in the model and consequently improve its validity. As stated previously, the approach has been used in popular Information Systems models such as DeLone and McLean's Information Systems Success Model (DeLone and McLean, 1992, 2003) and the service quality model, SERVQUAL (Parasuraman, Zeithaml and Berry, 1988).

While the number of dimensions decreased by 15.8%, the number of the defining sub-dimensions decreased from 64 to 55 which is 14.1%. While there was a decrease in the number of dimensions, most of the dimensions that make up the 14.1% that were removed were absorbed by the new dimensions, hence maintaining the content validity of the e-SQUUX Model.

Finally, Table 5.38 shows that the final Expert-reviewed model V2 had 101 descriptors that did not exist in Model V1 or the Provisional model PV2.

Table 5.38: Comparison of the Provisional (PV2) and Final (V2) expert-reviewed e-SQUUX Models in terms of number of components

Model name	**Number of Dimensions**	**Number of Main dimensions or defining Sub-dimensions**	**Number of Descriptors (statements)**
Provisional Model 2	19	64	-
Final Model 2	16	55	101
% decrease	15.8%	14.1%	

5.7 Conclusion

This chapter set out to analyse the empirical data obtained from an expert review of the conceptual e-SQUUX Model V1 by four evaluators. The results were used to refine the model and improve its content validity.

After the introduction in Section 5.1, Section 5.2 provided a brief profile of the four experts and an overview of the nature of data collected. All the experts were highly qualified, with three being academics and one a practitioner, all of them in Information Technology and/or HCI.

Section 5.3 focused on the results of the rankings of the most important and of the least important categories and dimensions, according to the experts' rankings. First, Table 5.7 summarised the reviewers' 9 most important categories out of 24. Similarly, Table 5.11 provided the 11 most important dimensions out of 75. In general, there was consensus among the set of four experts on ranking the top five most important components, to such a degree that 9 of 24 categories and 11 of the 75 dimensions overlapped. In addition, there was a high level of consistency on the rankings of most important categories and dimensions by the experts. Second, Table 5.9 provided a summary of the reviewers' 8 least important categories out of 24, while Table 5.13 provided the 13 least important dimensions out of 75. In general, there was consensus among the four experts in ranking the 5 least important components, to such a degree that 8 of 24 categories and 13 of the 75 dimensions overlapped.

Section 5.4 focused on the analysis of the experts' comments on the e-SQUUX Model. In addition to scoring components in terms of Importance (IP), Suitability (ST), and Relatedness (RT) on different scales, ranging from 1 to 5, experts were free to add, remove, combine, separate, relocate components or make any other adjustments. As a consequence, a number of recommendations were made and are listed in Sections 5.4.1 to 5.4.9. This resulted in a general decrease in the number of categories, main dimensions and associated dimensions.

Section 5.5 dealt with merging the rankings data of Section 5.3 with the suggestions data of Section 5.4 in order to produce a more refined Provisional e-SQUUX Model PV2. PV2 consisted of 19 categories, 64 main dimensions and 125 associated dimensions. Since the original model consisted of 24 categories, 75 main dimensions and 163 associated dimensions, there were decreases in the number of components by 21%, 15% and 23% respectively as provided in Table 5.34.

Finally, in Section 5.6, there was further refinement of the conceptual e-SQUUX Model V1 based on the definitions of its components of mainly the Main dimensions of the Provisional e-SQUUX Model PV2 and to a lesser extent of their Associated dimensions.

Based on the outcome of this chapter in the form of e-SQUUX Model V2 and a set of descriptors that form the bank of potential questionnaire items, a questionnaire-based survey was conducted with users of web portals of UNISA, in the form of a pilot and main study as given in the next two chapters respectively.

Given that Study 1A (Chapter 4) and Study 1B (Chapter 5) were qualitative in nature and that the next two studies reported on in Chapters 6 (Study 2A) and 7 (Study 2B) are quantitative, this point marks the transition from a qualitative to a quantitative phase as recommended in mixed methods studies. The final outcome of the qualitative phase in the form of dimensions and descriptors (see Table 5.37) act as the basis for the quantitative phase in the form of dimensions and items of a questionnaire in line with Exploratory sequential design as stated in Chapter 3 Section 3.5.2.

Chapter 6: Pilot study: Study 2A

6.1 Introduction

The previous chapter dealt with analysing the empirical data received from the expert reviewers of the conceptual e-SQUUX Model V1. e-SQUUX V1 was refined and converted to V2 (Version 2). This chapter builds on that and is a further step towards the ultimate objective of answering all the subquestions and hence answering the main research question of this work. Specifically, this quantitative Study 2A sets out to answer **Subquestion 3**, namely:

3. *What is the value of a comprehensive pilot study prior to the main questionnaire survey on the components of an integrated model for evaluating e-SQUUX of a University web portal (UWP)?*

Table 6.1 summarises this chapter, presenting the main objectives, data collection method and analysis, profiling the participants who were involved in this study, and presenting the main outcomes of the chapter, namely, an improved questionnaire for use in the main study and an overview of the value of this pilot study.

Table 6.1: Summary of Chapter 6

Pilot study	
Purpose	The main objectives of this chapter are three-fold: 1. To improve and correct the questionnaire by testing its design and feasibility on a small-scale survey. 2. To determine the reliability of the constructs in the questionnaire and, consequently, the reliability, to a limited scale, of the content validated version of the conceptual e-SQUUX Model, namely e-SQUUX Model V2 3. To provide an overview of the reflection of the value of a comprehensive pilot study in an HCI survey evaluation.
Data collection	Survey using Pilot study questionnaire (see Appendix D-1)
Participants	26 participants from two target UNISA sites: One campus and one study centre
Data analysis	Quantitative – descriptive statistics and reliability testing
Outcome	Improved questionnaire to use in the main study

Questionnaires should be evaluated both formally and informally (Connaway and Radford, 2016). In terms of informal evaluations, two colleagues of the researcher conducted an informal pre-pilot review to evaluate the draft questionnaire. One of them was an expert, with a PhD in the field of HCI with over 15 years of academic experience in the field. The second holds a PhD qualification in Information Systems, though not specifically in HCI. This is in line with Connaway and Radford (2016) who recommend that this should be undertaken in survey studies since it improves the face validity of the questionnaire. Face validity is the extent to which the questions in the questionnaire measure a specific construct as viewed by stakeholders, such as the end users, designers and customers (Devlin, 2018). Furthermore, such an initial informal study helps the researcher to determine whether the survey will meet its goal and objectives (Deutschlander, 2009). Recommendations from the two evaluators were considered and changes made where advised. Following this small-scale pre-pilot, a comprehensive pilot study, Study 2A, was commenced.

Previous research has shown that if pilot studies are carried out with a reasonable number of participants and if only a few weaknesses are encountered in the pilot, then the result can be published (Arain *et al.*, 2010; Johanson and Brooks, 2010; Durand and Chantler, 2014). This is confirmed by various published articles, for example, Liu (2018) and Dow, Gerber and Wong (2013), which explicitly state the results that emanated from a pilot study, with some of them actually having the phrase ‘pilot study’ in the title of the published paper. Likewise, the researcher intends to present the contents of this chapter as a submission for publication.

Figure 6.1 shows how the chapter is laid out. The chapter commences with this introduction (Section 6.1), followed by Section 6.2 on sampling, and procedure and administration of the questionnaire that includes sampling for the pilot study (Subsection 6.2.1), and procedure and administration of the questionnaire (Subsection 6.2.2). Thereafter, Section 6.3 presents results on data capturing and profile of participants, and Section 6.4 reports on the reliability of the constructs in the questionnaire. Other changes to the questionnaire design and its distribution procedure are described in Section 6.5 with five subsections.

These are: re-ordering of the questionnaire (Subsection 6.5.1), use of tick or crosses in the questionnaire? (Subsection 6.5.2), Changes due to common errors found in the questionnaire during data capturing (Subsection 6.5.3), adjustment of the questionnaire distribution procedure with respect to gender (Subsection 6.5.4), and editing and additional modification of the questionnaire (Subsection 6.5.5). The overview of the value of the pilot study is presented in Section 6.6, and the conclusion of the chapter in Section 6.7.

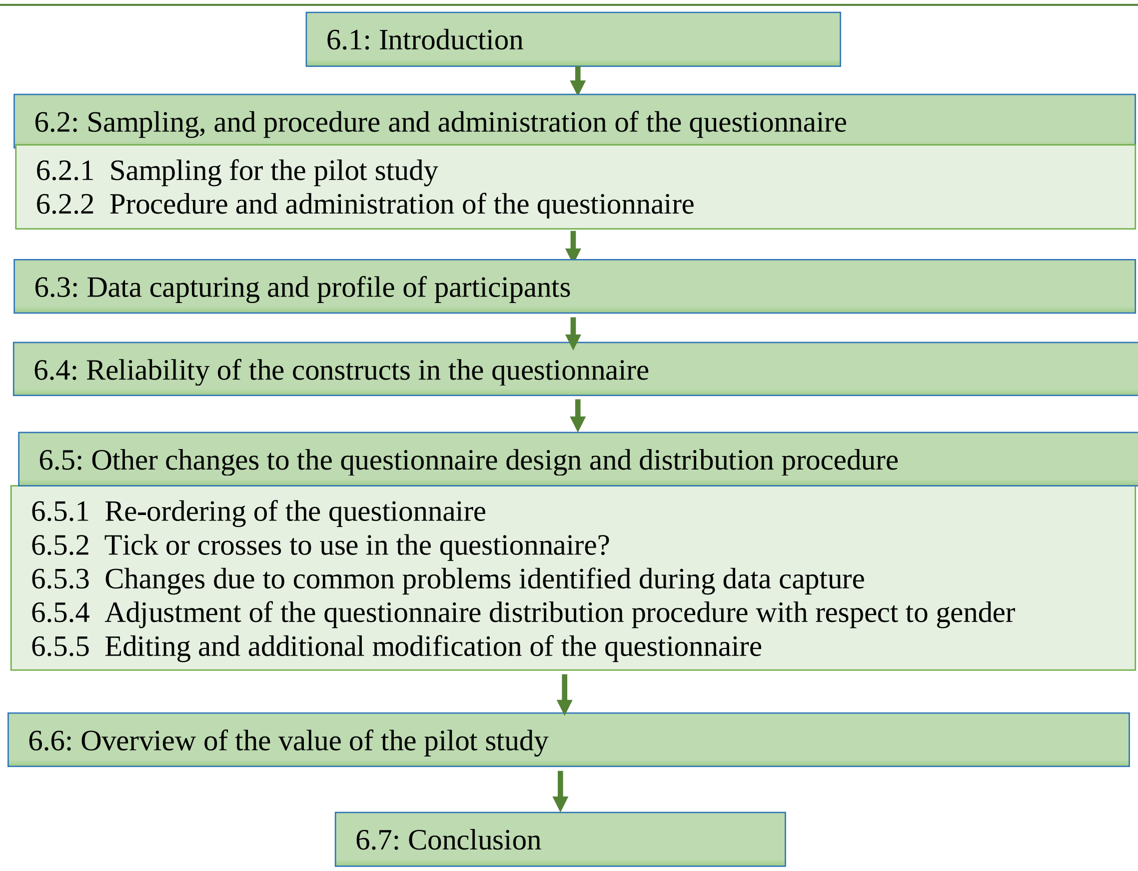


Figure 6.1: Layout of Chapter 6

6.2 Sampling, and procedure and administration of the questionnaire

Data for the pilot study was collected using a questionnaire that consisted of a brief introduction followed by a template for participants' profiles (Section A), and then the actual evaluation section (Section B). Appendix D-1 provides the pilot study questionnaire.

6.2.1 Sampling for the pilot study

Determination of sample size for a pilot study is challenging, for it depends on the particular purpose of the pilot study (Johanson and Brooks, 2010). According to a study undertaken by Johanson and Brooks to determine the most appropriate number of participants, the most common number required for a pilot study for questionnaire surveys is in the range of 10 to 30. Most of the sources they investigated, recommended at least 12 participants. However, on the same topic, Hertzog (2008) recommends a sample size of at least 25 participants for pilot studies, in order to be able to carry out a reliability test with alpha values of around 0.7 and higher. However, he acknowledges that many researchers use 10% of the sample required for the main study. Given that the aim for the full study for this current research was about 170 participants, this would imply at least 17 participants for the pilot study. To cover the various approaches discussed here, it was decided to have at least 25 participants in the pilot study. In addition to the sample size, Durand and Chantler (2014) and Connaway and Radford (2016) recommend that the sample must be representative of the target population. Consequently, data was collected from 29 participants from two sites, namely one campus and one study centre, of the six target UNISA locations to be used during the main survey.

6.2.2 Procedure and administration of the questionnaire

From the outset, the survey phase of this research was to be undertaken using a paper-based questionnaire, since the researcher would be present at all the sites and questionnaires would be handed over, face-to-face, to participants individually. It is recommended that pilot studies should preferably be carried out face-to-face to make it easier to get feedback from participants and to identify challenges that occur during the process (Durand and Chantler, 2014). Consequently, this approach was followed during the pilot study.

A self-administered questionnaire was used. The researcher personally approached individual potential participants, greeted them and handed out the consent forms, as provided in Appendix D-2, and questionnaires to those who were willing to participate. Even though the questionnaire had a brief introduction clearly stating who the researcher was, what he was researching and why, and the procedure to be followed, the researcher briefed each of them verbally on these issues in a few sentences. He then handed out the questionnaire and the consent form to one to three participants at a time. In addition, a pen to fill in the questionnaire was given to each participant. Participants were informed that it would take them 15-20 minutes to complete the form. The researcher then sat about 5 to 10 metres away and observed the participants as they completed the questionnaire. The aim was to make them comfortable to fill in the questionnaire freely without any interference from the researcher. As in other survey studies (Ho and Lee, 2007; Cottrell et al., 2015), as a sign of appreciation, an incentive in the form of a pen was given to respondents on completion of the questionnaire.

It was observed that there was much willingness on the part of individuals to participate in the study. A total of 31 participants from the two UNISA sites, one campus and one study centre, were approached. Two of the potential participants declined, since they claimed they did not have time to complete the questionnaires. One participant was called by a friend to leave and had only done about half the questionnaire, so this questionnaire was not used during the pilot study data analysis. On two occasions, participants requested that the questionnaires be collected later on the same day. This was acceptable to the researcher, since he realised that the time at which they were approached, was not convenient.

During the questionnaire completion stage, participants were timed to get an estimate of how long the process took. It emerged that they needed 10 to 21 minutes to complete the form. Even though the estimated time to complete the questionnaire was not written on it, as stated, the participants were informed, during the short briefing, that it would take them about 15 to 20 minutes. One participant filled it in hurriedly and took only 5 minutes to complete it. As recommended by Connaway and Radford (2016), this questionnaire was rejected since the data was not considered to be reliable.

Since this was an in-person pilot session, the forms were personally collected from the participants when they had finished. Thereafter, as a normal practice during pilot studies (Fouche and Delport, 2004; Rea and Parker, 2014), each participant was informally asked to mention any problems he/she had encountered, such as unclear statements or instructions, or to comment on the entire process. Finally, as recommended by a number of researchers (Deutschlander, 2009; Connaway and Radford, 2016; Lazar, Feng and Hochheiser, 2017), participants were politely requested not to take part in the upcoming main study.

6.3 Data capturing and profile of participants

Appendix D-1 shows the questionnaire that was used for the pilot. All the questions regarding participants' personal profiles were in Section A and the actual evaluation questions followed in Section B. Although other profile data was collected from participants during this stage, only the parts of it that are relevant to this phase of the study, are reported in this chapter. Table 6.2 shows the profile of the participants. The four columns respectively show the *Characteristics*, their corresponding *Categories*, and percentages (%) for each category. The *N* column shows the number of effective responses for each characteristic. Since two (2) of the 31 potential participants approached did not participate in the study, 29 questionnaires were collected. One was incomplete, and as previously stated, one was rushed. That left 27 questionnaires to be captured. Since two of the 31 people approached did not take part, the nonresponse rate was 6.5% for the pilot study resulting in a response rate of 93.5%.

The data was captured in a spreadsheet. During the capturing, it was realised that one of the participants used a constant pattern in filling it out, that is, for each item, the same options were selected. This form was rejected too. This left 26 questionnaires that were usable for the pilot study data analysis. In addition, it was confirmed that the spreadsheet was appropriately designed to capture the data.

Table 6.2 shows that for each of the questions, there were between 24 and 26 effective responses. A majority of the participants, 67%, were registered students while 17% were academic staff, and 16% belonged to the administrative or support staff category.

With respect to demographic data, Table 6.2 shows that the majority, 69%, of the participants were between 25 and 40 years old, followed by 19% older than 40, and 12% who were younger than 25. The majority, 81%, were female with only 19% male.

Table 6.2 Profile of participants

Characteristics	**N**	**Category**	**%**
Main role at UNISA	24	Student	67
		Academic	17
		Administrative and Support	16
		Other	0
Most used portal	26	myUnisa	80
		Staff portal	12
		Library portal	8
		Other	0
Age in years	26	Less than 25	12
		25 to 40	69
		More than 40	19
Gender	26	Female	81
		Male	19
Level of education	26	Some college or undergraduate	65
		Graduate (3rd level degree or Diploma)	12
		Postgraduate	23
Duration of portal use	25	Less than 3 months	4
		3-12 months	40
		More than 12 months	56
Frequency of use	24	Not more than once a month	21
		More than once every month but not every day	21
		Every day	58
e-Skills level (computer skills)	26	Novice	4
		Average	77
		Expert	19

In terms of e-skills levels, about three quarters (77%) of them considered themselves to possess average e-skills while 19% felt that they had expert-level e-skills. Only 4% were of the opinion that they had novice e-skills. With respect to education levels, the majority, 65%, were at undergraduate level, or had attained some college education, followed by postgraduate, 23%, and 12% at graduate level (3rd level degree or Diploma). This demographic profile shows a reasonable representation of the UNISA student population, with the exception of gender where the percentage of females in the pilot sample was 81% as opposed to 60% females (Van Zyl and Barnes, 2012) in the UNISA student population.

In terms of usage, of all the 26 participants, the most used university portal was myUnisa, 80%, followed by the Staff portal (12%) and the least used was the library portal with only 8% of the participants. The score of 0% for the ‘Other’ option indicated that no other portals were used by any of the participants.

The data in Table 6.2 further shows that a large proportion of participants, 56%, had used the portal for more than 12 months (more than a year). This was followed by those who had used it for 3 to 12 months at 40% and only a small proportion, 4%, who had used it for less than 3 months. Finally, in terms of usage frequency, more than half, 58%, used the portal daily, while 21% did not use it every day but at least once a month. Equally, 21% used it rarely; in fact, they accessed a UNISA portal at most once a month.

6.4 Reliability of the constructs in the questionnaire

Reliability is the consistency of measure, or the degree to which an instrument provides the same measurement each time it is used under the same conditions with the same subjects (Kumar and Phrommathed, 2011; Ayyub and McCuen, 2016). Cronbach’s coefficient alpha is the most widely used measure of internal consistency (reliability) in survey research (Johanson and Brooks, 2010).

IBM SPSS Statistics Version 24 software was used for statistical analysis. Appendix D-3 shows the statistics relating to the reliability of the 16 dimensions (constructs). Table 6.3 is a summary of the reliability of each dimension. The table shows the alpha values for each of the 16 dimensions, plus the number of items (the terms ‘item’ and ‘statement’ are used interchangeably) for each of the dimensions in each of the three categories, namely, e-service quality (e-SQ), usability (U) and user experience (UX). The N column represents the number of participants who answered the questions for each dimension. As with other studies such as Hassenzahl, Diefenbach and Goritz (2010), missing values were considered acceptable since this was a small-scale study. This resulted in slight variations in the number of participants per statement.

Table 6.3: Reliability coefficient alpha values of the dimensions

#	Dimension	No of Items	N	Alpha
	e-Service quality (e-SQ)			
1	Information quality	4	25	.854
2	Availability	5	25	.670
3	Responsiveness and Helpfulness	4	26	.872
4	Security and Privacy	4	26	.807
5	Assurance and Credibility	4	25	**.541**
6	Support	4	26	.886
	Usability (UB)			
7	Learnability	4	26	.874
8	Effectiveness	4	26	**.478**
9	Efficiency	4	26	**.571**
10	Navigation	4	26	**.584**
11	Errors	4	25	.876
12	Interface design	4	26	.785
	User experience (UX)			
13	Suitability and Relevance	4	25	.689
14	Satisfaction	4	26	.826
15	Flexibility and Personalisation	4	26	.842
16	Pleasure	4	26	.814

The Cronbach alpha value is provided in the *Alpha* column. For a construct to be reliable, the alpha value must fall within the range of zero to 1 (Cordiglia and Van Belle, 2017). Table 6.4 provides the criteria that were used to analyse the alpha values for each dimension (Straub and Gefen, 2004; Cordiglia and Van Belle, 2017).

Table 6.4: Reliability decision table based on alpha values

Range of alpha	Reliability of dimension
Less than 0.6	Not acceptable
0.6 to 0.8	Acceptable
Greater than 0.8	Good

According to Cordiglia and Van Belle (2017) and Straub and Gefen (2004), if the alpha value is less than 0.6, then the reliability is considered *Not acceptable*. In this case the construct should be re-examined for further action. If the value is in the range 0.6 to 0.8, then the construct is *Acceptable*. Lastly, if it is more than 0.8, it is considered to be a *Good* reliability. That means that for values of 0.6 and above, no further steps need to be taken, unless such a step improves the reliability value significantly. According to Table 6.3, dimensions numbered 5, 8, 9 and 10 were to be re-analysed since their alpha values (in bold font) fell below 0.6 (not acceptable). In addition, the alpha value for Dimension 13 (Suitability and Relevance) could be significantly increased if one of its items was deleted. However, this was not the case with Dimension 2 (Availability) even though its alpha value was less than that of Dimension 13. Table 6.5 shows the details of the five dimensions that were to be re-analysed. The alpha values of all the questionnaire items are provided in Appendix D-3.

Table 6.5: Reliability details of the dimensions that needed modifications (extracted from Appendix D-3)

#	Dimension	Item	N	Mean	SD	Loading	Alpha if removed	Alpha
	e-Service quality							
5	Assurance and Credibility	Qn5.1	26	3.58	.945	.446	.349	**.541**
		Qn5.2	25	3.28	1.021	.337	.472	
		Qn5.3	25	3.72	.678	.390	.434	(n=25)
		Qn5.4	26	3.88	.653	.171	.573	
	Usability							
8	Effectiveness	Qn8.1	26	3.62	.898	.422	.259	**.478**
		Qn8.2	26	3.73	.827	.549	.147	
		Qn8.3	26	3.65	.797	.446	.259	(n=26)
		Qn8.4	26	3.73	1.041	-.110	.775	
9	Efficiency	Qn9.1	26	3.81	.849	.323	.523	**.571**
		Qn9.2	26	3.96	.824	.439	.440	
		Qn9.3	26	3.46	1.174	.252	.619	(n=26)
		Qn9.4	26	3.81	.849	.459	.422	
10	Navigation	Qn10.1	26	3.54	.811	.514	.403	**.584**
		Qn10.2	26	3.81	.749	.224	.605	
		Qn10.3	26	3.85	.925	.605	.297	(n=26)
		Qn10.4	26	3.38	1.061	.196	.672	
	User experience							
13	Suitability and Relevance	Qn13.1	26	3.96	.824	.466	.630	.689
		Qn13.2	25	3.72	.936	.221	.809	
		Qn13.3	26	3.81	.634	.661	.532	(n=26)
		Qn13.4	26	4.00	.693	.679	.503	

After the analysis, the following four statements were deleted:

- 8.4: to raise the value of Dimension 8 (Effectiveness) from 0.478 to 0.775.
- 9.3: to raise the value of Dimension 9 (Efficiency) from 0.571 to 0.619.
- 10.4: to raise the value of Dimension 10 (Navigation) from 0.584 to 0.672.
- 13.2: to raise the value of Dimension 13 (Suitability and Relevance) from 0.689 to 0.809.

The consequence of this process was that four statements were removed from the questionnaire to improve the reliability of the constructs. The change made with respect to Dimension 13 (Suitability and Relevance) could have been made with Dimension 1 (Information quality) (not included in Table 6.5) to improve the alpha value from 0.854 to 0.901. However, following advice from the statistician, since the 0.854 value was already ‘Good’ and the change would be marginal, this change was not undertaken.

As seen in Table 6.5, for Dimension 5 (Assurance and credibility) no single item could be removed so that the alpha value becomes at least 6. Since this was a pilot study, two actions were taken. Firstly, statement 5.4 was removed to raise the value of alpha from 0.541 to 0.573 in order to bring the value closer to 0.6, the minimum value for an acceptable level. Secondly, the rest of the statements were reworded to make them clearer. For example, 5.1 was changed from “*The site provides promised services within reasonable time*.” to “*When I am promised a service, it is fulfilled (carried out) as promised within a realistic time (in reasonable or in good time).*” Since one out of four statements in this dimension had been deleted, it was decided to add one or two other statements since it was ‘risky’ to have only three statements in case it turned out that one of them had a low alpha value. It is risky because if one of the three statements did not correlate with the others, then only two statements would remain. However, it is advisable to have at least three statements for a dimension in order to do further statistical analysis such as EFA or CFA (Schreiber et al., 2010; Garson, 2016). After a rigorous scrutiny of literature, it was decided to add two other simple statements related to this dimension (5. Assurance and credibility). These were: “I trust WWWX.” and “I have confidence in WWWX.”.

To conclude, since the purpose of the pilot study was to improve the questionnaire for the main study, some items were removed and others were added.

6.5 Other changes to the questionnaire design and distribution procedure

Apart from changes made to improve the reliability of the dimensions, as stated in the introduction, one of the objectives of the pilot study was to enhance the questionnaire design using feedback from potential participants. As a result of this phase of the study, a number of changes were made to add value to the questionnaire and to the distribution procedures. Sections 6.5.1 to 6.5.5 report on the changes made.

6.5.1 Re-ordering of the questionnaire

As can be seen from Appendix D-1, the questionnaire for the pilot study, all the questions in Section A relating to the participants' profile, including usage and demographic data, were to be answered before the actual evaluation questions in Section B. These questions occupied about three pages, while the actual evaluation questions, in Section B, were five pages. During the distribution of the questionnaires and capturing of data, the following were observed:

- Some participants took considerable time answering the demographic questions, so that by the time they started on Section B, the actual evaluation, they were showing visual signs of fatigue or boredom.
- Participants appeared to be cautious and thoughtful, and took time while answering the questions at the beginning of the questionnaire, but tended to rush towards the end.
- While capturing data, unanswered questions were found more frequently at the end of the questionnaire than at the beginning.

Due to the above challenges, it was decided to move most of the profile-related questions to the end of the questionnaire, after the actual evaluation questions. Three questions were left at the beginning, with the purpose of helping participants to identify which of the three web portals to focus on, that is, myUnisa (my.unisa.ac.za), Staff (staff.unisa.ac.za) or

Library (library.unisa.ac.za). This restructuring is in line with suggestions by Durand and Chantler (2014) that the most important questions should be placed in the first half of the questionnaire since unfilled responses usually occur towards the end of the questionnaire.

6.5.2 Tick or crosses to use in the questionnaire?

Since the questionnaire was in paper-based hardcopy format and was completed manually, for many questions participants had to select their choice from the given options by marking beside the option with a cross or tick. In capturing the data of the pilot study phase, it was realised that for a few participants who had used ticks, it was difficult to determine which option had been selected. This was because they had inserted the tick almost halfway between two boxes. However, this was not the case with those who had used crosses. It was, therefore decided that only crosses should be used in the main study. This would hopefully improve accuracy in pinpointing the selected options. No previous study has been found to back this up and since it is not a primary focus in the present research, the claim has not been investigated. However, the consequential outcome of this change will be briefly reported in the next chapter.

6.5.3 Changes due to common problems identified during data capture

The following are some of the common issues identified while capturing data and making changes to the questionnaire. Some participants:

- *Marked more than one option where only one option should be selected*: For example, the question, "Which one of the following UNISA portals do you use most frequently? (Select ONLY ONE option.)" was changed to "Which one of the following UNISA portals do you use **MOST** frequently? (Select <u>**ONLY ONE**</u> option.)" This approach is recommended by Durand and Chantler (2014) as one of the tips that can minimise errors and improve responses.
- *Left some responses blank*: Research shows that this is a common occurrence during questionnaire data collection and to minimise this, it is recommended that an explicit appeal is made to participants to answer all question (Preece, Rogers and Sharp, 2015). Consequently, a statement was added in the introduction section of the questionnaire: "*I request you to answer ALL questions*".

- *Filled in the same response for several consecutive questions*: This was most common among those who returned the questionnaire very rapidly. This alerted the researcher to watch out for such participants during the main phase of data collection.

Most of the above errors result in unusable questionnaires, which reduces the number of questionnaires that are eligible for data analysis. This is unfortunate, since, for most statistical calculations or modelling techniques, the higher the number of records, the easier it is to make a meaningful analysis (Rea and Parker, 2014; Preece, Rogers and Sharp, 2015).

6.5.4 Adjustment of the questionnaire distribution procedure with respect to gender

In Section 6.2, it was found that of the 26 participants, 81% were female and only 19% were male. This shows a large skew towards females in the gender distribution of participants. Consequently, it was decided that measures would be taken to ensure a more equitable distribution of gender during the main survey. However, this step must also take cognisance of the fact that for students, who made up a large proportion of the participants compared to academics and other staff, the ratio of UNISA's female to male is 60% to 40%, respectively (Van Zyl and Barnes, 2012).

6.5.5 Editing and additional modification of the questionnaire

Even though the questionnaire had been edited a number of times, including refinements by two experts, further language changes were made to the questionnaire by the researcher after the pilot study to ensure that it was clear, understandable and legible.

During the pilot study, participants were asked individually by the researcher who personally collected all the data, whether they found anything confusing, and their thoughts regarding the questionnaire and the procedure. Nearly all the participants found it 'fine'. However, on the first day of data collection, three completed questionnaires were collected. They were scrutinised and when data was entered in the spreadsheet that had been designed for this purpose, one critical issue was identified. It was found that one of the options for a question in the profile section was missing. The question related to which device the participant owned, and one of the options ‘Mobile phone with no Internet capabilities’ was missing. This was added on the subsequent questionnaires.

6.6 An overview of the value of the pilot study

The detailed discussion that deals with the value of this comprehensive pilot study in an HCI survey evaluation (the third chapter objective in Table 6.1) is presented in Section 8.4 of Chapter 8. However, this brief Section 6.6 overviews the value of a pilot and, consequently, summarises the answer to Subquestion 3.

- First, from the actual experiences of the researcher and his research assistants, the questionnaire and its administrative procedures were improved in preparation for the main study.
- Second, in addition to the actual experiences, a set of ten specific recommendations and guidelines for questionnaire design and administration procedures were fulfilled (see Section 8.4.3)
- Third, it was possible to test the reliability of the dimensions in the questionnaire before the main survey.

6.7 Conclusion

This chapter set out to fulfil the three objectives shown in Table 6.1. As stated, the details of the third objective are dealt with in the Discussion chapter, Chapter 8. Consequently, the content of this chapter contributes to answering Subquestion 3, as provided in Section 6.1, that seeks to determine the value of a pilot study prior to the main questionnaire survey on the components of an integrated model for evaluating e-SQUUX of a University web portal.

Section 6.2 described the sampling, procedures and administration of questionnaires. A total of 31 participants from two UNISA sites, one campus and one study centre, were approached in the pilot. Data was collected from 29 participants of which 26 questionnaires were usable for analysis. The reliability of the constructs (the dimensions) was determined using reliability coefficients in the form of alpha values. Of the 16 dimensions, four of them needed modification by removal or rewording of items.

The pilot study data showed that there was a need to make further changes. These included: re-ordering of the questionnaire; changes to the instructions such as asking participants to use crosses rather than ticks; adjustment of the questionnaire distribution procedure with respect to gender so that a representative balance of male to female participants is achieved; and making editorial changes to make the questionnaire clear and simple to use. These changes were implemented during the main questionnaire survey. Consequently, the output of this pilot study chapter, in the form of an improved questionnaire, serves as input to the next chapter.

Chapter 7: Data analysis and results of the main study: Study 2B

7.1 Introduction

The previous chapter described the pilot study that aimed to improve the design of the questionnaire and to enhance execution of the main study. This chapter provides the data analysis and the results of the final (main) survey study, Study 2B, focusing on **Subquestions 4, 5 and 6,** namely:

4. *What are the components of an empirically validated integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of a University web portal (UWP)?*
5. *What is the structural model (relationships) of e-service quality, usability and user experience in the context of evaluation of a UWP?*
6. *What are the final components of e-service quality, usability and user experience following the structural modelling of the three in the context of evaluation of a UWP?*

However, the discussion part of Study 2B is in Chapter 8 where these subquestions are fully answered. Nonetheless, this chapter is a critical further step towards the refinement of the e-SQUUX Model with the ultimate objective of answering all the subquestions and hence answering the main research question of this research. The chapter does not present the findings of an evaluation of a UNISA web portal. Rather, it statistically analyses the performance of e-SQUUX as an evaluation tool in terms of the subquestions and objectives in Table 7.1 The table provides a summary of this chapter, including the main objectives, number of participants, data collection method, data analysis strategies, and the main chapter outcomes.

Table 7.1: Summary of Chapter 7

Main study	
Purpose	The main objectives of this chapter are: 1. To make a reassessment of the reliability of conceptual e-SQUUX Model V2 in order to compare the reliability of its Pilot study (Chapter 6) and the Main study (this chapter). 2. To perform data analysis, using Exploratory factor analysis (EFA), that leads to the validated e-SQUUX Model V3 using the main questionnaire survey data. 3. To process the structural model of e-service quality, usability and user experience on which the final e-SQUUX Model V4, in Chapter 8, is based.
Data collection	Survey using the main study questionnaire (see Appendix E-1)
Participants	174 participants from six UNISA sites: two campuses and four study centres.
Data analysis	Quantitative: 1. Descriptive statistics 2. Reliability testing (Item Analysis) 3. Validity: Exploratory factor analysis 4. Modelling: PLS-SEM
Outcome(s)	1. Reliability of expert-reviewed conceptual e-SQUUX Model V2 using the main survey data. 2. Composition of the validated e-SQUUX Model V3, according to the three facets (e-SQ, UB and UX) 3. The elements of the structural model of e-service quality, usability and user experience. 4. The basic components of the e-SQUUX Model V4

Figure 7.1 shows the layout of this chapter. Immediately after this introduction (Section 7.1), Section 7.2 presents data on sampling, and on the procedure and administration of the questionnaire. This is followed by data cleaning and profile data of participants with subsections on personal information and ICT devices owned (Subsections 7.3.1), affiliation (Subsections 7.3.2), portal access and usage (Subsections 7.3.3). Section 7.4 presents data related to reassessment of the reliability of the expert-reviewed conceptual e-SQUUX Model V2. Thereafter, Section 7.5 describes the data analysis leading to the validated e-SQUUX Model V3 with six subsections.

7.1: Introduction

7.2: Sampling, and procedure and administration of the questionnaire

7.3: Data cleaning and profile data of participants

7.3.1 Personal information and ICT devices owned
7.3.2 Affiliation
7.3.3 Portal Access and usage

7.4: Reassessment of the reliability of the expert-reviewed conceptual e-SQUUX Model V2

7.5: Data analysis leading to the validated e-SQUUX Model V3

7.5.1 Validity of e-service quality: Exploratory factor analysis
7.5.2 Reliability of the newly formed factors of the e-service quality part of e-SQUUX Model V3
7.5.3 Validity of usability: Exploratory factor analysis
7.5.4 Reliability of the newly formed factors of the usability part of e-SQUUX Model V3
7.5.5 Validity of user experience: Exploratory factor analysis
7.5.6 Reliability of the newly formed factors of the user experience part of e-SQUUX Model V3

7.6: Partial least square – Structural equation modelling (PLS-SEM): e-SQUUX Model estimation using SmartPLS

7.6.1 Round 1: Model estimation based on cross-loadings of indicators
7.6.2 Round 2: Model estimation based on loading of indicators on latent variables (LVs) and AVE values
7.6.3 Round 3: Model estimation based on average variance extracted (AVE)
7.6.4 Round 4: Model estimation based on heterotrait-monotrait (HTMT) ratio of correlation

7.7: e-SQUUX measurement model assessment using PLS-SEM

7.7.1 e-SQUUX measurement model: Loadings of indicators on latent variables
7.7.2 e-SQUUX measurement model: Internal consistency using Composite reliability
7.7.3 e-SQUUX measurement model: Convergent validity using average variance extracted
7.7.4 e-SQUUX measurement model: Discriminant Validity using Heterotrait-Monotrait ratio of correlations

7.8: e-SQUUX Structural model assessment using PLS-SEM

7.8.1 Collinearity using variance inflation factor
7.8.2 Measure of variance explained (R^2) for the endogenous constructs
7.8.3 Measure of the strength and significance of the paths of the structural model

7.9: Conclusion

Figure 7.1: Layout of Chapter 7

These are: validity of e-service quality – exploratory factor analysis (Subsection 7.5.1), reliability of the newly formed factors of the e-service quality part of e-SQUUX Model V3 (Subsection 7.5.2), validity of usability – exploratory factor analysis (Subsection 7.5.3), reliability of the newly formed factors of the usability part of e-SQUUX Model V3 (Subsection 7.5.4), validity of user experience – exploratory factor analysis (Subsection 7.5.5), and reliability of the newly formed factors of the user experience part of e-SQUUX Model V3 (Subsection 7.5.6). Section 7.6 presents results on partial least square – structural equation modelling (PLS-SEM) for e-SQUUX Model estimation using SmartPLS, with subsections corresponding to the four rounds that were undertaken.

These are: Round 1 – model estimation based on cross-loadings of indicators (Subsection 7.6.1), Round 2 – model estimation based on loading of indicators on latent variables (LVs) and AVE values (Subsection 7.6.2), Round 3 – model estimation based on average variance extracted (AVE) (Subsection 7.6.3), and Round 4 – model estimation based on heterotrait-monotrait (HTMT) ratio of correlation (Subsection 7.6.4). Thereafter, the results of e-SQUUX measurement model assessment using PLS-SEM are presented in Section 7.7, with subsections on e-SQUUX measurement model – loadings of indicators on latent variables (Subsection 7.7.1), e-SQUUX measurement model – internal consistency using composite reliability (Subsection 7.7.2), e-SQUUX measurement model – convergent validity using average variance extracted (Subsection 7.7.3), e-SQUUX measurement model – discriminant validity using Heterotrait-Monotrait ratio of correlations (Subsection 7.7.4). In this study, the latent variables are the three facets, namely, e-service quality, usability and user experience.

Section 7.8 focuses on the results of e-SQUUX structural model assessment using PLS-SEM, with subsections on collinearity using variance inflation factor (Subsection 7.8.1), measure of variance explained (R^2) for the endogenous constructs (Subsection 7.8.2), and measure of the strength and significance of the paths of the structural model (Subsection 7.8.3). Section 7.9 is the chapter conclusion.

7.2 Sampling, and procedure and administration of the questionnaire

The reader is requested to peruse the questionnaire prior to reading this chapter, and to refer back to it when necessary. The questionnaire, in its entirety, is in Appendix E-1. As discussed in Section 6.3.1 of the pilot study chapter (Chapter 6), apart from three important initial questions in the beginning of the 'Section A: Evaluation', in the questionnaire, the rest of the profile-related questions appeared at the end of the questionnaire in 'Section B: Demographic information', while most of Section A presented the actual evaluation questions. Similar to the pilot study, a consent form, as provided in Appendix E-2, was given to each participant. The number of items in the main study was 64 for the 16 dimensions for which data was collected, compared to 65 items for the same dimensions in the pilot survey questionnaire.

Sampling, procedure and administration of the questionnaire survey, was outlined in Section 3.8.4 for both the pilot and main study and in Section 3.10 for the issues that only applied to the main survey. The participants applied the questionnaire, based on e-SQUUX to evaluate a UNISA UWP, mainly the learning management system (LMS), myUnisa, although some of them evaluated the Staff or the Library portal of the university.

In brief, as already stated, using a stratified sampling method, as was done in similar studies such as Kundu and Datta (2014) data was collected from 196 participants. This was done over a period of one month from mid-May 2015, covering six UNISA sites, entailing two campuses and four study centres.

As stated in Section 3.10.2, participants took 15–20 minutes to complete the form. However, unlike the pilot study where only the current researcher facilitated, three research assistants who had been trained by the researcher helped in the process. In addition, an appeal was made to the participants to fill in the questionnaires carefully without leaving blank spaces. As in the pilot study, an incentive in the form of a pen was donated to the participants on completion of the questionnaire.

7.3 Data cleaning and profile data of participants

Data analysis was conducted after eliminating inconsistent and incomplete responses to ensure the reliability of the data as has been done in other survey studies such as (Nathan and Yeow, 2011). In total, 196 users participated in the study by completing the questionnaires. For similar reasons to these given during the pilot study, 11 people who were approached to take part did not participate. Since 11 of the total 206 (196+11) people approached did not take part, the nonresponse rate was 5.3% for the main study resulting in a response rate of 94.7%. Given this response rate there was no need to test for non-response bias since 94.7% is above the cut-off value of 80% as reflected in the statement "The thresholds that trigger a nonresponse bias analysis are an expected unit response rate of less than 80 percent or an item response rate of less than 70 percent" (Plewes and Tourangeau, 2013, p. 46).

Research assistants were used to capture the data into a spreadsheet. To ensure data integrity, the researcher double-checked to ascertain that the entries in the spreadsheet corresponded with the actual data on the questionnaires, to ensure that the data was captured correctly. Once the data from these questionnaires was captured, the following criteria were used to eliminate certain questionnaire data records:

1. All entries where the option(s) selected were not clear, were removed. For example, situations where the cross that indicated the preferred choice on a Likert scale was halfway between two options.
2. All records (or questionnaires) where there was missing data (blanks), were removed.
3. Similar to the pilot study, all records where a constant pattern was used in completing the questionnaire (i.e. selecting the same option for each item of a dimension) were deleted.
4. All cases where more than one option was selected, where the question required only one option, were deleted.

During the above process, 22 of the 196 questionnaires were eliminated. This left 174 (88.8%) that were usable for data analysis.

In order to present the information in a meaningful manner, the profile data has been grouped and analysed as follows:

1. Personal information and ICT devices owned (Section 7.3.1).
2. Affiliation (Section 7.3.2).
3. Portal access and usage (Section 7.3.3).

This grouping is different from the way the questionnaire was structured, since the structure of the questionnaire was geared towards efficiency in terms of the logic and flow of questions. The following sections present the groups.

Tables 7.2 to 7.4 show the demographic and other profile data of the participants. For each table, the first column shows the *Characteristics*, such as Gender and Age. The second shows the different *Categories* for a specific characteristic such as whether the gender is male or female. The third column, *f* (frequency), shows the number of times a specific category was selected, and the *%* column shows that number in a percentage format. An asterisk (*) alongside a characteristic name indicates that participants were allowed to select more than one option (category). Consequently, the percentages (%) for such categories total more than 100. Although the sum of the percentages of the other characteristics related to situations where only one option could be picked, in some cases, this sum is more than 100 since the percentage values have been approximated to one decimal place. In all cases, the total number of participants was 174 (N = 174) as has been stated already.

7.3.1 Personal information and ICT devices owned

Table 7.2 shows the data related to personal information and ownership of devices. In all cases, the highest percentage (%) for each *Characteristic* is shown in bold. The table indicates that of the 174 participants, a large majority, 94 (54%), were female, compared to 80 (46%) male participants. In terms of age, the 25 to 40 years category had the highest frequency with 60%, followed by those below 25 years of age at 26%, whereas those above 40 years comprised only 14% of the total 174 participants.

Table 7.2 thus shows that most participants (47%) were at undergraduate level, followed by postgraduates at 32% and graduates at 21%. In terms of e-skills, a relatively large proportion (57%) considered themselves to be at an expert level, followed by average users at 39% and only a small proportion, namely, 4% at the novice level. This shows that the great majority (96% = 57+39) had either average or expert e-skills. Further to that, a majority of the participants, 69%, had used computers for over 5 years, followed by the 3 to 5 years category at 20%, 1 to 3 years at 9%, and less than a year at only 2%. Similarly, 65% used the Internet very frequently (many times a day), followed by frequently (about once a day) at 26%, occasionally (once a week) at 9% and rarely (once a week) at 0%. This means that none of the participants spent a week without using the Internet.

Table 7.2: Personal information and devices ownership

Characteristics	**Category**	**f**	**%**
Gender	Male	80	46
	Female	94	**54**
Age in years	Less than 25	44	26
	25 to 40	104	**60**
	More than 40	24	14
Level of education	Some college or undergraduate	82	**47**
	Graduate (3rd level degree or Diploma)	37	21
	Postgraduate	55	32
e-Skills level (computer skills)	Novice	7	4
	Average	68	39
	Expert	99	**57**
Years of using computers	0 – 1 (less than a year)	4	2
	1 – 3	16	9
	3 – 5	34	20
	5+ (more than 5 years)	120	**69**
Frequency of use of the Internet	Rarely (once a month)	0	0
	Occasionally (once a week)	16	9
	Frequently (once a day)	44	26
	Very frequent (many times a day)	114	**65**
Device(s) owned*	Desktop PC/Mac	34	20
	Laptop	111	64
	Tablet	58	33
	Smart Phone	118	**68**
	Features phone	9	5
	Mobile phone with NO Internet capabilities.	14	8
	None of the above	0	0

Furthermore, Table 7.2 shows an asterisk (*) beside the device ownership characteristic, indicating that participants could select more than one option, as previously explained. The table shows that in terms of ownership, of the 174 participants, a notable majority, 118 (68%) owned smart phones, closely followed by laptop ownership with a frequency of 111 (64%). Below these numbers, follows ownership of tablets at 33% and desktops at 20%. A considerable minority, only 8%, owned mobile phones without Internet capabilities and 5% owned a features phone. No participant selected the ‘None of the above’ option, showing that all participants owned at least one IT computing device.

7.3.2 Affiliation

The University of South Africa, from which all data was collected, has seven academic colleges where the employees are not only academics, but the staff complement also includes support and administrative staff. The data collected incorporated participants from all seven colleges. Table 7.3 shows participants’ affiliations and that an overwhelming majority, 92%, were students or staff affiliated with these colleges. In addition, the university has departments that do belong to any of these colleges, such as the ICT and Estates. Table 7.3 shows that only 4% of the participants belonged to this group. Another 4% did not belong to any of these categories. In terms of the participants’ statuses (what they do) at the university, as expected, a high percentage, 87%, were students, 13% were academic staff, 10% were support or administrative staff and only 2% did not belong to any of these categories.

Table 7.3: Affiliation

Characteristics	**Category**	**f**	**%**
College of study or work	Academic colleges	160	**92**
	Administrative and Support	7	4
	Other	7	4
Status at UNISA*	Student	151	**87**
	Academic	23	13
	Administrative and Support	18	10
	Other	3	2
Main role at UNISA	Student	142	**82**
	Academic	18	10
	Administrative and Support	11	6
	Other	3	2

7.3.3 Portal Access and usage

Each participant used the questionnaire to evaluate one of the three main UNISA web portals, namely myUnisa, Staff or the Library portal. Table 7.4 shows the portal access and usage summary data. The table shows that the most common device used to access the

Table 7.4: Portal access and usage

Characteristics	Category	f	%
Most common equipment used to access the portal	Desktop PC/Mac	21	11
	Laptop	87	**50**
	Tablet	24	14
	Features Phone	1	1
	Smart Phone	40	23
	Other	1	1
Access location*	Home	89	51
	Work	52	30
	Internet café	30	17
	UNISA campus	112	**64**
	UNISA centre	45	26
	Other	1	1
Length of portal use	Less than 3 months	17	10
	3 – 12 months	39	22
	1 – 3 years	42	24
	More than 3 years	76	**44**
Frequency of use of portal	Not more than once a month	10	6
	More than once every month but not every day	74	42
	Every day	90	**52**
Portal(s) used*	myUnisa	171	**98**
	Staff portal	23	13
	Library portal	42	24
	Other	8	5
Most used portal	myUnisa	145	**83**
	Staff portal	19	11
	Library portal	9	5
	Other	1	1
Ever used a university/higher education web portal other than that of UNISA?	No	74	43
	Yes	100	**57**
Ever used any other portal other than a higher education portal?	No	47	27
	Yes	127	**73**

portal was the laptop, used by half of the participants (50%), followed by a smart phone at 23%. Fourteen percent (14%) used a tablet, 11% a desktop and only 1% used a features phone or other device. The table also shows that most of the participants, 64%, access the portal at one of the UNISA campuses with another 26% at one of the UNISA centres. Furthermore, it shows that just more than half of them, 51%, access the portal from their homes. A fair percentage, 30%, access the portal while at work, while 17% use an Internet cafe to do so.

In terms of portal usage, over 44% of the participants had used the portal for more than 3 years, followed by 24% with 1 to 3 years of use, and 22% with 3 months to a year. Only 10% had used the portal for less than 3 months. The majority of the participants, 52% were using the portal every day, while 42% used it more than once a month, though not every day. Only 6% used the portal less than once a month.

Furthermore, Table 7.4 shows that nearly all the participants, 171 out of 174 (98%), use the myUnisa portal, while 24% use the Library portal and 13% the Staff portal. Only 5% use some other UNISA portal. However, in terms of the portal used most frequently, while a high majority, 145 (83%), use myUnisa most frequently, only 5% use the Library portal most. Eleven percent (11%) mainly use the staff web portal and only 1% selected some other web portal.

Finally, Table 7.4 shows that when participants were asked whether they had ever used a university/higher education web portal other than one of UNISA's, a majority of them, 57%, replied 'Yes' and 43% replied 'No'. Similarly, when asked whether they had ever used any web portal other than a higher education portal, an even bigger majority, 73%, replied 'Yes' and 27% 'No'.

Having presented the profile data, the next section deals with reliability issues.

7.4 Reassessment of the reliability of the expert-reviewed conceptual e-SQUUX Model V2

This section reassesses the reliability of the final expert-reviewed conceptual model for evaluation of e-service quality, usability and user experience (e-SQUUX Model V2) and compares the results in this main study with those acquired during the pilot study as described in Table 6.3 in Section 6.4 of Chapter 6.

Table 7.5 compares the reliability co-efficient alpha values of the pilot and main study dimensions of e-SQUUX. The table also includes the number of items for both studies. Notwithstanding the fact that data from only 26 participants was used in the pilot study compared to 174 in the main study, certain comparisons can be made about the reliability of the two studies using information in Table 7.5. For the main study, the *Main alpha* column in Table 7.5 shows the reliability coefficient values of the 16 dimensions. The table shows that the values ranged from 0.778 to 0.882. Using the Reliability decision Table 6.4 in Chapter 6, it can be concluded that all dimensions are reliable since their values are either acceptable (0.6 to 0.8) or Good ($\geq$ 0.8). In fact, 15 (94%) out of 16 dimensions, have values above 0.8, which translates into *good* reliability. Only one dimension, Learnability, has a value below 0.8, that is 0.778, which is marginally less than 0.8.

Alpha values should be between 0 and 1 whereby the greater the value, the more reliable a construct is, though values beyond 0.95 are not desirable (Sarstedt et al., 2014; Hair et al., 2016). Table 7.5 shows that the mean Alpha value in the main study was much higher at 0.854 compared to that of the pilot at 0.748. Moreover, the standard deviation (SD) for the main was much smaller at 0.029, nearly 5 times less, compared to that of the pilot at 0.138.

This means that the alpha values for the main study were generally higher than those of the pilot study and their values were closer to each other, than those of the pilot study. This is confirmed by the fact that the range for the main study was only 0.778 (minimum) to 0.882 (maximum) compared to the pilot, where the range was 0.478 to 0.886. Another confirmation is that while none of the alpha values for the main study was less than 0.7, six (37.5%), of the pilot study constructs were below this value, with four of the six below 0.6, and hence their reliability considered ‘Not acceptable’, in Table 6.4, the Reliability decision table.

Table 7.5: Comparison of reliability co-efficient alpha values of the pilot and main studies of the dimensions of e-SQUUX

#	Category and it its dimensions	Pilot Items no.	Pilot Alpha	Main Items no.	Main Alpha
	e-Service quality (e-SQ)				
1	Information quality	4	0.854	4	0.853
2	Availability	5	0.670	5	0.845
3	Responsiveness and Helpfulness	4	0.872	4	0.882
4	Security and Privacy	4	0.807	4	0.818
5	Assurance and Credibility	4	**0.541**	5	0.849
6	Support	4	0.886	4	0.879
	Usability (UB)				
7	Learnability	4	0.874	4	0.778
8	Effectiveness	4	**0.478**	3	0.882
9	Efficiency	4	**0.571**	4	0.859
10	Navigation	4	**0.584**	3	0.860
11	Errors	4	0.876	4	0.852
12	Interface design	4	0.785	4	0.867
	User experience (UX)				
13	Suitability and Relevance	4	0.689	3	0.879
14	Satisfaction	4	0.826	4	0.815
15	Flexibility and Personalisation	4	0.842	5	0.865
16	Pleasure	4	0.814	4	0.881
	Total number of items	**65**		**64**	
	Minimum		**0.478**		**0.778**
	Maximum		**0.886**		**0.882**
	Mean		**0.748**		**0.854**
	SD		**0.138**		**0.029**

7.5 Data analysis leading to the validated e-SQUUX Model V3

This section provides the data analysis and the results of **Subquestion 4,** namely:

4. *What are the components of an empirically validated integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of a University web portal (UWP)?*

The answer to this question is also discussed in detail in Section 8.5 of Chapter 8.

As previously stated, Appendix E-1 shows the questionnaire for the main survey study. Table 7.6 summarises the questionnaire evaluation section showing its facets, dimensions and items. It is based on the three core facets (named Categories in the questionnaire). First, e-service quality (e-SQ or SQ) with six dimensions and 26 items altogether, having 4 or 5 items for each dimension. Second, usability (U or UB) facet with six dimensions and 22 items altogether ranging from 3 to 4 items for each dimension. Third, user experience (UX) with four dimensions and 16 items having 3 to 5 items for each dimension. The three facets thus comprise a total of 64 (26+22+16) items. In the following subsections, information in Table 7.6 such as the dimension numbers, will be constantly referred to.

Table 7.6: Summary of the questionnaire evaluation section showing its facets, dimension names, number of items and item labels

Facet	#	Dimension name	No. of items	Item labels
e-Service quality (e-SQ or SQ)	1	Information quality	4	1.1, 1.2, 1.3, 1.4
	2	Availability	5	2.1, 2.2, 2.3, 2.4, 2.5
	3	Responsiveness and Helpfulness	4	3.1, 3.2, 3.3, 3.4
	4	Security and Privacy	4	4.1, 4.2, 4.3, 4.4
	5	Assurance and Credibility	5	5.1, 5.2, 5.3, 5.4, 5.5
	6	Support	4	6.1, 6.2, 6.3, 6.4
	Total number of items (e-SQ)		***26***	
Usability (U or UB)	7	Learnability	4	7.1, 7.2, 7.3, 7.4
	8	Effectiveness	3	8.1, 8.2, 8.3
	9	Efficiency	4	9.1, 9.2, 9.3, 9.4
	10	Navigation	3	10.1, 10.2, 10.3
	11	Errors	4	11.1, 11.2, 11.3, 11.4
	12	Interface design	4	12.1, 12.2, 12.3, 12.4
	Total number of items (UB)		***22***	
User experience (UX)	13	Suitability and Relevance	3	13.1, 13.2, 13.3
	14	Satisfaction	4	14.1, 14.2, 14.3, 14.4
	15	Flexibility and Personalisation	5	15.1, 15.2, 15.3, 15.4, 15.5
	16	Pleasure	4	16.1, 16.2, 16.3, 16.4
	Total number of items (UX)		***16***	
Total (e-SQ, UB and UX)			**64**	

For validation purposes, Exploratory factor analysis was undertaken using SPSS for each of the three facets of the e-SQUUX Model, namely, e-service quality (e-SQ), usability (U or UB) and user experience (UX). A principal component factor analysis was conducted with a Varimax rotation. Thereafter, for each of the components, the reliability of its new factors was determined. In summary, for each facet, the following were determined to ensure the validity and reliability of the conceptual e-SQUUX Model:

1. Sampling adequacy: Kaiser-Meyer-Olkin (KMO) value in order to determine the adequacy of sampling (Bhattacharya, Gulla and Gupta, 2012). It is recommended that the cut-off value for KMO be 0.5 to make factor analysis robust (Liu, Du and Tsai, 2009; Bhattacharya, Gulla and Gupta, 2012; Jiang and Ji, 2014).
2. Validity: extracted factors for which Eigen values were greater than 1 (one), the cut-off value (Liu, Du and Tsai, 2009; Bhattacharya, Gulla and Gupta, 2012).
3. Validity: determined the number of factors using the screen plot (Cordiglia and Van Belle, 2017), and the variance explained (VE) by each factor, which, according to Kundu and Datta (2014), should be at least 60%.
4. Validity: determined the factor loadings on the new factors. For an item to be considered to load on a factor, the minimum value was 0.4 as recommended by researchers (Yang et al., 2005; Marsh et al., 2014; Hair et al., 2017). Items that did not load on any factor or were cross-loading (loaded on more than one factor) were deleted.
5. Reliability: determined the Cronbach alpha of the new factors.

The following subsections provide the results of this process for each facet of e-SQUUX.

7.5.1 Validity of e-service quality: Exploratory factor analysis

The responses to the 26 items of e-service quality (e-SQ) namely, 1.1 through to 6.4 within six dimensions, shown in Table 7.6 and in the questionnaire in Appendix E-1, were analysed using SPSS. The KMO value was 0.913, which is greater than 0.5. As stated in Section 3.8.2.4, these items were rated by participants on a Likert scale, which is clearly indicated in the last five columns of the questionnaire. This meant that e-SQ was adequate for factor analysis.

Five factors were initially extracted as evident in Figure 7.2. The figure shows that the five had Eigen values greater than 1.00 with the minimum value being 1.0722. The screen plot (see Appendix E-3) shows the same number of factors since its last sharp drop in value (the elbow) occurred at the value of 5. This method of determining the number of factors has been described in previous studies (Kundu and Datta, 2014; Cordiglia and Van Belle, 2017).

Number	Eigenvalue	Percent	20 40 60 80	Cum Percent
1	11.4282	43.955		43.955
2	2.3867	9.179		53.134
3	1.5927	6.126		59.260
4	1.1694	4.498		63.757
5	1.0722	4.124		67.881
6	0.8463	3.255		71.136
7	0.7944	3.055		74.191
8	0.6946	2.672		76.863
9	0.6108	2.349		79.212
10	0.5976	2.298		81.510
11	0.5297	2.037		83.547
12	0.5024	1.932		85.480
13	0.4615	1.775		87.255
14	0.4138	1.592		88.846
15	0.3814	1.467		90.313
16	0.3605	1.387		91.700
17	0.3384	1.302		93.002
18	0.3122	1.201		94.202
19	0.2689	1.034		95.237
20	0.2285	0.879		96.116
21	0.2042	0.785		96.901
22	0.1967	0.756		97.657
23	0.1840	0.708		98.365
24	0.1622	0.624		98.989
25	0.1350	0.519		99.508
26	0.1279	0.492		100.000

Figure 7.2: Number of factors extracted from e-service quality showing the Eigen values and the percentage of variance explained

Table 7.7 shows the variance explained by the five **e-SQ** factors. It shows that Factors 1 to 5 accounted for about 61% of the variance. This is appropriate since it exceeds the recommended cut-off value of 60% (Kundu and Datta, 2014).

Table 7.7: Variance explained by each factor of e-service quality

Factor	Variance	Percentage	Cum Percentage
Factor 1	5.1689	19.880	19.880
Factor 2	3.2002	12.308	32.189
Factor 3	3.0278	11.646	43.834
Factor 4	2.4735	9.513	53.348
Factor 5	2.0620	7.931	61.278

After the analysis of variance, the loadings of the items on constructs were analysed. Table 7.8 shows the loadings of the 26 items on the five extracted e-SQ factors. As already stated, values more than or equal to 0.4 indicated that an item loaded on the factor that is the header of the column where the value is located. In the table, these values are bolded and those below 0.4 are in normal (regular) text.

Further analysis of Table 7.8 identified items that did not load on any factor or were cross-loading or loaded on more than one factor, and, as has been discussed already, these were deleted. Consequently, three items namely, 2.3, 4.4 and 6.2 were deleted since they cross-loaded. This reduced the number of items from 26 to 23. Table 7.9 shows summary information of the five factors of e-service quality. The content of Table 7.9 is explained in association with that of Table 7.6 that shows all the dimensions names and item labels numbers of e-service quality as they appeared in the evaluation section of the questionnaire used to collect the data. The actual items are presented in Appendix E-1. Although the reader is advised to read this chapter in consultation with the questionnaire in Appendix E-1, all the items labels as they appeared in the questionnaire, are provided in Table 7.6, under the *Item labels* column.

Table 7.9 shows the factor numbers and their items as they appeared in Table 7.8. The *Count* column shows the number of items that make up the factor. The *Factor name* column shows the name given to the formed factor. The *Old factor & Old name* column shows the original names of the dimension, and their dimension number in cases where the factor name(s) changed. For example, the first factor, excluding the deleted Item 6.2, is made up of four items from Dimension 3 (Responsiveness and Helpfulness), and three from

Table 7.8: Factor loadings of the items of e-service quality

Item	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**
3.1	**0.83**	0.10	0.11	0.05	0.06
3.2	**0.82**	0.04	0.13	0.07	0.18
3.3	**0.78**	0.20	0.10	0.14	0.03
3.4	**0.66**	0.28	0.00	0.17	0.09
6.3	**0.63**	0.31	0.11	0.34	0.12
6.1	**0.57**	0.35	0.16	0.24	0.14
5.1	**0.56**	0.27	0.22	0.22	0.12
6.2	**0.55**	**0.49**	0.17	0.18	0.14
2.4	**0.53**	0.14	0.19	0.28	0.22
6.4	**0.44**	0.38	0.24	0.17	0.21
5.4	0.25	**0.71**	0.15	0.27	0.17
5.3	0.25	**0.69**	0.29	0.16	0.24
5.5	0.33	**0.61**	0.22	0.34	0.10
4.4	0.24	**0.51**	0.18	0.03	**0.41**
5.2	0.27	**0.44**	0.29	0.05	0.24
1.1	0.22	0.09	**0.8**	0.15	0.19
1.3	0.12	0.15	**0.76**	0.23	0.17
1.4	0.03	0.22	**0.66**	0.15	0.02
1.2	0.19	0.24	**0.61**	0.23	0.12
2.2	0.23	0.21	0.24	**0.74**	0.16
2.1	0.17	0.11	0.39	**0.65**	0.13
2.3	**0.41**	0.22	0.24	**0.62**	0.09
2.5	0.29	0.29	0.33	**0.41**	0.22
4.2	0.19	0.16	0.10	0.26	**0.93**
4.3	0.33	0.35	0.21	0.28	**0.52**
4.1	0.06	0.31	0.21	0.02	**0.47**

Dimension 6 (Support). The factor also includes Items 2.4 and 5.1, totalling nine items. Analysis of the two main dimensions that form the core of this factor resulted in Responsiveness and Support as the most appropriate name for the combined Factor 1.

Table 7.9: Summary information of the factors of e-service quality

Factor	Items	Count	Factor name	Old factor & Old name	Comments
1	3.1; 3.2; 3.3; 3.4 6.3; 6.1; 5.1; 2.4; 6.4	9	**Responsiveness and Support**	**3**: Responsiveness and Helpfulness **6**: Support Plus **2.4**	2.4 Fits in properly in terms of Support. 5.1 Fits in properly in terms of Responsiveness 6.2 deleted: loads on two factors
2	5.4; 5.3; 5.5; 5.2	4	**Assurance and Credibility**	**5**: unchanged	4.4 deleted: loads on two factors
3	1.1; 1.3; 1.4; 1.2	4	**Information quality**	**1**: unchanged	
4	2.2; 2.1; 2.5	3	**Availability**	**2**: unchanged	2.3 deleted: loads on two factors
5	4.2; 4 .3; 4.1	3	**Security and Privacy**	**4**: unchanged	
Total		**23**			

The *Comments* column of Table 7.9 shows what items were dropped that loaded highest on this factor but cross-loaded on another one. For example, for Factor 1, Item 6.2 was dropped, because even though this item was loaded on Factor 1 with a value of 0.55, it also loaded on Factor 2 with a value of 0.49 (which is greater than 0.4). The *Comments* column also indicates how well the item(s) that do not belong to the 'major merged dimensions that form the factor' fit together with the newly formed factor in terms of meaning, that is, content validity. For example, included in Factor 1, Item 2.4 'I can easily contact the people I need by means of the portal (e.g. by portal's email facility)' is closely related to Support. Likewise, Item 5.1 'When I am promised a service, it is fulfilled (carried out) as promised within realistic time (in reasonable or in good time)' is closely associated to Responsiveness. As already stated, Table 7.9 shows that three items were deleted from this e-service quality reducing the number of items from 26 to 23.

7.5.2 Reliability of the newly formed factors of the e-service quality part of e-SQUUX Model V3

Table 7.10 shows the reliability of the newly formed five e-SQ factors. These factors with a total of 23 items, as explained in relation to Table 7.9, constitute the e-service quality part of the validated e-SQUUX Model V3 (Version 3). Table 7.10 shows that the Cronbach's alpha values of these factors range from 0.779 to 0.912, which is higher than the recommended cut-off value of 0.6 that is recommended for exploratory studies such as this one (Straub and Gefen, 2004; Cordiglia and Van Belle, 2017). In fact, it is even higher than 0.7, the cut-off value for Confirmatory factor analysis (Garson, 2016; Venkatesh, Thong and Xu, 2016). Using this fact and the criteria in the reliability decision table (Table

Table 7.10: Reliability of the newly formed e-service quality factors

	Factor	Item	N	Mean	SD	Alpha if removed	Alpha
1	**Responsiveness and Support**	Qn3.1	174	3.17	1.3	0.898	0.912
		Qn3.2	174	3.35	1.152	0.897	
		Qn3.3	174	3.39	1.11	0.896	
		Qn3.4	174	3.04	1.189	0.903	
		Qn6.1	174	3.53	1.046	0.902	
		Qn6.3	174	3.44	1.088	0.897	
		Qn6.4	174	3.84	0.964	0.908	
		Qn5.1	174	3.41	1.102	0.904	
		Qn2.4	174	3.33	1.264	0.908	
2	**Assurance and Credibility**	Qn5.2	174	3.57	1.06	0.868	0.843
		Qn5.3	174	3.84	0.94	0.772	
		Qn5.4	174	3.82	0.923	0.766	
		Qn5.5	174	3.82	1.058	0.794	
3	**Information quality**	Qn1.1	174	3.93	1.059	0.777	0.853
		Qn1.2	174	3.85	1.081	0.829	
		Qn1.3	174	4.00	0.968	0.791	
		Qn1.4	174	3.84	1.028	0.849	
4	**Availability**	Qn2.1	174	3.43	1.199	0.711	0.811
		Qn2.2	174	3.56	1.274	0.680	
		Qn2.5	174	3.68	1.091	0.813	
5	**Security and Privacy**	Qn4.1	174	3.6	1.152	0.820	0.779
		Qn4.2	174	3.94	1.032	0.591	
		Qn4.3	174	3.79	1.151	0.684	

6.4, in Section 6.3 of Chapter 6), it was concluded, from this range of values, that all the factors portray good reliability.

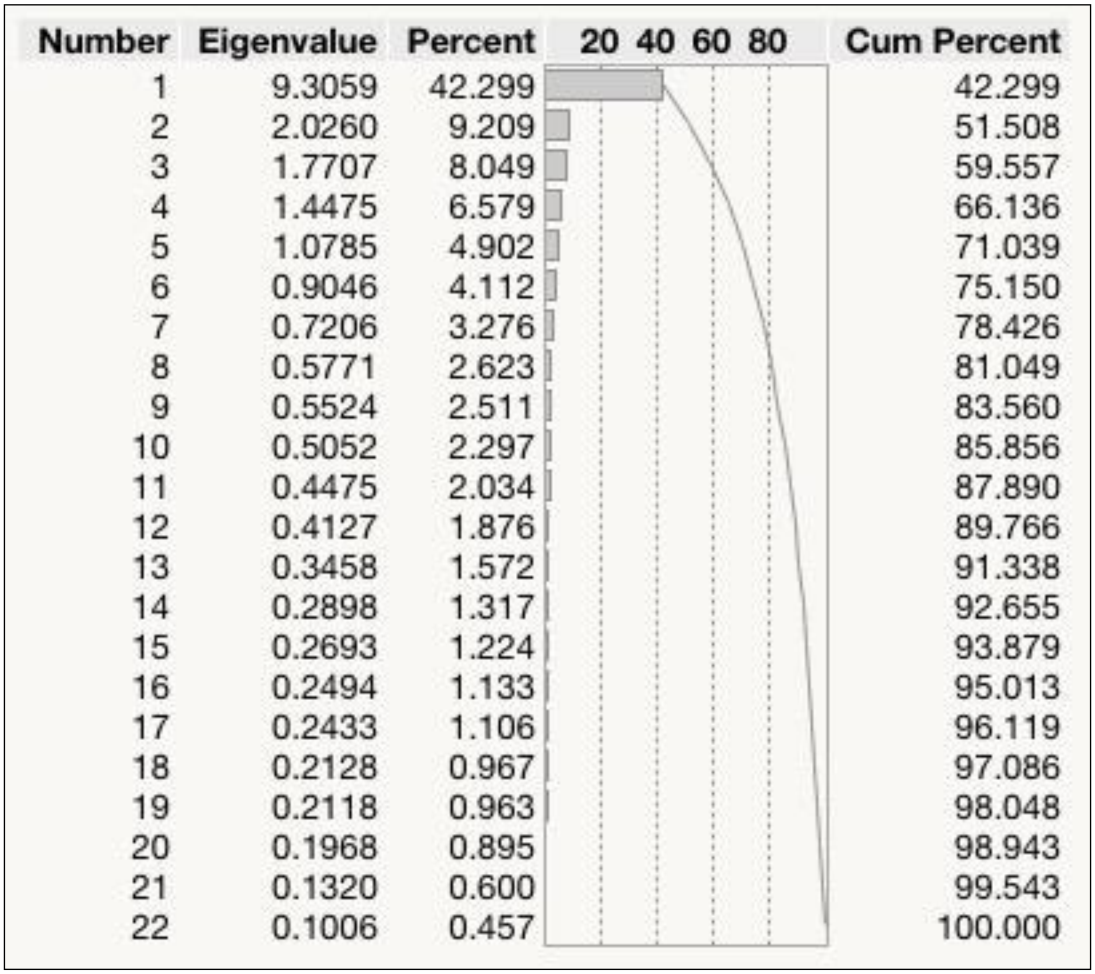
The results of this subsection and those of the previous one, Section 7.5.1, show that the five factors that resulted from the factor analysis of e-service quality items comply with the requirements of the five reliability and validity tests of the constructs as outlined at the beginning of this section (Section 7.5) and make up the e-service quality part of the validated e-SQUUX Model V3 that will be discussed in Section 8.5.4.

7.5.3 Validity of usability: Exploratory factor analysis

This section is similar to Section 7.5.1 in the way that data analysis was undertaken. The only difference is that it focuses on the facet of usability rather than e-service quality. Consequently, the knowledge claims (theory) of that section will be assumed in this section without referring to the literature sources again.

The responses to 26 items of e-service quality (e-SQ) namely, 1.1 through to 6.4 within six dimensions, shown in Table 7.6 and in the questionnaire in Appendix E-1, were analysed using SPSS. Similarly, with respect to usability (UB), its 22 items namely, 7.1 through to 12.4 within six dimensions (shown in Table 7.6 and in the questionnaire in Appendix E-1), were analysed. The KMO value was 0.884, which is greater than 0.5, indicating that the UB data was adequate for factor analysis.

Five factors were initially extracted as evident in Figure 7.3. The figure shows that five factors had Eigen values that were greater than 1.00, with the minimum such value being 1.0785. The screen plot (see Appendix E-4) shows the same number of factors.



Number	Eigenvalue	Percent	Cum Percent
1	9.3059	42.299	42.299
2	2.0260	9.209	51.508
3	1.7707	8.049	59.557
4	1.4475	6.579	66.136
5	1.0785	4.902	71.039
6	0.9046	4.112	75.150
7	0.7206	3.276	78.426
8	0.5771	2.623	81.049
9	0.5524	2.511	83.560
10	0.5052	2.297	85.856
11	0.4475	2.034	87.890
12	0.4127	1.876	89.766
13	0.3458	1.572	91.338
14	0.2898	1.317	92.655
15	0.2693	1.224	93.879
16	0.2494	1.133	95.013
17	0.2433	1.106	96.119
18	0.2128	0.967	97.086
19	0.2118	0.963	98.048
20	0.1968	0.895	98.943
21	0.1320	0.600	99.543
22	0.1006	0.457	100.000

Figure 7.3: Number of factors extracted from usability showing the Eigen values and the percentage of variance explained

Table 7.11 shows the variance explained by the five factors of UB. It shows that Factors 1 to 5, accounted for about 63% of the variance. This is appropriate since it exceeds the recommended cut-off value of 60% (Kundu and Datta, 2014).

Table 7.11: Variance explained by each factor of usability

Factor	Variance	Percentage	Cum Percentage
Factor 1	4.2318	19.236	19.236
Factor 2	2.8432	12.924	32.159
Factor 3	2.7268	12.394	44.554
Factor 4	2.0607	9.367	53.921
Factor 5	2.0266	9.212	63.132

After the analysis of variance, the loadings of the items on constructs were analysed. Table 7.12 shows the loadings of the 22 items on the five extracted usability (UB) factors.

Table 7.12: Factor loadings of the items of usability

Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
9.2	**0.80**	0.12	0.21	0.21	0.04
9.3	**0.78**	0.13	0.26	0.17	0.05
10.2	**0.68**	0.32	0.19	0.12	0.17
10.1	**0.61**	0.36	0.18	0.05	0.14
9.1	**0.59**	0.13	0.20	0.12	0.2
9.4	**0.57**	0.22	0.14	0.30	0.2
10.3	**0.54**	0.29	0.22	0.10	0.28
8.3	**0.52**	0.25	0.14	**0.44**	0.25
11.2	0.08	**0.79**	0.08	0.13	0.00
11.1	0.25	**0.74**	0.12	0.09	0.09
11.3	0.24	**0.69**	0.13	0.13	0.13
11.4	0.31	**0.61**	0.19	0.18	0.00
12.3	0.21	0.10	**0.84**	0.04	0.08
12.2	0.28	0.18	**0.75**	0.18	0.02
12.4	0.15	0.13	**0.67**	0.09	0.16
12.1	0.31	0.14	**0.6**	**0.41**	0.17
7.1	0.1	0.17	0.22	**0.66**	0.07
7.2	0.22	0.04	**0.41**	**0.55**	0.24
8.2	**0.43**	0.24	0.00	**0.54**	0.26
8.1	0.3	**0.42**	0.00	**0.51**	0.31
7.3	0.2	0.07	0.14	0.17	**0.86**
7.4	0.26	0.05	0.18	0.24	**0.83**

Items that did not load on any factor or that cross-loaded or loaded on more than one factor, were deleted. Consequently, five items namely, 7.2, 8.1, 8.2, 8.3 and 12.1 were deleted, which reduced the number of items from 22 (in Table 7.12) to 17. In addition, Item 7.1 loaded on its own as Factor 4. Since a factor should have at least two items (Marsh et al., 2014; Garson, 2016), this item was also deleted, which reduced the number of items from 17 to 16. As a result, Factor 4, with only one item remaining, 7.1 (about Learning), was removed. The three other items, namely, 7.2, 8.1 and 8.2 that would have contributed to the formation of this factor loaded on other factors. This meant that the number of factors for usability were four rather than five. Table 7.13 shows summary information of the five factors of usability (UB), which became four factors when the original Factor 5 became the new ‘Factor 4’. The content of Table 7.13 is explained in association with that of Table 7.6. For example, Table 7.13 shows the item labels only as they appear in Table 7.6. Similar to Table 7.9, the actual items are presented in Appendix E-1.

Table 7.13: Summary information of the factors of usability

Factor	Items	Count	Factor name	Old factor & Old name	Comments
1	9.2; 9.3; 10.2; 10.1; 9.1; 10.3; 9.4	7	**Efficiency and Navigation**	**9**: Efficiency **10**: Navigation	9 and 10 combined to one factor 8.3 dropped: loads on two factors
2	11.2; 11.1; 11.3, 11.4	4	**Errors**	**11**. unchanged	
3	12.3; 12.2; 12.4	3	**Interface design**	**12**: unchanged	12.1 dropped: loads on two factors
4 (deleted)	7.1	1 (NA)	**NA**	**7**. some of Learnability **8**: Effectiveness	7.2: dropped: loads on two factors 8.2: dropped: loads on two factors 8.1: dropped: loads on two factors Only one Item, 7.1 (about Learning), remains hence **Factor 4 is removed** since the 3 other items that would form this factor load on other, and different, factors. This means that **7: Learnability and 8: Effectiveness are removed**
5 (new Factor 4)	7.3; 7.4	2	**Understand-ability**	**7**: Learnability	Understandability was merged with Learnability during formation of categories (that became the dimensions) but it emerged as a separate factor once again.
Total		**16**			

Similar to the explanations about Table 7.9, the *Comments* column shows the dimensions and the items that were deleted. For example, Dimensions 9 (Efficiency), and 10 (Navigation) loaded on one factor, Factor 1, and this new factor was renamed Efficiency and Navigation. Dimension 11 (Errors) loaded on its own and so did Dimension 12

(Interface design). Consequently, there were no name changes for these two dimensions. Of the four original items of Dimension 7 (Learnability), only items 7.3 and 7.4 loaded together. During the formation of the Learnability dimension, in Chapter 5, Section 5.4.9, Understandability was fused into the Learnability dimension. However, the items that loaded together, 7.3 and 7.4, were particularly related to Understandability. Consequently, the original Factor 5 (new Factor 4) was named Understandability as shown in Table 7.13 under the *Factor name* column.

7.5.4 Reliability of the newly formed factors of the usability part of e-SQUUX Model V3

Table 7.14 shows the reliability of the newly formed four UB factors resulting from the EFA process. These factors with a total of 16 items, as explained in relation to Table 7.13, constitute the usability part of the validated e-SQUUX Model V3. Table 7.14 shows that the Cronbach's alpha values of these factors range from 0.840 to 0.914. Yet again, as stated in Section 7.5.2, using this fact and the criteria in the reliability decision table (Table 6.4, in Section 6.3 of Chapter 6), it was concluded from this range of values, that all the factors portray good reliability.

Table 7.14: Reliability of the newly formed usability factors

	Factor	Item	N	Mean	SD	Alpha if removed	Alpha
1	Efficiency and Navigation	Qn9.1	174	4.06	0.92	.896	.902
		Qn9.2	174	3.93	1.043	.882	
		Qn9.3	174	3.93	1.009	.883	
		Qn9.4	174	3.91	0.911	.893	
		Qn10.1	174	3.68	0.892	.888	
		Qn10.2	174	3.7	1.045	.882	
		Qn10.3	174	3.87	0.983	.891	
2	Errors	Qn11.1	174	3.47	1.046	.799	.852
		Qn11.2	174	3.48	1.024	.808	
		Qn11.3	174	3.63	0.969	.807	
		Qn11.4	174	3.34	0.982	.830	
3	Interface design	Qn12.2	174	3.99	1.003	.773	.840
		Qn12.3	174	4.07	0.916	.683	
		Qn12.4	174	4.21	0.821	.855	
4	Understandability	Qn7.3	174	4.36	0.753	NA	.914
		Qn7.4	174	4.28	0.814	NA	

The results of this subsection and those of the previous one, Section 7.5.3, show that four (originally five) factors that resulted from the factor analysis of usability comply with the requirements of reliability and validity tests of constructs (see Table 7.14) as outlined at the beginning of this section (Section 7.5) and make up the usability part of the validated e-SQUUX Model V3 that will be discussed in Section 8.5.4.

7.5.5 Validity of user experience: Exploratory factor analysis

As with Section 7.5.3, this section is similar to Section 7.5.1 but this time focusing on user experience rather than usability. Consequently, the theoretical foundation of Section 7.5.1 will be assumed in this section without referring back to the literature sources.

For user experience (UX), the responses with respect to 16 items namely, 13.1 through to 16.4 within four dimensions, shown in Table 7.6 and in the questionnaire in Appendix E-1, were analysed. The KMO value was 0.928, which is greater than 0.5, indicating that the UX data was adequate for factor analysis.

Two factors were initially extracted as evident in Figure 7.4. The figure shows that two factors had Eigen values that were greater than 1.00 with the smaller value being 1.3163. The screen plot (see Appendix E-5) shows the same number of factors.

Number	Eigenvalue	Percent	20 40 60 80	Cum Percent
1	8.7874	54.921		54.921
2	1.3163	8.227		63.148
3	0.9273	5.796		68.944
4	0.8134	5.084		74.028
5	0.6828	4.267		78.295
6	0.5640	3.525		81.820
7	0.4350	2.719		84.539
8	0.4022	2.514		87.053
9	0.3688	2.305		89.358
10	0.3418	2.136		91.494
11	0.3111	1.945		93.439
12	0.2543	1.590		95.028
13	0.2333	1.458		96.487
14	0.2163	1.352		97.839
15	0.1798	1.124		98.962
16	0.1660	1.038		100.000

Figure 7.4: Number of factors extracted from user experience showing the Eigen values and the percentage of variance explained

Table 7.15 shows the variance explained by the two factors of user experience. It shows that two factors, Factors 1 and 2, accounted for about 60.2% of the variance. This is appropriate since it exceeds the recommended cut-off value of 60% (Kundu and Datta, 2014).

Table 7.15: Variance explained by each factor of user experience

Factor	Variance	Percentage	Cum Percentage
Factor 1	5.7609	36.006	36.006
Factor 2	3.8721	24.201	60.207

After the analysis of variance, the loadings of the items on constructs were analysed. Table 7.16 shows the loadings of the 16 items on the two extracted UX factors.

Table 7.16: Factor loadings of the items of user experience

Item	Factor 1	Factor 2
16.2	**0.79**	0.32
16.3	**0.76**	0.15
16.1	**0.72**	0.36
16.4	**0.70**	0.34
15.4	**0.70**	0.37
15.2	**0.68**	0.38
14.2	**0.64**	0.39
14.3	**0.63**	0.40
15.3	**0.62**	0.22
15.1	**0.61**	0.38
14.4	**0.58**	0.25
15.5	**0.52**	0.40
13.2	0.32	**0.82**
13.1	0.22	**0.79**
13.3	0.39	**0.73**
14.1	0.35	**0.60**

For e-SQ and UB, some items that did not load on any factor or were cross-loading or loaded on more than one factor, were deleted. However, no item of UX was deleted since none of them exhibited any of these characteristics. Table 7.17 shows summary information of the two factors of user experience. The content of Table 7.17 is explained in association with that of Table 7.6, similarly to the way it was addressed in the cases of e-SQ and UB.

Of the 16 items of UX, 12 loaded on one factor and four on another. In general, the 12 items of Factor 1 were constituted by three dimensions, namely 14: Satisfaction, 15: Flexibility and Personalisation, and 16: Pleasure, as shown in the *Old factor and Old name* column in Table 7.17. The name given to this merged dimension was Hedonic Quality and Flexibility. As explained in the *Comments* column, the hedonic quality includes pleasure and satisfaction (Hassenzahl and Tractinsky, 2006; Pucillo and Cascini, 2014). In addition, personalisation is considered a subset of Flexibility since flexibility allows for personalisation (Mugge, Schoormans and Schifferstein, 2009).

Unlike with Factor 1 that comprised items from three dimensions, Factor 2 of UX, in the main, was constituted by only one dimension, namely, 13: Suitability and Relevance. The only other item in this factor was 14.1 ‘I quickly adopted (accepted) the use of this portal’, which also relates well to both Suitability and Relevance.

Table 7.17: Summary information of the factors of user experience

Facet name		**User experience (UX)**			
Factor	**Items**	**Count**	**Factor name**	**Old factor & Old name**	**Comments**
1	16.2; 16.3; 16.1; 16.4; 15.4; 15.2; 14.2; 14.3; 15.3; 15.1; 14.4; 15.5	12	Hedonic Quality and Flexibility	16: Pleasure 14: Satisfaction 15: Flexibility and Personalisation	Hedonic quality includes Pleasure and Satisfaction Personalisation is a subset of Flexibility since flexibility allows for personalisation.
2	13.2; 13.1; 13.3; 14.1	4	Suitability and Relevance	13: Unchanged 14.1: Unchanged	14.1 (Adoption) fits in properly in terms of both Suitability and Relevance.
Total		**16**			

7.5.6 Reliability of the newly formed factors of the user experience part of e-SQUUX Model V3

Table 7.18 shows the reliability of the newly formed two user experience UX factors resulting from the EFA process. These factors with a total of 16 items, as explained in relation to Table 7.17, constitute the user experience part of the validated e-SQUUX Model V3. Table 7.18 shows that the Cronbach’s alpha values of these factors are 0.934 and 0.875 respectively. Since both values are above 0.7, it can be concluded that both factors portray good reliability.

The results of this subsection and those of the previous one, Section 7.5.5, show that the two factors that resulted from the factor analysis of user experience comply with the requirements of reliability and validity tests of constructs as outlined at the beginning of this section (Section 7.5) and make up the user experience part of the validated e-SQUUX Model V3 that will be discussed in Section 8.5.4. In fact, there is a summary of Subsections

7.5.1 to 7.5.6 in Chapter 8, Section 8.5, where the entire validated e-SQUUX Model V3 will be further discussed.

Table 7.18: Reliability of the newly formed user experience factors

	Factor	Item	N	Mean	SD	Alpha if removed	Alpha
1	Hedonic Quality and Flexibility	Qn14.2	174	3.9	0.913	.928	0.934
		Qn14.3	174	3.89	0.958	.928	
		Qn14.4	174	3.61	1.238	.932	
		Qn15.1	174	3.76	1.079	.928	
		Qn15.2	174	3.65	1.025	.926	
		Qn15.3	174	3.38	1.13	.931	
		Qn15.4	174	3.68	0.99	.926	
		Qn15.5	174	3.83	1.011	.932	
		Qn16.1	174	3.53	1.018	.926	
		Qn16.2	174	3.61	0.995	.924	
		Qn16.3	174	3.13	1.254	.929	
		Qn16.4	174	3.57	1.103	.926	
2	Suitability and Relevance	Qn13.1	174	4.1	0.887	.843	0.875
		Qn13.2	174	3.95	0.945	.808	
		Qn13.3	174	3.95	0.875	.827	
		Qn14.1	174	4.13	0.899	.879	

As with a number of studies that serve as precedents for the present work (Heo et al., 2009; Saha, Nath and Salehi-Sangari, 2012; Jiang and Ji, 2014; Hallak, Assaker and El-Haddad, 2018), after the EFA process, structural equation modelling (SEM) was performed to refine the e-SQUUX Model further and to determine the relationships amongst its three facets. In so doing, partial least squares – structural equation modelling (PLS-SEM) (Joreskog, 1978; Hair, Ringle and Sarstedt, 2012; Hair et al., 2016) was undertaken rather than covariance-based structural equation modelling (CB-SEM) (Lohmoller, 1988; Hair, Ringle and Sarstedt, 2012; Hair et al., 2016). Sections 7.6 to 7.8 provide the data analysis and results of this process.

7.6 Partial least square – structural equation modelling (PLS-SEM): e-SQUUX Model estimation using SmartPLS

PLS-SEM model assessment is undertaken in two phases. The first is to assess the measurement model and the second is to analyse the structural model. However, before this is done, the actual process of path model estimation should be undertaken (Hsu and Tsou, 2011; Hair et al., 2016). Model estimation involves using PLS-SEM software to process the data until a model that fulfils the minimum requirements of PLS-SEM is acquired. This section (Section 7.6) presents the results of this process. Thereafter, Sections 7.7 and 7.8 provide the measurement and structural assessment phases, respectively. SEM, which according to Udo, Bagchi and Kirs (2011) has been used in a number of IS studies, was used in this study.

For model estimation, the software used was SmartPLS Version 3. The 55 items (see Section 7.5) comprising 23, 16 and 16 of e-SQ, UB, and UX, respectively, were uploaded to Smart PLS. In PLS, items are also referred to as *indicators* (Hair et al., 2016) and the two terms will be used interchangeably. These 55 items or indicators represent the actual Likert scale values allocated to each statement or item in the questionnaire by each of 174 participants.

As already stated in Chapter 3 (Research methodology and design), when using PLS, one should know whether the constructs are reflective or formative (Sarstedt et al., 2014; Hair et al., 2017; Obonyo, Okeyo and Kambona, 2018). The model in this study consists of reflective constructs only. Consequently, the procedure for analysis and modelling of such a model is followed using SmartPLS. It should be noted that e-SQ and SQ are used interchangeably in the rest of this document. This is because during the actual model processing, using SmartPLS, the term SQ rather than e-SQ was used.

Subsections 7.6.1 to 7.6.3 provide the results of processing rounds undertaken to arrive at a model that met the reliability and validity of a PLS-SEM model. During these rounds, each time an item(s) was removed, the software was rerun to determine the next set of results.

7.6.1 Round 1: Model estimation based on cross-loadings of indicators

The first round involved analysing the loadings of the 55 items (indicators). The outer-loadings data is provided in Appendix E-6. In PLS-SEM, items that load on another latent variable (LV) with a value higher than their parent LVs should be removed (Hair et al., 2016; Wani et al., 2017). It was found that Item 6.4 loaded higher on UX than on SQ, its parent LV, with values of 0.713 and 0.701 respectively. Consequently, this item was deleted from SQ.

The second set of data to be analysed, closely related to the first one, was the loadings of the remaining 54 items on their respective LVs. The new outer-loadings of the 54 indicators had minimum and maximum values of 0.439 and 0.825, respectively. It was initially realised that certain loadings were below the minimum value of 0.7 recommended in literature (Hair, Ringle and Sarstedt, 2012; Saiyidi, 2014; Garson, 2016; Rahman, Qi and Jinnah, 2016). Second, some of the values of the average variance extracted (AVE) were less than 0.5, the recommended AVE cut-off value (Venkatesh, Thong and Xu, 2012; Saiyidi, 2014; Hsu et al., 2017). These two conditions led to the necessity for a second round.

7.6.2 Round 2: Model estimation based on loading of indicators on latent variables (LVs) and AVE values

To test for convergence validity of a latent variable, the AVE should be at least 0.5 for PLS-SEM (Venkatesh, Thong and Xu, 2012; Saiyidi, 2014; Hsu et al., 2017). If this is not met, some items should be removed to increase the AVE value. The AVEs of SQ, UB and UX, at this stage, were 0.434, 0.433 and 0.549 respectively. Since two of them were below the value of 0.5, some items had to be deleted to raise the value of these two. As proposed by Wani et al. (2017) and Chinn (1998), all items with loading less than 0.6 were removed first. There were seven of them out of 54, hence leaving 47 items. The AVEs for SQ, UB and UX were now 0.458, 0.517 and 0.549 respectively. Two of the three values increased, with the AVE for UB also going above the cut-off value of 0.5. However, that of SQ was still below the mark of 0.5 at 0.458. This meant that another round had to be performed to remove some items in order to push up the AVE for SQ since, according to Reinartz et al. (2009), one weak construct affects the latent variable estimates. This led to Round 3.

7.6.3 Round 3: Model estimation based on average variance extracted (AVE)

This round focused only on the loadings of SQ since its AVE was below 0.5. All indicators of SQ with loadings below 0.7 were identified and grouped together. The differences between these indicators' loadings and the other two LVs' indicators were calculated. These differences were put in ascending order of magnitude from the lowest to the highest value. Starting with the lowest value, an iterative process was performed where one item was removed at a time and the value of the AVE recalculated. Each time the AVE was below 0.5, the process was repeated where all indicators of SQ with loadings below 0.7 were re-identified, regrouped, and the differences between SQ indicators' loadings and the other two LVs' indictors' loadings were recalculated. Once again the item with the lowest difference was removed and the AVE of SQ recalculated. The process was repeated after each recalculation of AVE until the AVE value went above the minimum of 0.5. The order of deletion of the items was 1.1, 1.3, 5.2, 1.2 and 2.1 and the corresponding AVE for SQ were 0.465, 0.474 0.482, 0.494 and 0.501. This means that five items were removed, reducing the total number of items from 47 to 42. The number of items in SQ, UB and UX, at this stage, were 15, 11 and 16 respectively. Since all AVE values were below 0.5, namely 0.501, 0.517 and 0.549 for SQ, UB and UX respectively, it meant that the model had satisfied the criteria for convergence validity (Hair et al., 2016; Obonyo, Okeyo and Kambona, 2018). However, at this stage, the HTMT values were 0.737, 0.814 and 0.882. This meant that more items had to be removed to decrease all HTMT values to below 0.85, which is the cut-off value for a conservative, more 'stringent' value of, HTMT (Henseler, Ringle and Sarstedt, 2015). This led to Round 4.

7.6.4 Round 4: Model estimation based on heterotrait-monotrait (HTMT) ratio of correlation

Since the HTMT values were 0.737, 0.814 and 0.882, respectively, more items had to be removed to decrease all values to below 0.85, the cut-off value for a conservative HTMT (Henseler, Ringle and Sarstedt, 2015). A process similar to that used in Round 3 was used. However, in this round the focus was on the LVs that had a value of HTMT above 0.85 between them, that is, at their intersection point, namely, SQ and UX. Since this value is influenced by the loadings of the LV's indicators, all indicators of SQ and UX with loadings values below 0.7 were identified and grouped together. The differences between their loadings were calculated. These difference were put in ascending order from the lowest to highest. Starting with the lowest value, items were removed one-by-one. Each time, the value of the HTMT between SQ and UX was recorded. The process was repeated after each recalculation of HTMT values until this value was below 0.85. Three items, one at a time, were removed during this round. These were, in order, 14.1, 14.4 and 12.2 and the HTMT values between SQ and UX moved from 0.873 to 0.864, and lastly to 0.842. This reduced the total number of items from 42 to 39. At this stage, the number of items in SQ, UB and UX were 15, 10 and 14 respectively. Since all values were below the cut-off value of 0.85, the model had met the requirements of discriminant validity, using the more conservative HTMT.85 criterion.

As stated at the beginning of Section 7.6, once the model has been created through the process of path model estimation, the model is assessed using two phases, namely, measurement and structural model assessment (Hsu and Tsou, 2011; Hair et al., 2016) that are presented in the next sections namely, Sections 7.7 and 7.8.

It should be noted that the 39 items compartmentalised in the three facets, namely e-service quality, usability and user experience, form the e-SQUUX Model V4, the final model in this work. However, it is premature, at this stage, to state this with confidence before the measurement (Section 7.7) and structural (Section 7.8) assessments are undertaken. The consequence of this is that the reference to e-SQUUX in Sections 7.7 and 7.8 refers to a transitional e-SQUUX Model V4.

7.7 e-SQUUX measurement model assessment using PLS-SEM

As stated at the beginning of Section 7.6, the model in this research is made up of reflective constructs only. Consequently, the reflective measurement model approach is applied to assess it.

7.7.1 e-SQUUX measurement model: Loadings of indicators on latent variables

Table 7.19 shows the loadings of the 39 indicators to the three latent variables, that is, to the three core facets of e-SQUUX, It demonstrates that the values of the loadings ranged from 0.606 to 0.844. It is recommended that there should be a minimum cut-off value of 0.7 as the loadings of indicators on their respective LVs (Garson, 2016; Hair et al., 2016; Lazar, Feng and Hochheiser, 2017). However, for exploratory studies, such as the present one, it is proposed that a minimum value of 0.6 can be used (Garson, 2016; Cordiglia and Van Belle, 2017; Lazar, Feng and Hochheiser, 2017).

The second reason why 0.6 was used in this study was to reduce the number of items to be deleted from the original model. This is in agreement with Hair et al. (2016) and Henseler et al. (2015) who propose that researchers must be careful not to remove indicators that would greatly affect the content validity of the model. This ensures that the original meaning of the constructs is preserved by capturing most of the aspects of the domain under research. Despite using a cut-off value of 0.6, the minimum requirements of the measurement model for reliability and validity were met, as discussed in the next four subsections.

Table 7.19: Loadings of indicators of e-SQ, U and UX

Item	**SQ**	**UB**	**UX**		**Item**	**SQ**	**UB**	**UX**
Qn10.1		0.788			Qn2.2	0.662		
Qn10.2		0.823			Qn2.4	0.698		
Qn10.3		0.747			Qn2.5	0.699		
Qn11.1		0.649			Qn3.1	0.674		
Qn11.3		0.659			Qn3.2	0.700		
Qn11.4		0.663			Qn3.3	0.743		
Qn13.1			0.658		Qn3.4	0.680		
Qn13.2			0.746		Qn4.2	0.606		
Qn13.3			0.756		Qn4.3	0.734		
Qn14.2			0.749		Qn5.1	0.711		
Qn14.3			0.764		Qn5.3	0.715		
Qn15.1			0.751		Qn5.4	0.720		
Qn15.2			0.804		Qn5.5	0.757		
Qn15.3			0.658		Qn6.1	0.755		
Qn15.4			0.807		Qn6.3	0.791		
Qn15.5			0.690		Qn9.1		0.674	
Qn16.1			0.807		Qn9.2		0.795	
Qn16.2			0.844		Qn9.3		0.793	
Qn16.3			0.715		Qn9.4		0.725	
Qn16.4			0.785		**Total**	**15**	**10**	**14**

7.7.2 e-SQUUX measurement model: Internal consistency using composite reliability

Table 7.20 shows both the Cronbach's alpha (Alpha) and composite reliability (CR) of the constructs of the model. CR defines the relationship between the construct and its indicators by showing that the construct is made up of its indicators (Henseler, 2017). Although PLS recommends the use of CR rather than Alpha values in assessing internal reliability of the constructs (Garson, 2016; Hair et al., 2016), the Alpha values are also shown. Table 7.20 shows that all the CR reliability values were greater than 0.7, which is the cut-off value in order for a construct to be considered consistent in PLS (Saiyidi, 2014; Sarstedt et al., 2014; Foroudi, Gupta and Sivarajah, 2018). This means that the model fulfils the reliability criteria.

Table 7.20: Cronbach's alpha and composite reliability (CR)

Construct	Alpha	CR
SQ	0.93	0.939
UB	0.904	0.921
UX	0.941	0.948

7.7.3 e-SQUUX measurement model: Convergent validity using average variance extracted

As already stated, in order for a model to display convergence validity, in PLS-SEM, the value of the average variance extracted (AVE) should be greater than 0.5 (Venkatesh, Thong and Xu, 2012; Saiyidi, 2014; Hsu et al., 2017). Table 7.21 shows that the AVE values of the e-SQ, UB, and UX were 0.506, 0.539 and 0.569, respectively. Since they are all greater than 0.5, the model satisfies the conditions for convergence validity.

Table 7.21: Average variance extracted (AVE) of the constructs

Construct	AVE
SQ	0.506
UB	0.539
UX	0.569

7.7.4 e-SQUUX measurement model: Discriminant Validity using Heterotrait-Monotrait ratio of correlations

In recent years (since 2015), it has been proposed that the best method to ensure discriminant validity of the constructs is by use of the Heterotrait-Monotrait (HTMT) ratio of correlations (Henseler, Ringle and Sarstedt, 2015; Garson, 2016). This is because the use of HTMT has been found to produce more stable results than the Fornell and Larcker (1981) criterion and the cross-loadings (Chinn, 1998) method. Consequently, HTMT was used to assess this model for discriminant validity. More specifically, the HTMT.85 criterion was used since it is more sensitive (stringent) than the HTMT.90 (Henseler, Ringle and Sarstedt, 2015; Garson, 2016). Table 7.22 shows that the HTMT values range from 0.720 to 0.842 and hence below the 0.85 mark. This shows that the model has discriminant validity.

Table 7.22: HTMT values of the constructs

	SQ	**UB**	**UX**
SQ	–	–	–
UB	0.72	–	–
UX	0.809	0.842	–

Once the measurement model assessment has been shown to be satisfactory, one can move on to the next phase, which is the PLS-SEM evaluation stage (Saiyidi, 2014; Sarstedt et al., 2014; Rahman, Qi and Jinnah, 2016). This is provided in Section 7.8, following.

7.8 e-SQUUX Structural model assessment using PLS-SEM

The second phase of PLS-SEM involves determining the causal association between constructs by testing its regression paths (Foroudi, Gupta and Sivarajah, 2018). The structural model is made up of endogenous and exogenous constructs and the relationships that exist between them (Henseler, 2017).

According to a number of authors such as Garson (2016) and Hair, Ringle and Sarstedt (2012), PLS-SEM does not require a measure for global goodness of fit (GoF). Though goodness of fit values are used in the assessment of covariance-based structural equation modelling (CB-SEM), in variance-based structural equation modelling (VB-SEM) such as PLS, this measurement is of no value (Hair, Ringle and Sarstedt, 2012). Consequently, it is not reported in this study.

Sections 7.8.1 to 7.8.3 present the assessment of the structural model.

7.8.1 Collinearity using variance inflation factor

Before the first step is undertaken in PLS-SEM structural assessment, it is advisable to determine whether there is possible collinearity between the LVs (Sarstedt et al., 2014). This is done by determining the value of the variance inflation factor (VIF). There are various suggestions for the recommended maximum values of collinearity. While Andrei et al. *(*2017) propose a cut-off value of 3.3, other researchers recommend varying values. For example, 4.0 by Garson (2016), and 5.0 by Hair et al. (2010) and Kock and Lynn (2012) as the cut-off values. In this study, a value of 3.3 was selected since it is the smallest of the values suggested by the cited sources. Table 7.23 shows that the VIF values ranged from 1.00 to 1.82, indicating that there was multicollinearity among the variables of the structural model since all the VIF values are much lower than the threshold value. This means that the structural model is suitable for assessment.

Table 7.23: Collinearity statistics – the inner VIF values of the LVs.

	SQ	UB	UX
SQ	–	–	1.82
UB	1	–	1.82
UX	–	–	–

7.8.2 Measure of variance explained (R^2) for the endogenous constructs

The first main part of the assessment of the structural model was to determine the coefficient of determination, R^2. R^2 shows how a latent variable is being explained by the other LVs (Wong, 2013; Sarstedt et al., 2014). Consequently, it is applicable to dependent variables or the endogenous constructs. In this study, these are SQ and UX, while UB is an exogenous construct. Table 7.24 and Figure 7.5 (see inside the oval shapes) show that R^2 for the endogenous constructs SQ and UX are 0.451 (45.1%) and 0.721 (72.1%), respectively. Since R^2 of UX is 72.1%, it means that the combined variance explained by both SQ and UB of UX is 72.1%. Likewise, UB alone explains 45.1% of the SQ variance. Another way of stating it is that the predictive power of SQ and UX are 0.451 (45.1%) and 0.721 (72.1%), respectively (Sarstedt et al., 2014).

Table 7.24: The coefficient of determination (R^2) of the endogenous constructs

Construct	R^2	R^2 (%)
SQ	0.451	45.1
UX	0.721	72.1

A number of proposals exist for the cut-off value of R^2. For example, according to Wani et al. (2017), values of 0.75, 0.5 and 0.25 should be considered substantial, moderate and weak, respectively. However, according to Saiyidi (2014) and Chinn (1998) values of 0.67,

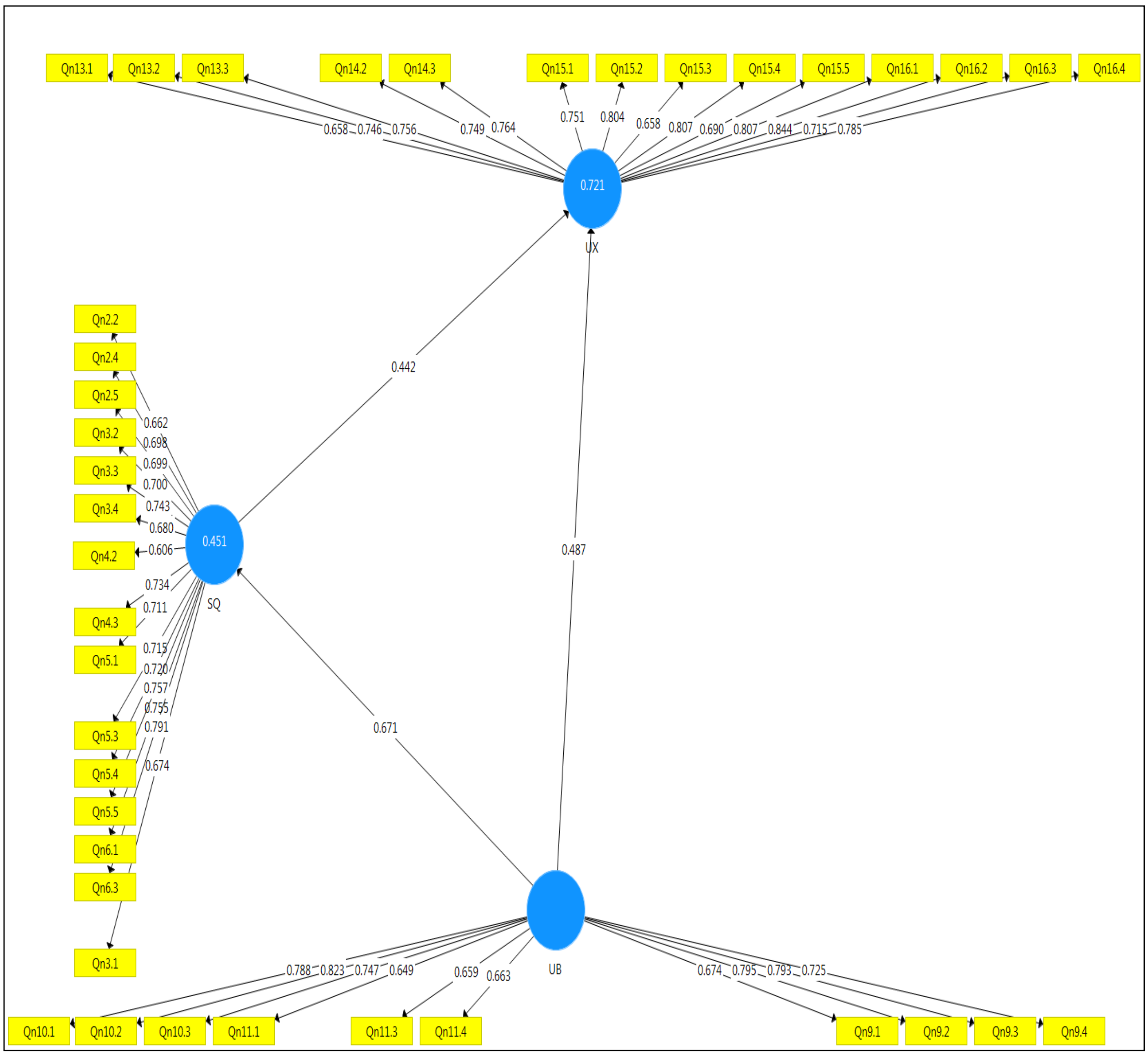


Figure 7.5: The path coefficients and coefficients of determination, R^2, of the structural model of e-SQUUX

0.33 and 0.19 are considered substantial, moderate and weak, respectively. In both cases, the R^2 of UX of 72.1% can be considered substantial, while that of SQ of 45.1% is moderate. UB does not have any value because it is an exogenous construct – it only acts as an independent variable.

In Figure 7.5, the values along the arrows from each of the three constructs (blue ovals) to the respective indicators (yellow rectangles), show the approximate loading values of indicators with regard to their respective constructs, as discussed in Sections 7.6.1 and 7.7.1.

7.8.3. Measure of the strength and significance of the paths of the structural model

The second part of the PLS structural model assessment involves determination of strength and significance of the paths in order to evaluate the relationships (structural paths) between the constructs (Sarstedt et al., 2014). This involves the determination of both the path coefficients for strength, and the t-values for significance. To achieve this, first, the PLS algorithm was run using SmartPLS to determine the path coefficients. The path coefficients explain how strong variables affect another one (Wong, 2013; Sarstedt et al., 2014). Path coefficients range from -1 to +1, with positive values showing a positive relationship (Sarstedt et al., 2014; Garson, 2016). The values close to absolute 1, positive or negative, show a *strong* path while those close to 0 (zero) show a *weak* one (Garson, 2016). Table 7.25 and Figure 7.6 show the path coefficients of the model.

Table 7.25: Path coefficient and t-values and p values

Path	**Path Coefficients (β)**	**t Statistics**	**p Values**	**Accept / Reject H_i (support relationship)**
SQ --> UX	0.442	5.753	0.000	Accept
UB --> SQ	0.671	9.306	0.000	Accept
UB --> UX	0.487	6.773	0.000	Accept

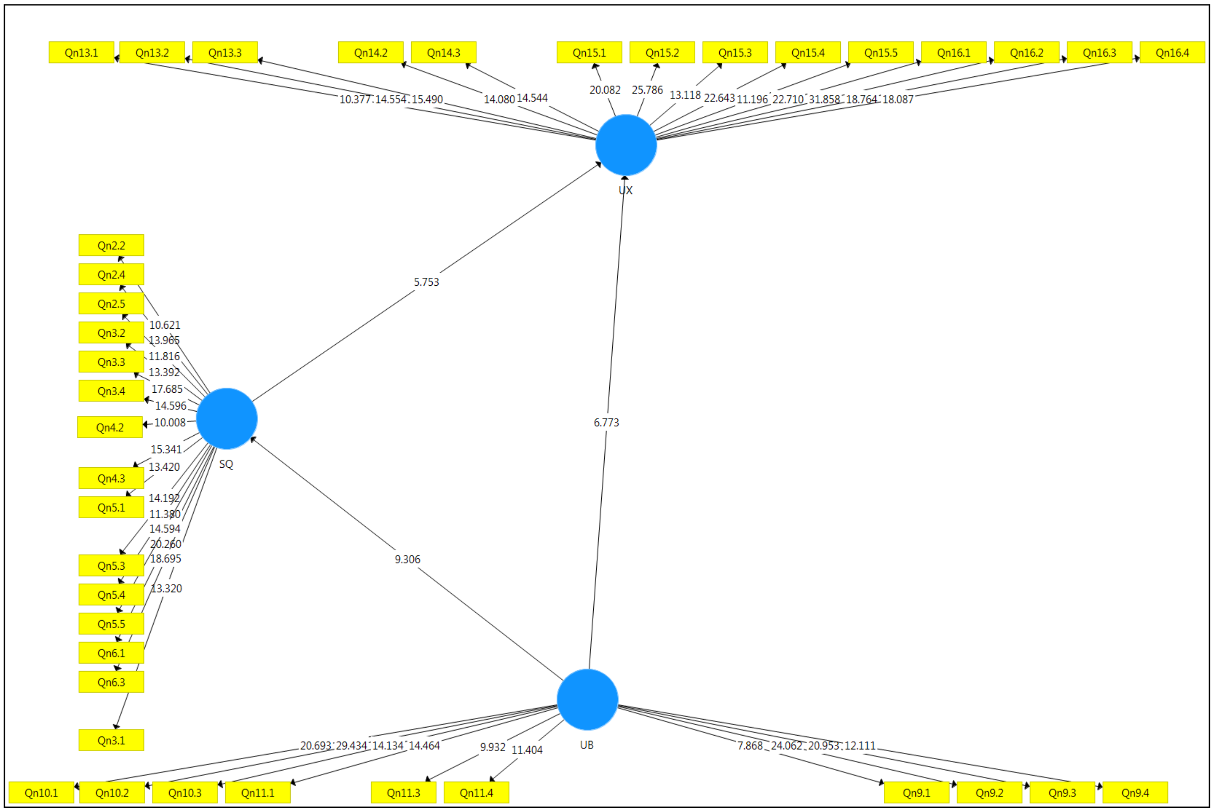


Figure 7.6: The t-values of the relationships between e-SQ, U and UX

As for Figure 7.5, in Figure 7.6, the values along the arrows from each of the three constructs (blue circles) to the respective indicators (yellow rectangles), show the approximate t-statistics values with regard to their respective constructs as discussed at the beginning of this section.

Both Table 7.25 and Figure 7.6 shows that all three relationships are positive and *strong* since they range from 0.442 to 0.670. The usability to e-service quality relationship exhibited the strongest relationship followed with a coefficient value of 0.670. This is followed by the usability to user experience relationship with a value of 0.487. The service quality to user experience relationship, though strong, is the weakest of the three relationships with a path coefficient value of 0.442.

Second, the t-values were determined in order to evaluate the significance of the relationships (Revythi and Tselios, 2017). To achieve this, the model PLS algorithm was run using the bootstrap resampling procedure as recommended by Hair et al. (2012) and Hsu and Tsou (2011). For exploratory studies such as the current research, a value of 500 resamples is recommended (Garson, 2016). Bootstrapping allows for a measure of accuracy by providing values such as confidence interval and variance (Garson, 2016). In SmartPLS, the 'Complete Bootstrapping' rather than the 'Basic Bootstrapping' option was used. While the latter calculates basic results such as path coefficients, outer-loadings, HTMT and total effects, the former option, in addition to these, computes significances for R-square, t-values, AVEs, and Cronbach alpha values (Hair et al., 2017). For a significant relationship, the t-values should be at least 1.96 (Revythi and Tselios, 2017). In this study, the significance level was set as at 0.05 even though, for exploratory studies, 0.1, a less significant level, can be used (Garson, 2016). Table 7.25 shows the t-statistics that are also demonstrated in Figure 7.6. In all cases, the values range from 5.753 to 9.306. In addition, p is less or equal to 0.05 ($p \leq 0.05$). These results demonstrate that there is a significant relationship in all three cases since according to Garson (2016) and Revythi and Tselios (2017) all t-values above 1.96 are significant at the 0.05 level.

Given that the path coefficients of the three relationships were found to be strong, the following three conclusions can be made:

1. UB has a strong and significant positive effect on SQ.
2. UB has a strong and significant positive effect on UX.
3. SQ has a strong and significant positive effect on UX.

These three findings will be discussed in Chapter 8.

Another observation to make with regard to Figure 7.6 and the t-statistics values of all indicators of each of the three LVs (see Appendix E-7), namely, SQ, UB and UX, is that these values were greater than 1.96 (cut-off value) and significant ($p \leq 0.05$). The values ranged from 7.868 to 31.858.

At this stage, it is important to note the following:

- First, Figures 7.5 and 7.6, when combined provide the answer to **Subquestion** 5, namely:

  5. What is the structural model (relationships) of e-service quality, usability and user experience in the context of evaluation of a UWP?

  However, the detailed answer to this subquestion is provided in Sections 8.6 and 8.7.1 of Chapter 8.

- Second, the indicators in Figures 7.5 and 7.6, shown in the small yellow rectangles, provide the labels (as in the original main questionnaire) of the items that form the answer to **Subquestion 6**, in the form of e-SQUUX Model V4, namely:

  6. What are the final components of e-service quality, usability and user experience following the structural modelling of the three in the context of evaluation of a UWP?

As with Subquestion 5, the detailed answer to this subquestion is provided in Chapter 8, in Sections 8.7.2 to 8.7.5. These components of e-SQUUX Model V4, in terms of the 39 items, were briefly mentioned in the last paragraph of Section 7.6, but are presented comprehensively in Table 8.8 in Section 8.7.2.

7.9 Chapter conclusion

The focus of this chapter was to analyse the data collected during the main questionnaire survey and to present its results. In so doing, the e-SQUUX Model was developed and refined further. The process involved both validation, using EFA, and structural modelling of the e-SQUUX using PLS-SEM. The contents of this chapter are directly related to answering Subquestions 4 to 6 that constitute the quantitative phase of this mixed-methods study.

Section 7.2 explained how the data cleaning exercise was undertaken. Thereafter, Section 7.3 presented data on the profile of the participants. Data was collected from students, academics and administrative staff over a period of one month from mid-May 2017, at six

UNISA sites, entailing two campuses and four study centres. Of the 196 questionnaires, 174 were usable for data analysis.

Section 7.4 compared the reliability of the e-SQUUX the pilot study to that of the main study. One of the main findings was that due to the improvements resulting from the pilot study, there was a significant increase in the reliability of the dimensions.

Section 7.5 focused on data analysis, validity and reliability, of the model leading to the identification of the components of a validated e-SQUUX Model V3 based on the user survey and hence provide a foundation for the answer to Subquestion 4. Exploratory factor analysis was performed for the validation, and the identification of the inherent factors in the e-service quality, usability, and the user experience component. During this process, the total number decreased from 16 to 11 factors and from 64 to 55 items.

Sections 7.6 to 7.8 provide the data analysis and results of structural equation modelling (SEM) that was performed to refine the e-SQUUX Model further and to determine the relationships amongst its three facets. This is associated with answering research Subquestion 5. SmartPLS Version 3 software was used for the actual processing. Section 7.6 dealt with the results of the model estimation phase of PLS-SEM; Section 7.7 described the measurement model assessment phase and Section 7.8 provided the structural model assessment phase which determines the causal relationships between the constructs. Figures 7.5 and 7.6 in Section 7.8, related to the answer to Subquestion 5, showed that the relationships were that (i) UB has a strong and significant positive effect on SQ, (ii) UB has a strong and significant positive effect on UX, and (iii) SQ has a strong and significant positive effect on UX. At that point, the total number of items, normally referred to as indicators in PLS-SEM, decreased from 55 to 39. After Section 7.6, it was noted that these 39 items that constituted the three facets, namely e-service quality, usability and user experience, form the e-SQUUX Model V4, the final model in this work and hence are the basic elements of the answer to Subquestion 6. However, it was premature at that stage to state that with confidence before the measurement (Section 7.7) and structural (Section 7.8) assessments of the model were undertaken. Consequently, the model was considered a transitional e-SQUUX Model V4 even though it comprised the basic components of the e-SQUUX Model V4. The detailed and elaborated answers to Subquestions 4, 5 and 6 are provided in Chapter 8.

This chapter, based on Study 2B, contributed greatly to the research since its content serves as a basis for answering three of the six subquestions, namely 4, 5 and 6. The next chapter, Chapter 8, presents a comprehensive discussion of the results of this research that emanate from Chapter 4 through to this chapter.

Chapter 8: Discussion

8.1 Introduction

The previous chapter presented the data analysis and the results of the main phase of the questionnaire survey undertaken in this research. This chapter is devoted to discussion, and contributes, not only to the outcome of the last chapter, but to this study in its entirety.

Table 8.1 provides a summary of this chapter that includes the main objectives, namely, to discuss the results and findings of both the qualitative and quantitative studies, and to show how the results and findings answer the research questions of this research, contributing to the sequential development of e-SQUUX. The table also indicates that the main outcome of this chapter is to revisit all the research questions and provide their answers.

Table 8.1: Summary of Chapter 8

Discussion	
Purpose	The main objectives of this chapter are: 1. To discuss the results and findings of both the qualitative and quantitative studies. 2. To show how the results and findings answer the research questions of this research.
Outcome(s)	Answers to the research questions

Figure 8.1 presents the layout of the chapter. Following this, Section 8.2 discusses the consolidated conceptual model of e-service quality, usability and user experience (e-SQUUX Model V1) for evaluating Web-based applications. The achievement of the content validity of the e-SQUUX conceptual model by means of expert reviews is then described in Section 8.3 with subsections on the qualitative (Section 8.3.1), the quantitative (Section 8.3.2), and the merged (Section 8.3.3) results.

8.1: Introduction

8.2: A consolidated conceptual model of e-service quality, usability and user experience (e-SQUUX) for evaluating Web-based applications

8.3: Content validity of the e-SQUUX conceptual model by means of expert reviews

8.3.1 Discussion based on quantitative results
8.3.2 Discussion based on qualitative results
8.3.3 Discussion based on the merged results, and refined model – provisional e-SQUUX model PV2

8.4: Value of a pilot study in a questionnaire survey evaluation of e-service quality, usability and user experience (e-SQUUX)

8.4.1 Testing the design and feasibility of the questionnaire
8.4.2 Reliability of the constructs in the questionnaire
8.4.3 Reflection: value of a comprehensive pilot study in a survey evaluation in the discipline of HCI

8.5: Validation of expert-reviewed e-SQUUX Model V2 by means of a user survey

8.5.1 Comparison of the reliability of the pilot and main studies
8.5.2 Factor analysis of e-SQUUX and its reliability and validity
8.5.3 Factor analysis of e-SQUUX and its content validity
8.5.4 Components of a validated e-SQUUX Model V3 based on user survey

8.6: Proposed model: Partial least square – Structural equation modelling (PLS-SEM) of e-SQUUX

8.7: Discussion of the PLS-SEM e-SQUUX Model

8.7.1 The relationships in the PLS-SEM e-SQUUX Model
8.7.2 Components of the proposed PLS-SEM e-SQUUX Model V4
8.7.3 Dimensions of e-service quality and recommendations
8.7.4 Dimensions of usability and recommendations
8.7.5 Dimensions of user experience and recommendations

8.8: Conclusion

Figure 8.1: Layout of Chapter 8

Thereafter, Section 8.4 highlights the value of a pilot study in the questionnaire survey evaluation of the e-service quality, usability and user experience. This is done by means of subsections on testing the design and feasibility of the questionnaire (Section 8.4.1), reliability of the constructs in the questionnaire (Section 8.4.2), and reflection on the value of a comprehensive pilot study in a survey evaluation study in the discipline of HCI (Section 8.4.3). Following 8.4, Section 8.5 focuses on validating the expert-reviewed e-SQUUX Model V2 by means of the main user survey. Thereafter, four subsections follow, namely: comparison of the reliability of the pilot and main studies (Subsection 8.5.1), factor analysis of e-SQUUX and its reliability and validity (Subsection 8.5.2), factor analysis of e-SQUUX and its content validity (Subsection 8.5.3), and components of the validated e-SQUUX Model V3 that resulted from the main survey (Subsection 8.5.4). Section 8.6 presents the proposed model using the partial least square – structural equation modelling (PLS-SEM) of e-SQUUX which is followed by Section 8.7 that discusses the PLS-SEM e-SQUUX Model under five subsections. These are: the relationships in the PLS-SEM e-SQUUX Model (Subsection 8.7.1), components of the proposed PLS-SEM e-SQUUX Model V4 (Subsection 8.7.2), dimensions of e-service quality and recommendations (Subsection 8.7.3), dimensions of usability and recommendations (Subsection 8.7.4), and dimensions of user experience and recommendations (Subsection 8.7.5). Finally, Section 8.8 concludes the chapter.

8.2 A consolidated conceptual model of e-service quality, usability and user experience (e-SQUUX) for evaluating Web-based applications

Answer to Subquestion 1

This section deals with how **Subquestion 1** below was answered:

1. *What are the components of a conceptual integrated model, synthesised from the literature, for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications?*

Chapter 4 provides the details of how this part of the study, namely, Study 1A of the qualitative phase, was addressed and its outcomes. Moreover, a published paper, cited below, emanated from this part of the study.

> Ssemugabi, S. and De Villiers, M.R., 2016. Make Your Choice: Dimensionality of an Open Integrated Conceptual Model for Evaluating e-Service Quality, Usability and User Experience (e-SQUUX) of Web-Based Applications. In *Proceedings of SAICSIT, 2016, Annual Conference of the South African Institute of Computer Scientists and Information Technologists, Johannesburg, South Africa, 2016.* ACM.

Although there are varying definitions and dimensions for e-service quality, usability and user experience, the three constructs, though different, are closely related. However, no prior research could be found that provides an integrated model of the dimensions of all three. This identified a gap in the literature that this work aims to address. Through an extensive systematic literature review, a multi-dimensional conceptual model was derived that can be used to evaluate the three constructs and it was named e-SQUUX. In order to determine the dimensions of e-SQUUX, Barbara Kitchenham's guidelines for a systematic literature review (Kitchenham, 2004), which are provided in Section 4.2, were followed. The sources used were published journal articles, papers from proceedings, and books. Furthermore, websites that reported on e-service quality, usability and/or user experience were used. These websites emanated from large corporations where research had been conducted in any of these areas. They included Microsoft, Nokia, Samsung, Apple, Oracle and SAP, many of which included information that had been published in journal articles or in conference proceedings. Of the 509 sources consulted, 264 were deemed to be relevant for the study as explained in Section 4.3.2 of Chapter 4. This gave rise to an initial set of 723 dimensions. Through four reduction cycles, as described in Section 4.3, the conceptual e-SQUUX Model V1 was formed comprising 24 categories, 75 main dimensions, and 163 associated dimensions. This model is provided in Table 4.18 and answers Subquestion 1.

8.3 Content validity of the e-SQUUX conceptual model by means of expert reviews

Answer to Subquestion 2

The discussion in this section, based on Chapter 5, explains how **Subquestion 2** below was answered:

2. *What are the components of the conceptual integrated model for evaluation of e-service quality, usability and user experience (e-SQUUX) of Web-based applications following an expert review?*

Chapter 5 set out to analyse the empirical data received in the expert review, Study 1B of the qualitative phase. Four highly qualified and competent experts reviewed the conceptual e-SQUUX Model V1. The results were used to refine the model. As stated in the previous paragraph, Model V1 resulted from a systematic literature review (Chapter 4). It consisted of 24 categories, 75 main dimensions and 163 associated dimensions as presented in Table 4.18. As previously stated, the term 'components' refers to the categories, main dimensions and associated dimensions of the model as has been done in other similar studies (Venkatesh, Thong and Xu, 2012; Wani et al., 2017). Although this model, derived from the literature, has both theoretical and practical merits, as described in Ssemugabi and De Villiers (2016), it important that such a model is reviewed by experts to improve its content validity. The outcome of such a process is usually a more refined model that is easier for practitioners to apply (Joo and Lee, 2011).

It is essential that the set of reviewers should possess a variety of relevant skills, such as domain and application expertise (Aziz et al., 2016). To this end, all the experts were highly qualified, with three academics and one practitioner, all skilled in Information Technology and/or HCI. A template was given to the reviewers to guide them in providing their inputs, including:

- Suggestions.
- Rankings of data of components.

These were collected and analysed. The results of the data analysis presented in Chapter 5 are discussed in Subsections 8.3.1 to 8.3.3.

8.3.1 Discussion based on rankings results

The experts were required to rank both the categories and main dimensions from most important to least important. Section 5.3 of Chapter 5 provides the analysis of the data collected. They were required to list their top five most important, and then the five least important, categories and dimensions.

The result in Table 5.7 shows the most important categories, with the top two being (i) Effectiveness and usefulness and (ii) Learnability and understandability. Based on Table 5.6 that showed the ranking of the five most important categories for each expert, the interesting finding was made that there was a divergence of views by experts on what constituted the very topmost important categories. This is because, of the *top two categories* identified by the four experts, only one was common and the other six were different. However, Table 5.7 shows that with regard to the *top five categories* that were ranked by the experts, they overlapped to such a degree that, in all, nine of the 24 categories were included in the five most important ones, which was a sign of consensus among the experts. Similarly, Table 5.11 shows that the rankings assigned by the experts to the most important *dimensions* overlapped to such a degree that only 11 of the 75 dimensions were included in the *top five*, reconfirming a general consensus among the experts with regard to the top five.

With respect to the least important categories and dimensions as ranked by experts, the discussion is similar to that of the most important ones. For example, Table 5.8 shows that only one category, namely, Pleasure and Hedonics (4), was common and the other six were different in the *two least important* categories among the five selected by each expert. This means that there was a divergence of views by experts on what constituted the *two least important* categories. However, Table 5.9 shows that the ranking of the 24 categories that were ranked by the experts overlapped to such a degree that, in all, eight *categories* were included in the *five least important* ones, which was a sign of consensus among the experts.

Similarly, Table 5.13 shows that the rankings assigned by the experts overlapped to such a degree that, only 13 of the 75 *dimensions* were included in the five least important ones, further reconfirming the consensus.

Another finding emanating from the qualitative data results was that, in a few cases, what literature considered to be minor categories or dimensions were viewed as important by the experts and vice versa. For example, Table 5.6 shows that for Exp C (Expert C), the two most important categories, namely, Accessibility and Timeliness, were, according to the literature review, ranked 14th and 23rd respectively. On the other hand, Pleasure and Hedonics, which was ranked 4th in the literature review was ranked least important by Exp C and second-least important by Exp A, as shown in Table 5.8.

8.3.2 Discussion based on suggestions results

A section of the experts' review form (that is, the template) allowed them to add, remove, combine, separate, and relocate components or make any adjustments they felt appropriate, accompanied by open-ended textual responses if necessary. Section 5.4 of Chapter 5 presented the analysis of this data. The analysis in Section 5.4 categorised the suggestions and listed each set of suggestions in eight tables (Tables 5.18 to 5.25). Table 8.2 summarises information extracted from these tables. The *Suggestion categories* column shows the different types of suggestions by experts. The *Reference table* column refers back to the table where this type of suggestion was presented. For example, Table 5.18 is where the suggestions by experts to combine components were discussed. Table 8.2 also shows the *Number of experts who made the same type of suggestion*, where *One* means the number of times that this type of suggestion was put forward by only one expert, *Two* means the number of times that this type of suggestion was put forward by two different experts, and *Three* means the number of times that this type of suggestion was put forward by three different experts. For example, under the *Suggestion category* Combining Components in Table 8.2, whose data is extracted from Table 5.18, the frequency of *One* is two, and that of *Two* is one. There was no case where three experts made the same type of suggestion, hence the blanks under the *Three* column in the Table.

Table 8.2: Summary of the number of suggestions by the evaluators

			Number of experts who made the same suggestion			**Total**	**Accepted**	
#	**Suggestion categories**	**Reference Table**	**One**	**Two**	**Three**	**f**	**Y**	**N**
1	Combining components	5.18	2	1		3	2	1
2	Removing (deleting) components	5.19	10	9	2	21	18	3
3	Relocating (moving) components	5.20	16			16	15	1
4	Adding components	5.21	3			3	3	0
5	Decoupling (separating) components	5.22	6	5	1	6	6	0
6	Renaming of categories	5.23	6			6	6	0
7	Elimination of synonyms	5.24	10			10	9	1
8	Dealing with miscellaneous suggestions	5.25	4			4	3	1
		Total	**56**	**11**	**2**	**69**	**60**	**9**
		Percentage	**81%**	**16%**	**3%**	**100%**	**87%**	**13%**

This means that the total number of suggestions (*f*) made with respect to Combining categories is 3 (2+1). Since for all the suggestions in Section 5.4, there were no cases where four experts made the same suggestion, there is no column called *Four* in Table 8.2. In addition, for each suggestion made as listed in Tables 5.18 to 5.25 (see *Reference Table* column in Table 8.2) the researcher had to make a decision whether to implement it or not. Under the *Accepted* column, *Y* shows the number of suggestions accepted and *N* the number rejected. For example, for the *Suggestion category* of the type Combining Components, two of the three suggestions were accepted and one was rejected as shown in Table 8.2.

In summary, Table 8.2 shows that in total, there were 69 suggestions. Of these 56 (81%) were proposed by one individual (single), 11 (16%) by two, and 2 (3%) by three individuals. This leads to the finding that a majority (81%) of the suggestions were proposed by not more than one person, although all four experts contributed to making suggestions. In addition to the fact that in only 2 cases (3%) where three experts made the same suggestion, this shows that there was little consensus on what should be modified. However, in no case did any expert make contradictory suggestions. This means that although experts had divergent views, they were not contradictory to each other. In addition, of the 69 total suggestions, Table 8.2 shows that after due consideration, 60 (87%) of them were accepted and implemented by the researcher. This shows the positive value of this phase of study to the research as a whole. In particular, this phase contributed greatly to the content validity of the conceptual model (Brod, Tesler and Christensen, 2009; Newman, Lim and Pineda, 2013).

8.3.3 Discussion based on the merged results, and refined model – Provisional e-SQUUX Model PV2

In general, the suggestions identified components to be deleted or modified while the rankings of categories and dimensions determined the importance of categories and dimensions that resulted in the ranking of categories.

The 60 suggestions in Table 8.2 that were implemented, out of the total of 69 suggestions, resulted in reduction of the number of components. The number of original components of e-SQUUX Model V1 in Chapter 4, namely, 24 categories, 75 main dimensions and 163 associated dimensions, was reduced to 19 categories, 64 main dimensions and 125 associated dimensions, respectively, in Provisional e-SQUUX Model PV2.

In determining the importance (ranking) of categories, two processes took place as described in Section 5.5. First, in Section 5.5.1, for the most important categories, three variables, described in full in Section 5.5.1, namely, CatScore, CatPoints and DimPoints (see Table 5.28), were used to calculate their sum, namely CatTotal (see Table 5.29). The researcher generated a formula to convert CatTotal to a new ranking for each category. This was used to determine and list the 13 most important categories as given in Table 5.29. In summary, the higher each of the three variables and correspondingly the higher their total, the more important the category was. Second and similarly, in Section 5.5.2, for the least important categories, three variables, similarly, CatScore, CatPoints and DimPoints (see Table 5.30), were used to calculate their sum, namely CatTotal (see Table

5.31), which was used to determine and list the six least important categories as given in Table 5.31. Table 5.32 provides the combined list of the 19 categories ranked from most to least important. It was found that there were no commonalities between the least and most important categories. It is of interest that the experts did not stress the UX aspects of e-SQUUX, for example hedonics. Rather, they emphasised the more traditional usability issues, such as effectiveness and efficiency.

As previously demonstrated in Section 5.5 of Chapter 5, a combination of the suggestions and rankings data resulted in Table 5.33, a Provisional expert-reviewed e-SQUUX Model PV2, which showed the outcome of the review by experts only. It comprised 19 categories, 64 main dimensions and 125 associated dimensions compared to 24, 75 and 163 respectively, in the original e-SQUUX Model V1 (see Table 4.18 in Chapter 4). As stated in Chapter 4, in general there was consolidation and a decrease in the number of components, with the greatest decrease being 23% for the associated dimensions, followed by categories with a decrease of 21% and by main dimensions that decreased by 15%, resulting in an overall average of 20%. This is in line with the methodological approach taken in this study whereby each sequential stage of the study aims to reduce the number of components in the model, consequently decreasing its complexity. This approach has been used in popular Information Systems models such as DeLone and McLean's Information Systems Success Model (DeLone and McLean, 1992, 2003) and the service quality model SERVQUAL (Parasuraman, Zeithaml and Berry, 1988).

Before the expert review process was finalised, the researcher embarked on the process of describing each of the 19 categories. The descriptions were in the form of statements derived from definitions in the literature of, mainly, the main dimensions (Level 2) of each category, although the associated dimensions (Level 3) were also considered. During this process, it was found that some changes/refinements to the model were necessary. Table 5.35 of Chapter 5 shows the refinements carried out by the researcher on the Provisional expert-reviewed e-SQUUX Model PV2. After implementing these changes, the final expert-reviewed conceptual model for evaluation of e-service quality, usability and user experience (e-SQUUX Model V2) was compiled as provided in Table 5.37 of Chapter 5.

Unlike the provisional model (PV2) (see Table 5.33) that consisted of categories, main dimensions and associated dimensions as in the case of the original conceptual model (V1) (see Table 4.18), V2 was formulated to consist of dimensions, defining dimensions and descriptors (statements).

After this refinement process, the e-SQUUX Model V2 comprised 16 categories remaining from the 19 categories in Model PV2. They were renamed dimensions. Model V2 thus comprised 16 dimensions (previously termed categories) and 55 defining dimensions (previously called main dimensions in model V1). This resulted in a decrease of 15.8% and 14.1%, respectively, compared to the e-SQUUX Model PV2 (see Table 5.38). This shows that the final step in Study 1B, based on the definitions of components, contributed greatly to the refinement of the e-SQUUX Model. A further benefit was that it resulted in 101 descriptors that did not exist in Model V1 or the provisional model PV2. Since descriptors can easily be converted into scale items/statements in a measurement instrument such as a questionnaire, this made the model easier to apply in terms of evaluation of e-service quality, usability and user experience.

In conclusion and to summarise, the conceptual e-SQUUX Model V1, as was presented in Chapter 4, emanated from a systematic literature review. The expert review of V1 resulted in a consolidated, more refined e-SQUUX Model V2 in the form of Table 5.33 that was presented in Chapter 5. This review process by a set of experts, ratified by further investigation in the literature was successful in improving the content validity of e-SQUUX.

After the content validation by experts, a pilot study was conducted in preparation for the main study, which was a major questionnaire survey. The next section discusses the results of this phase.

8.4 Value of a pilot study in a questionnaire survey evaluation of e-service quality, usability and user experience (e-SQUUX)

Answer to Subquestion 3

The discussion in this section, based on Chapter 6, deals with how **Subquestion 3** below was answered:

3. *What is the value of a comprehensive pilot study prior to the main questionnaire survey on the components of an integrated model for evaluating e-SQUUX of a University web portal (UWP)?*

Chapter 6 set out to determine the value of a comprehensive pilot study in HCI evaluation studies, conducted by user-based questionnaire surveys. In particular, this study, Study 2A, was situated in the context of a University web portal and was the first part of the quantitative phase of the research. The entire questionnaire was tried out by the participants of the pilot study. Based on the results of the pilot, this was achieved by fulfilling the objectives of the chapter as provided in Section 6.1, namely:

1. To improve and correct the questionnaire by testing its design and feasibility on a small-scale survey.
2. To determine the reliability of the constructs in the questionnaire and, consequently, the reliability, to a limited scale, of the content validated version of the conceptual e-SQUUX Model, namely e-SQUUX Model V2.
3. To reflect on the value of a comprehensive pilot study in an HCI survey evaluation.

These objectives are discussed in Subsections 8.4.1 to 8.4.3, respectively.

8.4.1 Testing the design and feasibility of the questionnaire

As stated in Section 6.1, the main purpose of a pilot study is to test whether the questionnaire design is realistic and feasible (Connaway and Radford, 2016). Consequently, this phase of the research tested the contents of the questionnaire and its administration procedure.

Firstly, reliability testing resulted in modifications to six of 16 dimensions as discussed in Section 6.4.1. Secondly, in Section 6.5.1, it was explained that the questionnaire had to be restructured by shifting most of the profile related questions to the end of the questionnaire for the main study. As stated by Cottrell et al. *(*2015), the aim of doing this, is to ensure that participants respond to the actual evaluation before fatigue sets in. Other changes made, included editing of the terminology, incorporating of missing content, and improving the readability. An example was the addition of one critical response option that was missing in one of the profile questions. Moreover, certain other changes were made to the questionnaire to minimise the errors listed in Section 6.5.3. For example, some words or phrases were highlighted or bolded to make statements clearer.

Another major change related to the distribution process of the questionnaire for the main study was that an effort would be made to ensure that an increased proportion of male participants, as compared to females, would be included in the main study. A further change was that participants would be specifically requested to provide responses to all questions so as to avoid the occurrence of encountering missing values during data capturing and analysis. In addition, participants would be requested to exercise great care and concentration when answering questions and to avoid providing random answers to questions rather than responses that were not carefully thought through. This is highlighted in Section 6.3 where it was reported that one participant used a constant pattern to complete the questionnaire. This reduces the validity of the data.

8.4.2 Reliability of the constructs in the questionnaire

Section 6.4 provides a detailed account of how the reliability of the 16 dimensions, also known as constructs, was determined. It was advised by the statistician whom the researcher consulted, that at least 20 participants are required in order to accurately determine the reliability. This advice, coupled with the discussion in Section 6.2.1 (Sampling for the pilot study), resulted in the researcher's decision to use at least 25 participants. Consequently, data was collected from 29 participants, of which 26 questionnaires were usable for reliability testing. Given the literature consulted and the fact that the data collected in this study was sufficient to meet the objectives of the pilot study, it was confirmed that the minimum of 25 participants had been adequate for the pilot study.

As presented in Table 6.3, for each dimension, 25 or 26 usable records were processed. SPSS software was used to calculate the Cronbach alpha values for each of the dimensions. Of the 16 constructs, Table 6.3 shows that 12 (75%) were found to have alpha values that were greater than 0.6, which is the minimum value needed for a construct to be usable. Of these 12, 10 had values greater than 0.7, which is a cut-off point used by several researchers (Hertzog, 2008; Saiyidi, 2014; Sarstedt et al., 2014; Foroudi, Gupta and Sivarajah, 2018). In fact, these 10 dimensions had values greater than 0.8. Furthermore, Table 6.5 shows that one of the 12 dimensions, namely, Suitability and Relevance (13) could have its alpha value significantly increased if one of its items was removed. This change was made in the questionnaire for the main study (final questionnaire). For the four constructs that had values below 0.6, three of them, namely Effectiveness (8), Efficiency (9) and Navigation (10) could have their alpha values increased to more than 0.6 if one of the items was removed as discussed in Section 6.4. This meant that 15 (12 plus 3) dimensions (94%) could now acquire acceptable levels of reliability. This left one construct, namely Assurance and Credibility (5) that had an alpha value of less than 0.6 and had to be scrutinised further. As explained in Section 6.4, this dimension was modified with the hope of making it more reliable. These results demonstrated that pilot studies can be used effectively to improve the reliability of the constructs and hence performance in the main study.

8.4.3 Reflection: value of a comprehensive pilot study in a survey evaluation in the discipline of HCI

Table 8.3 presents a summary of the value that was empirically realised in this pilot study. The *Section* column refers to the section where the realisation was presented and/or discussed, while *Reference* column provides references to other literature sources where these items are discussed. The *Value item* column lists the values synthesised from literature by the researcher (see the *Reference column*) and realised as a result of the pilot study.

Table 8.3: A summary of the value that was empirically realised in this pilot study

#	Value item	Section	Reference
1	Test the data capturing and analysis tools to be used for the final study to determine if the process operates as expected.	3.9.1, 6.3	Deutschlander (2009)
2	Provide an indication of how easy or difficult it will be to get the required number of participants for the main study. This helps in determining whether the target (anticipated) number of participants would be acquired and hence justify the sampling plan.	3.9.1, 6.2.1, 6.7.2	Dillman, Sinclair and Clark (2014)
3	Determine how easy it will be to recruit representative participants. This helps in determining whether the target (anticipated) distribution of participants could be achieved, particularly in terms of gender.	6.2.1, 6.7.2 6.3, 6.7.4	Johanson and Brooks (2010)
4	Estimate the time required to complete the questionnaire.	6.2.2, 6.7.2	Deutschlander (2009), Dillman, Sinclair and Clark (2014) and Durand and Chantler (2014)
5	Observe how comfortable participants will be with the questionnaire.	3.9.1, 6.0.2, 6.22	Welman and Kruger (1999)
6	Determine the reliability of the constructs. This helped in the modification of constructs in order to improve their reliability prior to the main study.	6.4, 6.7.3,	Johanson and Brooks (2010)
7	Identify and edit syntax language errors, wording and omission errors within the questionnaire, to prevent encountering such issues during the main study when it would be too late to rectify them.	6.5.3, 6.7.1	Johanson and Brooks (2010), Durand and Chantler (2014) and Lazar et al. (2017)
8	Assist in removing ambiguous and confusing questionnaire content prior to the main study.	3.9.1, 6.5.5, 6.7.1	Durand and Chantler (2014) and Lazar et al. (2017)
9	Restructure the questionnaire to a more suitable format for the participants in order to meet the objective of the survey.	6.5.1, 6.5.5, 6.7.1,	Deutschlander (2009) and Durand and Chantler (2014)
10	Serve as a learning curve for the researcher in preparation of the main questionnaire.	6.1, 6.7.1	Connaway and Radford (2016)

In Chapter 6, reliability details of the dimensions that needed modifications, were identified as listed in Table 6.5. These included four dimensions that had Cronbach values that were less than the required minimum of 0.6. The values of those dimensions are bolded in Table 7.5. In all these categories, namely, Assurance and Credibility, Effectiveness, Efficiency and Navigation, their values increased greatly from 0.541, 0.478, 0.571 and 0.584 to 0.849 0.882 0.859 and 0.860, respectively, as shown in Table 7.5. Consequently, the reliability of these constructs changed their status from 'Not Acceptable' to 'Good' reliability. In addition, by removing one of the items in category 13 (Suitability and Relevance), its reliability increased from 0.689 to 0.879, that is, from 'Acceptable' to 'Good' reliability. Once again, all these cases demonstrate the usefulness of conducting a pilot study of this nature in HCI survey evaluations although these may be useful in other disciplines. The better results in the main study would not have been realised if a pilot stage had not been undertaken.

As promised in Section 6.5.2, on the user of ticks or crosses for participants to show their choice from the given options in the questionnaire, from the collected data it was not possible to make a conclusion as to which is a better option to use.

8.5 Validation of expert-reviewed e-SQUUX Model V2 by means of a user survey

Answer to Subquestion 4

The discussion in this section, based on Sections 7.4 and 7.5 of Chapter 7, reports how **Subquestion 4** below was answered:

4. *What are the components of an empirically validated integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of a University web portal (UWP)?*

8.5.1 Comparison of the reliability of the pilot and main studies

This section describes the empirical validation of e-SQUUX Model V3 that was undertaken in Study 2B, the quantitative main questionnaire survey. Section 7.4 presented the data for the re-assessment of the original e-SQUUX Model V2 that was conceptualised in Chapter 4. As presented in Table 7.5 (Comparison of reliability co-efficient alpha values of the pilot and main studies), at that stage in that section, the model contained 16 dimensions. There were 26 and 174 participants in the pilot and main study phases, respectively. One of the main findings was that due to the improvements resulting from the pilot study, there was a significant increase in the reliability of the dimensions in that the mean of the Cronbach alpha values of the 16 dimensions increased by 18% from 0.748 in the pilot study to 0.882

in the main studies. As seen in Table 7.5, this is confirmed by the fact that none of the alpha values for the main study was less than 0.7, the most frequently used cut-off value for a construct to be considered reliable (Foroudi, Gupta and Sivarajah, 2018). However, six (37.5%) of the pilot study constructs had been below this value, with four of the six below 0.6 (reliability 'Not acceptable'). The improvement in the main study shows that a comprehensive pilot study followed by corrections and refinements, can contribute greatly to improving the reliability of the study. This is in line with the findings from other studies (Hertzog, 2008; Venkatesh, Thong and Xu, 2012; Rea and Parker, 2014).

8.5.2 Factor analysis of e-SQUUX and its reliability and validity

Section 7.5 provided the results of the factor analysis that was undertaken on the three facets of e-SQUUX, namely, e-service quality, usability and user experience. For each facet, Exploratory factor analysis was undertaken using SPSS to determine its inherent factors. A principal component factor analysis was conducted with a Varimax rotation. As already stated in Chapter 7, for each facet, the following were determined to ensure the validity and reliability of the conceptual e-SQUUX Model:

1. Sampling adequacy: KMO cut-off value of 0.5.
2. Validity: Extracted factors for which Eigenvalues were greater than 1.
3. Validity: used Eigenvalues, screen plots and variances explained to determine the number of factors.
4. Validity: used 0.4 as the factor loading cut-off value for an item to load on a factor.
5. Reliability: reassessed the reliability of new factors.

Subsections of Section 7.5, specifically 7.5.1 to 7.5.6, provide the details of data analysis and results of this process for each of the facets. Section 7.5 also included the reliability of the newly formed factors in the form of Tables 7.10 (for e-SQ), 7.14 (UB) and 7.18 (UX). These tables show items for each of the factors. Table 8.4 presents a summary of the results, while Table 8.5 compares the number of factors and items before and after EFA.

__Table 8.4: Summary of exploratory factor analysis of facets of e-SQUUX: old and new factors__

	Facet	Before EFA			After EFA			
		#	Factors	n	#	Factors	n	Alpha
1	**e-Service quality (e-SQ)**	1	Information quality	4	1	Information quality	4	0.853
		2	Availability	5	2	Availability	3	0.811
		3	Responsiveness and Helpfulness	4	3	Responsiveness and Support	9	0.912
	(see Table 7.9)	4	Support	4				
		5	Security and Privacy	4	4	Security and Privacy	3	0.779
		6	Assurance and Credibility	5	5	Assurance and Credibility	4	0.843
			Sub-total	26		***Sub-total***	23	
2	**Usability (U or UB)**	1	Learnability	4	1	Understandability	2	0.914
		2	Efficiency	4	2	Efficiency and Navigation	7	0.902
		3	Navigation	3				
	(see Table 7.13)	4	Errors	4	3	Errors	4	0.852
		5	Interface design	4	4	Interface design	3	0.840
		6	Effectiveness	3		NA	NA	
			Sub-total	22		***Sub-total***	16	
3	**User experience (UX)**	1	Suitability and Relevance	3	1	Suitability and Relevance	4	0.875
		2	Satisfaction	4	2	Hedonic quality and Flexibility	12	0.934
	(see Table 7.17)	3	Flexibility and Personalisation	5				
		4	Pleasure	4				
			Sub-total	16		***Sub-total***	16	
Total factors:		**16 (before)**			**11 (after)**			
			Total items	**64**		**Total items**	**55**	

First, Table 8.4 shows the factors before and after EFA. Both Tables 8.4 and 8.5 show that before EFA, there was a total of 64 items (*n* column in Table 8.4) belonging to e-service quality (e-SQ), usability (UB) and user experience (UX) with 26, 22 and 16 items respectively. This was reduced to a total of 55, after EFA, made up of 23, 16 and 16 items, correspondingly. Similarly, the total number of factors (# column and *n* column in Table 8.4) reduced from 16 made up of 6, 6 and 4 factors belonging to e-SQ, UB and UX respectively, to 11 factors consisting of 5, 4 and 2 corresponding factors. Table 8.5 shows that there was a decrease of 31.3% in the number of factors and 14.1% in the total number of items. This is in line with most EFA studies (Heo et al., 2009; Saha, Nath and Salehi-Sangari, 2012; Jiang and Ji, 2014) where the number of factors and items reduce during this process.

Table 8.5: Comparison of the number of the factors and of items before and after EFA

	Number of Factors	**Number of items**			
		e-SQ	**UB**	**UX**	**Total**
Before EFA	16	26	22	16	64
After EFA	11	23	16	16	55
% decrease	31.3	11.5	27.3	0.00	14.1

Second, Table 8.4 shows that all of the 11 resultant factors after EFA, exhibited good reliability with alpha values greater than 0.8, the cut-off value for 'Good' reliability (see Table 6.4) except Security and Privacy with a value of 0.779, which can be described as 'Acceptable' reliability. Given this fact and that all factors complied with all requirements for validity as provided in the first paragraph of this subsection (8.5.2), it can be concluded that the newly formed factors of e-SQUUX fulfilled all the requirements for reliability and validity. That said, two issues are worthy of further discussion.

Firstly, while Learnability is one of the most listed components of usability (Nielsen, 1993; Yahya and Razali, 2015; Kous et al., 2018), it was surprising to find that the two items that referred directly to learning (from which Learnability is derived) did not load on any other factor nor load on their own, to form a factor. Rather, the other two statements related to Understandability loaded together. This meant that Learnability as a theme disappeared from the model. One of the causes of this could be because learning depended indirectly on, or was represented by, other factors that were already part of the model since each of its items cross-loaded to more than one factor. The other possibility, which may require further study, is that its conceptualisation was not appropriate. For example, there could be a hidden factor, to which it belongs, that is not part of the current model. However, it is important to point out that one of its items, Item 7.1 (It is easy to learn how to use WWWX on the first time of use) loaded strongly with a value of 0.66 on its own (see Table 7.12). This means that Learnability should continue to be part of this e-SQUUX. However, since a factor should have at least two items (Marsh et al., 2014; Garson, 2016), it was also deleted. That said, Understandability, which was initially part of Learnability and thus contributes to Learnability, continues to be part of the e-SQUUX Model, under usability.

Secondly, *Effectiveness* which is defined by the ISO as part of usability (ISO 9140: 1998) and hence of e-SQUUX, had to be removed as a factor. The main reason is that each of its items cross-loaded (see Table 7.12). Similar to Learnability, the reason could be that Effectiveness is a result of many other factors that are already included in the e-SQUUX design as it stands. However, further studies would be needed to establish this.

8.5.3 Factor analysis of e-SQUUX and its content validity

With respect to the content of each of the facets of e-SQUUX, namely, e-service quality, usability and user experience, further findings emerged. First, with regard to e-service quality (e-SQ), Table 8.4 shows that four of the six factors remained unchanged since all or most of the items that constituted the new factor were the same. These are identified using the fact that the name before and after EFA remained the same. For e-service quality, these are Information quality, Availability, Security and Privacy, and Assurance and Credibility. In addition, the remaining two factors namely, Responsiveness and Helpfulness, and Support merged smoothly to form a single factor that was named Responsiveness and Support, as explained in Section 7.5.1 (see Table 7.9). From these two observations, it can be concluded that there was much agreement between the conceptualisation of the factors of e-service quality by the researcher and the empirical evidence as a result of the EFA of the participants' data collected and analysed. That shows that the factors of e-service quality exhibited good content validity (Brod, Tesler and Christensen, 2009; Newman, Lim and Pineda, 2013).

Second, with regard to UX, Table 8.4 shows three of the four factors, namely, Satisfaction, Pleasure, and Flexibility and Personalisation, merged to form one factor Hedonic quality and Flexibility as explained in Section 7.5.5 in Chapter 7 (see Table 7.17). The remaining factor, Suitability and Relevance, remained intact. Similar to e-service quality, from these two observations, it can be concluded that user experience exhibited good content validity. This is further confirmed in that none of its 16 items was deleted.

Third, the level of content validity of usability was not as good as that of e-service quality and user experience. Table 8.4 shows that two of the six factors, namely, Errors, and Interface design remained intact. In addition, Efficiency and Navigation merged to form one factor named Efficiency and Navigation. However, Effectiveness was completely removed from the model since all its items were deleted during EFA and, likewise, two items related to Learnability were deleted to the extent that Learnability scaled down to Understandability, as already explained. Both of these points are explained in Section 8.5.2 and in Table 7.13 of Section 7.5.3 of Chapter 7. These two, plus the fact that 6 of its 22 items (27%) were deleted during the EFA, show that the conceptualisation of usability was not as good as that of the other two facets, namely e-service quality and user experience, and hence its content validity was lower than the other two. However, this is not necessarily a negative occurrence, since in several studies of this nature, it is regarded as advantageous to reduce the number of items in the model (Parasuraman, Zeithaml and Berry, 1988; Venkatesh et al., 2003; Zhang, Rau and Salvendy, 2010).

8.5.4 Components of a validated e-SQUUX Model V3 based on user survey

In Table 8.4, the 11 factors in the *After EFA* column for e-service quality, usability and user experience make up the validated e-SQUUX Model in a summarised form. This information is extracted from Tables 7.10 (for e-SQ), 7.14 (UB) and 7.18 (UX) of Chapter 7. Each of these tables shows the actual items that make up each factor, using item labels as they were assigned in the main questionnaire such as Qn14.2 or simply 14.2. Table 8.6 presents the detailed model in the form of the *Components of the validated e-SQUUX Model V3 as a result of the user survey*. It shows not only the item labels but also the actual items as both appeared in the questionnaire that was administered in the user survey. As already stated, it consists of a total of 55 items of e-SQ, UB and UX with 23, 16 and 16 items respectively.

Table 8.6: Components of the validated e-SQUUX Model V3 as a result of the user survey (see Table 8.4)

e-Service quality		
Dimensions	**Label**	**Item**
Information quality	Qn1.1	The portal's (WWWX) information is accurate.
	Qn1.2	The portal's information is current since it is continuously updated.
	Qn1.3	The portal's information is appropriate (suitable for its intended use).
	Qn1.4	The portal's information is adequate.
Availability	Qn2.1	The portal is reliable since it remains operational over time.
	Qn2.2	I can access the portal quickly wherever there is Internet access.
	Qn2.5	It is easy to access content (items/things I need) on the portal.
Responsiveness and Support	Qn2.4	I can easily contact the people I need by means of the portal (e.g. by portal's email facility).
	Qn3.1	The queries I submit online are responded to promptly.
	Qn3.2	The responses I get for online queries help me to solve the problems at hand.
	Qn3.3	The portal provides feedback where I require it.
	Qn3.4	The portal enquires whether I am satisfied with the feedback I receive for my queries.
	Qn5.1	When I am promised a service, it is fulfilled (carried out) as promised within realistic time (in reasonable or in good time).
	Qn6.1	The site offers support to problems that arise.
	Qn6.3	The support I receive is timely.
	Qn6.4	The site provides me with options for online self-service.
Security and Privacy	Qn4.1	I feel safe to make transactions on the site (portal or WWWX).
	Qn4.2	The site protects my personal information.
	Qn4.3	I have confidence in the organisation that owns the site.
Assurance and Credibility	Qn5.2	The process for carrying out transactions (e.g. making payments) is transparent since it is clear to me how it is done step by step.
	Qn5.3	The site gives me a sense of loyalty in the sense that I will reuse it in the future.
	Qn5.4	I trust WWWX.
	Qn5.5	I have confidence in WWWX.
Usability		
Dimensions	**Label**	**Item**
Understandability	Qn7.3	The language on the site is clear and easy to understand.
	Qn7.4	The site's content is legible (easy to read).
Efficiency and Navigation	Qn9.1	Once I have learned how to use WWWX, I take minimal time and energy to complete tasks successfully.
	Qn9.2	It is quick to find what I want on the site.
	Qn9.3	I can rapidly move back and forth through the pages of WWWX.

	Qn9.4	The site provides me with only the necessary information or features to perform the tasks I require.
	Qn10.1	WWWX has an intuitive and consistent navigation structure.
	Qn10.2	WWWX has effective search facilities.
	Qn10.3	At any time, I know where I am and where I want to go next on the site.
Errors	Qn11.1	The site is built in such a way that it prevents me from committing many errors.
	Qn11.2	The site does not allow me to commit serious errors.
	Qn11.3	If I make errors, I can easily recover from them.
	Qn11.4	Fault tolerance: the site is robust since it does not fail to function due to system generated or user errors.
Interface design	Qn12.2	The site has an attractive appearance.
	Qn12.3	The site uses colours appropriately.
	Qn12.4	The site's design portrays the corporate image of the organisation that owns it.
	User experience	
Dimensions	**Label**	**Item**
Suitability and Relevance	Qn13.1	The site is fit for the purposes it is intended to fulfil.
	Qn13.2	The services provided by the site match my current requirements.
	Qn13.3	The facilities on the site are in line with current information technology developments.
	Qn14.1	I quickly adopted (accepted) the use of this portal.
Hedonic Quality and Flexibility	Qn14.2	The portal inspires a positive attitude in me.
	Qn14.3	The portal enables me to achieve my online goals satisfactorily.
	Qn14.4	I am not frustrated when I use this site.
	Qn15.1	The site is portable since it can work well in different browsers.
	Qn15.2	The portal is interoperable since it can exchange and communicate information with other sites.
	Qn15.3	The site allows me to personalise (customise) it according to my preferences (personal needs).
	Qn15.4	When I use the site, I feel that I am in control.
	Qn15.5	The site enables me to collaborate with other users.
	Qn16.1	The site provides a pleasurable experience that invokes positive emotions in me.
	Qn16.2	The site is enjoyable to work with since it is interesting, stimulating, motivating, gratifying and fun to use.
	Qn16.3	I feel emotionally attached to the site.
	Qn16.4	I feel at ease when using WWWX.

To conclude this Section (8.5), based on data collected during the questionnaire survey among users, the e-SQUUX Model V3 was well validated by means of exploratory factor analysis.

Similar to other studies (Heo et al., 2009; Saha, Nath and Salehi-Sangari, 2012; Jiang and Ji, 2014; Hallak, Assaker and El-Haddad, 2018), after the EFA phase, the study moved on to structural modelling. The results of this are discussed in the next section (Section 8.6). Structural modelling is done for the following reasons:

- To determine how well items load on their respective constructs – the facets
- To determine the causal relationships between the facets
- To refine the e-SQUUX Model by way of reducing the number of items.

8.6 Proposed model: Partial least square – structural equation modelling (PLS-SEM) of e-SQUUX

Answer to Subquestion 5

The discussion in this section and Section 8.7.1, based on Sections 7.6 to 7.8 of Chapter 7, deal with how **Subquestion 5** below was answered:

5. *What is the structural model (relationships) of e-service quality, usability and user experience in the context of evaluation of a University web portal*?

In this section, the results of partial least square – structural equation modelling (PLS-SEM) of e-SQUUX are discussed. The actual results are provided in Sections 7.6 to 7.8. Section 7.6 presented the model estimation process. The assessment using PLS-SEM consists of two phases, namely, the measurement model and the structural model. Section 7.7 provided the results of the first phase, the measurement model, and Section 7.8 provided the second phase, the structural model.

In Chapter 7 Section 7.6, the 55 items (or indicators, as usually termed in PLS-SEM) of the three facets (termed latent variables (LVs) were loaded to SmartPLS version 3.0 (Ringle, Wende and Becker, 2015), a PLS-SEM software. They underwent several rounds of processing and refined the 55 items/indicators to 39 indicators, a reduction of 29.1%. One of the criteria used during the processing stage was cross-loading of indicators. According to Hair et al. *(*2016) and Wani et al. (2017), items that load on another latent variable (LV) with a value higher than the parent LV should be removed. Of the 55 items only one (Item 6.4) cross-loaded and was removed. Given that each item was theorised to belong to e-service quality, usability or user experience, this result justified the allocation of items to these different facets. This, yet again, confirms the reliability and content validity of the model. Though this study does not assume that the three facets are mutually exclusive, this finding vindicated the allocation of the 16 dimensions to the different facets (see Table 7.6 and the main questionnaire) by the current researcher and the HCI expert as explained in Chapter 8 Section 3.8.2.3 and the grouping of dimensions in the questionnaire.

Section 7.7 in Chapter 7 showed that the 39 indicators and their latent variables (that is, the three facets) complied with the minimum requirement for reliability and validity of a PLS-SEM measurement model. That is, the measurement model displayed internal consistency (reliability), and convergent and discriminatory validity as follows:

- Internal consistency: the smallest convergent reliability (CR) value of the three LVs was 0.921 (see Table 7.20) which was far higher than the recommended cut-off value of 0.7 (Saiyidi, 2014; Sarstedt et al., 2014; Foroudi, Gupta and Sivarajah, 2018).
- Convergence validity: the smallest value of 0.506 (see Table 7.21) of the average variance extracted (AVE) was more than the recommended minimum value of 0.5 (Venkatesh, Thong and Xu, 2012; Saiyidi, 2014; Hsu et al., 2017).
- Discriminatory validity: the highest Heterotrait-Monotrait (HTMT) ratio of correlations of 0.842 (see Table 7.22) was below 0.85 which is the recommended value for a more conservative measure (more ‘stringent’ value) of the significant level of discriminatory validity standard of HTMT.85 (Henseler, Ringle and Sarstedt, 2015; Garson, 2016).
- Despite meeting the three required criteria, as pointed out in Section 7.7.1, the loading of indicators on their respective LVs ranged from 0.606 to 0.844 (see Table 7.19) even though the preferred minimum value should be 0.7 (Hallak, Assaker and

El-Haddad, 2018). Though this was the case, it is proposed that for exploratory studies, such as this one, a minimum value of 0.6 can be used (Garson, 2016; Cordiglia and Van Belle, 2017; Lazar, Feng and Hochheiser, 2017).

- In fact, according to Hair et al. *(*2016), indicators with values between 0.4 and 0.7 may be retained if removing them does not result in improvement of AVE or CR values. This study has thus empirically demonstrated that, indeed, a reliable and validated measurement model can be achieved with a minimum cut-off value of 0.6, which is in line with the work of other researchers (Garson, 2016; Cordiglia and Van Belle, 2017; Lazar, Feng and Hochheiser, 2017) as already pointed out.

Since Section 7.7 showed that the minimum criteria for the PLS-SEM measurement model had been met, the researcher went on to assess the structural model in Section 7.8 since the former is a prerequisite for the latter (Hsu and Tsou, 2011; Hair et al., 2016). As already stated, structural model assessment seeks to determine the causal association between constructs by testing its regression paths (Foroudi, Gupta and Sivarajah, 2018). It is made up of two phases. However, some researchers, such as Sarstedt et al. *(*2014) and Shukla and Sharma (2018), recommend that before the two are undertaken, it should be determined whether there is possible collinearity between the LVs. This is done by determining the value of the variance inflation factor (VIF) as was presented in Section 7.8.1. It was found that the VIF values ranged from 1.00 to 1.82 (see Table 7.23) indicating that there is multicollinearity among the variables of the structural model, since all values were much lower than 3.3 (Hair et al., 2010; Kock and Lynn, 2012) as was used as the maximum cut-off value for this study. This meant that the structural model was suitable for assessment and the two phases of structural modelling could be undertaken. The first phase involved the determination of variance explained (R^2) for the endogenous constructs (see Section 7.8.2). The second phase measured the strength and significance of the structural model (Sarstedt et al., 2014; Foroudi, Gupta and Sivarajah, 2018) – see Section 7.8.2.

Common method bias (CMB), also known as common method variance (CMV) is "variance that is attributable to the systematic measurement error rather than study constructs that the measures represent" (Min, Park and Kim, 2016, p. 126). It occurs when errors in the value of the variance between responses is due to the instrument rather than the participants. Though there is ongoing debate as to whether it is real or a myth (Podsakoff, MacKenzie and Podsakoff, 2012; Kock, 2015), a test was undertaken to determine whether it existed in this resaerch or not. In PLS-SEM if the variance inflation factors (VIFs) are all less than 3.3 then there is no CMB (Kock, 2015). As stated, in Table 7.23, the VIF values ranged from 1.00 to 1.82, which shows there was no CMB since all values were less than 3.3.

The results in Section 7.8.2 showed that the coefficient of determination (R^2) values of the endogenous LVs, namely UX and SQ, were 72.1% and 45.1% respectively, which meant that the variance explained could be considered Substantial and Moderated, respectively (Chinn, 1998; Saiyidi, 2014; Wani et al., 2017). Consequently, these results suggest the following:

- Together, SQ and UB substantially (72.1%) explained the variance of UX.
- UX, on its own, moderately (45.1%) explained the variance of SQ.

Section 7.8.3 provided the results of the second phase of the structural model. This phase can be considered the ultimate phase in PLS-SEM. This phase seeks to determine the *strength* and *significance* of the paths in order to evaluate the nature of relationships between the constructs (Sarstedt et al., 2014). In this study, the constructs were the three facets of e-SQUUX, namely e-service quality, usability and user experience. The results in Section 7.8.3 show that the path coefficients were (see Table 7.25 and Figure 7.6):

- 0.442 for the relationship between SQ and UX.
- 0.487 for the relationship between UB and UX.
- 0.671 for the relationship between UB to SQ.

This demonstrated that the three relationships were positive and strong (Garson, 2016). Correspondingly, the t-values of the relationships were 5.753, 6.773 and 9.306 (see Table 7.25 and Figure 7.6), respectively, at a significance level of 0.05. This demonstrated that the three relationships were statistically significant since t-values above 1.96 are considered significant (Revythi and Tselios, 2017).

In summary, as stated in Section 7.8.3, the following conclusions were made:

1. e-Service quality (e-SQ) has a strong and significant positive effect on user experience (UX) ($\beta = 0.442$, $t = 5.753$, $p \leq 0.05$): this means that higher levels of e-service quality (e-SQ) were associated with higher levels of user experience (UX).
2. Usability (UB) has a strong and significant positive effect on user experience (UX) ($\beta = 0.487$, $t = 6.773$, $p \leq 0.05$): this means that higher levels of usability (UB) were associated with higher levels of user experience (UX).
3. Usability (UB) has a strong and significant positive effect on e-service quality (e-SQ) ($\beta = 0.671$, $t = 9.306$, $p \leq 0.05$): this means that higher levels of usability (UB) were associated with higher levels of e-service quality (e-SQ).

These three relationships, which include the measures of their strength and significance, summarise the answer to **Subquestion 5**, namely: *'What is the structural model (relationships) of e-service quality, usability and user experience in the context of evaluation of a University web portal?*' The structural model is also graphically illustrated by the diagrams in Figures 7.5 and 7.6 in Chapter 7. In line with Hair et al., 2016 (2016, p. 39) this is considered to be a first-order model since it shows the "a single layer of constructs".

These three relationships will be addressed in detail in the next section (Section 8.7), Subsection 8.7.1. In addition, the section includes a summary of the PLS-SEM e-SQUUX Model, that is, e-SQUUX Model V4, in which the content of its components and the relationships between them are discussed in detail.

8.7 Discussion of the PLS-SEM e-SQUUX Model

8.7.1 The relationships in the PLS-SEM e-SQUUX Model

8.7.1.1 e-Service quality has a strong and significant positive effect on user experience

In the context of this study, it was found that if high quality services are provided by a University web portal, its users – in this case, the students and staff – are likely to have positive user experiences. Other empirical studies, in different contexts, have produced similar findings (Wani et al., 2017; Jagannathan, Balasubramanian and Natarajan, 2018). For example, in their study of the relationship between service quality and user experience for travel websites, Wani et al. (2017) found that e-service quality (e-SQ) had a significant positive effect on users' experience with a system. However, they emphasised that the context of the study plays a role. For example, factors found significant for travel websites may be insignificant for others such as a University web portal. An interesting observation about their study and this research is that their path coefficient value of 0.403 was comparable to that in this study of 0.442. This is the case despite the fact that, in addition to the different contexts, the e-SQ and UX items used in both studies were different.

8.7.1.2 Usability has a strong and significant positive effect on user experience

This finding is in line with that by Napitupulu (2017), who found usability to have a significant and positive effect on satisfaction, which is part of user experience in the e-SQUUX Model. That study was undertaken for a university website, which is similar to a part of this research. The finding is also in line with the suggestion by Lee and Kozar (2012) that usability of a website is fundamental for positive user experience. The researcher has found it difficult to find other studies that related usability to user experience. Consequently, this identifies the need for further possible studies to close this gap.

8.7.1.3 Usability has a strong and significant positive effect on e-service quality

This finding is in line with those by a number of researchers (Caro et al., 2006; Nilashi et al., 2016; Napitupulu, 2017) whose empirical studies showed that usability had a significant and positive effect on e-service quality, though in different contexts to those of this study. The finding also supports findings in numerous studies (Barnes and Vidgen, 2000, 2001; Zeithaml, Parasuraman and Malhotra, 2002; Parasuraman, Zeithaml and Malhotra, 2005; Tate et al., 2007), which found usability to be one of the consistent contributors to e-service quality. In most cases, these studies used development scales for measuring e-service quality, for example, E-S-QUAL (Parasuraman, Zeithaml and Malhotra, 2005) and WebQUAL (Barnes and Vidgen, 2000), that have since been adopted in numerous other studies (Marimon et al., 2010; Paschaloudis, 2014; Pathania and Rasool, 2017).

While the empirical findings show that both UB and SQ significantly affect UX, it should be noted that UB has both a direct and indirect effect on UX. The value of the path coefficient of the direct effect between UB and UX is 0.487, which is marginally greater than that between SQ and UX of 0.442 (see Table 7.25). However, there is an indirect effect between the UB and UX variables via SQ which is calculated as the product of the path coefficients of the two paths (Hair et al., 2016) namely, UB to SQ and SQ to UX, resulting in 0.297 (0.671 x 0.442). Since the total effect is the sum of the direct and indirect effects (Hair et al., 2016), the total effect is the sum of 0.487 and 0.297, which is 0.784, meaning that the total effect of UB to UX is pronounced and much higher than the 0.442 between SQ and UX. It can thus be concluded that in this research usability had a greater influence on user experience than e-service quality did.

The fact that UB influences both e-SQ and UX, according to the structural model and consequently e-SQUUX V4, underscores the fundamental value and impact of usability. Although usability is currently less prominent than user experience in literature, it remains a key concept that underlay the interaction that the current participants had when they evaluated web portals.

8.7.2 Components of the proposed PLS-SEM e-SQUUX Model V4

Answer to Subquestion 6

The discussion in Subsections 8.7.2 through to 8.7.5 are primarily based on the results of Section 7.8 of Chapter 7 – the PLS-SEM e-SQUUX Model V4. Consequently, these sections report on the answer to **Subquestion 6**, namely:

6. *What are the final components of e-service quality, usability and user experience following the structural modelling of the three in the context of evaluation of a University web portal?*

Table 8.7 presents information about the proposed PLS-SEM e-SQUUX V4 model that emanated from PLS-SEM that was presented in Sections 7.8.2 and 7.8.3 of Chapter 7 and briefly discussed in Section 8.6 of this Chapter. For each of the three facets (latent

Table 8.7: Summary of the structural model components of e-SQUUX Model V4

Facet	**#**	**Factor after PLS-SEM**	**No. of items**	**Item labels (Original)**	***Theorised factor (original dimensions in V2)***	**Factors removed**
e-Service quality (e-SQ or SQ)	1	Availability	2	2.2, 2.5	*1. Availability*	• Information quality
	2	Responsiveness and Support	8	3.1, 3.2, 3.3, 3.4 ---------------- 6.1, 6.3 ---------------- 2.4, 5.1	*2. Responsiveness and Helpfulness* --------------------- *3. Support* --------------------- *NA*	
	3	Security and Privacy	2	4.2, 4.3	*4. Security and Privacy*	
	4	Assurance and Credibility	3	5.3, 5.4, 5.5	*5. Assurance and Credibility*	
	Sub total		**15**			
Usability (U or UB)	5	Efficiency and Navigation	7	9.1, 9.2, 9.3, 9.4 ---------------- 10.1, 10.2, 10.3	*6. Efficiency* --------------------- *7. Navigation*	• Understand-ability • Interface design
	6	Errors	3	11.1, 11.3, 11.4	*8. Errors*	
	Sub total		**10**			
User experience (UX)	7	Suitability and Relevance	3	13.1, 13.2, 13.3	*9. Suitability and Relevance*	
	8	Hedonic quality and Flexibility	11	14.2, 14.3 ---------------- 15.1, 15.2, 15.3, 15.4, 15.5, --------------- 16.1, 16.2, 16.3, 16.4	*10. Satisfaction* --------------------- *11. Flexibility and Personalisation* --------------------- *12. Pleasure*	
	Subtotal		**14**			
Total	**8**		**39**		**12**	

variables), namely, e-service quality, usability and user experience (e-SQUUX), the table shows the names of remaining factors (*Factor after PLS-SEM* column), previously referred to as dimensions, that were a result of the factor analysis process performed before SEM modelling (see Table 8.4). This is followed by the number of remaining items (*No. of items*), and the actual *Item labels* such as 2.2 and 2.5 for Availability, as they appeared in Table 7.5 in Chapter 7 and in the questionnaire in Appendix E-1.

Table 8.8 presents the components of e-SQUUX Model V4; it includes the actual item statements for each of the factors of each facet. V4 is based on the structural model (PLS-SEM) of e-service quality, usability and user experience (see Figures 7.5 and 7.6, and Table 8.7) based on the main questionnaire (see Appendix E-1) survey data. It shows the eight factors after PLS-SEM, and labels and items as they appeared in the questionnaire of the main survey. The three facets, namely e-service quality, usability and user experience respectively, include 15, 10 and 14 items as compared to 23, 16 and 16 in Table 8.6. The total number of items has thus decreased from 55 (Table 8.4) to 39 in Tables 8.7 and 8.8.

Table 8.8: Components of e-service quality, usability and of user experience Model V4 based on their structural model – e-SQUUX Model V4 (see Table 8.7)

e-Service quality		
Factor after PLS-SEM	**Label**	**Item**
Availability	Qn2.2	I can access the portal quickly wherever there is Internet access.
	Qn2.5	It is easy to access content (items/things I need) on the portal.
Responsiveness and Support	Qn2.4	I can easily contact the people I need by means of the portal (e.g. by portal's email facility).
	Qn3.1	The queries I submit online are responded to promptly.
	Qn3.2	The responses I get for online queries help me to solve the problems at hand.
	Qn3.3	The portal provides feedback where I require it.
	Qn3.4	The portal enquires whether I am satisfied with the feedback I receive for my queries.
	Qn5.1	When I am promised a service, it is fulfilled (carried out) as promised within realistic time (in reasonable or in good time).
	Qn6.1	The site offers support to problems that arise.
	Qn6.3	The support I receive is timely.
Security and Privacy	Qn4.2	The site protects my personal information.
	Qn4.3	I have confidence in the organisation that owns the site.
Assurance and Credibility	Qn5.3	The site gives me a sense of loyalty in the sense that I will reuse it in the future.
	Qn5.4	I trust WWWX.
	Qn5.5	I have confidence in WWWX.

Usability		
Factor after PLS-SEM	**Label**	**Item**
Efficiency and Navigation	Qn9.1	Once I have learned how to use WWWX, I take minimal time and energy to complete tasks successfully.
	Qn9.2	It is quick to find what I want on the site.
	Qn9.3	I can rapidly move back and forth through the pages of WWWX.
	Qn9.4	The site provides me with only the necessary information or features to perform the tasks I require.
	Qn10.1	WWWX has an intuitive and consistent navigation structure.
	Qn10.2	WWWX has effective search facilities.
	Qn10.3	At any time, I know where I am and where I want to go next on the site.
Errors	Qn11.1	The site is built in such a way that it prevents me from committing many errors.
	Qn11.3	If I make errors, I can easily recover from them.
	Qn11.4	Fault tolerance: the site is robust since it does not fail to function due to system generated or user errors.
User experience		
Factor after PLS-SEM	**Label**	**Item**
Suitability and Relevance	Qn13.1	The site is fit for its intended purpose.
	Qn13.2	The services provided by the site match my current requirements.
	Qn13.3	The facilities on the site are in line with current information technology developments.
Hedonic Quality and Flexibility	Qn14.2	The portal inspires a positive attitude in me.
	Qn14.3	The portal enables me to achieve my online goals satisfactorily.
	Qn15.1	The site is portable since it can work well in different browsers.
	Qn15.2	The portal is interoperable since it can exchange and communicate information with other sites.
	Qn15.3	The site allows me to personalise (customise) it according to my preferences (personal needs).
	Qn15.4	When I use the site, I feel that I am in control.
	Qn15.5	The site enables me to collaborate with other users.
	Qn16.1	The site provides a pleasurable experience that invokes positive emotions in me.
	Qn16.2	The site is enjoyable to work with since it is interesting, stimulating, motivating, gratifying and fun to use.
	Qn16.3	I feel emotionally attached to the site.
	Qn16.4	I feel at ease when using WWWX.

Discussing Table 8.7 further, the second last column shows the dimensions that formed expert-reviewed e-SQUUX Model V2 but also appeared in the questionnaire, and were not removed in the sequential processing of e-SQUUX up to V4. Furthermore, the *Factors removed* column shows the factors that were part of the e-SQUUX Model V3 after EFA (see Tables 8.4 and 8.6) but were removed during structural modelling when the 55 items were reduced to 39 indicators (see Sections 7.6 to 7.8 of Chapter 7). As stated, this removal reduced the number of factors from 11 (see Table 8.4) to 8 as shown in the # column in Table 8.7. The factors removed were (i) Information quality from e-service quality, and (ii) Understandability and (iii) Interface design from usability. This is because, during the SEM process, all the items that belonged to these dimensions were deleted. This result is in agreement with Hair et al. (2016) and Garson (2016) who posit that during structural modelling, especially in the case of exploratory studies, several indicators may be deleted, and consequently, the number and nature of factors will be affected. No factor was removed from user experience. The refinement process of the model leading to the reduction of the items to an optimal number was motivated by research such as Heberlein and Baumgartner (1978) and Cottrell et al. *(*2015) that showed that very lengthy questionnaires tend to receive lower response rates than shorter ones. Consequently, the present researcher reduced the number of items from 101 (named descriptors) in expert reviewed e-SQUUX Model V2 to 39 (termed indicators) in structural e-SQUUX Model V4 through a rigorous process.

Table 8.9 shows a comparison of validated (V3) and structural (V4) *e-SQUUX Models in terms of number of components.* While the validated e-SQUUX Model V3 in Table 8.6 consisted of 11 factors, the structural e-SQUUX Model V4 in Tables 8.7 and 8.8 consists of 8 factors which is a 27.3% reduction in the overall number of factors (dimensions) to consider for evaluation of e-service quality, usability and user experience. Secondly, the number of items reduced from 55 to 39 respectively, a reduction of 29.1%. This correspondingly leads to a 29.1% decrease in the length of the questionnaire. These results show that this stage of the study contributed greatly to refinement of e-SQUUX. Once again, as stated, this is in line with the methodological approach taken in this research whereby each sequential stage of the study aims to reduce the number of components in the model and consequently improve its validity.

Table 8.9: Comparison of the validated (V3) and structural (V4) e-SQUUX Models in terms of number of components

Model name	**Number of factors**	**Number of items/indicators**
Validated (V3)	11	55
Structural (V4)	8	39
% decrease	27.3%	29.1%

Although the focus of this research was not to determine the relationships between e-service quality, usability and user experience, the structural modelling technique contributed considerably to the refinement of the components of the model. In fact, models such as TAM (Davis, 1989; Davis, Bagozzi and Warshaw, 1989; Venkatesh and Bala, 2008; Wu and Chen, 2017), UTAUT (Venkatesh et al., 2003), and SERVQUAL (Parasuraman, Zeithaml and Berry, 1985), as mentioned in Section 2.2 of Chapter 2, used the same approach to develop the models.

Although Table 8.8 presents the basic answer to Subquestion 6, more detailed discussion of each of the three facets of proposed e-SQUUX Model V4 is presented in the next subsections (8.7.3 to 8.7.5). Some might query whether the continuous reduction in the number of categories/dimensions and corresponding questionnaire items is a benefit or a disadvantage. The researcher acknowledges this viewpoint and felt it necessary to discuss the content of the final proposed model (V4) in terms of the originally theorised dimensions that emerged from the expert-reviewed e-SQUUX Model V2. The dimensions in V2 are likely to be simpler to use than those in V4, especially by practitioners. For example in V4, the factor Hedonic Quality and Flexibility, replaces three factors in V2, namely, Satisfaction, Flexibility and Personalisation, and Pleasure (see Table 8.7). These three are easier to evaluate and comprehend, using their respective items, than the one factor in V4.

8.7.3 Dimensions of e-service quality and recommendations

Table 8.10 shows the *Original questionnaire item (indicators)* column that corresponds to each of the e-service quality *Item labels (Original)* column in Table 8.7. The *Original* dimension column in Table 8.10 corresponds with the *Theorised factor (original* *dimensions)* column in Table 8.7 and both show the original questionnaire dimensions. The # in Table 8.10 corresponds with the numbering of the 12 theorised factors in Table 8.7. With reference back to the originally conceptualised Dimensions of e-SQUUX, Table 8.10 shows that in e-service quality (e-SQ) five of the original six dimensions, namely (i) Availability (with 2 items) (ii) Responsiveness and Helpfulness (4 items), (iii) Security and Privacy (2 items), (iv) Assurance and Credibility (3 items) and (v) Support (2 items) – making up a total of 13 items, were not eliminated during the refinement process.

It should be noted that Items 2.4 and 5.1 that belong to V4 do not belong to a single original theorised dimension related to Responsiveness and Support (see Table 8.7), where they are indicated as NA (not applicable) in that column in Table 8.7. Consequently, these two items do not appear in Table 8.10.

Table 8.10: e-Service quality (e-SQ) theorised dimensions and their corresponding items (indicators) in the PLS-SEM e-SQUUX Model

#	Original dimension	Item label	Original questionnaire item (indicators)
1	Availability	2.2	I can access the portal quickly wherever there is Internet access.
		2.5	It is easy to access content (items/things I need) on the portal.
2	Responsiveness and Helpfulness	3.1	The queries I submit online are responded to promptly.
		3.2	The responses I get for online queries help me to solve the problems at hand.
		3.3	The portal provides feedback where I require it.
		3.4	The portal enquires whether I am satisfied with the feedback I receive for my queries.
3	Support	6.1	The site offers support to problems that arise.
		6.3	The support I receive is timely.
4	Security and Privacy	4.2	The site protects my personal information.
		4.3	I have confidence in the organisation that owns the site.
5	Assurance and Credibility	5.3	The site gives me a sense of loyalty in the sense that I will reuse it in the future.
		5.4	I trust WWWX (the portal that I am evaluating).
		5.5	I have confidence in WWWX.

The conditions for a dimension to remain and retain its name were that (i) it had at least two items left, (ii) the remaining items had content that still warranted the continued usage of that name. It was interesting to find that for five of the original six dimensions of e-service quality, these criteria were met. Furthermore, there were no random items (a set of items from different dimensions) that remained, despite the fact that the conceptualised model underwent several refinements. Indirectly, these findings also demonstrate that there was a high degree of content validity in the originally conceptualised model. In addition, apart from the Security and Privacy dimension, with two items, the other four had three to five items. This is important since a factor, a dimension, in this case, should comprise at least three items if psychometric tests such as reliability testing and factor analysis are to be performed. However, if this is not feasible, two items should be considered, especially for EFA (Hinkin, Tracey and Enz, 1997; Hair et al., 2016).

In summary, first, based on the *original dimension* column, this table shows that within the context of this research, designers, developers and managers of UWP should seriously consider the following as recommendations for design and as evaluation criteria:

- Ensure that the portal is always available and does not fail.
- The portal is helpful and responsive to the needs of the users.
- The security and privacy of the portal are of a high level.
- An assuring and credible web environment is provided to their users.
- User support is provided wherever and whenever it is needed.

These recommendations closely match the research findings by Parasuraman, Zeithaml and Malhotra (2005) and by Chang et al. (2014), who identified system availability, privacy, and fulfilment and support as main determinants of e-service quality. Similarly, Ladhari (2010), and Persad and Padayacheey (2015) identified security, credibility and responsiveness as some of the main characteristics of e-service quality. This further supports the findings of this (the present) research.

Second, the questionnaire items listed in the table may be used for their primary purpose of evaluation by researchers who need to assess University web portals (UWPs).

As already stated in Section 8.7.2, Table 8.7 showed that the Information quality dimension was removed from SQ. Consequently, it does not appear in Table 8.10. However, this result is related to a study by Nelson, Todd and Wixom (2005) who found no direct relationships between information quality and system quality, that included services offered. The reasons provided were that, first, a mere presence of information quality may not be sufficient to evoke a good system although its absence might create dissatisfaction. Second, as technologies evolve over time, augmented features, such as information quality, tend to become basic expectations to users and are thus not seen as important (Nelson, Todd and Wixom, 2005; Wani et al., 2017).

It is acknowledged that some designers, evaluators and other practitioners might prefer to use one of the earlier, more extensive, versions of e-SQUUX or, conversely, might evaluate from a specific perspective and apply only certain selected factors (dimensions) and their constituent items.

8.7.4 Dimensions of usability and recommendations

Table 8.11 is similar to Table 8.10 but refers to usability. Consequently, the description of column headers in both tables is the same. Table 8.11 shows that usability retained three of the original dimensions, namely (i) Efficiency (4 items), (ii) Navigation (3 items), and (iii) Errors (3 items) – resulting in a total of 10 items. It was interesting to find that only three (50%) of the six conceptualised dimensions were retained. The removed dimensions were (i) Learnability, (ii) Information quality, and (iii) Interface design (see Tables 8.6 and 8.7). First, during EFA, Learnability was reduced to Understandability. Then, during SEM, Understandability indicators were removed.

As explained in Section 8.5.3, this could be because learning depends on many other factors that are already part of the model, since each of its items cross-loaded to more than one factor. Another possible explanation is that, similar to the case with Information quality, as technologies evolve over time, augmented features eventually become less important as technology evolves (Wani et al., 2017). Consequently, this issue may require further studies. Nevertheless, as will be addressed in the concluding chapter, Chapter 9, e-SQUUX is customisable by individual users. Therefore, as stated, researchers and practitioners conducting evaluations with e-SQUUX may incorporate dimensions from earlier versions if they so desire. For example, Understandability can be used in a customised version of e-

SQUUX. Second, similar to Learnability, Effectiveness does not appear in Table 8.11 since all its factors were removed during EFA. The same explanation used for the removal of Learnability may be applicable to Effectiveness. Third, similar to Effectiveness and for the same possible reasons, Interface design was removed from the usability facet of e-SQUUX.

Table 8.11: Usability (UB) theorised dimensions and their corresponding items (indicators) in the PLS-SEM e-SQUUX Model

#	Original dimension	Item Label	Original questionnaire item (indicators)
6	Efficiency	9.1	Once I have learned how to use WWWX, I take minimal time and energy to complete tasks successfully.
		9.2	It is quick to find what I want on the site.
		9.3	I can rapidly move back and forth through the pages of WWWX.
		9.4	The site provides me with only the necessary information or features to perform the tasks I require.
7	Navigation	10.1	WWWX has an intuitive and consistent navigation structure.
		10.2	WWWX has effective search facilities.
		10.3	At any time, I know where I am and where I want to go next on the site.
8	Errors	11.1	The site is built in such a way that it prevents me from committing many errors.
		11.3	If I make errors, I can easily recover from them.
		11.4	Fault tolerance: the site is robust since it does not fail to function due to system generated or user errors.

In summary, first, based on Table 8.11, as in the case of e-service quality, within the context of this research, designers, developers and managers of UWPs should seriously consider the following as following as recommendations for design and as evaluation criteria:

- The portal performs its tasks efficiently.
- It is easy to navigate the portal.
- Errors are minimised and it is easy to recover when they occur.

These recommendations are in line with the research findings by Shaha et al. (2012) and Barnes and Vidgen (2006) that navigation and rapid access are important characteristics and should be investigated in website evaluation. This is further confirmed by the finding by Muqtadiroh et al. *(*2017) that both minimisation of, and recovery from errors and efficiency positively affect website usability.

Second, the questionnaire items listed in Table 8.11 may be used by researchers who need to evaluate UWPs.

8.7.5 Dimensions of user experience and recommendations

As with usability, discussed in the previous subsection (Section 8.7.4), Table 8.12 is similar to Tables 8.10 and 8.11 but this time discusses user experience. Table 8.7 shows that user experience (UX) retained all the four original dimensions, namely, (i) Suitability and

Table 8.12: User experience (UX) theorised dimensions and their corresponding items (indicators) in the PLS-SEM e-SQUUX Model

#	Original dimension	Item label	Original questionnaire item (indicators)
9	Suitability and Relevance	13.1	The site is fit for its intended purpose.
		13.2	The services provided by the site match my current requirements.
		13.3	The facilities on the site are in line with current information technology developments.
10	Satisfaction	14.2	The portal inspires a positive attitude in me.
		14.3	The portal enables me to achieve my online goals satisfactorily.
11	Flexibility and Personalisation	15.1	The site is portable since it can work well in different browsers.
		15.2	The portal is interoperable since it can exchange and communicate information with other sites.
		15.3	The site allows me to personalise (customise) it according to my preferences (personal needs).
		15.4	When I use the site, I feel that I am in control.
		15.5	The site enables me to collaborate with other users.
12	Pleasure	16.1	The site provides a pleasurable experience that invokes positive emotions in me.
		16.2	The site is enjoyable to work with since it is interesting, stimulating, motivating, gratifying and fun to use.
		16.3	I feel emotionally attached to the site.
		16.4	I feel at ease when using WWWX.

Relevance (3 items), (ii) Satisfaction (2 items), (iii) Flexibility and Personalisation (5 items) and (iv) Pleasure (4 items) – making up a total of 14 items.

Unlike the case with e-service quality and usability, none of the conceptualised dimensions were removed during the model refinement process that included EFA and SEM. This, yet again, affirms a good level of content validity of the e-SQUUX conceptualised model.

In summary, first, based on Table 8.12, as in the case of e-service quality, designers, developers and managers of UWPs should seriously consider the following as recommendations for design and as evaluation criteria:

- Develop sites that are suitable for, and relevant to, their intended purpose.
- Provide satisfaction to the users.
- Ensure that the sites are flexible in the way they handle user needs and allow for personalisation.
- Ensure that the sites are a pleasure to work with.

It should be noted that apart from Suitability and Relevance, the other three dimensions namely, Satisfaction, Flexibility and Personalisation, and Pleasure were each a subset of Hedonic quality before EFA was performed (see Table 8.7). Since hedonic quality is closely related to pleasure and emotions, in addition to other concepts such as fun, enjoyment, stimulation and personal needs (Diefenbach, Kolb and Hassenzahl, 2014; Hassenzahl et al., 2015), the researcher's recommendations above are supported in the literature. With respect to Suitability and Relevance, according to Vaananen-Vainio-Mattila, Oksman and Vainio (2007), user experience is greatly influenced by the suitability of the system to users' needs. Furthermore, according to Tseng, Jiao and Wang (2010, p. 175) "personalisation aims at effectively and efficiently satisfying individual needs" with the ultimate aim of improving user experience. The last two statements show support for the recommendation of this research that suitability, relevance and personalisation are indeed important components of user experience. Finally, in line with the recommendations of this research, according to Rusu et al. *(*2015), satisfaction, in particular, subjective satisfaction, is part of user experience.

Second, the questionnaire items listed in Table 8.12 may be used by researchers who need to assess UWPs.

8.8 Conclusion

This chapter discussed the results of this research, based on the data collected in Chapters 4 to 7 and Studies 1A, 1B, 2A and 2B, with the aim of answering the research subquestions. The chapter is structured according to the six subquestions. Since Section 8.1 is the introduction to the chapter, Sections 8.2 to 8.7 discuss Subquestion 1 to Subquestion 6 respectively. For each of these sections (8.2 to 8.7), a research question is given followed by discussion of the results. Thereafter, an elaboration of the answer to the research question is provided. However, before each subquestion, an indexed text in the format ‘Answer to Subquestion x’, where x is the subquestion number, was inserted. The intention of this is to make it easy for the reader to spot where each subquestion is discussed and answered.

After this discussion chapter, the next chapter provides the conclusion of the current research, where the main processes undertaken and what emerged out of this work is wrapped up.

Chapter 9: Conclusion

9.1 Introduction

As set out in the Section 1.4.1, the primary purpose of this mixed-methods research was initially to develop a conceptual integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications and then contextualise it to evaluation of a University web portal (UWP). Based on an extensive literature review of the components of e-service quality, usability and user experience, a conceptual integrated e-SQUUX Model was developed for evaluating Web-based applications. The model was then empirically refined through a sequential series of validations. First, it was content validated by a set of expert reviewers. Thereafter, in the context of a University web portal, a questionnaire survey was undertaken that included a comprehensive pilot study prior to the main survey. The main survey data was used to determine a validated model, using EFA, followed by a structural model, using PLS-SEM, that consisted of the components of the final e-SQUUX Model in the context of a University web portal. To achieve its purpose, a main research question and six subquestions were posed at the beginning of this research (Section 1.5). The main purpose of this chapter is to overview how the research questions were answered so as to meet the aim and objectives of this research. Furthermore, the chapter considers the contributions, recommendations, limitations, and possible future research directions.

Figure 9.1 shows the chapter layout. After this introduction (Section 9.1), Section 9.2 deals with answering the research questions, with Subsections 9.2.1 to 9.2.6 showing how each of the six Subquestions 1 to 6 were respectively answered. Thereafter, Section 9.3 highlights the theoretical (9.3.1), practical (9.3.2) and methodological (9.3.3) contributions of this research. This is followed by Section 9.4 that overviews the implementation of the Exploratory sequential design of this mixed methods research. Section 9.5 focuses on the overall validity, reliability and triangulation of this research. Thereafter, recommendations are provided in Section 9.6, followed by limitations and future research issues in Section 9.7. Finally, Section 9.8 concludes this study.

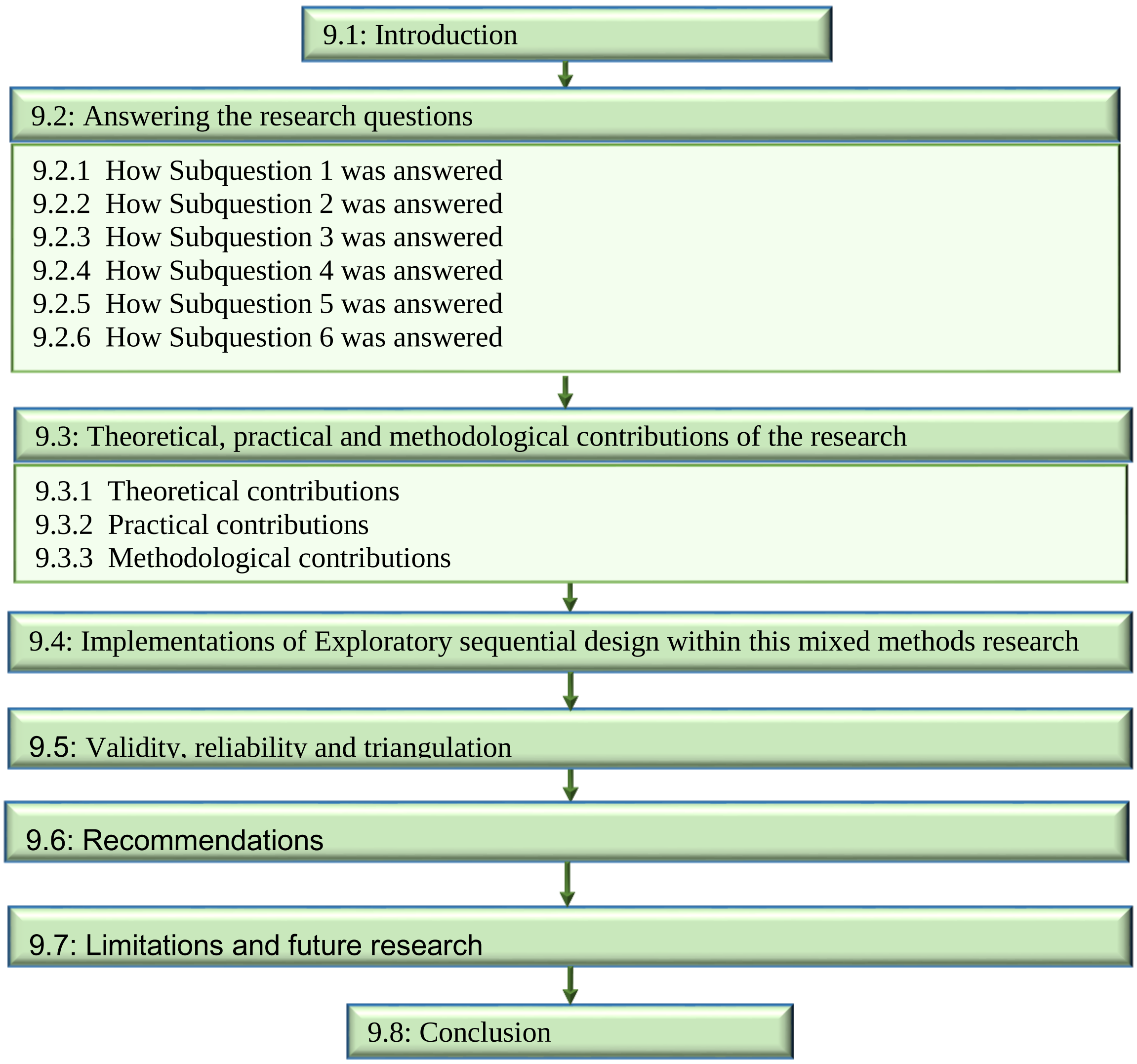


Figure 9.1: Layout of Chapter 9

9.2 Answering the research questions

As discussed with regards to Table 3.1 in Section 3.2 of Chapter 3, Table 9.1, which is a

Table 9.1: The research questions map for this thesis document

Main research question (see Section 1.5.1)

What are the components of a conceptual integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications, and of its validated and structural models that are suitable for evaluating a University web portal?

#	**Research subquestions (**see Section 1.5.2**)**	**Locations**				
		Study	**Main Chapter & e-SQUUX Model version**	**Section(s) in Chapter 3 (Methodology)**	**Sections in Discussion Chapter (8)**	**Sections in Introduction & Conclusion Chapters**
1	What are the components of a conceptual integrated model, synthesised from the literature, for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications?	Study 1A	Chapter 4 Version 1	Section 3.6	Section 8.2	1.5.2 1.8.2.1 9.2.1
2	What are the components of the conceptual integrated model for evaluating e-SQUUX of Web-based applications following an expert review?	Study 1B	Chapter 5 Preliminary and final Version 2	Section 3.7	Section 8.3	1.5.2 1.8.2.2 9.2.2
3	What is the value of a comprehensive pilot study prior to the main questionnaire survey on the components of an integrated model for evaluating e-SQUUX of a University web portal (UWP)?	Study 2A	Chapter 6 ---NA---	Sections 3.8 & 3.9	Section 8.4	1.5.2 1.8.2.3 9.2.3
4	What are the components of an empirically validated integrated model for evaluating e-SQUUX of a UWP?	Study 2B	Chapters 7 & 8 Version 3	Sections 3.8 & 3.10	Section 8.5	1.5.2 1.8.2.3 9.2.4
5	What is the structural model (relationships) of e-SQUUX in the context of evaluation of a UWP?	Study 2B	Chapters 7 & 8 ---NA---	Sections 3.8 & 3.10	Sections 8.6 & 8.7.1	1.5.2 1.8.2.3 9.2.5
6	What are the final components of e-service quality, usability and user experience following the structural modelling of the three in the context of evaluation of a UWP?	Study 2B	Chapters 7 & 8 Version 4	Sections 3.8 & 3.10	Sections 8.7.2 to 8.7.5	1.5.2 1.8.2.3 9.2.6

copy of Table 3.1, shows the research questions map of this thesis. It includes the main research question, namely:

> ***What are the components of a conceptual integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications, and of its validated and structural models that are suitable for evaluating a University web portal?***

In addition, the table shows Subquestions 1 to 6 and the locations in this thesis where they are addressed. For each subquestion, it shows the main chapter(s) and/or sections where they are dealt with, namely: the *Main Chapter* and version of the e-SQUUX Model that was the outcome of that chapter, the *Sections(s) in Chapter 3* (Research design and methodology) where the design considerations are made, the *Sections in the Discussion Chapter* (Chapter 8), and sections in the *Introduction & Conclusion Chapters* where the questions are introduced and concluded.

The next six subsections show how each of these were addressed. Chapter 8 has already discussed, in considerable detail, how each subquestion was answered. The discussions also included the outcomes of the various studies undertaken and their main findings. Consequently, this chapter provides only a concise overview of the answer to each question. By answering the subquestions, the main research question has been addressed.

9.2.1 How Subquestion 1 was answered

> ***What are the components of a conceptual integrated model, synthesised from the literature, for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications?***

As stated in Sections 1.2.5 and 1.3, the criteria used to evaluate e-service quality, usability and user experience of Web-based applications have certain common features and the three are geared towards meeting users' needs. However, it was established that a gap exists for an integrated model that can be used as a basis for evaluating them. As shown in Table 9.1, Section 3.6 of Chapter 3 describes how this was undertaken in Study 1A. A systematic literature review was conducted by identifying the dimensions of e-service quality, usability and user experience and integrating them. Barbara Kitchenham's guidelines for a systematic literature review (Kitchenham, 2004), were used as a basis for collecting and analysing the textual data. The entire Chapter 4 is dedicated to the qualitative Study 1A that answers Subquestion 1. As shown in the Map Table (Table 9.1), in this chapter, data analysis was performed to present results of the extensive data collection from many literature sources that were systematically analysed, to synthesise an integrated multi-dimensional conceptual model that can be used to evaluate e-service quality, usability and user experience of Web-based applications. As explained in Section 8.2, of the 509 total sources that were consulted, 264 were deemed relevant for analysis in this research. From a thorough analysis of these, an initial set of 723 dimensions arose. Through four reduction cycles, described in Section 4.4.3, the conceptual e-SQUUX Model V1 was developed comprising 24 categories, 75 main dimensions, and 163 associated dimensions. This model is provided in Table 4.18 and answers Subquestion 1. The main components of this model were the 24 categories, as provided in Table 9.2 and ranked from the most to the least frequent. Using the 264 sources as the base, the current researcher tallied the number of sources in which the concepts that comprise each dimension appeared. These respective totals were used as the frequencies, *f* column, in Table 9.2. They were used not only to rank the sources but to also assign a weight to each dimension in terms of percentages as shown in the *%* column. For each dimension, this is the percentage of its frequency to the sum of all the frequencies. The table shows, for example, that the dimension Learnability and Understandability was ranked 1st with a weight of 9.3%, and Motivation and Challengeability ranked 24th with a weight of only 0.9%. The weights helped to determine the degree of importance attached to each category.

Furthermore, Sections 4.4 described and illustrated the potential application of the conceptual e-SQUUX Model V1 (Figure 4.9). In addition, a published article, cited below, emanated from this part of the study.

> Ssemugabi, S. and De Villiers, M.R., 2016. Make Your Choice: Dimensionality of an Open Integrated Conceptual Model for Evaluating e-Service Quality, Usability and User Experience (e-SQUUX) of Web-Based Applications. In *Proceedings of SAICSIT, 2016, Annual Conference of the South African Institute of Computer Scientists and Information Technologists, Johannesburg, South Africa, 2016.* ACM.

Table 9.2: The main components of the conceptual e-SQUUX Model V1 – the 24 categories ranked according to their frequency and weight

Rank	**Categories**	**f**	**%**		**Rank**	**Categories**	**f**	**%**
1	Learnability and Understandability	181	9.3		13	Satisfaction	74	3.8
2	Flexibility and Personalisation	145	7.5		14	Accessibility	65	3.4
3	Efficiency	143	7.4		15	Navigation	62	3.2
4	Pleasure and Hedonics	131	6.8		16	Errors and Robustness	50	2.6
5	Responsiveness and Helpfulness	120	6.2		17	Maintainability	41	2.1
6	Reliability	117	6.0		18	Relevance and Suitability	41	2.1
7	Information Quality	116	6.0		19	Consistency and Innovativeness	37	1.9
8	Effectiveness and Usefulness	107	5.5		20	Competence	37	1.9
9	Interface design and Appearance	107	5.5		21	Aesthetics	27	1.4
10	Appeal and Attractiveness	98	5.1		22	Sociability and Collaboration	27	1.4
11	Security and Safety	87	4.5		23	Timeliness	21	1.1
12	Assurance and Credibility	85	4.4		24	Motivation and Challengeability	17	0.9
						Total	**1936**	**100**

9.2.2 How Subquestion 2 was answered

> ***What are the components of the conceptual integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications following an expert review?***

Although a systematic and rigorous process was followed to derive e-SQUUX Model V1 which had both theoretical and practical merits, as described in Chapter 4 and in Ssemugabi and De Villiers (2016), it was important to have it reviewed by experts to enhance its content validity. As previously stated in Section 5.6, the outcome of such a process is usually a more refined model that is easier for practitioners to apply. As indicated in the Map Table (Table 9.1), Section 3.7 showed how this was undertaken. Study 1B and the whole of Chapter 5 were dedicated to answering this subquestion. Four experts, consisting of three academics and one practitioner in Information Technology and/or HCI participated in this Study 1B. A template was used to collect data that was analysed to achieve the results.

In addition to scoring components in terms of their importance, suitability and relatedness, experts were free to add, remove, combine, separate or relocate components, or make any other adjustments. They, therefore, proposed a number of recommendations that are listed in Sections 5.4.1 to 5.4.9 resulting in a general decrease in the number of categories, main dimensions and associated dimensions in the new Provisional e-SQUUX Model PV2 (Table 5.34). The resulting model, produced by integrating the results of the rankings and suggestions data from the experts, consisted of 19 categories, 64 main dimensions and 125 associated dimensions. Since the original model (V1) consisted of 24 categories, 75 main dimensions and 163 associated dimensions, there was a decrease in the number of components by 21%, 15% and 23% respectively.

Thereafter, the resulting model (e-SQUUX PV2) was refined further as a result of the definitions of its components. By acquiring the definitions from the literature of the main dimensions of the provisional model and, to a lesser extent their associated dimensions, the researcher described each of these components in the form of statements named Descriptors. During this definition/description-making process, some changes were made to the expert-reviewed Provisional e-SQUUX Model PV2 as explained in Table 5.35. The outcome of this process was the final expert-reviewed e-SQUUX Model V2, in the form of Table 5.37, the main outcome of Study 1B. The new model contained 16 dimensions (previously called categories in model V1) and 55 defining dimensions (previously called main dimensions in model V1). e-SQUUX Model V2 resulted in decreases of 15.8% and 14.1% respectively, compared to the Provisional e-SQUUX Model PV2 (Table 5.33). The main components of this model were the 16 dimensions (which were termed Categories in Model V1) as provided in Table 9.3. Unlike Table 9.2, the numbering, in the # column, is arbitrary, since the expert review process was mainly qualitative in nature. The change in the naming of components was done from this point onwards, to make the model simpler and easier to understand compared to the previous Model V1, especially by those who may want to apply this version.

As stated in Section 5.5.3, this reduction is in line with a methodological approach undertaken in a number of previous Information Systems studies where each sequential stage of the study aims to improve its content validity by reducing the number of its components.

Table 9.3: The main components of the expert reviewed e-SQUUX Model V2 – the 16 dimensions

#	Dimensions		#	Dimensions
1	Learnability		9	Suitability and Relevance
2	Effectiveness		10	Errors
3	Efficiency		11	Assurance and Credibility
4	Information quality		12	Satisfaction
5	Availability		13	Flexibility and Personalisation
6	Navigation		14	Interface design
7	Responsiveness and Helpfulness		15	Pleasure
8	Security and Privacy		16	Navigation

In addition, for the 16 dimensions, there was a set of Descriptors ranging from 4 to 10 for each, totalling 101 (see Table 5.38). Since these can easily be converted into scale items in a measurement instrument, it made the model easier to apply in terms of evaluation of e-service quality, usability and user experience.

9.2.3 How Subquestion 3 was answered

What is the value of a comprehensive pilot study prior to the main questionnaire survey on the components of an integrated model for evaluating e-SQUUX of a University web portal (UWP)?

Study 2A on which Chapter 6 is based, set out to undertake a comprehensive pilot survey (prior to the main questionnaire) on the components of an integrated model for evaluating e-SQUUX in the context of a University web portal. This was achieved by carrying out the following, as stated in Section 6.1:

- Improving and correcting the questionnaire by testing its design and feasibility on a small-scale survey.
- Determining the reliability of the constructs in the questionnaire and, consequently, the reliability, to a limited scale, of the content validated version of the conceptual e-SQUUX Model, namely e-SQUUX Model V2
- Reflecting on the value of the value of a comprehensive pilot study in an HCI survey evaluation.

The full questionnaire was designed before the pilot study was undertaken. At this stage, following advice from a statistician who was consulted from this point of this research onwards, each of the 16 e-SQUUX dimensions was assigned to e-service quality, usability or user experience. The statistician advised this because the research questions would best be answered if the questionnaire was structured in that manner. This was indeed the case during statistical analysis, including validation stages of the model. A professor in Information Systems, with over 25 years in HCI research, and the current researcher performed this categorisation procedure. The result was that there were 6, 6 and 4 dimensions in e-service quality, usability and user experience categories, respectively. Each dimension had 4 to 5 items that were evaluated using a five-point Likert scale ranging from Strongly disagree (1) to Strongly agree (5). Apart from the evaluation questions, there were certain items related to the demographics of the participants.

The questionnaire was administered to 29 participants in the pilot study. Data was collected of which 26 datasets were usable. Reliability testing using Cronbach alpha values resulted in modifications to 6 of 16 dimensions as discussed in Section 6.4. In addition, the questionnaire for the main study was re-structured by shifting most of the profile related questions to its end. This was done to ensure that participants responded to the actual evaluation before fatigue set in. Table 8.3 shows that a total of 10 benefits were empirically realised in this pilot study. The table links each of the benefits to literature sources and to the actual sections in Chapter 6 where they were applied. The benefits demonstrate the value of conducting a comprehensive pilot study prior to the main questionnaire survey. These benefits, listed in Table 8.3, constitute the answer to Subquestion 3**.**

9.2.4 How Subquestion 4 was answered

> ***What are the components of an empirically validated integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of a University web portal (UWP)?***

Following the pilot study, a Main Questionnaire Survey (Study 2B) was conducted using the improved questionnaire. Data was collected over a period of one month from mid-May 2017, at six UNISA sites, entailing two campuses and four study centres. Once data was collected, the first process was data cleaning during which 22 of the 196 questionnaires collected from participants were eliminated. For the remaining 174 participants, 54% were female and 46% were male participants, 60% of them were in the age range of 25 to 40 years, and a great majority, 96%, had either average or expert computer skills. Though data was collected from students, academics and administrative staff, most participants (82%) were students. In terms of portal access and usage, of the three portals included in the survey, myUnisa was most used at 98%. In addition, it was found that 64% of the participants accessed the portals from UNISA premises (campuses or study centres).

At this stage, there were still 16 factors, corresponding to the dimensions in Table 9.3, made up of 6, 6 and 4 factors having 26, 22, 16 items of e-service quality, usability and user experience factors, respectively. Exploratory factor analysis was then performed on each of the three facets of e-service quality, usability and user experience, which led to considerable reduction of components. The result was 11 new factors made up of 5, 4 and 2 factors having 23, 16 and 16 items, respectively. Consequently, the number of items was reduced from 64 to 55. As showed in Table 8.4, the 11 factors exhibited good reliability with alpha values greater than 0.8, the cut-off value for 'Good' reliability (Table 6.4) except for the factor Security and Privacy that had a value of 0.779 which can be described as

'Acceptable' reliability. Given this fact and that all factors complied with all requirements for validity, it was concluded that the newly formed factors of e-SQUUX fulfilled all the requirements for reliability and validity. This resultant model after EFA, details of which are provided in Table 8.6, constitutes the components of the validated e-SQUUX Model V3 as a result of the user survey and, consequently, provides the answer to Subquestion 4.

The main components of V3 were the 11 factors (which were termed dimensions in Model V2) as provided in Table 9.4. Similar to Table 9.3, the numbering, in the # column, is arbitrary.

Table 9.4: The main components of the validated e-SQUUX Model V3 – the 11 factors

	Facet	**#**	**Factors**	**Number of items**
1	e-Service quality (e-SQ)	1	Information quality	4
		2	Availability	3
		3	Responsiveness and Support	9
		4	Security and Privacy	3
		5	Assurance and Credibility	4
2	Usability (UB)	1	Understandability	2
		2	Efficiency and Navigation	7
		3	Errors	4
		4	Interface design	3
3	User experience (UX)	1	Suitability and Relevance	4
		2	Hedonic quality and Flexibility	12
Total		**11**		**55**

9.2.5 How Subquestion 5 was answered

What is the structural model (relationships) of e-service quality, usability and user experience in the context of evaluation of a University web portal?

In order to refine the model further and investigate relationships between the three constructs, also called latent variables (LVs) in structural modelling equation (SEM), namely e-service quality, usability and user experience, structural modelling was conducted. The partial least square – structural equation modelling (PLS-SEM) technique was used for this purpose. SmartPLS Version 3 software was used for the actual processing. Structural modelling involved three stages as described in Section 7.6.

First, it dealt with the results of the model estimation phase of PLS-SEM. In this phase, through a number of software processing rounds, the number of items of e-SQ, UB and UX, which were 23, 16 and 16 respectively in e-SQUUX Model V3, were, correspondingly, reduced to 15, 10 and 14. This meant that the total number decreased from 55 to 39, a reduction of 29.1%. Similarly, the number of factors decreased from 11 to 8, a reduction of 27.3% as shown in Table 8.9.

Second, the first of the two assessment phases of PLS-SEM, namely the measurement model assessment phase, was performed as described and discussed in Sections 7.7 and 8.6, respectively. Third, the second of the two assessment phases of PLS-SEM, namely the structural model assessment that determines the causal relationships between the latent variables (LV), was performed as described and discussed in Sections 7.8 and 8.6, respectively. Within the scope of this research, the following conclusions were made (see Figure 9.2):

1. e-Service quality (e-SQ) has a strong and significant positive effect on user experience (UX) ($\beta = 0.442$, $t= 5.753$, $p \leq 0.05$): this means that higher levels of e-service quality (e-SQ) were associated with higher levels of user experience (UX).
2. Usability (UB) has a strong and significant positive effect on user experience (UX) ($\beta = 0.487$, $t= 6.773$, $p \leq 0.05$): this means that higher levels of usability (UB) were associated with higher levels of user experience (UX).
3. Usability (UB) has a strong and significant positive effect on e-service quality (e-SQ) ($\beta = 0.671$, $t= 9.306$, $p \leq 0.05$): this means that higher levels of usability (UB) were associated with higher levels of e-service quality (e-SQ).

These three relationships summarise the answer to **Subquestion 5**. The three relationships are graphically displayed in Figures 7.5 and 7.6 which are combined and shown in Figure 9.2.

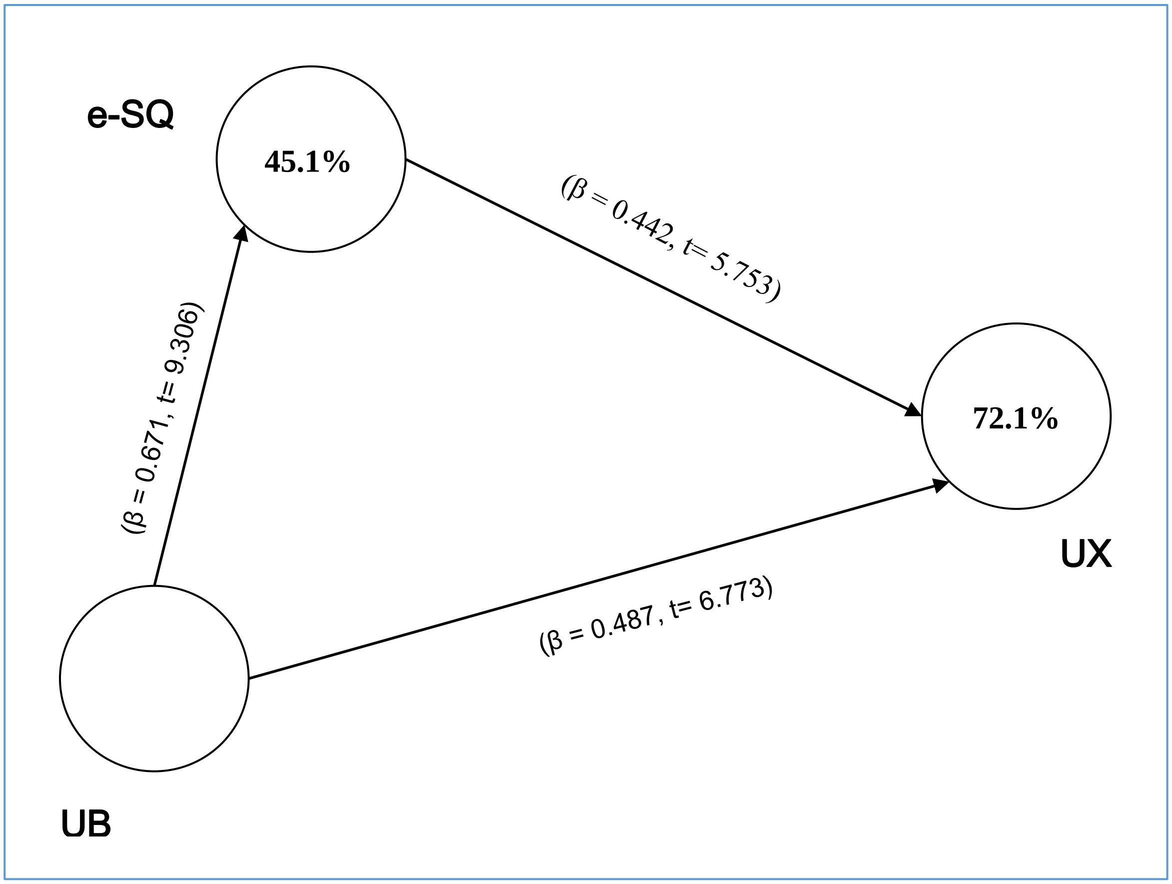


Figure 9.2: Path analysis model of e-SQUUX (Figures 7.5 and 7.6 combined)

9.2.6 How Subquestion 6 was answered

What are the final components of e-service quality, usability and user experience following the structural modelling of the three in the context of evaluation of a University web portal?

The aim of this question was to show the components of the proposed final version of the model. These are the details of the latent variables namely, e-service quality, usability and user experience following the structural modelling of the three in the context of evaluation of a University web portal. As presented in the previous section (Section 9.2.5), each of the three latent variables, which are the facets of the e-SQUUX Model, consists of a number of factors and items. These are the items (statements) that were in the main survey questionnaire but were not removed during the development and refinement processes up to the end. The components, including the factors and items of the three facets of the structural e-SQUUX Model V4 are presented and discussed in Chapter 8 as follows:

- e-Service quality: Table 8.10 and Section 8.7.3
- Usability: Table 8.11 and Section 8.7.4
- User experience: Table 8.12 and Section 8.7.5

In summary, Tables 8.10, 8.11 and 8.12 present the components of e-service quality, usability and user experience following the structural modelling of the three in the context of evaluation of a University web portal, and hence answer Subquestion 6. Table 9.5 presents a summary of the main components of the PLS-SEM e-SQUUX Model V4. Each row, with one of the eight PLS-SEM factors, also shows the corresponding theorised factors as they appeared in the questionnaire in the expert-reviewed e-SQUUX Model V2, in the form of dimensions.

Table 9.5: The main components of the PLS-SEM e-SQUUX Model V4

Facet	**#**	**PLS-SEM Factor**	Number of items	***Theorised factors (as per the original dimensions in e-SQUUX Model V2)***
e-Service quality (e-SQ or SQ)	1	Availability	2	*1. Availability*
	2	Responsiveness and Support	8	*2. Responsiveness and Helpfulness* *3. Support*
	3	Security and Privacy	2	*4. Security and Privacy*
	4	Assurance and Credibility	3	*5. Assurance and Credibility*
Usability (U or UB)	5	Efficiency and Navigation	7	*6. Efficiency* *7. Navigation*
	6	Errors	3	*8. Errors*
User experience (UX)	7	Suitability and Relevance	3	*9. Suitability and Relevance*
	8	Hedonic quality and Flexibility	11	*10. Satisfaction* *11. Flexibility and Personalisation* *12. Pleasure*
Total	**8**		**39**	**12**

Compared to e-SQUUX Model V3, the factors omitted are (i) Information quality from e-service quality, and (ii) Understandability, and (iii) Interface design from usability. This is because, during the SEM process, all the items that belonged to these factors were removed. This result agrees with the point made by Hair et al. (2016) who posit that during structural modelling, especially in the case of exploratory studies, several indicators may be deleted thus affecting the number and nature of factors.

As already stated, Sections 8.7.3 to 8.7.5 provide a detailed discussion of e-SQUUX Model V4 with corresponding details of the components of e-SQ, UB and UX in Tables 8.10, 8.11 and 8.12, respectively, that together form this model.

9.3 Theoretical, practical and methodological contributions of the research

9.3.1 Theoretical contributions

This research extended knowledge by developing and statistically validating a model that serves as a basis to understand and theorise the foundation of e-service quality, usability and user experience. Consequently, the research enriches the body of knowledge on IS and HCI by providing the e-SQUUX as an evaluation tool. This work generated the components of the e-SQUUX Model for WBAs and contextualised the model to a University web portal. Its structure and dimensionality were then examined through a sequential process entailing several research methods. e-SQUUX is a valid contribution to knowledge since it was developed from literature, hence it is grounded in existing theory, and was content validated by a set of expert reviewers. Furthermore, the contextualisation to a UWP involved execution of proven psychometric techniques, namely, EFA and PLS-SEM.

From a theoretical perspective, this study provided the multifaceted dimensions of the e-SQUUX model and coherently examined its structure and dimensionality through a number of research methods. First, on a conceptual level, the research theorised the six main generic WBA components of *e-service quality* (e-SQ), namely, (i) Information quality, (ii) Availability, (iii) Responsiveness and helpfulness, (iv) Security and privacy, (v) Assurance and Credibility, and (vi) Support (See questionnaire, or Table 8.6 in Section 8.5 of Chapter 8. Chk all these cross-refs). Similarly, it identified six components of *usability* (UB), namely, (i) Learnability, (ii) Effectiveness, (iii) Efficiency, (iv) Navigation, (v), Errors, and

(vi) Interfaces design. Furthermore, the four components of *User experience* (UX) were theorised, namely, (i) Suitability and Relevance, (ii) Satisfaction, (iii) Flexibility and personalisation, and (iv) Pleasure. Together, they total up to 16 integrated components. Second, through a qualitative expert review, followed by a quantitative survey, followed by EFA and structural modelling, the conceptual model was empirically refined to arrive at the validated proposed e-SQUUX model applicable to University web portals. The proposed validated model consisted of five of the six conceptualised components of e-service quality with the Information quality dimension removed. Similarly, three of the six components of usability, namely Learnability, Effectiveness, and Interfaces design were removed. However, all the user experience components remained as theorised.

To the current researcher's knowledge, almost no studies have comprehensively investigated the relationships between e-service quality, usability and user experience. This study has therefore addressed a gap in the literature and contributed to the theory on the relationships amongst these three, within the context of a University web portal.

9.3.2 Practical contributions

In addition to the theoretical contributions, several practical contributions emanated from this research. First, one of the major contributions is that, as far as the researcher is aware, no other study has integrated e-service quality, usability and user experience for the purpose of evaluating University web portals. For example, a study by Al-Khalifa (2014) concentrated only on evaluating the usability of university websites without due consideration of e-service quality and user experience.

Second, as discussed in Sections 8.7 and 9.6, this work can also serve as a set of design guidelines, since it provides recommendations and questions that practitioners should critically consider when designing UWPs. Similar questions may be relevant in other web-based domains. Developers, including designers and managers, should critically ask themselves questions aligned to these recommendations as they develop applications for their students and staff.

Third, the fact that UB and UX make up 72.1% of variance explained (R^2) of UX, means that designers and managers of UWPs should seriously take cognisance of these two factors. They should ensure that the portals they develop have a high level of usability and provide high-quality enjoyable e-services to their users or stakeholders, who, in a university context, are mainly students and staff.

Fourth, related to the third, some studies have found that designers do not provide proper user experience to their users (Al-Khalifa, 2014; Hassenzahl, 2018). The results of this study suggest that to achieve this, they need to include features that directly provide positive experiences, such as pleasure and satisfaction, in addition to good usability and quality e-services. This is in line with suggestions by Wani et al. (2017) and Law, Van Schaik and Roto (2014) that providers of websites should focus on all elements of the users' needs and thus provide a means to fulfil user expectations. This is important because positive user experience is a measure of system success.

Fifth, since the model was empirically validated, the 39 items in the structural model (Tables 8.10, 8.11 and 8.12 in Sections 8.7.3, 8.7.4 and 8.7.5, respectively) compositely provide a tool for evaluation of e-SQ, UB and UX. In particular, the items listed in the proposed PLS-SEM e-SQUUX Model for UWPs can be used by University web portal designers and managers to evaluate portals prior to release or prior to re-engineering.

Sixth, with specific reference to the e-SQUUX Model V1, apart from the description of the conceptual model, the research provided the 'Implementation framework of the e-SQUUX conceptual model' that was shown in Figure 4.12 of Chapter 4. This is a hierarchical model where Level 1 refers to the main categories, Level 2 to the main dimensions, and Level 3 to the associated dimensions. The last one, Level 4 is the implementation level. This level shows how each of the first three levels can be applied in practice. For example, Level 1 can be applied at Level 4 by writing criteria in the form of evaluation statements for each of the 24 dimensions, worded appropriately for the respective target group. For example, for the Category: Flexibility and Personalisation, the evaluation statement could be 'The site (or App) is flexible in the sense that I can personalise it to my own style'. In the use and application of the e-SQUUX conceptual model, the research takes cognisance of the fact that such models need to be domain- and context-specific. Stakeholders in both academia and industry can 'make a choice' on how best to use the model in their personal contexts. Components can be selected and customised to generate evaluation criteria for particular domains and web environments. The implementation in Figure 4.12 demonstrated how e-SQUUX can be the basis of a framework for evaluating Web-based applications. Furthermore, if appropriate for a particular highly-detailed evaluation, e-SQUUX Model V2 or Model V3 can be used.

9.3.3 Methodological contributions

The Exploratory sequential design (Creswell, 2014) applied during this research, based on the mixed methods research approach, where a qualitative phase is followed by a quantitative phase, displays a number of methodological contributions.

First, this research is an exemplar for developing an integrated evaluation model for specific facets or domains, and of its application (testing) in a particular context, in this case, a University web portal. The study applied a systematic literature review method to conceptualise such a consolidated model to integrate various concepts (i.e. facets). The process of identifying 509 publications in this literature review, then filtering out 264 relevant ones using a set of criteria, then identifying 723 dimensions of e-SQUUX, categorising them to 24 main components, was indeed a rigorous methodology for identifying an initial integrated set of components of e-service quality, usability and user experience. According to Okoli and Schabram (2010) and Pare et al. *(*2015) many researchers use only 5 to 15 publications to make their findings. However, since the three concepts investigated in this research are very extensive in both meaning and application (Hassenzahl et al., 2015; Kabir and Han, 2016; Ali, 2018) this work took a different approach, seeking to include as many relevant publications as possible, using Kitchenham's systematic literature review to build a conceptual model. This is recommended and can be emulated in other studies in HCI and IS research while determining the components of other concepts in particular fields.

Second, well-established psychometrics techniques, such as factor analysis and PLS-SEM were applied to validate it and determine the relationships between its variables. In particular, the research used psychometric criteria such as item and construct reliability, and content, construct and discriminatory validity as has been undertaken in several methodologically-related studies (Parasuraman, Zeithaml and Berry, 1985, 1988; Joo and Lee, 2011; Venkatesh, Thong and Xu, 2012; Obonyo, Okeyo and Kambona, 2018). These techniques enhanced the reliability and validity of the work and reduced the 24 main components to 16, then to 11, and finally to 8.

Third, the research made use of PLS-SEM, a variance-based SEM method that is relatively new compared to a covariance-based one (Hair, Ringle and Sarstedt, 2012; Hair et al., 2016). Furthermore, a recently developed new technique, HTMT (Henseler, Ringle and Sarstedt, 2015), was used to determine discriminatory validity. In addition, one of the most popular and recent software systems, SmartPLS Version 3 (Ringle, Wende and Becker, 2015), was used as the structural modelling tool. These tools and techniques brought innovation to the analysis process. Other researchers can make use of both of these psychometric approaches for statistical analysis and interpretation of quantitative survey data, particularly because they have brought more flexibility in the volume of data required for validation and modelling, and the manner in which data analysis is conducted (Hair et al., 2016; Henseler, 2017; Wani et al., 2017). One of the main advantages is that a much smaller number of participants' data (questionnaire records) is required for the same statistical inferences and models, compared to the traditional statistical techniques.

In conclusion, it is hoped that this research will be transferable and serve as a precedent for development and validation of integrated evaluation models for e-service quality, usability, user experience and for other attributes of WBAs in general and for specific types of portals, in particular.

9.4 Implementations of Exploratory sequential design within this mixed methods research

This section reflects on the research design that was applied in this research as described in Chapter 3. A set of issues that should be considered for any research design were provided at the beginning of Section 3.5. Thereafter, the specific characteristics of the design used in this research, namely, Exploratory sequential design (ESD), were provided in 3.5.2. The cornerstone characteristic of ESD is that a qualitative study is undertaken during the first phase and its findings are used to undertake a quantitative study during the second phase.

Section 3.4.2 provided the main characteristics of mixed methods research as posited by Mertler (2016). These are repeated in Table 9.6 which shows how they were implemented in this study, which is based on the Exploratory sequential design of this mixed-methods research.

In line with Exploratory sequential designs, the findings of the qualitative work in this research, influenced the subsequent quantitative study. e-SQUUX Model V1 originated from the primary data (textual data) acquired in the literature review, and was then refined to e-SQUUX Model 2 in the qualitative expert review. Section 5.6 reports that potential Likert-scale questionnaire items were derived from the definitions and meanings of the categories in e-SQUUX Model V2. In this way, the questionnaire that provided the quantitative data for analysis in Phase 2 emerged from the qualitative foundations of Phase 1. These questionnaire items/statements, in turn, facilitated the design of a practical evaluation instrument as presented in Section 3.8.2.

Table 9.6: Mixed-methods research characteristics and how they were implemented in this Exploratory sequential design

Characteristic (Mertler, 2016)	**Implementation in this research**
Collects and analyses rigorously both qualitative and quantitative data, based on research questions.	Studies 1A and 1B, that form the first phase of the research, collected qualitative data that was analysed in Chapters 4 and 5 respectively. The data was rigorously analysed to arrive at e-SQUUX Model V1 and V2, respectively. Study 2A served as a pilot study for Study 2B that was the main part of the second phase of the research that collected quantitative data that was presented in Chapters 7 and 8 to arrive at e-SQUUX Models V3 and V4. Each of the studies and the resulting models are based on specific research subquestions as shown in the research question map Table 9.1 and explained in Section 9.2
Mixes by integrating or linking the two forms of data either concurrently by combining or merging them, sequentially by having one build on the other, or embedding one within the other.	Since this study is based on an Exploratory sequential design, the qualitative data is sequentially linked to the quantitative data. The qualitative phase resulted in a generic model (V2) for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications. This model was used as an input to the quantitative phase that customised it first to Model V3, then to a more refined web-based Model V4 that is suitable for evaluating e-SQUUX of a University web portal.
Gives priority to one or to both forms of data, again based on the research questions.	In this research, both qualitative and quantitative data were equally important. This is the case even though numerically-ranked data was collected and used in Study 1B, which was in the qualitative phase.
Use the qualitative and quantitative procedures for collecting data in a single research study or in multiple phases of a program of research.	In an Exploratory sequential design, a qualitative phase is conducted first, followed by a quantitative phase and thus multiple phases are used in a program of research. Studies 1A and 1B were mainly in the qualitative phase while Studies 2A and 2B collected and statistically analysed data for the quantitative phase.
Frames the procedures within philosophical worldviews.	As has been stated in Section 3.3.5, the pragmatic worldview is the most suitable for the mixed methods research and it was used in this research. Interpretivist-based methods in the form of systematic literature review and expert model reviews were used initially, since these are appropriate when there is a need to understand the context of the information system where the context and the system influence each other. Thereafter, a positivist-based method, a questionnaire survey, was applied during the refinement and validation of the e-SQUUX Model in the environment of a University web portal.
Combines the procedures into specific research designs.	In this mixed-methods research, the qualitative and quantitative procedures for collecting data were undertaken using Exploratory sequential design after due consideration of alternative research designs, such as design science research (DSR) and case study designs as used in previous similar studies (see Section 3.5).

Table 9.7 is an overview of the e-SQUUX Model components evolution. It shows the studies and the components of the e-SQUUX that resulted from each of them such as categories, dimensions, factors, items and indicators.

Table 9.7: Overview of the e-SQUUX Model components evolution

Studies		**Components**				
Study name	**Study description**	**e-SQUUX model**	**Number of facets**	**Level 1**	**Level 2**	**Level 3**
Study 1A	Systematic literature review	V1	None	24 Categories	75 Main dimensions	163 Associated dimensions
Study 1B	Expert review	PV2	None	19 Categories	64 Main dimensions	125 Associated dimensions
		V2	None	16 Dimensions	55 Main dimensions	101 Descriptors
Study 2A	Pilot study for the questionnaire survey	-	3	3 Facets	16 Dimensions • 6 (e-SQ) • 6 (UB) • 4 (UX)	64 Items • 26 (e-SQ) • 22 (UB) • 16 (UX)
Study 2B	Main study of the questionnaire survey	V3 (Validated model)	3	3 Facets	11 Factors • 5 (e-SQ) • 4 (UB) • *2 (UX)*	55 Items • 23 (e-SQ) • 16(UB) • 16 (UX)
		V4 (SEM-PLS model)	3	3 Facets (latent variables)	8 Factors • 4 (e-SQ) • 2 (UB) • 2 (UX)	39 Indicators • 15 (e-SQ) • 10 (UB) • 14 (UX)
		V4	3	3 facets (core concepts)	12 Factors (original dimensions) • 5 (e-SQ) • 3 (UB) • 4 (UX)	39 Items • 13 (e-SQ) • 2 (undefined) • 10 (UB) • 14 (UX)

9.5 Validity, reliability and triangulation

Section 3.11 dealt with the theory related to reliability, validity and triangulation. Table 9.8 revisits these three and shows how the relevant concepts were implemented in this research.

Table 9.8: How validity, reliability and triangulation were implemented in this research

Concept	**Type**	**Implementation in this research**
Validity of qualitative data	Content validity	As presented in Chapter 4, a systematic literature review was undertaken using a specific set of accredited guidelines (protocol). Previous literature was used to create components, thus ensuring that the content of e-SQUUX V1 was grounded in existing established theory. As described in Chapter 5, an expert review of the components of the conceptual model was undertaken to ascertain content validity. As also mentioned in Chapter 5, the researcher made certain modifications to the components of the expert-reviewed model, based on specific definitions of the model components from the literature.
	Face validity	Experts assessed the face validity of the components of the conceptual model as they assessed its content validity. This is also addressed in Chapter 5.
Reliability of qualitative data	Accuracy of data collection and interpretation	All experts used the same template during data collection in the expert review study. One person (the current researcher) interpreted the data from the reviewers.
Validity of quantitative data	Content validity	As presented in Chapter 6, a well-qualified and experienced HCI researcher worked with the researcher to allocate dimensions to each core facet of the questionnaire, namely, e-service quality, usability and user experience A statistician was contacted, when necessary, from the design phase of the questionnaire to the end of the study.
	Face validity	As explained in Chapter 6, a comprehensive pilot study was undertaken to try out the data gathering procedures and content of the survey questionnaire, and to gauge the views of participants on its design and content.
	Construct validity	Both convergence and discriminant validity tests were undertaken as described in Chapters 7 and 8.

		Exploratory factor analysis using SPSS was conducted to determine construct validity, using Kaiser-Meyer-Olkin (KMO) sampling adequacy, Eigen values and factor loading values. A partial least square – structural equation modelling (PLS-SEM) technique using SmartPLS software was used to determine • Convergence validity: based on average variance extracted (AVE) values • Discriminant validity: based on Heterotrait-Monotrait (HTMT) ratio of correlations values.
	External validity	The large sample of 174 participants in the survey was considerably greater than the recommended number of 100 according to PLS-SEM recommendations.
Reliability of quantitative data	Reliability	As stated in Chapters 6, 7 and 8, internal consistency (reliability) was carried out using both Cronbach's alpha (Alpha) and composite reliability (CR) values.
Triangulation	Data triangulation	Both qualitative and quantitative data were used during data analysis.
	Investigator triangulation	Even though only one researcher (the current researcher) carried out this research, other researchers such as some of the expert reviewers, played crucial roles in the foundation stages of this investigation.
	Theory triangulation	Theories emanating from IS, HCI and marketing research were used in this work.
	Methodological triangulation	More than one method of data collection was used.

9.6 Recommendations

The original conceptual e-SQUUX Model V1 that was synthesised from literature provides a wide range of generic components that are useful as a basis for evaluations of the e-service quality, usability and user experience of Web-based applications. The model is thus 'open' and customisable, in that practitioners and researchers can make their own personal selection from its components to synthesise an implementation of the model to be used as an evaluation framework.

The recommendations by the four expert reviewers provided insights into pertinent issues for using e-SQUUX to evaluate WBAs. This indicates how important it is that a researcher or practitioner using e-SQUUX as an evaluation tool, should first fully understand the theoretical components before applying them.

One of the main outcomes of this research is that each of the versions, V1 to V4, can be of use depending on the nature of what is required as an evaluation tool. In certain situations, it might be preferable to use an earlier version of e-SQUUX rather than the final one. This is particularly the case when multiple fine-grained items are required to evaluate a section of a UWP in great detail. The comprehensive V1 can be used in the same way as V2, except that V2 is more compact and concise since it was content validated by experts. Similarly, the further reduced versions, e-SQUUX V3 and V4, can be employed as frameworks for evaluating University web portals. Both exhibited good reliability and have been statistically validated. However, V4 comprises only 39 items, and is therefore much easier to implement than V3 with 55 items, since according to Heberlein and Baumgartner (1978) and Cottrell et al. *(*2015) an evaluation model or scale should not consist of too many items, unless removing them dilutes the content of the model. For this reason, the compact V4 was put forward as the final proposed e-SQUUX for evaluating UWPs.

Based on V4, sets of essential recommendations were provided in Sections 8.7.3, 8.7.4 and 8.7.5 of Chapter 8. They are consolidated and repeated here. Within the scope of this research, designers, developers and managers of UWPs should use e-SQUUX to ensure that:

1. Portals perform their tasks efficiently.
2. It is easy to navigate a portal.
3. Errors are minimised and that it is easy to recover when they occur.
4. Portals are suitable for, and relevant to, their intended purpose.
5. User satisfaction is achieved.
6. Portals are flexible in the way they handle user needs and allow for personalisation.
7. Portals are a pleasure to work with.
8. Portals are always available and do not fail.
9. Portals are helpful and responsive to the needs of the users.
10. The security and privacy of the portal are of a high level.

11. An assuring and credible web environment is provided to portal users.
12. User support is provided wherever and whenever it is needed.

9.7 Limitations and future research

According to Ghosh (2018) and Saha, Nath and Salehi-Sangari (2012), every research project undertaking has its limitations. Notwithstanding that a number of contributions have been made by this research (Sections 9.3.1 to 9.3.4), it has limitations too, some of which require further investigation.

The first limitation concerns generalisability of the findings. Like certain other studies such as that by Udo, Bagchi and Kirs (2011), one of the limitations of the present work is that the participants came from a single institution. However, firstly, since it is an open distance e-learning (ODeL) university, it has over 350 000 registered-students spread not only over the nine provinces of South Africa but globally too. Secondly, participants included not only students but also academic, support and administrative staff. Thirdly, three portals, namely Staff, myUnisa (the university's learning management system (LMS) used by both staff and students), and the Library web portals were included in the evaluation by survey participants using e-SQUUX. Fourthly, data was collected at six different UNISA locations in different regions of South Africa, including the two main campuses. Furthermore, two of the sites were rural and the other four urban. All these measures strengthened the spread of cross-sectional data collected and helped to minimise bias. Despite these efforts, the survey findings are not generalisable. Further research could investigate how the findings would be affected if other universities, within South Africa or even worldwide, were involved in the survey.

In addition to generalisability, certain other limitations exist, also presenting possible directions for further studies. Second, one of the main limitations is that this research was an exploratory study. Further research needs to be carried out to test the findings in other settings in order to confirm its reliability and validity, most probably by using CFA and PLS-SEM for data analysis.

Third, closely related to the second limitation, the survey part of the research was undertaken in a mandatory context of use with students and staff as the respondents, since they are respectively compelled to use the portals for their studies and workplace activities. Further research should consider a voluntary context to test the boundary conditions of the proposed model. A related matter is that the survey focused only on official university websites. Since the use of mobile Apps is increasing, future studies should include other IS domains such as mobile Apps used by university stakeholders. Although this would be a different medium, it is probable that there would not be great differences between a model developed to evaluate mobile Apps and the proposed e-SQUUX Model, since the three facets apply equally to the two types of portals.

Fourth, e-SQ and UB explained 72.1% of UX. Further studies could explore whether there are other factors that could be added to these two to increase the explanatory percentage.

Fifth, according to Venkatesh (2012) and Wu and Chen (2017), there is a significant body of IS research that has showed that behaviour intention (BI) results in actual use of a system. Further studies could set out to determine how the three core facets of the present work relate to BI and hence to actual use of a portal. Of the three, it would be particularly important to determine how UX relates to BI since the other two (e-SQ and UB) have been shown to contribute greatly (72.1%) to UX, in this research. A further future study direction, that was outside the scope of this research, is to determine the moderating effect of variables such as age and gender on the relationships between the endogenous latent variables, namely, e-SQ and UX.

Even though during the different stages of the sequential refinement of e-SQUUX, e-service quality, usability and user experience were operationalised using a number of items (see Models V1 to V4), the researcher does not claim that these three facets are mutually exclusive. However, the PLS-SEM e-SQUUX Model V4 satisfied the discriminatory validity criterion. For example, although user experience was operationalised using 14 items belonging to four dimensions, namely Suitability and Relevance, Satisfaction, Flexibility and Personalisation, and Pleasure, the study does not claim that these are the minimum or maximum sets of components of UX. This is because UX is highly multifaceted and difficult to measure (Agarwal, Meyer and Alto, 2009; Kujala, Roto, Väänänen-vainio-mattila, et al., 2011; Hassenzahl et al., 2015).

9.8 Conclusion

This mixed-method research set out to develop an integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) for Web-based applications and then contextualising it to evaluating University web portals. This was achieved by answering a set of research questions as summarised in Section 9.2. In the process of doing this, a number of theoretical, practical and methodological contributions were realised and recommendations made. It is hoped that this research generated new insights for both researchers and practitioners in the HCI and IS fields. The researcher believes that this research is distinct, and is one of a kind, in its effort to develop an evaluation model that integrates three vital concepts in HCI, and indeed in IS, namely e-service quality, usability and user experience.

References

Abran, A., Khelifi, A., Suryn, W. and Seffah, A. (2003) ‘Usability meanings and interpretations in ISO standards’, *Software Quality Journal*, 11(4), pp. 325–338. Available at: http://link.springer.com/article/10.1023/A:1025869312943 (Accessed: 30 August 2013).

Abras, C., Maloney-krichmar, D. and Preece, J. (2004) ‘User-Centered Design’, *Encyclopedia of Human-Computer Interactio*. Sage publications.

Acharya, R. N., Kagan, A., Lingam, S. R. and Gray, K. (2008) ‘Impact of website usability on performance : a heuristic evaluation of community bank homepage implementation’, *Journal of business and economics research*, 6(6), pp. 139–148.

Adams, A. and Cox, A. L. (2008) ‘Questionnaires, in-depth interviews and focus groups’, in *Research Methods for Human Computer Interaction*, pp. 17–34. doi: 10.1017/CBO9780511814570.003.

Agarwal, A., Meyer, A. and Alto, P. (2009) ‘Beyond Usability : Evaluating Emotional Response as an Integral Part of the User Experience’, in *CHI’09 Extended Abstracts on Human Factors in Computing Systems*, pp. 2919–2930.

Agarwal, R. and Venkatesh, V. (2002) ‘Assessing a firm’s web presence: a heuristic evaluation procedure for the measurement of usability’, *Information systems research*, 13(2), pp. 168–186.

Agosto, D. E., Bell, J. P., Bernier, A., Agosto, D. E. and Kuhlmann, M. (2015) ‘“ This Is Our Library, and It ’s a Pretty Cool Place ”: A User-Centered Study of Public Library YA Spaces’, *Public Library Quarterly*, 34(1), pp. 23–43. doi: 10.1080/01616846.2015.1000777.

Ajzen, I. and Fishbein, M. (1980) ‘A theory of reasoned action: Some applications and implications’, in *Symposium on Motivation*. University of Nebraska Press. Available at: https://scholar.google.co.za/scholar?q=theory+of+reasoned+action+theory+Ajzen+%26+

Fishbein%2C+1980+&hl=en&as_sdt=0%2C5&as_ylo=1980&as_yhi=1980 (Accessed: 21 June 2015).

Al-Khalifa, H. S. (2014) ‘A framework for evaluating university mobile websites’, *Online Information Review*, 38(2), pp. 166–185. doi: 10.1108/OIR-12-2012-0231.

Al-Momani, K., Azila, N. and Noor, M. (2009) ‘E-Service Quality, Ease of Use, Usability and Enjoyment as Antecedents of E-CRM Performance: An Empirical Investigation in Jordan Mobile Phone Services’, *The Asian Journal of Technology Management*, 2(2), pp. 50–63. doi: 10.1093/molbev/msh125\rmsh125 [pii].

Alexander, R., Murray, D., Engineering, N. T.I. S. and 2017, U. (2017) ‘Cross-Cultural web usability model’, in *Conference on Web Information Systems Engineering*. springer, pp. 75–89. Available at: https://link.springer.com/chapter/10.1007/978-3-319-68786-5_6.

Ali, H. (2018) ‘Measurement of e-services quality: an empirical study of University of Bahrain’, *Education and Information Technologies*. Springer, pp. 1–18. doi: 10.1007/s10639-018-9775-6.

AllAboutUX (2015) ‘All about UX: Information for user experience professionals’. Available at: http://www.allaboutux.org/virpiroto (Accessed: 1 March 2015).

Alshamayleh, H., Aljaafreh, R., Aljaafreh, A. and Albadayneh, D. (2015) ‘Measuring the quality of E-services and its impact on students satisfaction at Jordanian universities’, *Journal of Theoretical and Applied Information Technology*, 74(3), pp. 274–285.

Andargoli, A. E., Scheepers, H., Rajendran, D. and Sohal, A. (2017) ‘Health information systems evaluation frameworks: A systematic review’, *International Journal of Medical Informatics*. Elsevier Ireland Ltd, 97(1), pp. 195–209. doi: 10.1016/j.ijmedinf.2016.10.008.

Anderson, P. (2018) ‘Usability evaluation and redesign recommendations for MyNet portal thesis guidelines’. Available at: https://www.theseus.fi/bitstream/handle/10024/149231/son Polina_ Usability evaluation and redesign recommendations for MyNet portal thesis guidelines.pdf?sequence=1 (Accessed: 15 March 2018).

Andrei, A. G., Zait, A., Vătămănescu, E. M. and Pĭnzaru, F. (2017) ‘Word-of-mouth generation and brand communication strategy: Findings from an experimental study explored with PLS-SEM’, *Industrial Management and Data Systems*, 117(3), pp. 478–495. doi: 10.1108/IMDS-11-2015-0487.

Arain, M., Campbell, M. J., Cooper, C. L. and Lancaster, G. A. (2010) ‘What is a pilot or feasibility study? A review of current practice and editorial policy’, *BMC Med Res Methodol*, 10(1), pp. 1–7. doi: 10.1186/1471-2288-10-67.

Aranyi, G. and Van Schaik, P. (2015) ‘Modeling user experience with news websites’, *Journal of the Association for Information Science and Technology*, 66(12), pp. 2471–2493. doi: 10.1002/asi.23348.

Ardito, C., Buono, P., Caivano, D., Costabile, M. F. and Lanzilotti, R. (2014) ‘Investigating and promoting UX practice in industry: An experimental study’, *International Journal of Human Computer Studies*. Elsevier, 72(6), pp. 542–551. doi: 10.1016/j.ijhcs.2013.10.004.

Arif, M., Ameen, K. and Rafiq, M. (2018) ‘Factors affecting student use of Web-based services: Application of UTAUT in the Pakistani context’, *Electronic Library*, 36(3), pp. 518–534. doi: 10.1108/EL-06-2016-0129.

Ariffin, Z. Z., Heng, K. T., Yaakop, A. Y., Mokhtar, N. F. and Mahadi, N. (2017) ‘Conceptualizing GHEN Y online shopping behaviour: Integrating Task Technology Fit (TTF) Model and extended technology’, in *Proceeding of ICARBSS 2017*, pp. 330–338. Available at: https://www.researchgate.net/profile/Azizul_Yaakop/publication/322518379_Conceptualizing_Gen_Y_Online_Shopping_Behaviour_Integrating_Task-Technology_Fit_TTF_Model_and_Extended_Technology_Acceptance_Model_TAM/links/5a5d70d4aca272d4a3dd9a28/Conceptualizing-.

Avgerou, C. and Cornford, T. (1998) *Developing information systems: concepts, issues and practice*. Macmillan International Higher Education.

Ayo, C. k., Oni, A. A., Adewoye, O. J. and Eweoya, I. O. (2016) ‘E-banking users’ behaviour: e-service quality, attitude, and customer satisfaction’, *International Journal of Bank Marketing*, 34(3), pp. 347–367. doi: 10.1108/IJBM-12-2014-0175.

Ayyub, B. M. and McCuen, R. H. (2016) *Probability, Statistics, and Reliability for Engineers and Scientists*. CRC Press. doi: 10.1201/b12161.

Aziz, A. S., Salam, A. S. N., Ariffin, A. M. and Ismail, S. (2016) ‘Validating an integrated multimedia presentation conceptual model through expert reviews’, *Journal of Telecommunication, Electronic and Computer Engineering*, 8(8), pp. 161–163. doi: 10.1080/09500690110066485.

Bahry, F. D. S., Anwar, N. and Amran, N. (2012) ‘Predicting intended to use of Web portal Using Extended Technology Acceptance Model (TAM) Some perspective on Information Management students’, *Ieee Symposium on Business, Engineering and Industrial Applications (Isbeia 2012)*, pp. 229–234. doi: 10.1109/ISBEIA.2012.6422875.

Balapour, A. and Walton, S. M. (2017) ‘Usability of Apps and Websites : A Meta-Regression Study’, in *Twenty-third Americas Conference on Information Systems*, pp. 1–10.

Baran, R. (2016) ‘How Marketers Conduct Mixed Methods Research: Incorporating the Exploratory Sequential’, in *Mixed Methods Research for Improved Scientific Study*. IGI Global., pp. 187–197. doi: 10.4018/978-1-5225-0007-0.ch010.

Barnes, S. J. and Vidgen, R. (2001) ‘An Evaluation of Cyber-Bookshops: The WebQual Method’, *International Journal of Electronic Commerce*, 6(1), pp. 11–30. doi: 10.1080/10864415.2001.11044225.

Barnes, S. and Vidgen, R. (2000) ‘WebQual: an exploration of website quality’, in *ECIS 2000 Proceedings*, pp. 74–83. Available at:

https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1050&context=ecis2000.

Barnes, S. and Vidgen, R. (2002) 'An integrative approach to the assessment of e-commerce quality', *Journal of Electronic Commerce Research*, 3(3), pp. 114–127. doi: 10.1080/00223891.2013.770400.

Barnes, S. and Vidgen, R. (2004) 'The E-Qual approach to evaluating E-commerce Quality'. Available at: https://kar.kent.ac.uk/34834.

Barnes, S. and Vidgen, R. (2005) 'Data triangulation in action: using comment analysis to refine web quality metrics', in *ECIS 2005 Proceedings*, p. 24. Available at: https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1007&context=ecis2005.

Barnes, S. and Vidgen, R. (2006) 'Data triangulation and web quality metrics: A case study in e-government', *Elsevier*, 43(6), pp. 67–777. Available at: https://www.sciencedirect.com/science/article/pii/S037872060600053X.

Barnett, L., Harvey, C. and Gatzidis, C. (2018) 'First Time User Experiences in mobile games: An evaluation of usability', *Entertainment Computing*. Elsevier, 27(March), pp. 82–88. doi: 10.1016/j.entcom.2018.04.004.

Baskerville, R., Baiyere, A., Gergor, S., Hevner, A. and Rossi, M. (2018) 'Design Science Research Contributions: Finding a Balance between Artifact and Theory', *Journal of the Association for Information Systems*, 19(5), pp. 358–376. doi: 10.17705/1jais.00495.

Bennett, J. L. (1984) 'Managing to meet usability requirements', in *Terminals: Usability Issues and Health Concerns*. rentice-Hall, pp. 161–184.

Bevan, N. (1995) 'Measuring usability as quality of use', *Software Quality Journal*, 4(2), pp. 115–130. doi: 10.1007/BF00402715.

Bevan, N. (2006) 'Intertnational standards for HCI', *Encyclopedia of Human Computer Interaction*. Available at: http://www.google.no/books?hl=no&lr=&id=h9iZh_I1YREC&pgis=1.

Bevan, N. (2009) ‘What is The Difference Between The Purpose of Usability and User Experience Evaluation Methods?’, in *Interact 2009 conference, User Experience Evaluation Methods in Product Development (UXEM’09), Uppsala, Sweden*, pp. 1–4. doi: 10.20982/tqmp.09.2.p079.

Bevan, N., Carter, J., Earthy, J., Geis, T. and Harker, S. (2018) *Human-Computer Interaction. Theories, Methods, and Human Issues*. Springer International Publishing. doi: 10.1007/978-3-319-91238-7.

Bevan, N., Carter, J. and Harker, S. (2015) ‘ISO 9241-11 revised : What have we learnt about usability since 1998?’, in *International Conference on Human-Computer Interaction*. Springer, pp. 143–151.

Bevan, N. and Macleod, M. (1994) ‘Usability measurement in context’, *Behaviour & information technology*, 13(1–2), pp. 132–145.

Bevan, N. and Raistrick, S. (2011) ‘ISO 20282 : Is a Practical Standard for the Usability of Consumer Products Possible ?’, in *International Conference of Design, User Experience, and Usability*, Heidelberg, pp. 119–127.

Bhattacharya, D., Gulla, U. and Gupta, M. P. (2012) ‘E-service quality model for Indian government portals: Citizens’ perspective’, *Journal of Enterprise Information Management*, 25(3), pp. 246–271. doi: 10.1108/17410391211224408.

Booth, R. G. (2012) ‘Examining the functionality of the DeLone and McLean information system success model as a framework for synthesis in nursing information and communication’, *CIN: Computers, Informatics, Nursing*, 30(6), pp. 330–345. Available at: https://journals.lww.com/cinjournal/Abstract/2012/06000/Examining_the_Functionality_of_the_DeLone_and.9.aspx.

Borsci, S., Federici, S., Bacci, S., Gnaldi, M. and Bartolucci, F. (2015) ‘Assessing User Satisfaction in the Era of User Experience: Comparison of the SUS, UMUX, and UMUX-LITE as a Function of Product Experience’, *International Journal of Human-Computer*

Interaction. Taylor & Francis, 31(8), pp. 484–495. doi: 10.1080/10447318.2015.1064648.

Bressolles, G. and Nantel, J. (2004) ‘Electronic service quality: A comparison of three measurement scales’, in *Proceedings of the 33 th EMAC Conference*, pp. 1–7. Available at: http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Electronic+Service+Quality:+A+Comparison+of+Three+Measurement+Scales#0.

Bringula, R. P. and Basa, R. S. (2011) ‘Factors Affecting Faculty Web Portal Usability’, *Journal of educational technology & society*, 14(4), pp. 253–265.

Brod, M., Tesler, L. E. and Christensen, T. L. (2009) ‘Qualitative research and content validity: Developing best practices based on science and experience’, *Quality of Life Research*, 18(9), pp. 1263–1278. doi: 10.1007/s11136-009-9540-9.

Bron, M., Redi, M., Lalmas, M., Silvestri, F., Evans, H. and Chute, M. (2017) ‘Friendly, Appealing or Both?: Characterising User Experience in Sponsored Search Landing Pages.’, *WWW (Companion Volume)*, pp. 699–707. doi: 10.1145/3041021.3054193.

Burgess, L. (2004) ‘A Conceptual Framework for Understanding and Measuring Perceived Service Quality in Net-based Customer Support Systems’, in *CollECTeR LatAm Conference*. Available at: http://pdf.aminer.org/000/304/459/a_conceptual_framework_for_e_tailing_quality_and_its_evaluation.pdf.

Calero, Æ. C., Caballero, Æ. I., Piattini, Æ. M., Caro, A., Calero, C., Caballero, I. and Piattini, M. (2008) ‘A proposal for a set of attributes relevant for Web portal data quality’, *Software Quality Journal*, 16(4), pp. 513–542. doi: 10.1007/s11219-008-9046-7.

Calero, C., Cachero, C., Córdoba, J. and Moraga, M. Á. (2007) ‘PQM vs . BPQM : Studying the Tailoring of a General Quality Model to a Specific Domain PQM vs . BPQM : Studying the Tailoring of a General Quality Model to a Specific Domain’, in *International Conference on Conceptual Modeling*, pp. 192–201. doi: 10.1007/978-3-

540-76292-8.

Caro, A., Calero, C., Caballero, I. and Piattini, M. (2006) ‘Defining a Data Quality Model for Web Portals’, in *Web Information Systems -- WISE 2006: 7th International Conference on Web Information Systems Engineering Proceedings*, pp. 363–374. doi: 10.1007/11912873_38.

Caro, A., Calero, C., Caballero, I. and Piattini, M. (2008) ‘A proposal for a set of attributes relevant for Web portal data quality’, *Software Quality Journal*, 16(4), pp. 513–542. doi: 10.1007/s11219-008-9046-7.

Carrasco, R. A., Sánchez-Fernández, J., Muñoz-Leiva, F., Francisca Blasco, M. and Herrera-Viedma, E. (2017) ‘Evaluation of the hotels e-services quality under the user’s experience’, *Soft Computing*. Springer Berlin Heidelberg, 21(4), pp. 995–1011. doi: 10.1007/s00500-015-1832-0.

Cebi, S. (2013) ‘A quality evaluation model for the design quality of online shopping websites’, *Electronic Commerce Research and Applications*. Elsevier B.V., 12(2), pp. 124–135. doi: 10.1016/j.elerap.2012.12.001.

Chan, G. W. W., Cheung, C. M. K., Kwong, T., Limayem, M., Zhu, L., Kwong, T., Chan, G. W. W. and Limayem, M. (2003) ‘eTransformation Online Consumer Behavior : A Review and Agenda for Future Research’, in *16th Bled eCommerce Conference*, pp. 194–218. Available at: http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1112&context=bled2003.

Chang, S. F., Chang, J. C., Lin, K. H., Yu, B., Lee, Y. C., Tsai, S. B., Zhou, J., Wu, C. and Yan, Z. C. (2014) ‘Measuring the Service Quality of E-Commerce and Competitive Strategies’, *International Journal of Web Services Research*, 11(3), pp. 96–115. doi: 10.4018/ijwsr.2014070105.

Chen, W. and Hirschheim, R. (2004) ‘A paradigmatic and methodological examination of information systems research from 1991 to 2001’, *Information systems journal*, 14(3), pp. 197–235.

Chen, Y.-H., Germain, C. A. and Rorissa, A. (2009) 'An analysis of formally published usability and Web usability definitions', in *Proceedings of the American Society for Information Science and Technology*, pp. 1–18. doi: 10.1002/meet.2009.1450460213.

Chen, Y. H. and Chengalur-Smith, I. (2015) 'Factors influencing students' use of a library Web portal: Applying course-integrated information literacy instruction as an intervention', *Internet and Higher Education*. Elsevier Inc., 26, pp. 42–55. doi: 10.1016/j.iheduc.2015.04.005.

Chinn, W. W. (1998) 'The Partial Least Squares Approach to Structural Equation Modelling', *Modern Methods for Business Research*, 29(2), pp. 295–336.

Churchill, G. A. (1979) 'A paradigm for developing better measures of marketing constructs', *Journal of Marketing Research*, 16(1), pp. 64–73.

Cohen, L., Manion, L. and Morrison, K. (2018) *Research methods in education*. Routledge.

Connaway, L. S. and Radford, M. L. (2016) *Research methods in library and information science*. ABC-CLIO.

Cordiglia, M. and Van Belle, J. P. (2017) 'Consumer attitudes towards proximity sensors in the South African retail market', in *2017 Conference on Information Communication Technology and Society, ICTAS 2017 - Proceedings*, pp. 1–6. doi: 10.1109/ICTAS.2017.7920651.

Corkindale, D., Ram, J. and Chen, H. (2018) 'The adoption of Firm-Hosted Online Communities: an empirical investigation into the role of service quality and social interactions', *Enterprise Information Systems*. Taylor & Francis, 12(2), pp. 173–195. doi: 10.1080/17517575.2017.1287431.

Cottrell, E., Roddy, E., Rathod, T., Thomas, E., Porcheret, M. and Foster, N. E. (2015) 'Maximising response from GPs to questionnaire surveys : do length or incentives make a difference ?', pp. 1–7.

Coursaris, C. K. and Kim, D. J. (2006) ‘A Qualitative Review of Empirical Mobile Usability Studies’, in *AMCIS 2006 Proceedings*, pp. 352–363.

Creswell, J. H. and Guetterman, T. C. (2018) *Educational research: planning, conducting, and evaluating quantitative and qualitative research*. Pearson education.

Creswell, J. W. (2014) *Research designs: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Creswell, J. W. and Clark, V. L. P. (2011) ‘Designing and Conducting Mixed Methods Studies’, in *Workshop for the 2011 Society for Social Work and Research annual meeting*. Sage, pp. 1–57. doi: 10.1111/j.1753-6405.2007.00097.x/full.

Creswell, J. W. and Creswell, J. D. (2017) *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Creswell, J. W., Klassen, A. C., Clark, V. L. and Smith, K. C. (2011) ‘Best practices for mixed methods research in the health sciences’, in *National Institutes of Health*. Bethesda (Maryland): National Institutes of Health, pp. 541–545.

Cronin, J. J. and Taylor, S. A. (1992) ‘Measuring Quality : A Reexamination and extension’, *The journal of marketing*, 56(3), pp. 55–68.

Cronin, N. (2014) ‘Using case study research as a rigorous form of inquiry’, *Nurse Research*, 21(5), pp. 19–27. Available at: http://repository.essex.ac.uk/id/eprint/11140.

Dash, A. R. and Patra, M. R. (2018) ‘Ensuring Quality of Web Portals Through Accessibility Analysis’, in *Learner Experience and Usability in Online Education*. IGI Global, pp. 194–234. doi: 10.4018/978-1-5225-4206-3.ch008.

Davis, F. D. (1989) ‘Perceived usefulness, perceived ease of use, and user acceptance of information technology’, *MIS quarterl*, 13(3), pp. 319–340. Available at: https://www.jstor.org/stable/249008.

Davis, F. D., Bagozzi, R. P. and Warshaw, P. R. (1989) ‘User Acceptance of Computer

Technology: A Comparison of Two Theoretical Models', *Management Science*, 35(8), pp. 982–1003. doi: 10.1287/mnsc.35.8.982.

Deci, E. and Ryan, R. M. (1985) *Intrinsic motivation and self-determination in human behavior*. Science & Business Media. Available at: https://books.google.co.za/books?hl=en&lr=&id=p96Wmn-ER4QC&oi=fnd&pg=PA1&dq=Deci+%26+Ryan,+1985&ots=3eIVv2p876&sig=evGDEeTUN1wqsDtZ3muivQTXP1o.

De Kock, E., Van Biljon, J. and Pretorius, M. (2009) 'Usability evaluation methods: Mind the gaps', in *Proceedings of the 2009 annual research conference of the south african institute of computer scientists and information technologists*. ACM, pp. 122–131.

DeLone, W. H. and McLean, E. R. (1992) 'Information Systems Success: The Quest for the Dependent Variable', *Information Systems Research*, 3(1), pp. 60–95. doi: 10.1287/isre.3.1.60.

DeLone, W. H. and McLean, E. R. (2003) 'The DeLone and McLean Model of Information Systems Success: A Ten-Year Update', *Journal of Management Information Systems*, 19(4), pp. 9–30. doi: 10.1080/07421222.2003.11045748.

DeLone, W. H. and McLean, E. R. (2016) 'Information systems success measurement', *Foundations and Trends*, 2(1), pp. 1–116. Available at: http://www.nowpublishers.com/article/Details/ISY-005.

Denzin, N. and Lincoln, Y. (2012) *Qualitative research manual*. Gedisa.

Deutschlander, C. (2009) *Surveying fundamentals for business analysts*. Management Concepts Inc.

De Villiers, M. R. (2005) 'Interpretive research models for Informatics: action research, grounded theory, and the family of design-and development research', *Alternation*, 12(2), pp. 10–52.

Devlin, A. S. (2018) *The Research Experience: Planning, Conducting, and Reporting Research*. Sage publications.

Diefenbach, S., Hassenzahl, M. and Diefenbach, S. (2011) 'The dilemma of the hedonic - Appreciated, but hard to justify', *Interacting with Computers*. British Informatics Society Limited., 23(5), pp. 461–472. doi: 10.1016/j.intcom.2011.07.002.

Diefenbach, S., Kolb, N. and Hassenzahl, M. (2014) 'The " Hedonic " in Human-Computer Interaction – History , Contributions , and Future Research Directions', in *Proceedings of the 2014 conference on Designing interactive systems - DIS '14*, pp. 305–314. doi: 10.1145/2598510.2598549.

Dillman, D. O. N. A., Sinclair, M. D. and Clark, J. O. N. R. (2014) 'Effects of questionnaire length, and a difficult question on occupant-addressed census mail surveys', *The Public Opinion Quarterly*, 57(3), pp. 289–304.

Dix, A., Finlay, J., Abowd, G. and Beale, R. (2004) *Human-computer interaction*. Pearson.

Dourish, P. (2004) 'What we talk about when we talk about context', *Personal and ubiquitous computing*, 8(1), pp. 19–30. doi: 10.1007/s00779-003-0253-8.

Dow, S., Gerber, E. and Wong, A. (2013) 'A pilot study of using crowds in the classroom', in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '13*, p. 227. doi: 10.1145/2470654.2470686.

Doyle, L. and Brady, A. (2009) 'An overview of mixed methods research', *Journal of Research in Nursing*, 14(2), pp. 175–185. doi: 10.1177/1744987108093962.

Drechsler, A. and Hevner, A. (2016) 'A four-cycle model of IS design science research: capturing the dynamic nature of IS artifact design', in *Breakthroughs and Emerging Insights from Ongoing Design Science Projects: Research-in-progress papers and poster presentations from the 11th International Conference on Design Science Research in Information Systems and Technology (DESRIST) 2016*. DESRIST 2016.

Dumas, J. S. and Redish, J. C. (1994) ‘A practical guide to usability’. Intellect books. Available at: https://books.google.co.za/books?hl=en&lr=&id=4lge5k_F9EwC&oi=fnd&pg=PR5&dq=Dumas+and+Redish,+1993&ots=vrh66CccwE&sig=dGW3ia3uO8eOvi2UrXAI_YLx7IY.

Durand, M. A. and Chantler, T. (2014) *Principles of social research*. London: McGraw-Hill Education.

ELSERVIER (2015) ‘About Scopus’. Available at: https://www.elsevier.com/solutions/scopus (Accessed: 15 June 2015).

Fetters, M. D., Curry, L. A. and Creswell, J. W. (2013) ‘Achieving integration in mixed methods designs - Principles and practices’, *Health Services Research*, 48(6 PART2), pp. 2134–2156. doi: 10.1111/1475-6773.12117.

Fink, A. (2015) *How to conduct surveys: A step-by-step guide*. Sage publications.

Fischer, P. T., Kuliga, S., Eisenberg, M., Amin, I., Weimar, B. and Weimar, B. (2018) ‘Space is Part of the Product: Using AttrakDiff to Identify Spatial Impact on User Experience with Media Façades’, in *Proceedings of the 7th ACM International Symposium on Pervasive Displays*. ACM, pp. 5–16. doi: 10.1145/3205873.3205875.

Fitzpatrick, R. (1996) ‘Software Quality : Definitions and Strategic Issues Software Quality ’:, (April), pp. 1–34.

Flavian, C., Guinaliu, M. and Gurrea, R. (2006) ‘The role played by perceived usability, satisfaction and consumer trust on website loyalty’, *Information and Management*, 43(1), pp. 1–14. doi: 10.1016/j.im.2005.01.002.

Flick, U. (2018) *Doing triangulation and mixed methods*. Sage. Available at: https://books.google.co.za/books?hl=en&lr=&id=v5xcDwAAQBAJ&oi=fnd&pg=PT16&dq=mixed+methods+triangulation&ots=iBnFkMA0jJ&sig=WbhpRaqbagCZpTlRN15F1W6XGHM.

Folmer, E. and Bosch, J. (2004) ‘Architecting for usability: a survey’, *Journal of Systems and Software*, 70(1–2), pp. 61–78. doi: 10.1016/S0164-1212(02)00159-0.

Foroudi, P., Gupta, S. and Sivarajah, U. (2018) ‘Investigating the effects of smart technology on customer dynamics and customer experience’, *Computers in Human Behavior*, 80(1), pp. 271–282. Available at: https://www.sciencedirect.com/science/article/pii/S0747563217306489.

Fouche, C. B. and Delport, C. S. L. (2004) ‘Introduction to the research process’, in *Research at grass roots: For the social sciences and human service professionals.* Van Schaik.

Fowdur, T. P., Hurbungs, V. and Beeharry, Y. (2016) ‘Statistical analysis of energy consumption of mobile phones for Web-based applications in Mauritius’, in *2016 International Conference on Computer Communication and Informatics, ICCCI 2016*, pp. 1–8. doi: 10.1109/ICCCI.2016.7480018.

Franklin, M. I. (2012) *Understanding research: Coping with the quantitative-qualitative divide*. Routledge.

Frich, J., Biskjaer, M. M. and Dalsgaard, P. (2018) ‘Twenty Years of Creativity Research in Human-Computer Interaction’, in *Proceedings of the 2018 on Designing Interactive Systems Conference 2018 - DIS ’18*, pp. 1235–1257. doi: 10.1145/3196709.3196732.

Gable, G. G. (1994) ‘Integrating case study and survey research methods: an example in information systems’, *European journal of information systems*, 3(2), pp. 112–126.

García-Zubia, J., Orduña, P., López-de-Ipiña, D. and Alves, G. R. (2009) ‘Addressing software impact in the design of remote laboratories’, *IEEE Transactions on Industrial Electronics*, 56(12), pp. 4757–4767. doi: 10.1109/TIE.2009.2026368.

Garson, G. D. (2016) *PARTIAL LEAST SQUARES (PLS-SEM) 2016 Edition*. Available at: www.statisticalassociates.com.

Ghosh, M. (2018) ‘Measuring electronic service quality in India using E-S-QUAL’, *International Journal of Quality and Reliability Management*, 35(2), pp. 430–445. doi: 10.1108/IJQRM-07-2016-0101.

Giacomin, J. (2014) 'What Is Human Centred Design?', *The Design Journal*, 17(4), pp. 606–623. doi: 10.2752/175630614X14056185480186.

Golafshani, N. (2003) 'Understanding Reliability and Validity in Qualitative Research', 8(4), pp. 597–606.

Gorla, N. (2011) 'An Assessment of Information Systems Service Quality Using SERVQUAL +', 42(3), pp. 46–70.

Gough, D., Oliver, S. and Thomas, J. (2017). *An introduction to systematic reviews*. Sage.

Gratton, C. and Jones, I. (2010) *Research methods for sports studies*, *Routledge*.

Gravem, S. A., Bachhuber, S. M., Fulton-Bennett, H. K., Randell, Z. H., Rickborn, A. J., Sullivan, J. M. and Menge, B. A. (2017) 'Transformative Research Is Not Easily Predicted', *Trends in Ecology and Evolution*. Elsevier Ltd, 32(11), pp. 825–834. doi: 10.1016/j.tree.2017.08.012.

Gravetter, F. J. and Forzano, L. A. B. (2018) *Research methods for the behavioral sciences*. Cengage Learning.

Gregor, S. and Hevner, A. R. (2013) 'Positioning and presenting design science research for maximum impact', *MIS Quarterly,* 37(2), pp. 337–355.

Gube, B. J. (2010) 'What Is User Experience Design ? Overview , Tools And Resources', pp. 1–39.

Gumussoy, C. (2016) 'Usability guideline for banking software design', *Computers in Human Behavior*. Elsevier Ltd, 62, pp. 277–285. doi: 10.1016/j.chb.2016.04.001.

Hair, J. F., Anderson, R. E., Tatham, R. L. and Black, W. C. (2010) *Multivariate Data Analysis: A Global Perspective*. Seventh. Upper Saddle River: Pearson.

Hair, J. F., Hollingsworth, C. L., Randolph, A. B. and Chong, A. Y. L. (2017) 'An updated and expanded assessment of PLS-SEM in information systems research', *Industrial Management & Data Systems*, 117(3), pp. 442–458. doi: 10.1108/IMDS-04-2016-0130.

Hair, J. F., Hult, G., Ringle, C. and Sarstedt, M. (2016) *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage publications.

Hair, J. F., Ringle, C. and Sarstedt, M. (2012) 'Partial least squares: the better approach to structural equation modeling?', *Long Range Planning*, 45(5), pp. 312–319.

Hallak, R., Assaker, G. and El-Haddad, R. (2018) 'Re-examining the relationships among perceived quality, value, satisfaction, and destination loyalty: A higher-order structural model', *Journal of Vacation Marketing*, 24(2), pp. 118–135. doi: 10.1177/1356766717690572.

Han, S. H., Hwan Yun, M., Kim, K. J. and Kwahk, J. (2000) 'Evaluation of product usability: Development and validation of usability dimensions and design elements based on empirical models', *International Journal of Industrial Ergonomics*, 26(4), pp. 477–488. doi: 10.1016/S0169-8141(00)00019-6.

Hartson, R. and Pyla, P. S. (2012) *The UX Book: Process and guidelines for ensuring a quality user experience*. Elsevier.

Hassenzahl, M. (2007) 'The Hedonic/Pragmatic Model of User Experience', *Towards a UX Manifesto. COST294-MAUSE affiliated workshop*, 2(2), pp. 10–14. doi: 10.1183/09031936.00022308.

Hassenzahl, M. (2008) 'User Experience (UX) Towards an experiential', pp. 11–15. doi: 10.1109/UIC-ATC-ScalCom-CBDCom-IoP.2015.126.

Hassenzahl, M. (2018) 'The Thing and I: Understanding the Relationship Between User and Product', in *Funology 2*. Springer, Cham, pp. 301–313. doi: 10.1007/978-3-319-68213-6_19.

Hassenzahl, M., Burmester, M. and Koller, F. (2003) 'AttrakDiff: A Questionnaire to

Measure Perceived Hedonic and Pragmatic Quality', in *Proceedings of Mensch & Computer 2003. Interaktion in Bewegung*, pp. 187–196.

Hassenzahl, M., Diefenbach, S. and Goritz, A. (2010) 'Needs, affect, and interactive products - Facets of user experience', *Interacting with Computers*. Elsevier B.V., 22(5), pp. 353–362. doi: 10.1016/j.intcom.2010.04.002.

Hassenzahl, M. and Roto, V. (2004) 'Being and doing - A perspective on User Experience and its measurement', *Interfaces*, 72(Autumn 2007), pp. 10–12.

Hassenzahl, M. and Tractinsky, N. (2006) 'User experience - A research agenda', *Behaviour and Information Technology*, 25(2), pp. 91–97. doi: 10.1080/01449290500330331.

Hassenzahl, M., Wiklund-Engblom, A., Bengs, A., Hägglund, S. and Diefenbach, S. (2015) 'Experience-Oriented and Product-Oriented Evaluation: Psychological Need Fulfillment, Positive Affect, and Product Perception', *Intl. Journal of Human–Computer Interaction*, 31, pp. 530–544. doi: 10.1080/10447318.2015.1064664.

Hathcoat, J. D. and Meixner, C. (2017) 'Pragmatism, Factor Analysis, and the Conditional Incompatibility Thesis in Mixed Methods Research', *Journal of Mixed Methods Research*, 11(4), pp. 433–449. doi: 10.1177/1558689815622114.

Heale, R. and Forbes, D. (2013) 'Understanding triangulation in research', *Evidence Based Nursing*, 16(4), pp. 98–98. doi: 10.1136/eb-2013-101494.

Heale, R. and Twycross, A. (2018) 'What is a case study?', *Evidence Based Nursing*, 21(1), pp. 7–8. doi: 10.1136/eb-2017-102845.

Heberlein, T. and Baumgartner, R. (1978) 'Factors affecting response rates to mailed questionnaires: A quantitative analysis of the published literature', *American sociological review*, 43(4), pp. 447–462. Available at: https://www.jstor.org/stable/2094771.

Hedegaard, S. and Simonsen, J. G. (2013) 'Extracting usability and user experience information from online user reviews', in *Proceedings of the SIGCHI Conference on*

Human Factors in Computing Systems - CHI '13, pp. 2089–2099. doi: 10.1145/2470654.2481286.

Helander, M. (2014) *Handbook of human-computer interaction*. Elsevier.

Henseler, J. (2017) 'Bridging Design and Behavioral Research With Variance-Based Structural Equation Modeling', *Journal of Advertising*, 46(1), pp. 178–192. doi: 10.1080/00913367.2017.1281780.

Henseler, J., Ringle, C. M. and Sarstedt, M. (2015) 'A new criterion for assessing discriminant validity in variance-based structural equation modeling', *Journal of the Academy of Marketing Science*, 43(1), pp. 115–135. doi: 10.1007/s11747-014-0403-8.

Heo, J., Ham, D. H., Park, S., Song, C. and Yoon, W. C. (2009) 'A framework for evaluating the usability of mobile phones based on multi-level, hierarchical model of usability factors', *Interacting with Computers*. Elsevier B.V., 21(4), pp. 263–275. doi: 10.1016/j.intcom.2009.05.006.

Herrera, M., Moraga, M. Á., Caballero, I. and Calero, C. (2010) 'Quality in Use Model for Web Portals (QiUWeP)', in, pp. 91–101. doi: 10.1007/978-3-642-16985-4_9.

Hertzog, M. A. (2008) 'Considerations in determining sample size for pilot studies', *Research in nursing & health*, 31(2), pp. 180–191.

Hertzum, M. and Clemmensen, T. (2012) 'How do usability professionals construe usability ?', *Journal of Human Computer Studies*. Elsevier, 70(1), pp. 26–42. doi: 10.1016/j.ijhcs.2011.08.001.

Hevner, A. R. (2007) 'A Three Cycle View of Design Science Research A Three Cycle View of Design Science Research', 19(2), pp. 87–92.

Hevner, A. R., March, S. T., Park, J. and Ram, S. (2004) 'Design Science in Information Systems Research', *MIS Quarterly*, 28(1), pp. 75-1–5. doi: 10.2307/25148625.

Hinkin, T. R., Tracey, J. B. and Enz, C. A. (1997) 'Scale construction: Developing reliable and valid measurement instruments’, *Journal of Hospitality & Tourism Research*, 21(1), pp. 100–120. doi: 10.1177/109634809702100108.

Ho, C. I. and Lee, Y. L. (2007) ‘The development of an e-travel service quality scale’, *Tourism Management*, 28(6), pp. 1434–1449.

Ho, M. R., Smyth, T. N., Kam, M. and Dearden, A. (2009) ‘Human-Computer Interaction for Development : The Past , Present , and Future’, *Information Technologies & International development*, 5(4), pp. 1–18. doi: 10.1145/1467247.1467265.

Hollingsed, T., Novick, D. G. and Paso, E. (2007) ‘Usability Inspection Methods after 15 Years of Research and Practice’, in *Proceedings of the 25th annual ACM international conference on Design of communication*, pp. 249–255.

Holzinger, A., Searle, G., Kleinberger, T., Seffah, A. and Jevahery, H. (2008) ‘Investigating usability metrics for the design and development of applications for the elderly’, in *International Conference on Computers for Handicapped Persons*, pp. 98–105. doi: http://dx.doi.org/10.1533/9781845698232.1.13.

Hong, Tam and Yim (2016) *e-Service Environment: Impacts of Web Interface Characteristics on Consumers’ Online Shopping Behavior*. New York: Routledge.

Hong, W., Chan, F. K. Y., Thong, J. Y. L., Chasalow, L. C. and Dhillon, G. (2014) ‘A framework and guidelines for context-specific theorizing in information systems research’, *Information Systems Research*, 25(1), pp. 111–136. doi: 10.1287/isre.2013.0501.

Hornbaek, K. (2006) ‘Current practice in measuring usability : Challenges to usability studies and research’, *International journal of human-computer studies*, 64(2), pp. 79–102. doi: 10.1016/j.ijhcs.2005.06.002.

Hornbaek, K. and Frokjaer, E. (2008) ‘Making Use of Business Goals in Usability Evaluation : An Experiment with Novice Evaluators’, in *The SIGCHI Conference on Human Factors in Computing Systems*. ACM, pp. 903–912.

Hornbaek, K. and Hertzum, M. (2017) 'Technology acceptance and user experience: a review of the experiential component in HCI', *ACM Transactions on Computer-Human Interaction (TOCHI)*, 24(5), p. 33. Available at: https://dl.acm.org/citation.cfm?id=3127358.

Hsu, C. L., Chen, Y. C., Yang, T. N. and Lin, W. K. (2017) 'Do website features matter in an online gamification context? Focusing on the mediating roles of user experience and attitude', *Telematics and Informatics*. Elsevier Ltd, 34(4), pp. 196–205. doi: 10.1016/j.tele.2017.01.009.

Hsu, H. Y. and Tsou, H. T. (2011) 'Understanding customer experiences in online blog environments', *International Journal of Information Management*. Elsevier Ltd, 31(6), pp. 510–523. doi: 10.1016/j.ijinfomgt.2011.05.003.

Huang, S. J., Chen, W. C. and Chiu, P. Y. (2016) 'Evaluation Process Model of the Software Product Quality Levels', in *Proceedings - 2015 International Conference on Industrial Informatics - Computing Technology, Intelligent Technology, Industrial Information Integration, ICIICII 2015*, pp. 55–58. doi: 10.1109/ICIICII.2015.101.

Humphrey, C. (2013) 'A Paradigmatic Map of Professional Education Research', *Social Work Education*, 32(1), pp. 3–16. doi: 10.1080/02615479.2011.643863.

Inoco, J. O. (2017) 'Assessment on Effectiveness of eStudent Information Portal (eSIP) and Client Satisfaction', in *umanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM), 2017*. IEEE, pp. 1–4.

ISO-8402 (1994) 'ISO 8402:1994 Quality management and quality assurance'. Available at: https://www.iso.org/standard/20115.html (Accessed: 24 February 2016).

ISO/IEC 25010:11 (2011) 'ISO/IEC 25010:2011, Systems and Software Engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - System and Software Quality Models.' Available at: https://www.iso.org/standard/35733.html (Accessed: 17 May 2016).

ISO/IEC 9126-1 (2001) ‘ISO/IEC 9126-1: Software engineering -- Product quality -- Part 1: Quality model’. Available at: https://www.iso.org/standard/22749.html (Accessed: 18 May 2016).

ISO 9241-11 (1998) ‘ISO 9241-11: Ergonomics of human-system interaction -- Part 11: Usability: Definitions and concepts’. Available at: https://www.iso.org/standard/63500.html (Accessed: 17 May 2016).

ISO 9241-210 (2010) ‘ISO 9241-210:Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems’. Available at: https://www.iso.org/standard/52075.html (Accessed: 18 May 2016).

Issa, T. and Turk, A. (2010) ‘Usability and human computer interaction in developing websites: an Australian perspective’, in *Proceedings of the IADIS international conferences: interfaces and human computer interaction 2010 and game and entertainment technologies 2010*, pp. 27–34.

Iwaarden, J. Van, Wiele, T. Van Der, Ball, L. and Millen, R. (2004) ‘Perceptions about the quality of web sites : a survey amongst students at Northeastern University and Erasmus University’, 41(1), pp. 947–959. doi: 10.1016/j.im.2003.10.002.

Jagannathan, V., Balasubramanian, S. and Natarajan, T. (2018) ‘An Extension to the DeLone and Mclean Information Systems Success Model and Validation in the Internet Banking Context’, *Encyclopedia of Information Science and Technology, Fourth Edition*, pp. 49–60. doi: 10.4018/978-1-5225-2255-3.ch004.

Jain, A. and Chande, S. V (2013) ‘Information portal system for a digital campus based on information architecture’, in *Proceedings of the 2013 IEEE International Conference in MOOC, Innovation and Technology in Education, MITE 2013*, pp. 349–352. doi: 10.1109/MITE.2013.6756365.

Jamwal, D. (2010) ‘Analysis of Software Quality Models for Organizations’, *nternational Journal of Latest Trends in Computing*, 1(2), pp. 19–23.

Javed, S. (2018) 'Assessing the E-Services of the Banking Sector by Using E-Servqual Model: A Comparative Study of Local Commercial Banks and Foreign Banks in Pakistan', *Journal of Internet Banking and Commerce*, 23(1), pp. 1–12.

Jenabi, G. and Ghanadan, A. (2014) 'Impact of service quality on Internet banking customer satisfaction: A review of literature', in *Proceedings - 2013 International Conference on Advanced Computer Science Applications and Technologies, ACSAT 2013*, pp. 538–543. doi: 10.1109/ACSAT.2013.112.

Jiang and Ji (2014) 'E-Government web portal adoption: A service level and service quality perspective', in *Proceedings of the Annual Hawaii International Conference on System Sciences*, pp. 2179–2188. doi: 10.1109/HICSS.2014.275.

Johanson, G. A. and Brooks, G. P. (2010) 'Initial scale development: Sample size for pilot studies', *Educational and Psychological Measurement*, 70(3), pp. 394–400. doi: 10.1177/0013164409355692.

Johnson, B. and Christensen, L. (2008) *Educational research: Quantitative, qualitative, and mixed approaches*. Sage.

Johnson, B. and Turner, L. A. (2010) 'Data collection strategies in Mixed Methods Reseach', in *Sage Handbook of Mixed Methods in Social & Behavioral Research*. Sage, pp. 297–320. Available at: https://books.google.co.za/books?hl=en&lr=&id=F8BFOM8DCKoC&oi=fnd&pg=PA297&dq=Johnson,+B.+%26+Turner,+L.A.,+2003.+Data+collection+strategies+in+mixed+methods+research.+Handbook+of+mixed+methods+in+social+and+behavioral+research.++pp.+297-319.+Johnson,+B.+.

Jonker, J. and Pennink, B. W. (2010) 'Looking at Research', in *The Essence of Research Methodology*. Springer, pp. 1–19.

Joo, S. and Lee, J. (2011) 'Measuring the usability of academic digital libraries', *The Electronic Library*, 29(4), pp. 523–537. doi: 10.1108/02640471111156777.

Joreskog, K. G. (1978) ‘Structural analysis of covariance and correlation matrices’, *Psychometrika*, 43(4), pp. 443–477. doi: 10.1007/BF02293808.

Kabir, M. A. and Han, B. (2016) ‘An improved usability evaluation model for point-of-sale systems’, *International Journal of Smart Home*, 10(7), pp. 269–282. doi: 10.14257/ijsh.2016.10.7.27.

Kaplan, B. and Duchon, D. (1988) ‘Combining Qualitative and Quantitative Methods in Information Systems Research: A Case Study’, *MIS Quarterly*, 12(4), p. 571. doi: 10.2307/249133.

Karlsson, K. and Olsson, J. (2008) ‘University Web Portals Quality Assurance : User Perspective’.

Karolic, B. (2013) ‘Increasing the availability of information using modern technologies of the open Web to build user interfaces for mobile devices.’, *Online Journal of Applied Knowledge Management*, 1(2).

Kelly, B. and Vidgen, R. (2005) ‘A quality framework for web site quality: user satisfaction and quality assurance’, in *Special interest tracks and posters of the 14th international conference on World Wide Web*. ACM, pp. 930–931.

Khwaldeh, S. M., Al-Hadid, I., Masa’deh, R. and Alrowwad, A. (2017) ‘The Association between E-Services Web Portals Information Quality and ICT Competence in the Jordanian Universities’, *Asian Social Science*, 13(3), p. 156. doi: 10.5539/ass.v13n3p156.

Kincl, T., Štrach, P., Taylor, P., Kincl, T. and Štrach, P. (2012) ‘Measuring website quality: Asymmetric effect of user satisfaction’, *Behaviour and Information Technology*, 31(7), pp. 647–657. doi: 10.1080/0144929X.2010.526150.

Kitchenham, B. (2004) ‘Procedures for performing systematic reviews’. Keele University, pp. 1–26. doi: 10.1.1.122.3308.

Kocaballi, A. B. and Coiera, E. (2018) ‘Measuring User Experience in Conversational Interfaces : A Comparison of Six Questionnaires’, in *Proc. of British Computer Society*

Human Computer Interaction Conference (BCS HCI ’18), pp. 1–12. doi: 10.14236/ewic/HCI2018.21.

Koch, M., Schwabe, G. and Briggs, R. O. (2015) ‘CSCW and Social Computing’, *Business & Information Systems Engineering*, 57(3), pp. 149–153. doi: 10.1007/s12599-015-0376-2.

Kock, N., 2015. ‘Common method bias in PLS-SEM: A full collinearity assessment approach’. *International Journal of e-Collaboration (IJeC)*. 11(4), pp.1-10.

Kock, N. and Lynn, G. (2012) ‘Lateral collinearity and misleading results in variance-based SEM: An illustration and recommendations’, *Journal of the Association for Information Systems*, 13(7), pp. 549–580.

Koohang, A. (2004) ‘Expanding the concept of usability’, *Informing Science*, 7(1), pp. 129–141. doi: 10.28945/508.

Kous, K., Pušnik, M., Heričko, M. and Polančič, G. (2018) ‘Usability evaluation of a library website with different end user groups’, *Journal of Librarianship and Information Science*. doi: 10.1177/0961000618773133.

Kujala, S., Roto, V., Väänänen-vainio-mattila, K., Karapanos, E. and Sinnelä, A. (2011) ‘Interacting with Computers UX Curve : A method for evaluating long-term user experience’, *Interacting with Computers*. British Informatics Society Limited., 23(5), pp. 473–483. doi: 10.1016/j.intcom.2011.06.005.

Kujala, S., Roto, V., Väänänen-Vainio-Mattila, K. and Sinnelä, A. (2011) ‘Identifying hedonic factors in long-term user experience’, in *Proceedings of the 2011 Conference on Designing Pleasurable Products and Interfaces - DPPI ’11*, pp. 1–8. doi: 10.1145/2347504.2347523.

Kujala, S., Walsh, T., Nurkka, P. and Crisan, M. (2014) ‘Sentence completion for understanding users and evaluating user experience’, *Interacting with Computers*, 26(3), pp. 238–255. doi: 10.1093/iwc/iwt036.

Kumar, N., Dadhich, R. and Shastri, A. (2015) ‘Quality Models for Web-based Application: A Comparative Study’, *International Journal of Computer Applications*, 125(2), pp. 25–32. doi: 10.5120/ijca2015905840.

Kumar, N., Dray, S., Dearden, A., Dell, N., Densmore, M., Grinter, R. E., Liu, Z., Moreno Rocha, M. A., Peters, A., Sari, E., Thies, W., Medhi-Thies, I., Tucker, W. D., Valderrama Bahamondez, E. and Wyche, S. P. (2016) ‘Development Consortium: HCI Across Borders’, in *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems*, pp. 3620–3627. doi: 10.1145/2851581.2856507.

Kumar, R. (2014) *Research methodology: A step-by-step guide for beginners*. Sage Publications Limited.

Kumar, S. and Phrommathed, P. (2011) *Research methodology*. Springer.

Kundu, S. and Datta, S. K. (2014) ‘A Scale for Measuring Internet Banking Service Quality’, *Journal of Electronic Commerce in Organizations*, 12(3), pp. 12–39. doi: 10.4018/jeco.2014070102.

Kuo, T., Lu, I., Huang, C. and Wu, G. (2005) ‘Measuring users’ perceived portal service quality: An empirical study’, *Total Quality Management & Business Excellence*, 16(3), pp. 309–320. doi: 10.1080/14783360500053824.

Kurosu, M. (2015) ‘Usability, quality in use and model of quality characteristics’, in *Human-Computer Interaction: Design and Evaluation*. Springer, pp. 227–237.

Ladhari, R. (2010) ‘Developing e-service quality scales: A literature review’, *Journal of Retailing and Consumer Services*. Elsevier, 17(6), pp. 464–477. doi: 10.1016/j.jretconser.2010.06.003.

Lallemand, C., Gronier, G. and Koenig, V. (2015) ‘User experience: A concept without consensus? Exploring practitioners’ perspectives through an international survey’, *Computers in Human Behavior*. Elsevier Ltd, 43(February), pp. 35–48. doi: 10.1016/j.chb.2014.10.048.

Laugwitz, B., Held, T. and Schrepp, M. (2008) ‘Construction and evaluation of a user experience questionnaire’, in *Symposium of the Austrian HCI and Usability Engineering Group*. Springer, pp. 63-76.

Law, E. L. C., Van Schaik, P. and Roto, V. (2014) ‘Attitudes towards user experience (UX) measurement’, *International Journal of Human Computer Studies*, 72(6), pp. 526–541. doi: 10.1016/j.ijhcs.2013.09.006.

Lazar, J., Feng, J. H. and Hochheiser, H. (2017) *Research methods in human-computer interaction*. Morgan Kaufmann.

Ledo, D., Houben, S., Vermeulen, J., Marquardt, N., Oehlberg, L. and Greenberg, S. (2018) ‘Evaluation Strategies for HCI Toolkit Research’, in *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, pp. 1–17.

Lee, C., Grogan, P. T. and Weck, O. L. De (2012) ‘Process-Oriented Evaluation of User Interactions in Integrated System Analysis Tools’, in *Sytems, Man, and Cybernetics (SMC), 2012 IEEE International Conference*. IEEE, pp. 888–893. doi: 10.1109/ICSMC.2012.6377840.

Lee, D., Moon, J., Jin, Y. and Yi, M. Y. (2015) ‘Information & Management Antecedents and consequences of mobile phone usability : Linking simplicity and interactivity to satisfaction , trust , and brand loyalty’, *Information & Management*. Elsevier B.V., 52(3), pp. 295–304. doi: 10.1016/j.im.2014.12.001.

Lee, Y. and Kozar, K. A. (2012) ‘Understanding of website usability: Specifying and measuring constructs and their relationships’, *Decision Support Systems*. Elsevier B.V., 52(2), pp. 450–463. doi: 10.1016/j.dss.2011.10.004.

Leech, N. L. and Onwuegbuzie, A. J. (2009) ‘A typology of mixed methods research designs’, *Quality & quantity*, 43(2), pp. 265–275. doi: 10.1007/s11135-007-9105-3.

Legris, P., Ingham, J. and Collerette, P. (2003) ‘Why do people use information technology ? A critical review of the technology acceptance model’, *Information & management*, 40(3), pp. 191–204.

Lenth, R. V. (2001) ‘Some Practical Guidelines for Effective Sample Size Determination’, *The American Statistician*, 55(3), pp. 187–193. doi: 10.1198/000313001317098149.

Limayem, M., Khalifa, M. and Frini, A. (2000). What makes consumers buy from Internet? A longitudinal study of online shopping. *IEEE Transactions on systems, man, and Cybernetics-Part A: Systems and Humans*, *30*(4), pp.421-432.

Lin, R., Chen, R. and Kuan- Shun-Chiu, K. (2010) ‘Customer relationship management and innovation capability: an empirical study’, *Industrial Management & Data Systems*, 110(1), pp. 111–133. doi: 10.1108/02635571011008434.

Lincoln, Y. S. and Guba, E. G. (1985) *Naturalistic inquiry*. Sage publications.

Liu, C. T., Du, T. C. and Tsai, H. H. (2009) ‘A study of the service quality of general portals’, *Information and Management*, 46(1), pp. 52–56. doi: 10.1016/j.im.2008.11.003.

Liu, Y. (2018) ‘The application of human-computer interaction in smart city planning and design’, in *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, pp. 101–111. doi: 10.1007/978-3-319-91797-9_8.

Lohmoller, J. (1988) ‘The PLS Program System : Latent Variables Path Analysis with Partial Least Squares Estimation’, *Behavioral Research*, 23(1), pp. 125–127. doi: 10.1207/s15327906mbr2301.

Lowry, P. B., Dinev, T. and Willison, R. (2017) ‘Why security and privacy research lies at the centre of the information systems (IS) artefact: Proposing a bold research agenda’, *European Journal of Information Systems*. Palgrave Macmillan UK, 26(6), pp. 546–563. doi: 10.1057/s41303-017-0066-x.

Mabila, J., Biljon, J. Van and Herselman, M. (2017) ‘A sustainability framework for mobile technology integration in schools : The case of resource- constrained environments in South Africa’, *The Journal of Community Informatics*, 13(2), pp. 59–86.

Machova, R., Hub, M. and Lnenicka, M. (2018) ‘Usability evaluation of open data portals: Evaluating data discoverability, accessibility, and reusability from a stakeholders’ perspective’, *Aslib Journal of Information Management*, 70(3), pp. 252–268. doi: 10.1108/AJIM-02-2018-0026.

Mahlke, S. (2002) ‘Factors influencing the experience of website usage’, in *CHI’02 extended abstracts on Human factors in computing systems*. ACM, pp. 846–847.

Malhotra, N. K., Agarwal, J. and Shainesh, G. (2018) ‘Does country or culture matter in global marketing? An empirical investigation of service quality and satisfaction model with moderators in three countries’, *Emerging Issues in Global Marketing: A Shifting Paradigm*, 1(3), pp. 61–91. doi: 10.1007/978-3-319-74129-1_3.

Mandl, T. (2008) ‘Automatic quality assessment for Internet pages’, *Handbook of Research on Web Information Systems Quality*, pp. 104–112. doi: 10.4018/978-1-59904-847-5.ch006.

Manouselis, N., Kastrantas, K., Sanchez-Alonso, S., Cáceres, J., Ebner, H. and Palmer, M. (2009) ‘Architecture of the Organic. Edunet web portal’, *International Journal of Web Portals (IJWP)*, 1(1), pp. 71–91.

Manouselis, N. and Sampson, D. (2004) ‘Multiple Dimensions of User Satisfaction As Quality Criteria for Web Portals’, (October).

Manzoor, A. (2016) ‘Designs of Mixed Method Research’, in *Mixed methods research for improved scientific study*. GI Global, pp. 79–105. doi: 10.4018/978-1-5225-0007-0.ch005.

March, S. T. and Smith, G. F. (1995) ‘Design and natural science research on information technology’, *Decision Support Systems*, 15(4), pp. 251–266.

March and Storey (2008) ‘Design Science in the Information Systems Discipline: An Introduction to the Special Issue on Design Science Research’, *MIS Quarterly*, 32(4), p. 725. doi: 10.2307/25148869.

Marchiori, D. M., Mainardes, E. W. and Rodrigues, R. G. (2017) ‘Validation of the ISS-QUAL and the role of gender, age and education on it service quality in the public sector’, *Information Technology and Management*. Springer US, 19(4), pp. 217–230. doi: 10.1007/s10799-017-0281-0.

Marimon, F., Vidgen, R., Barnes, S. and Cristobal, E. (2010) ‘Purchasing behaviour in an online supermarket: the applicability of E-S-QUAL’, *International Journal of Market Research*, 52(1), p. 111. doi: 10.2501/S1470785310201089.

Marsh, H. W., Morin, A. J. S., Parker, P. D. and Kaur, G. (2014) ‘Exploratory Structural Equation Modeling: An Integration of the Best Features of Exploratory and Confirmatory Factor Analysis’, *Annual Review of Clinical Psychology*, 10(1), pp. 85–110. doi: 10.1146/annurev-clinpsy-032813-153700.

Matera, M., Rizzo, F., Cortázar, R. and Perallos, A. (2008) ‘The usability dimension in the development of Web applications’, *Handbook of Research on Web Information Systems Quality*, 9241. doi: 10.4018/978-1-59904-847-5.ch014.

Matthews, T., Feng, J. H. and Zheng, Y. (2018) *Human Interface and the Management of Information. Information in Applications and Services*. Springer International Publishing. doi: 10.1007/s00011-010-0180-x.

Mayhew, D. J. (2005) ‘Cost justification of usability engineering for international web sites’, in *Cost-Justifying Usability*. Morgan Kaufmann, pp. 359–383.

Mayoh, J. and Onwuegbuzie, A. J. (2015) ‘Toward a Conceptualization of Mixed Methods Phenomenological Research’, *Journal of Mixed Methods Research*, 9(1), pp. 91–107. doi: 10.1177/1558689813505358.

Mazumder, F. K. and Das, U. K. (2014) ‘Usability Guidelines for usable user interface’, *International Journal of Research in Engineering and Technology*, 3(9), pp. 2319–2322. doi: 10.1364/OE.24.017060.

McGarry, K. and McDonald, S. (2017) ‘Computational methods for text mining user posts on a popular gaming forum for identifying user experience issues.', in *Proceedings of the 31st British Computer Society Human Computer Interaction Conference*. BCS Learning & Development Ltd., pp. 100–106. doi: 10.14236/ewic/HCI2017.100.

McNamara, N. and Kirakowski, J. (2006) 'Functionality, usability, and user experience: three areas of concern.', *Interactions*, 13(6), pp. 26–28.

Merriam, S. B. (1998) *Qualitative Research and Case Study Applications in Education. Revised and Expanded from" Case Study Research in Education."*. Jossey-Bass Publishers.

Mertens, D. M. (2017) 'Transformative research : personal and societal', *International Journal for Transformative Research*, 4(1), pp. 18–24. doi: 10.1515/ijtr-2017-0001.

Mertler, C. A. (2016) *Introduction to educational research*. Sage publications.

Miller, R. B. (1971) 'Human ease of use criteria and their tradeoffs'. IBM Corporation Press.

Mills, J., Harrison, H., Franklin, R. and Birks, M. (2017) 'ase study research: Foundations and methodological orientations', in *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*. DEU.

Mills, K. (2017) 'Computer-supported cooperative work (CSCW)', in *Encyclopedia of Library and Information Sciences*. CRC Press, pp. 1053–1067.

Min, H., Park, J. and Kim, H.J. (2016). 'Common method bias in hospitality research: A critical review of literature and an empirical study'. *International Journal of Hospitality Management*. 56 (1), pp.126-135.

Minge, M. and Thüring, M. (2018) 'Hedonic and pragmatic halo effects at early stages of User Experience', *International Journal of Human Computer Studies*, 109(July 2017), pp. 13–25. doi: 10.1016/j.ijhcs.2017.07.007.

Mmutle, T. and Shonhe, L. (2017) 'Customers' perception of service quality and its impact on reputation in the hospitality industry', *African Journal of Hospitality, Tourism and Leisure*, 6(3). doi: 10.1111/j.1552-6909.2008.00291.x.

Moczarny, I., De Villiers, M. R. and Van Biljon, J. (2012) 'How can usability contribute to user experience?: a study in the domain of e-commerce', in *Proceedings of the South African Institute for Computer Scientists and Information Technologists Conference*. ACM, pp. 216–225. Available at: https://dl.acm.org/citation.cfm?id=2389862 (Accessed: 14 March 2015).

Montero, F., Lozano, M. D. and Gonzalez, P. (2008) 'Usability-Oriented Quality Model Based on Ergonomic Criteria', *Handbook of Research on Web Information Systems Quality*, pp. 220–233. doi: 10.4018/978-1-59904-847-5.ch013.

Moraga, Á., Calero, C. and Piattini, M. (2006) 'Comparing different quality models for portals', *Online Information Review*, 30(5), pp. 555–568. doi: 10.1108/14684520610706424.

Moraga, C., Moraga, M. Á., Caro, A., Muñoz, R. R. and Calero, C. (2013) 'University educated users' data quality preferences in web portals', *International Journal of Information Quality*, 3(2), p. 107. doi: 10.1504/IJIQ.2013.054274.

Moraga, M., Calero, C. and Piattini, M. (2004) 'A first proposal of a portal quality model', in *Proceedings of the IADIS international conferences*, pp. 630–638. Available at: http://ejournal.narotama.ac.id/files/A FIRST PROPOSAL OF A PORTAL QUALITY MODEL.pdf.

Moumane, K., Idri, A. and Abran, A. (2016) 'Usability evaluation of mobile applications using ISO 9241 and ISO 25062 standards', *SpringerPlus*. Springer International Publishing, 5(1), pp. 548–559. doi: 10.1186/s40064-016-2171-z.

Mtebe, J. S. (2014) *Acceptance and Use of eLearning Solutions in Higher Education in East Africa*. University of Tampere press.

Mugge, R., Schoormans, J. P. L. and Schifferstein, H. N. J. (2009) 'Incorporating consumers in the design of their own products. The dimensions of product personalisation', *CoDesign*, 5(2), pp. 79–97. doi: 10.1080/15710880802666416.

Muqtadiroh, F. A., Astuti, H. M., Darmaningrat, E. W. T. and Aprilian, F. R. (2017) 'Usability Evaluation to Enhance Software Quality of Cultural Conservation System Based on Nielsen Model (WikiBudaya)', *Procedia Computer Science*. Elsevier B.V., 124(1), pp. 513–521. doi: 10.1016/j.procs.2017.12.184.

Napitupulu, D. (2017) 'Analysis of Factors Affecting The Website Quality (Study Case: XYZ University)', *International Journal on Advanced Science, Engineering and Information Technology*, 7(3), p. 792. doi: 10.18517/ijaseit.7.3.1748.

Narteh, B. (2018) 'Service quality and customer satisfaction in Ghanaian retail banks: the moderating role of price', *International Journal of Bank Marketing*, 36(1), pp. 68–88. doi: 10.1108/IJBM-08-2016-0118.

Nascimento, I., Silva, W., Lopes, A., Rivero, L., Gadelha, B., Oliveira, E. and Conte, T. (2016) 'An Empirical Study to Evaluate the Feasibility of a UX and Usability Inspection Technique for Mobile Applications', in *28th International Conference on Software Engineering & Knowledge Engineering*.

Nathan, R. J. and Yeow, P. H. P. (2011) 'Crucial web usability factors of 36 industries for students: A large-scale empirical study', *Electronic Commerce Research*, 11(2), pp. 151–180. doi: 10.1007/s10660-010-9054-0.

Nelson, R. R., Todd, P. A. and Wixom, B. H. (2005) 'Antecedents of Information and System Quality: An Empirical Examination Within the Context of Data Warehousing', *Journal of Management Information Systems*, 21(4), pp. 199–235. doi: 10.1080/07421222.2005.11045823.

Neuman, W. L. (2013) *Social research methods: Qualitative and quantitative approaches*. Pearson education.

Newman, I., Lim, J. and Pineda, F. (2013) 'Content Validity Using a Mixed Methods

Approach: Its Application and Development Through the Use of a Table of Specifications Methodology', *Journal of Mixed Methods Research*, 7(3), pp. 243–260. doi: 10.1177/1558689813476922.

Nielsen, J. (1991) *Usability engineering*. Boston: AP Professional.

Nielsen, J. (1993) 'What Is Usability?', *Usability Engineering*, (November 2004), pp. 23–48. doi: 10.1016/B978-0-08-052029-2.50005-X.

Nielsen, J. (2000) *Designing Web Usability: The Practice of Simplicity*. New Riders Publishing.

Nielsen, J. (2011) 'Mobile UX Sharpens Usability Guidelines', pp. 1–7. doi: 10.1007/s00441-013-1568-z.

Nielsen, J. (2012) 'Usability 101: Introduction to Usability', pp. 8–11. Available at: https://www.nngroup.com/articles/usability-101-introduction-to-usability/ (Accessed: 23 September 2014).

Nilashi, M., Jannach, D., Ibrahim, O. bin, Esfahani, M. D. and Ahmadi, H. (2016) 'Recommendation quality, transparency, and website quality for trust-building in recommendation agents', *Electronic Commerce Research and Applications*. Elsevier B.V., 19(1), pp. 70–84. doi: 10.1016/j.elerap.2016.09.003.

Norman, D. (2014) 'Some observations on mental models', in *Mental models*. Psychology Press, pp. 15–22.

Norman, D. A. (1986) *User-centered system design: a new perspective on Human Computer Interaction*. Lawrence Erlbaum Associates.

Oates, B. J. (2010) *Researching information systems and computing*. Sage publications.

Obonyo, G. O., Okeyo, D. O. and Kambona, O. O. (2018) 'Effect of Management Practices on Actual ICT Application in Kenyan Hotels: A PLS-SEM Approach', *International Journal of Hospitality and Tourism Administration*, 19(2), pp. 142–166.

doi: 10.1080/15256480.2017.1305311.

Obrist, M., Tscheligi, M., De Ruyter, B. and Schmidt, A. (2010) ‘Contextual User Experience : How to Reflect it in Interaction Designs?’, in *CHI’10 Extended Abstracts on Human Factors in Computing Systems*, pp. 3197–3200.

Ojasalo, J. (2010) ‘E-service quality: a conceptual model’, *International Journal of Arts and Sciences*, 3(7), pp. 127–143.

Okoli, C. and Schabram, K. (2010) ‘A Guide to Conducting a Systematic Literature Review of Information Systems Research’, *Sprouts*, 10(26), pp. 1–52.

Olivier, M. S. (2009) *Information technology research: A practical guide for computer science and informatics*. Van Schaik.

Olsina, L., Lafuente, G. and Rossi, G. (2001) ‘Specifying Quality Characteristics and Attributes for Websites’, pp. 266–278.

Oman, P. E. and Velasquez, J. D. (2013) ‘Cognitive science forweb usage analysis’, in *vanced Techniques in Web Intelligence-2*, pp. 35–73.

Onwuegbuzie, A. J. and Leech, N. L. (2006) ‘Linking Research Questions to Mixed Methods Data Analysis’, 11(3), pp. 474–498.

Owlia, M. S. and Aspinwall, E. M. (1996) ‘A framework for the dimensions of quality in higher education’, *rance in Education*, 4(2), pp. 12–20.

Palese, B. and Usai, A. (2018) ‘The relative importance of service quality dimensions in E-commerce experiences’, *International Journal of Information Management*, 40(1), pp. 132–140. doi: 10.1016/j.ijinfomgt.2018.02.001.

Panach, J. I., Condori-Fernández, N., Valverde, F., Aquino, N. and Pastor, Ó. (2008) ‘Understandability measurement in an early usability evaluation for model-driven development’, in *Proceedings of the Second ACM-IEEE international symposium on Empirical software engineering and measurement - ESEM ’08*. ACM, pp. 354–356. doi:

10.1145/1414004.1414080.

Parasuraman, A., Zeithaml, V. A. and Berry, L. L. (1985) ‘A Conceptual Model of Service Quality and Its Implications for Future Research’, *Journal of Marketing*, 49(4), p. 41. doi: 10.2307/1251430.

Parasuraman, A., Zeithaml, V. A. and Malhotra, A. (2005) ‘E-S-QUAL a multiple-item scale for assessing electronic service quality’, *Journal of Service Research*, 7(3), pp. 213–233. doi: 10.1177/1094670504271156.

Parasuraman, A., Zeithaml, V. and Berry, L. (1988) ‘SERVQUAL: A multiple-item scale for measuring consumer percceptions of service quality’, *Journal of Marketing*, pp. 12–40.

Pare, G., Trudel, M. C., Jaana, M. and Kitsiou, S. (2015) ‘Synthesizing information systems knowledge: A typology of literature reviews’, *Information and Management*, 52(2), pp. 183–199. doi: 10.1016/j.im.2014.08.008.

Park, J., Han, S. H., Kim, H. K., Oh, S. and Moon, H. (2014) ‘Modeling user experience: A case study on a mobile device’, *International Journal of Industrial Ergonomics*. Elsevier Ltd, 43(2), pp. 187–196. doi: 10.1016/j.ergon.2013.01.005.

Park, J., Han, S., Kim, H., Cho, Y. and Park, W. (2013) ‘Developing Elements of User Experience for Mobile Phones and Services: Survey, Interview, and Observation Approaches’, *Human Factors and Ergonomics in Manufacturing & Service Industries*, 23(4), pp. 279–293. doi: 10.1002/hfm.20316.

Park, N., Lee, K. M. and Cheong, P. H. (2007) ‘University instructors’ acceptance of electronic courseware: An application of the technology acceptance model’, *Journal of Computer-Mediated Communication*. doi: 10.1111/j.1083-6101.2007.00391.x.

Partala, T. and Kallinen, A. (2012) ‘Understanding the most satisfying and unsatisfying user experiences: Emotions, psychological needs, and context’, *Interacting with Computers*, 24(1), pp. 25–34. doi: 10.1016/j.intcom.2011.10.001.

Partala, T. and Kujala, S. (2016) ‘Exploring the role of ten universal values in using products and services’, *Interacting with Computers*, 28(3), pp. 311–331. doi: 10.1093/iwc/iwv007.

Paschaloudis, D. (2014) ‘Using E-S-QUAL to measure Internet service quality of E-Banking web sites in Greece’, *Journal of Internet Banking and Commerce*, 19(2). Available at: http://www.scopus.com/inward/record.url?eid=2-s2.0-84907721055&partnerID=40&md5=ef47752c380bd8a7485dfb34d9c36679.

Pathania, A. and Rasool, G. (2017) ‘Investigating E-tailer’s perceived website quality using analytical hierarchy process technique’, *Procedia Computer Science*, 122(1), pp. 1016–1023. Available at: https://www.sciencedirect.com/science/article/pii/S1877050917327217.

Patton, M. Q. (2002) *Qualitative evaluation and research methods*. Sage publications.

Pearson, J. M. and Pearson, A. M. (2008) ‘An exploratory study into determining the relative importance of key criteria in web usability: a multi-criteria approach’, *Journal of Computer Information Systems*, 48(4), pp. 115–127. Available at: https://www.tandfonline.com/doi/abs/10.1080/08874417.2008.11646041.

Peffers, K., Tuunanen, T., Rothenberger, M. A. and Chatterjee, S. (2007) ‘A Design Science Research Methodology for Information Systems Research’, *Journal of Management Information Systems*, 24(3), pp. 45–77. doi: 10.2753/MIS0742-1222240302.

Pengnate, S. F. and Sarathy, R. (2018) ‘An experimental investigation of the influence of website emotional design features on trust in unfamiliar online vendors’, *Computers in Human Behavior*, 67(2), pp. 49–60.

Persad, K. and Padayacheey, K. (2015) ‘The factors that influence customer e-services adoption’, *South African Computer Journal*, 56(1), pp. 80–106. doi: 10.18489/sacj.v56i1.209.

Petrie, H. and Bevan, N. (2009) ‘The Evaluation of Accessibility, Usability, and User Experience.’ Available at: https://pdfs.semanticscholar.org/6896/17fb8d66ec0d3cd2e1012171461c22f4c6f5.pdf (Accessed: 18 January 2017).

Petter, S., DeLone, W. and McLean, E. (2008) ‘Measuring information systems success: Models, dimensions, measures, and interrelationships’, *European Journal of Information Systems*, 17(3), pp. 236–263. doi: 10.1057/ejis.2008.15.

Pinhanez, C. (2007) ‘A services theory approach to online service applications’, in *Services Computing, 2007. IEEE International Conference*. IEEE International Conference, pp. 395–402.

Pinho, C., Franco, M. and Mendes, L. (2018) ‘Web portals as tools to support information management in higher education institutions: A systematic literature review’, *International Journal of Information Management*. Elsevier, 41(March), pp. 80–92. doi: 10.1016/j.ijinfomgt.2018.04.002.

Plewes, T.J. and Tourangeau, R. (2013). *Nonresponse in social science surveys: A research agenda*. National Academies Press.

Podsakoff, P.M., MacKenzie, S.B. and Podsakoff, N.P. (2012). ‘Sources of method bias in social science research and recommendations on how to control it’. *Annual review of psychology*. 63 (1), pp.539-569.

Preece, J. (1993) ‘A guide to usability: Human factors in computing’, in *Human factors in computing*. Reading.

Preece, J., Rogers, Y. and Sharp, H. (2015) *Interaction design: beyond human-computer interaction*. John Wiley & Sons.

Pretorius, M., Van Biljon, J. and De Kock, E. (2010) ‘Added Value of Eye Tracking in Usability Studies : Expert and Non-expert Participants’, *Human-Computer Interaction*, pp. 110–121.

Pucillo, F. and Cascini, G. (2014) ‘A framework for user experience, needs and affordances’, *Design Studies*. Elsevier Ltd, 35(2), pp. 160–179. doi: 10.1016/j.destud.2013.10.001.

Quinones, D., Rusu, C. and Rusu, V. (2018) ‘A methodology to develop usability/user experience heuristics’, *Computer Standards and Interfaces*. Elsevier, 59(1), pp. 109–129. doi: 10.1016/j.csi.2018.03.002.

Rahi, S. (2017) ‘Research Design and Methods: A Systematic Review of Research Paradigms, Sampling Issues and Instruments Development’, *International Journal of Economics & Management Sciences*, 06(02), pp. 1–5. doi: 10.4172/2162-6359.1000403.

Rahman, M. A., Qi, X. and Jinnah, M. S. (2016) ‘Factors affecting the adoption of HRIS by the Bangladeshi banking and financial sector’, *Cogent Business and Management*, 3(1), pp. 1–10. doi: 10.1080/23311975.2016.1262107.

Rasila, H., Rothe, P. and Kerosuo, H. (2010) ‘Dimensions of usability assessment in built environments’, *Journal of Facilities Management*, 8(2), pp. 143–153. doi: 10.1108/14725961011041189.

Rea, L. M. and Parker, R. A. (2014) *Designing and conducting survey research: A comprehensive guide*. John Wiley & Sons.

Reinartz, W., Haenlein, M. and Henseler, J. (2009) ‘An empirical comparison of the efficacy of covariance-based and variance-based SEM’, *International Journal of Research in Marketing*. Elsevier B.V., 26(4), pp. 332–344. doi: 10.1016/j.ijresmar.2009.08.001.

Revythi, A. and Tselios, N. (2017) ‘Extension of Technology Acceptance Model by using System Usability Scale to assess behavioral intention to use e-learning’, *arXiv preprint arXiv:1704.06127*, (1989). doi: 10.13140/RG.2.2.17396.76160.

Riedmann-streitz, C. (2018) ‘Redefining the customer centricity approach in the digital age’, in *International Conference of Design, User Experience, and Usability*. Springer, pp. 203–222.

Riihiaho, S. (2018) *Usability Testing, The Wiley Handbook of Human Computer Interaction*. Wiley.

Ringle, C. M., Wende, S. and Becker, J.-M. (2015) ‘Smartpls 3’. Available at: https://www.smartpls.com/.

Robertson, J. (2007) *11 usability principles for CMS products*.

Rocha, Á. (2012) ‘Framework for a global quality evaluation of a website’, *Online Information Review*, 36(3), pp. 374–382. doi: 10.1108/14684521211241404.

Rosenbaum, S., Rohn, J. A., Smith, T. B., Vredenburg, K. and Rohn, J. A. (2002) ‘Usability in Practice : User Experience Lifecycle — Evolution and Revolution’, pp. 898–903.

Rotchanakitumnuai (2008) ‘Measuring e-government service value with the E-GOVSQUAL-RISK model’, *Business Process Management Journal*, 14(5), pp. 724–737. doi: 10.1108/14637150810903075.

Rusu, C., Rusu, V., Roncagliolo, S. and Gonzalez, C. (2015) ‘Usability and User Experience’:, *International Journal of Information Technologies and Systems Approach*, 8(2), pp. 1–12. doi: 10.4018/IJITSA.2015070101.

Sa, F., Rocha, Á., Cota, M. P. and Perez, M. (2016) ‘Telematics and Informatics Potential dimensions for a local e-Government services quality model’, *Government Information Quarterly*. Elsevier Ltd, 33(2), pp. 270–276. doi: 10.1016/j.tele.2015.08.005.

Sabattini, L., Villani, V., Czerniak, J. N., Mertens, A. and Fantuzzi, C. (2017) ‘Methodological Approach for the Design of a Complex Inclusive Human-Machine System’. Available at: https://arxiv.org/pdf/1706.08461.pdf (Accessed: 15 March 2018).

Saghapour, M., Iranmanesh, M., Zailani, S. and Goh, G. G. G. (2018) ‘An empirical investigation of campus portal usage’, *Education and Information Technologies*, 23(2), pp. 777–795. doi: 10.1007/s10639-017-9635-9.

Saha, P., Nath, A. K. and Salehi-Sangari, E. (2012) ‘Evaluation of government e-tax websites: an information quality and system quality approach’, *Transforming Government: People, Process and Policy*, 6(3), pp. 300–321. doi: 10.1108/17506161211251281.

Sahi, G. (2015) ‘User satisfaction and website usability: Exploring the linkages in B2C E-commerce context’, in *2015 5th International Conference on IT Convergence and Security, ICITCS 2015 - Proceedings*, pp. 0–3. doi: 10.1109/ICITCS.2015.7293034.

Saiyidi, M. R. (2014) ‘Partial least square in a nutshell’. doi: 10.13140/RG.2.1.4125.4245.

Sari, P. K., Alamsyah, A. and Wibowo, S. (2018) ‘Measuring e-Commerce service quality from online customer review using sentiment analysis’, *Journal of Physics: Conference Series*, 971(1). doi: 10.1088/1742-6596/971/1/012053.

Sarstedt, M., Ringle, C. M., Smith, D., Reams, R. and Hair, J. F. (2014) ‘Partial least squares structural equation modeling (PLS-SEM): A useful tool for family business researchers’, *Journal of Family Business Strategy*. Elsevier Ltd, 5(1), pp. 105–115. doi: 10.1016/j.jfbs.2014.01.002.

Saunders, M., Lewis, P. and Thornhill, A. (2016) *Research methods for business students*. Pearson education.

Schaik, P., Ling, J., Schaik, P. Van and Ling, J. (2008) ‘Modelling user experience with web sites : Usability , hedonic value , beauty and goodness’, *Interacting with Computers*, 20(3), pp. 419–432. doi: 10.1016/j.intcom.2008.03.001.

Schoonenboom, J. and Johnson, R. B. (2017) ‘How to construct a mixed methods research design’, *KZfSS Cologne Journal of Sociology and Social Psychology*, 69(2), pp. 107–131. doi: 10.1007/s11577-017-0454-1.

Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., Schreiber, J. B., Nora, A., Stage, F.

K., Elizabeth, A. and Schreiber, J. B. (2010) ‘Modeling and Confirmatory Factor Analysis Results : A Review’, 0671. doi: 10.3200/JOER.99.6.323-338.

Schrepp, M., Hinderks, A. and Thomaschewski, J. (2017). ‘Design and Evaluation of a Short Version of the User Experience Questionnaire (UEQ-S)’. *IJIMAI*. 4(6), pp.103-108.

Seddon, P. B. (1997) ‘A Respecification and Extension of the DeLone and McLean Model of IS Success’, *Information Systems Research*, 8(3), pp. 240–253. doi: 10.1287/isre.8.3.240.

Seffah, A., Donyaee, M., Kline, R. B. and Padda, H. K. (2006) ‘Usability measurement and metrics : A consolidated model’, *Software Quality Journal*, 14(2), pp. 159–178. doi: 10.1007/s11219-006-7600-8.

Shackel, B. (1991) ‘Usability-context, framework, definition, design and evaluation’, in *Human factors for informatics usability*. Cambridge University Press, pp. 21–37.

Shaha, R., Mahmud, N., Zafar, R. Bin and Rahman, S. (2012) ‘Development of Navigation system for visually impaired person’. Available at: http://dspace.bracu.ac.bd/xmlui/bitstream/handle/10361/2123/09221025, 09221081, 09221227, 09221236.pdf?sequence=1 (Accessed: 6 February 2018).

Shneiderman, B. (1998) *Interaction, Designing the user interface: strategies for effective human-computer*. Pearson education.

Shneiderman, B. and Plaisant, C. (2005) *Designing the user interface: Strategies for effective. Human-Computer Interaction*. Pearson.

Shobaki, M. Al and Naser, S. (2017) ‘The Role of the Practice of Excellence Strategies in Education to Achieve Sustainable Competitive Advantage to Institutions of Higher Education-Faculty of Engineering and Information Technology at Al-Azhar University in Gaza: a Model’. Available at: https://philpapers.org/rec/ALSTRO-9 (Accessed: 28 January 2018).

Shukla, A. and Sharma, S. K. (2018) ‘Evaluating Consumers’ Adoption of Mobile

Technology for Grocery Shopping: An Application of Technology Acceptance Model', *Vision*, 22(2), pp. 185–198. doi: 10.1177/0972262918766136.

SIGCHI Award Recipients 1998-2013 (2013) 'SIGCHI Award Recipients'. Available at: https://sigchi.org/awards/sigchi-award-recipients/ (Accessed: 26 July 2015).

Sniegula, A. and Glinka, K. (2017) 'Usability Testing in Web Development Life Cycle', in *Agile Commerce*. Springer, pp. 131–145.

Ssemugabi, S. and De Villiers, M. R. (2016) 'Make your choice: Dimensionality of an open integrated conceptual model for evaluating E-service quality, usability and user experience (e-SQUUX) of Web-based applications', in *Proceedings of the Annual Conference of the South African Institute of Computer Scientists and Information Technologists*. ACM. doi: 10.1145/2987491.2987527.

Stahl, B. C. (2012) 'Morality, Ethics and Reflection: a categorization of normative IS Research.', *Journal of the Association for Information Systems*, 13(8), p. 636. Available at: https://www.dora.dmu.ac.uk/handle/2086/7575.

Stake, R. E. (1995) *The art of case study research*. Sage.

Stake, R. E. (2006) *Multiple case study analysis [IEd lib e-book]*. Guilford.

Stamenkov, G. and Dika, Z. (2015) 'A sustainable e-service quality model', *Journal of Service Theory and Practice*, 25(4), pp. 414–442. doi: 10.1108/JSTP-09-2012-0103.

Stojmenova, E., Lugmayr, A. and Dinevski, D. (2013) 'Persona-based expert review of an e-learning system for adults', in *Electronic Proceedings of the 2013 IEEE International Conference on Multimedia and Expo Workshops, ICMEW 2013*, pp. 23–31. doi: 10.1109/ICMEW.2013.6618367.

Stopher, P. (2012) *Collecting, managing, and assessing data using sample surveys*. Cambridge University Press.

Straub, D. and Gefen, D. (2004) 'Validation Guidelines for IS Positivist Research', *Communications of the Association for Information Systems*, 13(1), pp. 24–31. doi: 10.17705/1CAIS.01324.

Strawderman, L. and Koubek, R. (2008) ‘Human Factors and Usability in Service Quality’, *Ergonomics in Manufacturing & Service Industries*, 18(4), pp. 454–463. doi: 10.1002/hfm.

Sue, V. M. and Ritter, L. A. (2012) *Conducting Online Surveys Sampling*. Sage. doi: 10.4135/9781506335186.

Sulaiman, S., Okere, H. C., Awang, D. R. R. and Mean, F. O. (2016) ‘Expert review of the multimodal interaction model for Foot Reflexology VRST application’, in *2016 3rd International Conference on Computer and Information Sciences, ICCOINS 2016 - Proceedings*, pp. 530–535. doi: 10.1109/ICCOINS.2016.7783271.

Sun, H., Teh, P. and Chiu, A. (2012) ‘An empirical study on the websites service quality of Hong Kong small businesses’, *Total Quality Management & Business Excellence*, 7(1), pp. 931–947.

Swaid, S. I. and Wigand, R. T. (2009) ‘Measuring the quality of e-service: An empirical study’, *Journal of Electronic Commerce Research*, 10(1), pp. 13–28.

Sward, D. (2006) ‘Gaining a competitive advantage through user experience design’, in *Proceeding of the twenty-sixth annual CHI conference*, pp. 93–107. doi: 10.1145/1358628.1358749.

Tashakkori, A. and Teddlie, C. (2010) ‘Sage handbook of mixed methods in social & behavioral research: An Introduction’, in *Sage handbook of mixed methods in social & behavioral research*. Sage publications, pp. 1–2.

Tate, M., Hope, B., Evermann, J. and Barnes, S. (2007) ‘Perceived online service quality: Latent dimensions and ontological implications’, in *PACIS 2007 - 11th Pacific Asia Conference on Information Systems: Managing Diversity in Digital Enterprises*, pp. 14–21.

Taylor, P. and Hassenzahl, M. (2011) ‘The Interplay of Beauty , Goodness , and Usability in Interactive Products The Interplay of Beauty , Goodness , and Usability in Interactive’, *Online*, 19(919083124), pp. 319–349. doi: 10.1207/s15327051hci1904.

Taylor, P. and Hertzum, M. (2010) ‘Images of usability’, *Intl. Journal of Human–Computer Interaction*, 26(6), pp. 567–600. doi: 10.1080/10447311003781300.

Teddlie, C. and Tashakkori, A. (2012) ‘ommon “core” characteristics of mixed methods research: A review of critical issues and call for greater convergence’, *American Behavioral Scientist*, 56(6), pp. 774–788.

Thomas, V., Remy, C. and Bates, O. (2017) ‘The Limits of HCD’, in *Proceedings of the 2017 Workshop on Computing Within Limits - LIMITS ’17*, pp. 85–92. doi: 10.1145/3080556.3080561.

Tilley, S. and Rosenblatt, H. J. (2017) *Systems Analysis and Design*. New York: Cengage.

Toshihiro, K. (2008) ‘Usability evaluation based on international standards for software quality evaluation’, *NEC Technical*, 3(2), pp. 27–32.

Tran, B. (2016) ‘The nature of research methodologies: Terms and usage within quantitative, qualitative, and mixed methods’, in *Mixed Methods Research for Improved Scientific*. IGI Global, pp. 1–27. doi: 10.4018/978-1-5225-0007-0.ch001.

Trochim, W., Donnelly, J. and Arora, K. (2016) *Research methods: The essential knowledge*. Cengage Learning.

Tseng, M. M., Jiao, R. J. and Wang, C. (2010) ‘Design for mass personalization’, *CIRP Annals - Manufacturing Technology*. CIRP, 59(1), pp. 175–178. doi: 10.1016/j.cirp.2010.03.097.

Tsironis, L. K., Gotzamani, K. D. and Mastos, T. D. (2017) ‘e-Business critical success factors: toward the development of an integrated success model’, *Business Process Management Journal*, 23(5), pp. 874–896. doi: 10.1108/BPMJ-02-2016-0030.

Tullis, T. and Albert, B. (2013) ‘Measuring the user experience. Collecting, analyzing, and presenting usability metrics’. Available at: http://www2.engr.arizona.edu/~ece596c/lysecky/uploads/Main/Lec11.pdf.

Turner, S. F., Cardinal, L. B. and Burton, R. M. (2017) ‘Research Design for Mixed Methods: A Triangulation-based Framework and Roadmap’, *Organizational Research Methods*, 20(2), pp. 243–267. doi: 10.1177/1094428115610808.

Udo, G. J., Bagchi, K. K. and Kirs, P. J. (2011) ‘Using SERVQUAL to assess the quality of e-learning experience’, *Computers in Human Behavior*. Elsevier Ltd, 27(3), pp. 1272–1283. doi: 10.1016/j.chb.2011.01.009.

Ugale, P. A. (2018) ‘Human Computer Interaction (HCI)’, *International Journal of Engineering Research Management*, 4(1), pp. 1–5.

Unisa-DISA (2015) ‘Department of Institutional statistics and Analysis (DISA): DISA Outputs’. Available at: http://uir.unisa.ac.za/handle/10500/8135 (Accessed: 19 March 2016).

Unisa-PowerHEDA (2017) ‘Unisa’s Institutional Information and Analysis Portal. Available on the website of the University of South Africa, Department of Institutional Research and Business Intelligence’. Available at: ttp://wpheda.unisa.ac.za/PowerHEDA/dashboard.aspx (Accessed: 1 April 2008).

Unisa (2014) ‘Unisa Research Ethics Policy’. Available at: https://www.unisa.ac.za/static/corporate_web/Content/Library/Library services/research support/Policy on Research Ethics.pdf (Accessed: 7 February 2014).

Unisa (2015) ‘Unisa library’. Available at: https://www.unisa.ac.za/sites/corporate/default/Library (Accessed: 1 February 2015).

Vaananen-Vainio-Mattila, K., Oksman, V. and Vainio, T. (2007) ‘Exploring the User Experience Factors in Designing Successful Mobile Internet Services for Business Use’. Available at: http://www.cs.tut.fi/~kaisavvm/MIUX07_VVM-BusinessUse.pdf

(Accessed: 14 June 2017).

Van Biljon, J., Marais, M. and Platz, M. (2017) ‘Digital platforms for research collaboration: using design science in developing a South African open knowledge repository’, *Information Technology for Development*. Taylor & Francis, 23(3), pp. 463–485. doi: 10.1080/02681102.2017.1328654.

Van der Bijl-Brouwer, M. and Dorst, K. (2017) ‘Advancing the strategic impact of human-centred design’, *Design Studies*, 53(1), pp. 1–23. doi: 10.1016/j.destud.2017.06.003.

Vashishth, A. and Chakraborty, A. (2018) ‘Measuring the Service Quality of Services: TRADONIC SERVQUAL Model’, in *E-Manufacturing and E-Service Strategies in Contemporary Organizations*. IGI Global, pp. 219–241. Available at: https://www.igi-global.com/chapter/measuring-the-service-quality-of-services/201664.

Venable, J., Pries-Heje, J. and Baskerville, R. (2016) ‘FEDS: A Framework for Evaluation in Design Science Research’, *European Journal of Information Systems*, 25(1), pp. 77–89. doi: 10.1057/ejis.2014.36.

Venkatesh, V. (2018) ‘Reflecting on the Past and Charting a Future for ICT4D’, in *Proceedings of the 2018 ACM SIGMIS Conference on Computers and People Research*. ACM, pp. 1–2.

Venkatesh, V. and Bala, H. (2008) ‘Technology Acceptance Model 3 and a Research Agenda on Interventions’, *Decision Sciences*, 39(2), pp. 273–315.

Venkatesh, V., Brown, S. A. and Bala, H. (2013) ‘Bridging the qualitative-quantitative divide: Guidelines for conducting mixed methods research in information systems’, 37(1), pp. 1–34.

Venkatesh, V., Brown, S. A. and Sullivan, Y. W. (2016) ‘Guidelines for Conducting Mixed-methods Research: An Extension and Illustration’, *Journl of the Association of Information Systems*, 17(7), pp. 435–494. doi: Retrieved from http://aisel.aisnet.org.

Venkatesh, V. and Davis, F. D. (2000) ‘A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies’, *Management Science*, 46(2), pp. 186–204. doi: 10.1287/mnsc.46.2.186.11926.

Venkatesh, V., Morris, M., Davis, G. and Davis, F. (2003) ‘User acceptance of information technology: Toward a unified view’, *MIS quarterly*, 27(3), pp. 425–478. Available at: https://www.jstor.org/stable/30036540.

Venkatesh, V., Thong, J. and Xu, X. (2016) ‘Unified Theory of Acceptance and Use of Technology: A Synthesis and the Road Ahead’, *Journal of the Association for Imformation Systems*, 17(5), pp. 328–376.

Venkatesh, V., Thong, J. Y. and Xu, X. (2012) ‘Consumer accptance and use of information technology: Extending the unified theory’, 36(1), pp. 157–178.

Vermeeren, A. P. O. S., Roto, V. and Vaananen, K. (2016) ‘Design-inclusive UX research : design as a part of doing user experience research’, 3(1), pp. 20–37. doi: 10.1080/0144929X.2015.1081292.

Wahyuni, D. (2012) ‘The Research Design Maze: Understanding Paradigms, Cases, Methods and Methodologies’, *Journal of Applied Management Accounting Research*, 10(1), pp. 69–81. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2103082.

Walker, D. M., Menser, T., Yen, P. Y. and McAlearney, A. S. (2018) ‘Optimizing the User Experience: Identifying Opportunities to Improve Use of an Inpatient Portal’, *Applied Clinical Informatics*, 9(1), pp. 105–113. doi: 10.1055/s-0037-1621732.

Walls, J. G., Widermeyer, G. R. and El Sawy, O. A. (2004) ‘Assessing information system design theory in perspective: how useful was our 1992 initial rendition?’, *aisel.aisnet.org*, 6(2), pp. 6–17. Available at: https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1126&context=jitta.

Walsham, G. (1993) *Interpreting Information systems in organisations*. Wiley.

Walsham, G. (2017) ‘ICT4D research: reflections on history and future agenda’, *Information Technology for Development*, 23(1), pp. 18–41. doi: 10.1080/02681102.2016.1246406.

Wang, R., Liu, K., Zhang, M. and Ma, S. (2010) ‘Higher order factor analysis of SERVQUAL-Empirical findings from an e-learning system’, *Progress in Informatics and Computing (PIC),* 2(1), pp. 1293–1297. Available at: https://ieeexplore.ieee.org/abstract/document/5687930/.

Wani, M., Wani, M., Raghavan, V., Abraham, D. and Kleist, V. (2017) ‘Beyond utilitarian factors : User experience and travel company website successes’, *Systems Frontiers*. Information Systems Frontiers, 19(4), pp. 769–784. doi: 10.1007/s10796-017-9747-1.

Weber, S. (2010) ‘Design Science Research: Paradigm or Approach?’, in *AMCIS 2010 Proceedings*. AMCIS, pp. 214–223. Available at: https://pdfs.semanticscholar.org/7c31/a4019ab19db0123c90ba72250bc99d80ace5.pdf.

Weil, A. G., Bojanowski, M. W., Jamart, J., Gustin, T. and Lévêque, M. (2012) ‘Evaluation of the Quality of Information on the Internet Available to Patients Undergoing Cervical Spine Surgery.’, *World neurosurgery*, 82(2), pp. 31–39. doi: 10.1016/j.wneu.2012.11.003.

Welman, J. C. and Kruger, S. J. (1999) *Research methodology for the business and administrative sciences*. International Thompson.

Williams, C. (2007) ‘Research Methods’, *Journal of Business & Economic Research*, 5(3), pp. 65–72.

Williams, M. D., Rana, N. P. and Dwivedi, Y. K. (2015) ‘The unified theory of acceptance and use of technology (UTAUT): A literature review’, *Journal of Enterprise Information Management*, 28(3), pp. 443–448. doi: 10.1108/JEIM-09-2014-0088.

Wilson, C., Bennett Jr, W., Guarino, S., Bove, K. and Cain, T. L. (2018) ‘Applying a

User-Centered Design Approach to Developing Game-Based Training Environments for Aircraft Maintainers', in *End-User Considerations in Educational Technology Design*. IGI Global., pp. 212–237. doi: 10.4018/978–1–5225–2639–1.

Winter, S., Wagner, S. and Deissenboeck, F. (2008) 'A comprehensive model of usability', in *IFIP International Conference on Engineering for Human-Computer Interaction*, pp. 106–122. Available at: http://link.springer.com/chapter/10.1007/978-3-540-92698-6_7 (Accessed: 30 August 2013).

Wolniak, R. and Skotnicka-Zasadzien, B. (2012) 'The concept study of Servqual method's gap', *Quality & Quantity*, 46(4), pp. 1239–1247. Available at: https://link.springer.com/article/10.1007/s11135-011-9434-0.

Wolski, M., Walter, B., Kupiński, S. and Chojnacki, J. (2018) 'Software quality model for a research-driven organization—An experience report', *Journal of Software: Evolution and Process*, 30(5), pp. 1–14. doi: 10.1002/smr.1911.

Wong, K. (2013) 'Partial Least Squares Structural Equation Modeling (PLS-SEM) Techniques Using SmartPLS', *Marketing Bulletin*, 24(1), pp. 1–32. doi: 10.1097/MNM.0b013e328332f801.

Wright, P. C., Mccarthy, J. C. and Marsh, T. (2001) 'From Usability to User Experience', in *Interfaces*. British HCI group.

Wu, B. and Chen, X. (2017) 'Continuance intention to use MOOCs: Integrating the technology acceptance model (TAM) and task technology fit (TTF) model', *Computers in Human Behavior*. Elsevier Ltd, 67(1), pp. 221–232. doi: 10.1016/j.chb.2016.10.028.

Yahya, H. and Razali, R. (2015) 'Usability-Based Framework for Electronic Government', *ARPN Journal of Engineering and Applied Sciences*, 10(20), pp. 9414–9423.

Yang, Z., Cai, S., Zhou, Z. and Zhou, N. (2005) 'Development and validation of an instrument to measure user perceived service quality of information presenting Web portals', *Information and Management,* 42(4), pp. 575–589. doi: 10.1016/S0378-7206(04)00073-4.

Yilmaz, V., Ari, E. and Gurbuz, H. (2018) 'Investigating the relationship between service quality dimensions, customer satisfaction and loyalty in Turkish banking sector: An application of structural equation model', *International Journal of Bank Marketing*, 36(3), pp. 423–440. doi: 10.1108/IJBM-02-2017-0037.

Yin, R. K. (1984) *Case Study Research: Methods and Design*. Bloomsbury Publishing.

Yin, R. K. (1989) *Case study research: Design and methods, revised edition*. Applied Social Research Methods Series, 5.

Yin, R. K. (2014) *Case study research: Design and methods.* Sage.

Zahra, F., Hussain, A. and Mohamed, H. (2017) 'Usability Evaluation of Mobile Applications; where Do We Stand?', in *In AIP Conference Proceedings*, pp. 20–56. doi: 10.1063/1.5005389.

Zeithaml, V. A., Parasuraman, A. and Berry, L. L. (1990) *Delivering quality service: Balancing customer perceptions and expectations*. Simon and Schuster. Available at: https://books.google.co.za/books?hl=en&lr=&id=RWPMYP7-sN8C&oi=fnd&pg=PR9&dq=Zeithaml,+V.A.,+Parasuraman,+A.,+Berry,+L.L.+and+Berry,+L.L.,+1990.+Delivering+quality+service:+Balancing+customer+perceptions+and+expectations.+Simon+and+Schuster.&ots=cf9Aj9zYla.

Zeithaml, V. A., Parasuraman, A. and Malhotra, A. (2002) 'Service Quality Delivery through Web Sites: A Critical Review of Extant Knowledge', *Journal of the Academy of Marketing Science*, 30(4), pp. 362–375. doi: 10.1177/009207002236911.

Zhang, T., Rau, P. L. P. and Salvendy, G. (2010) 'Exploring critical usability factors for handsets', *Behaviour & Information Technology*, 29(1), pp. 45–55. doi: 10.1080/01449290802666747.

Zhou, R., Wang, X., Shi, Y., Zhang, R., Zhang, L. and Guo, H. (2018) 'Measuring e-service quality and its importance to customer satisfaction and loyalty: an empirical study in a telecom setting', *Electronic Commerce Research*. Springer US, pp. 1–23. doi: 10.1007/s10660-018-9301-3.

Zhu, H., Gao, J., Li, D. and Tang, D. (2012) 'A Web-based product service system for aerospace maintenance, repair and overhaul services', *Computers in Industry*, 63(4), pp. 338–348. doi: 10.1016/j.compind.2012.02.016.

Van Zyl, D. and Barnes, G. (2012) 'Department of Institutional Statistics & Analysis An institutional profile: Unisa Facts & Figures HEMIS 2007 - 2011'. Available at: www.unisa.ac.za (Accessed: 22 April 2015).

APPENDICES

Appendix A: Ethical clearance documents from UNISA

Appendix A-1: Ethical clearance permission letter

UNISA college of science, engineering and technology

Dear Mr Samuel Ssemugabi

Date: 2014-11-03

Application number: 185/SS//2014

REQUEST FOR ETHICAL CLEARANCE: A Consolidated Model and an Associated Measuring Instrument for Usability of a University Web Portal

The College of Science, Engineering and Technology's (CSET) Research and Ethics Committee has considered the relevant parts of the studies relating to the abovementioned research project and research methodology and is pleased to inform you that ethical clearance is granted for your research study as set out in your proposal and application for ethical clearance.

Therefore, involved parties may also consider ethics approval as granted. However, the permission granted must not be misconstrued as constituting an instruction from the CSET Executive or the CSET CRIC that sampled interviewees (if applicable) are compelled to take part in the research project. All interviewees retain their individual right to decide whether to participate or not.

We trust that the research will be undertaken in a manner that is respectful of the rights and integrity of those who volunteer to participate, as stipulated in the UNISA Research Ethics policy. The policy can be found at the following URL:
http://cm.unisa.ac.za/contents/departments/res_policies/docs/ResearchEthicsPolicy_apprvCounc_21Sept07.pdf

Please note that the ethical clearance is granted for the duration of this project and if you subsequently do a follow-up study that requires the use of a different research instrument, you will have to submit an addendum to this application, explaining the purpose of the follow-up study and attach the new instrument along with a comprehensive information document and consent form.

Yours sincerely

Prof Ernest Mnkandla
Chair: College of Science, Engineering and Technology Ethics Sub-Committee

Prof IOG Moche
Executive Dean: College of Science, Engineering and Technology

Appendix A-2: Permission to do research involving UNISA staff, student and data

UNISA university of south africa

PROF L LABUSCHAGNE
EXECUTIVE DIRECTOR: RESEARCH DEPARTMENT
Tel: +27 12 429 6368 / 2446
Email: llabus@unisa.ac.za
Address: Theo van Wijk Building, 10th Floor, Office no. 50 (TvW 10-50)

10 December 2014

Mr. S. Ssemugabi
School of Computing
College of Science, Engineering and Technology
Unisa

Dear Mr. S. Ssemugabi

PERMISSION TO DO RESEARCH INVOLVING UNISA STAFF, STUDENTS AND DATA

A study into: "A consolidated model and an associated measuring instrument for usability of a university web portal."

Your application regarding permission to conduct research involving Unisa staff, students and data in respect of the above study has been received and was considered by the Research Permission Subcommittee of the Unisa Senate Research and Innovation and Higher Degrees Committee (SRIHDC) on 05 December 2014.

It is my pleasure to inform you that permission has been granted for this study as per your application, for the period between 1 January 2015 and 30 November 2016.

The Department: Legal Services considers requests for access to records of the University of South Africa in accordance with the Promotion of Access to Information Act, Act No. 2 of 2000 and the Protection of Personal Information Act, Act No. 4 of 2013. Access to the details (personal information) of staff and students cannot be granted without the written consent of the mentioned individuals.

We would like to wish you well in your research undertaking.

Kind regards

PROF L LABUSCHAGNE
EXECUTIVE DIRECTOR: RESEARCH

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsmile: +27 429 12 429 4150
www.unisa.ac.za

Appendix B: Sources and dimensions in Study 1A: Systematic literature review

Appendix B-1: The 264 sources analysed

ID	SourceNo	TypeJorP	AreaeSQUUX	Levels	Diagram	Year	AuthorName
1	83	J	eSWQ	Y	Y	2007	Mohamad
2	160	J	UX	N	N	2010	Hassenzahl
3	87	P	eSWQ	N	N	1998	Keevil
4	469	W	UX	N	N	2012	Rummel (SAP)
5	89	B	eSQ	N	N	2004	Catherall
6	128	J	U	Y	Y	2004	Koohang
7	129	J	U	N	N	2009	Heo
8	130	J	U	Y	Y	2011	Green
9	88	P	eSQ	N	N	2008	Collis
10	132	J	U	N	N	2010	Rasila
11	133	J	eU	N	N	2011	Lee
12	134	B	U	N	N	2004	Williams
13	472	W	UX	N	N	2008	Microsoft1
14	168	J	U	N	Y	2006	Hornbaek
15	135	B	U	N	N	2000	Faulkner
16	171	P	U	N	N	2011	Panach
17	131	P	U	N	N	2008	Hussain
18	173	J	U	N	N	2010	Zhang
19	174	J	eSQ	N	N	2012	Sun
20	172	J	U	N	N	2010	Joo
21	182	J	U	N	N	1988	Chin
22	183	P	U	N	N	2004	Lee
23	178	J	U	N	N	2011	Wang
24	175	J	U	N	N	2006	Seffah
25	180	J	U	N	Y	1999	Park
26	26	J	eSQ	N	N	2005	Parasuraman
27	27	J	eSQ	N	N	2002	Zeithaml
28	29	J	eSWQ	Y	Y	2005	Knight
29	30	J	eSQ	N	Y	2009	Stiakakis
30	28	J	SQ	N	Y	1985	Parasuraman
31	25	J	SQ	N	N	1988	Parasuraman
32	86	J	eSWQ	Y	Y	2009	Lee
33	31	P	eSQ	N	N	2010	Wang
34	39	J	SQ	Y	Y	2008	Strawderman
35	34	J	SQ	N	Y	1992	Cronin

36	177	J	U	N	N	2006	Bertoa
37	37	P	ESQ	N	Y	2004	Bressolles
38	35	J	SQ	N	Y	2011	Gorla
39	38	J	eSQ	N	N	2010	Marimon
40	33	J	eSQ	N	Y	2011	Udo
41	32	J	SQ	Y	Y	2010	Naik
42	138	P	SWQ	N	N	2011	Mathew
43	142	J	UUX	N	N	2010	Pitariu
44	90	P	U	Y	Y	2009	De Kock
45	93	P	U	N	Y	2009	Al-Wabil
46	100	J	U	Y	Y	2002	Agarwal
47	466	P	UX	N	N	2011	Roto (Nokia)
48	169	J	U	N	N	2007	Jabbar
49	142	J	UUX	N	N	2010	Pitariu (Annet)
50	140	P	SWQ	N	N	2010	Bos
51	453	J	eSQ	N	N	2013	Akter
52	116	P	U	N	N	2009	Chao
53	104	P	U	N	N	2007	Andreasen
54	261	J	U	N	N	1999	Lee
55	108	J	U	N	N	2011	Bergstrom
56	2	P	eSQ	N	N	2007	Tate
57	36	J	SQ	N	Y	1993	Parasuraman
58	3	P	eSWQ	Y	Y	2001	Barnes
59	4	J	eSQ	Y	Y	2003	Barnes
60	6	J	eSWQ	Y	Y	2002	Barnes
61	5	P	eSQ	Y	Y	2003	Barnes
62	9	J	UX	N	N	2002	Eysenbach
63	10	J	eSWQ	Y	Y	2005	Cao
64	113	P	U	N	N	2004	DeBoard
65	1	P	eSQ	N	N	2000	Barnes
66	112	J	U	N	N	2010	Pretorius
67	12	J	U	N	Y	2005	Barnes
68	14	P	eSWQ	N	N	2005	Kelly
69	8	P	U	N	N	2008	Karlsson
70	16	P	U	N	N	1994	Bevan
71	19	J	eSQ	Y	Y	2008	Rotchanakitumnuai
72	15	P	eSQ	N	Y	2002	Barnes
73	23	P	eSQ	N	N	2007	Pinhanez
74	24	J	eSWQ	N	N	2010	Jati
75	64	J	DQ	Y	Y	2008	Caro
76	65	J	DQ	N	Y	2006	Caro
77	66	P	eSQ	Y	Y	2008	Moraga
78	67	P	DQ	N	Y	2008	Caro

79	68	P	U	N	N	2006	Moraga
80	69	J	SWQ	Y	Y	2006	Moraga
81	70	P	eSQ			2008	Mandl
82	71	P	eSQ	N	N	2008	Kamthan
83	72	P	SQ	Y	N	2004	Moraga
84	73	P	eSWQ	N	N	2008	Matera
85	74	P	SWQ	Y	Y	2007	Calero
86	119	J	U	N	N	2001	Ivory
87	366	J	eSQ	N	N	2010	Ladhari
88	17	P	SQ	N	N	2007	Tate
89	500	P	eSWQ	Y	Y	2013	Cebi
90	504	P	eSWQ	N	N	2013	Weil
91	506	J	eSWQ	N	N	2012	Kincl
92	505	J	eSWQ	N	N	2002	Dragulanescu
93	510	J	SWQ	Y	Y	1996	Fitzpatrick
94	507	J	eSWQ	N	N	2012	Kincl
95	508	J	eSWQ	N	N	2012	Sorum
96	509	P	SWQ	Y	Y	2011	Al-Badareen
97	511	P	SWQ	N	Y	2010	Brosseau
98	512	P	SWQ	N	N	2011	Coudert
99	473	P	UX	N	N	2006	Pandhi (Microsoft)
100	313	P	SWQ	N	N	2011	Navarro
101	11	P	eSQ	N	Y	2005	Barnes
102	317	J	U	Y		1996	Miller
103	319	J	SWQ	N	N	2014	Krsmanovic
104	320	J	SWQ	Y	Y	1978	Boehm (later)
105	321	J	SWQ	Y	Y	1978	Cavano & McCall
106	40	p	USWQ	Y	Y	2008	Winter
107	501	J	eSWQ	Y	Y	2011	Saha
108	20	P	SQ	N	N	2004	Manouselis
109	41	P	U	Y	Y	1998	ISO 1998
110	44	B	U	Y	Y	1995	unknown01
111	45	J	U	Y	Y	2008	Komiyama
112	42	P	U	N	N	2005	ISO/IEC 25000
113	46	W	USQ	Y	Y	1996	ISO 9241:10
114	47	P	eU	N	N	2006	Coursaris
115	49	P	U	Y	Y	2008	Holzinger
116	51	P	eU	N	Y	2005	Mehlenbacher
117	43	P	U	N	N	2009	Carvajal
118	46	B	U	Y	N	2006	Bevan
119	56	J	U	Y	Y	2004	Folmer
120	55	P	U	N	N	2005	Sauro
121	58	P	U	N	Y	2009	Frandsen-Thorlacius

122	53	P	U	N	N	2007	Robertson
123	60	P	U	Y	Y	1991	ISO 9126
124	61	J	U	Y	Y	2000	Han
125	62	J	SWQ	N	Y	2012	Rocha
126	63	P	U	N	N	1995	Pieratti (XEROX)
127	59	P	U	Y	Y	1995	Bevan
128	191	P	eU	N	N	2007	Petrie
129	148	P	UUXeSQ	Y	Y	2010	Lew (ISO 25010)
130	151	P	UX	N	N	2008	Hassenzahl
131	152	P	UUX	N	Y	2000	Hassenzahl
132	159	J	UX	N	N	2012	Partala
133	115	P	U	N	N	2001	Soon
134	162	P	UUX	N	Y	2006	McNamara
135	57	P	U	N	N	1995	Bevan
136	164	P	UX	N	Y	2004	McCarthy
137	300	P	UX	N	Y	2000	Hassenzahl
138	301	J	UX	N	N	2011	Hassenzahl
139	304	P	UX	N	N	2009	Law
140	305	J	UX	Y	Y	2010	Young
141	306	J	UX	N	N	2013	Park b
142	307	P	UX	N	N	2013	Brondenburg
143	308	B	UX	N	N	2007	Kuniavsky
144	309	J	UX	N	N	2010	Obrien
145	310	J	UX	N	Y	2010	Karapanos
146	317	J	UX	Y	Y	2009	Hassenzahl
147	318	P	UX	N	N	2002	Hassenzahl
148	319	J	UX	N	N	2007	Hassenzahl
149	322	J	UX	N	Y	2007	Jetter
150	323	J	UX	N	N	2008	schaik
151	321	P	UX	N	N	2014	Hassenzahl
152	321	B	UX	N	N	2014	Norman
153	315	P	eSWQ	Y	Y	2001	Olsina
154	326	J	UX	Y	Y	2004	Crawford
155	303	J	UX	Y	Y	1988	Watson
156	315	J	UX	N	N	2013	Park c
157	163	J	UUX	N	N	2010	Finstad
158	336	J	U	Y	Y	2011	Nathan
159	316	J	UX	N	N	2010	Nacke
160	354	W	eU	N	N	2010	Microsoft
161	337	P	U	N	N	2015	Aparna
162	338	P	eU	N	N	2013	Dollmat
163	339	P	eU	Y	Y	2013	Djordjevic
164	340	P	eU	N	N	2014	Rivero

165	342	J	eSQ	Y	Y	2003	Negash
166	343	J	eSQ	Y	Y	2006	Strawderman
167	353	P	eU	Y	Y	1999	Gehrke
168	344	P	UUX	Y	Y	2011	Mifsud
169	345	J	eU	N	N	2014	Lee
170	396	P	UUX	N	N	2009	Bevan
171	367	J	SQ	N	N	1993	Vandamme
172	368	P	eSQ	Y	Y	2014	Jiang
173	146	P	UX	N		2010	Obrist
174	369	J	eSQ	N	N	2014	Chang
175	372	P	eSQ	N	N	2013	Jenabi
176	373	J	eSQ	Y	Y	2014	Chen
177	374	J	eSQ	N	N	2014	Kundu
178	375	J	eSQ	Y	Y	2012	Gupta
179	376	P	eSQ	N	N	2014	Teimouri
180	385	J	eSQ	N	N	2007	Ho and Lee
181	377	J	SQ	N	N	2012	Tohidi
182	378	J	SQ	Y	N	2011	Finn
183	379	P	SQ	N	N	2012	calisir
184	380	J	SQ	N	Y	2010	Martinez
185	381	J	eSQ	N	Y	2005	Lee
186	383	J	eSQ	Y	Y	2005	Yang
187	397	J	UUXeSQ	Y	Y	2013	Park a
188	398	J	UUX	Y	Y	2014	Al-Khalifa
189	399	P	UUX	Y	Y	2012	Moczarny & Ruth
190	400	P	UUXeSQ	Y	Y	2010	Lew
191	401	J	USQ	N	Y	2008	Strawderman
192	402	J	UUX	N	N	2014	Kim
193	403	J	UXSQ	N	N	2008	Hartmann
194	405	J	USQ	Y	Y	2012	Haron
195	406	J	UUXeSQ	N	N	2009	Al-momani
196	407	J	USQ	Y	Y	2010	Gorla
197	408	P	UXSQ	N	N	2011	Boothe
198	348	P	U	N	N	2014	shitkova
199	353	B	U	N	N	1994	Nielsen
200	409	J	U	N	N	1999	Partala
201	411	P	UUX	N	N	2014	Lange
202	121	J	eU	Y	Y	2010	Chen
203	122	J	eU	N	N	2008	Pearson
204	123	J	eUUX	N	N	2012	Hertzum
205	410	P	UUX	N	N	2012	Viklund
206	188	J	eSQ	N	N	2002	Loiacono
207	412	P	UUX	N	N	2013	Hedegaard

208	124	J	U	N	N	2010	Hertzum
209	314	P	UX	N	N	2010	Brooks
210	388	J	SQ	Y	Y	2014	Stiglingh
211	390	J	eSQ	N	Y	2009	Swaid
212	386	J	eSQ	N	Y	2010	Ojasalo
213	389	J	eSQ	N	Y	2004	Burgess
214	635	J	UUX	N	N	2015	Roto
215	2622	J	UX	Y	Y	2012	Venkatesh UTAUT 2
216	13	P	eSQ	N	Y	2004	Nantel
217	77	J	SWQ	N	N	2004	Telang
218	466	B	U	N	N	2012	Watzman
219	3752	J	UUX	N	N	2013	Lindgaard
220	2626	J	UUX	Y	Y	2003	Venkatesh UTAUT 1
221	371	J	eSQ	Y	Y	2009	Liu
222	415	P	UUXeSQ	N	N	2015	Carrasco
223	470	B	UUX	N	N	2012	Mayhew
224	472	B	U	N	N	2012	Coutaz
225	467	B	UX	N	N	2012	Marcus
226	464	B	UX	N	N	2012	Hinckey
227	469	B	UX	N	N	2012	Lazzaro
228	473	B	UUX	N	N	2012	Dumas
229	468	B	U	N	N	2012	Ashman
230	471	B	UUX	N	N	2012	Mayhew
231	442	p	UX	N	N	2015	Oracle2
232	446	J	UX	N	N	2014	Pucillo
233	441	P	UX	N	N	2012	Oracle1
234	448	p	UX	N	N	2011	Kajala, Roto, etc
235	449	p	UX	N	N	2009	Ketola
236	447	J	UX	Y	Y	2014	Law, Schaik & Roto
237	445	p	UX	N	N	2013	Rantavuo & Roto
238	474	B	U	N	N	2012	Siegel
239	443	J	UX	N	N	2010	Vaataja
240	451	J	U	N	N	2008	Hussain
241	450	p	U	N	N	2000	Korhonen
242	454	J	UX	N	N	2013	Curran
243	456	J	U	N	N	2013	Lewis
244	455	J	U	N	N	2013	Lascu
245	459	J	UX	N	N	2013	McNamara
246	460	J	UX	N	N	2013	Norman
247	461	J	UX	N	N	2013	KonRadt
248	471	P	UX	N	Y	2007	Roto

249	487	P	eSQ	Y	Y	2014	Chinomona
250	486	J	eSQ	N	Y	2014	AL-Nuaimi
251	488	P	eSQ	N	N	2014	Teimouri
252	484	J	eSQ	Y	Y	2015	Blut
253	483	J	eSQ	N	N	2015	Carrasco
254	482	P	UX	N	Y	2014	Diefenbach
255	444	p	UX	N	N	2009	Law
256	470	P	UX	N	N	2014	Choi
257	485	J	eSQ	N	N	2014	Kin-Soon
258	479	W	UX	N	N	2015	Google1
259	457	J	U	N	N	2013	Sauro
260	475	J	U	N	N	1995	Lewis (IBM)
261	452	J	U	N	N	2013	Booi & Ditsa
262	463	J	UUX	N	N	2013	Finstad
263	481	W	UX	N	N	2015	Apple1
264	476	W	U	N	N	2000	Microsoft2

Appendix B-2: Top 70 dimensions by frequency

#	Dimension	Frequency
1	Efficiency	63
2	Reliability	47
3	Learnability	43
4	Security and Privacy	40
5	Assurance and Trust	37
6	Satisfaction	35
7	Effectiveness	33
8	Attractiveness	29
9	Responsiveness	26
10	Flexibility	24
11	Interactivity and Feedback	24
12	Empathy	23
13	Accessibility	21
14	Consistency	20
15	Memorability	20
16	Information quality	18
17	Navigation	18
18	Tangibility	17
19	Understandability	17
20	Accuracy	16
21	Control	15
22	Availability	13
23	Completeness	13
24	Usefulness	13

25	Adaptability	12
26	Hedonic qualities	11
27	Simplicity	11
28	Accessibility	10
29	Appeal	10
30	Pleasure	10
31	Relevance	10
32	Security risk	10
33	User satisfaction	10
34	Emotions	9
35	Innovativeness	9
36	Interaction quality	9
37	Personalisation	9
38	Pragmatic quality	9
39	Conciseness	8
40	Content	8
41	Fun	8
42	Interface Design/System structure	8
43	Maintainability/Maintainable	8
44	Navigability	8
45	Novelty	8
46	Presentation	8
47	Stimulation	8
48	Timeliness/Timely	8
49	User Support	8
50	Access	7
51	Attitude	7

52	Challenging/Challenge/Challengeability	7
53	Competence	7
54	Engaging/User Engagement	7
55	Exciting	7
56	Fulfilment	7
57	Informative	7
58	Motivating/Motivation	7
59	Portability	7
60	Readability	7
61	Responsiveness and Fulfilment	7
62	Safety	7
63	Content Quality	6
64	Download Speed	6
65	Ease Of Learning	6
66	Ease Of Navigation	6
67	Aesthetics	6
68	Familiarity	6
69	System Integrity	6
70	Interoperability	6

Appendix C: Documents for Study 1B: Expert review

Appendix C-1: Expert review: Template

<u>Section A:</u> Evaluation of categories, main dimensions and associated dimensions

Instructions (see Introduction and Instruction sheet)

#	**Level 1** **Category Name**	**Level 2** **Main dimensions**	***IP***	***ST***	**Level 3** **Associated dimensions**	***RT***
1	**Learnability and Understandability (1)**	Learnability (1.1)				
		Understandability (1.2)			Comprehensibility(1.2.1), Interpretability (1.2.2), Meaning (1.2.3), Nomenclature(1.2.4), Terminology(1.2.5), Wording and language (1.2.6), Text meaning (1.2.7), Use of existing knowledge (1.2.8)	
		Memorability (1.3)			Brevity (1.3.1), Ease of remembering (1.3.2), Mental load (1.3.3), Recall (1.3.3), Recognition(1.3.4), Workload (1.3.5)	
		Conciseness (1.4)			Minimalism (1.4.1), Preciseness (1.4.2), Economy (1.4.3), Explicitness (1.4.4), Focused (1.4.5), Preference (1.4.6)	
		Readability (1.5)			Legibility (1.5.1)	
		Clarity (1.6)			Granularity (1.6.1), Specific (1.6.2), Unambiguousness (1.6.3), Visibility (1.6.4), Progress indicator (1.6.5), Vividness (1.6.6)	
	Dimensions	**Comment**				

	Learnability (1.1)					
	Understandability (1.2)					
	Memorability (1.3)					
	Conciseness(1.4)					
	Readability (1.5)					
	Clarity (1.6)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
2	**Flexibility and personalisation (2)**	Flexibility (2.1)			Accommodation (2.1.1), Compatibility(2.1.2), Browser compatibility (2.1.3), Changeability (2.1.4), Ability to evolve (2.1.5), Forgiveness (2.1.6), Modifiability (2.1.7)	
		Personalisation (2.2)			Identification/identity (2.2.1), Exclusive (2.2.2), Individualisation (2.2.3), User centricity (2.2.4), User empowerment (2.2.5)	
		Empathy (2.3)				
		Controllability (2.4)				
		Adaptability (2.5)				
		Portability (2.6)			Interoperability (2.6.1), Technology use (2.6.2)	
	Dimensions	**Comment**				
	Flexibility (2.1)					
	Personalisation (2.2)					

	Empathy (2.3)					
	Controllability (2.4)					
	Adaptability (2.5)					
	Portability (2.6)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
3	**Efficiency (3)**	Efficiency (3.1)			Scalability (3.1.1), Integrative (3.1.2), Resources utilisation (3.1.3)	
		Simplicity (3.2)			Operability (3.2.1), Ease of operation (3.2.2), Non-frustration (3.2.3), Effortlessness (3.2.4), Non-obtrusiveness (3.2.5)	
		Performance Speed (3.3)			Network usage(3.3.1), Technical performance(3.3.2), Throughput (3.3.3), Velocity (3.3.4)	
	Dimensions	**Comment**				
	Efficiency (3.1)					
	Simplicity (3.2)					
	Performance speed (3.3)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***

4	**Pleasure and Hedonics (4)**	Pleasure (pleasurable) (4.1)			Good (4.1.1), Interesting (4.1.2), Happiness (4.1.3)	
		Hedonics (4.2)			Attachment (4.2.1), Be-goals (4.2.2), Continuance (4.2.3), Proud (4.2.4), Loyalty (4.2.5), Urge to use again (4.2.6)	
		Emotion (4.3)			Evocation (4.3.1)	
		Fun (4.4)				
		Enjoyment (4.5)				
		Effectiveness (4.6)				
		Entertainment (4.7)				
	Dimensions	**Comment**				
	Pleasure (pleasurable) (4.1)					
	Hedonics (4.2)					
	Emotion (4.3)					
	Fun (4.4)					
	Enjoyment (4.5)					
	Effectiveness (4.6)					
	Entertainment (4.7)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
5	**Responsiveness and helpfulness (5)**	Responsiveness (5.1)			Immersion (5.5.1)	
		Helpfulness (5.2)			Documentation (5.2.1), Customer service (5.2.2),	

					Assistance (5.2.3), Explanations (5.2.4)	
		Interactivity (5.3)				
		Feedback (5.4)				
		Engageability (5.5)			Immersion (5.5.1)	
		Fulfilment (5.6)				
	Dimensions	**Comment**				
	Responsiveness (5.1)					
	Helpfulness (5.2)					
	Interactivity (5.3)					
	Feedback (5.4)					
	Engageability (5.5)					
	Fulfilment (5.6)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
6	**Reliability (6)**	Reliability (6.1)			Objectivity (6.1.1), Predictability(6.1.2), Validity (6.1.3), Stability (6.1.4), Humility (6.1.5), Sustainability (6.1.6)	
		Accuracy (6.2)			Delicacy (6.2.1), Correctness (6.2.2)	
		Completeness (6.3)				
	Dimensions	**Comment**				
	Reliability (6.1)					
	Accuracy (6.2)					
	Completeness (6.3)					

	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
7	**Information quality (7)**	Information quality (7.1)				
		Data quality (7.2)				
		Content quality (7.3)			Multimedia capability (7.3.1)	
	Dimensions	**Comment**				
	Information quality (7.1)					
	Data quality (7.2)					
	Content quality (7.3)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
8	**Effectiveness and Usefulness (8)**	Effectiveness (8.1)				
		Usefulness (8.2)			User value (8.2.1), User need (8.2.2), Utility (8.2.3), Value added (8.2.4), Productivity (8.2.5), Constructiveness (8.2.6), Practicality(8.2.7), Self-service(8.2.8)	
		Functionality (8.3)				
	Dimensions	**Comment**				
	Effectiveness (8.1)					
	Usefulness (8.2)					
	Functionality (8.3)					

	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
9	**Interfaces design and appearance (9)**	Interfaces design (9.1)				
		Appearance (9.2)				
		Tangibility (9.3)				
		Presentation (9.4)				
	Dimensions	**Comment**				
	Interfaces design (9.1)					
	Appearance (9.2)					
	Tangibility (9.3)					
	Presentation (9.4)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
10	**Appeal and Attractiveness (10)**	Appeal (10.1)			Curiosity (10.1.1)	
		Attractiveness (10.2)				
		Exciting (10.3)			Enthusiastic (10.3.1), Arousal (10.3.2), Delight (10.3.3), Elatedness (10.3.4), Playfulness (10.3.5), Refreshing (10.3.6), Thrill (10.3.7)	
		Stimulation (10.4)				
	Dimensions	**Comment**				
	Appeal (10.1)					

	Attractiveness (10.2)					
	Exciting (10.3)					
	Stimulation (10.4)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
11	**Security and safety (11)**	Security (11.1)			Confidence (11.1.1), Privacy (11.1.2), Financial risk (11.1.3), Perceive risk (11.1.4), Guarantee (11.1.5)	
		Safety (11.2)				
	Dimensions	**Comment**				
	Security (11.1)					
	Safety (11.2)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
12	**Assurance and Credibility (12)**	Assurance (12.1)			Trust (12.1.1), User comfort (12.1.2), Honesty (12.1.3), Courtesy (12.1.4), Maturity(12.1.5), Authority of source(12.1.6), Corporate image(12.1.7), Dependability (12.1.8), Returnability (12.1.9)	
		Credibility (12.2)			Authority (12.2.1), Integrity (12.2.2), Reputation (12.2.3),	

					Popularity (12.2.4), Brand (12.2.5), Openness (12.2.6), Transparency (12.2.7)	
	Dimensions	**Comment**				
	Assurance (12.1)					
	Credibility (12.2)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
13	**Satisfaction (13)**	Satisfaction (13.1)				
		Attitude (13.2)				
	Dimensions	**Comment**				
	Satisfaction (13.1)					
	Attitude (13.2)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
14	**Accessibility (14)**	Accessibility (14.1)				
		Availability (14.2)				
	Dimensions	**Comment**				
	Accessibility (14.1)					
	Availability (14.2)					
	List of synonyms					
	Overall comment on category					

			IP	***ST***		***RT***
15	**Navigation (15)**	Navigation (15.1)			Flow (15.1.1), Order (15.1.2), Paths (15.1.3)	
		Searchability (15.2)				
		Findability (15.3)				
	Dimensions	***Comment***				
	Navigation (15.1)					
	Searchability (15.2)					
	Findability (15.3)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
16	**Errors and Robustness (16)**	Errors (16.1)			Mistakes (16.1.1), Failure (16.1.2)	
		Robustness (16.2)			Recoverability (16.2.1), Fault tolerance (16.2.2), Guidance (16.2.3), Undo (16.2.4)	
	Dimensions	**Comment**				
	Errors (16.1)					
	Robustness (16.2)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
17	**Maintainability (17)**	Maintainability (17.1)			Installability (17.1.1), Replaceability (17.1.2), Support (17.1.3),	

					Reusability (17.1.4), Administration (17.1.5), Back-compatibility (17.1.6), Testability (17.1.7)	
		Support (17.2)				
	Dimensions	**Comment**				
	Maintainability (17.1)					
	Support (17.2)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
18	**Relevance and Suitability (18)**	Relevance (18.1)			Applicability (18.1.1), Relatedness (18.1.2), Affordance (18.1.3), Continuance intention (18.1.4)	
		Suitability (18.2)			Appropriateness (18.2.1), Compliance (18.2.2), Adequacy/task Match (18.2.3), Conformity (18.2.4), Made for the media (18.2.5), Merit (18.2.6), Technical adequacy(18.2.7), Fit for the task (18.2.8)	
	Dimensions	**Comment**				
	Relevance (18.1)					
	Suitability (18.2)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
19	**Consistency and innovativeness**	Consistency (19.1)			Coherence (19.1.1)	
		Innovativeness (19.2)			Originality(19.2.1),	

					Self-descriptiveness (19.2.2), Intuitiveness (19.2.3)	
		Novelty (19.3)				
	Dimensions	**Comment**				
	Consistency (19.1)					
	Innovativeness (19.2)					
	Novelty (19.3)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
20	**Competence (20)**	Competence (20.1)				
	Dimensions	**Comment**				
	Competence (20.1)					
	Overall comment on category					
			IP	***ST***		***RT***
21	**Aesthetics (21)**	Aesthetics (21.1)				
		Colour (21.2)				
	Dimensions	**Comment**				
	Aesthetics (21.1)					
	Colour (21.2)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
22	**Sociability and collaboration (22)**	Sociability (22.1)			Cooperatively (22.1.1)	
		Collaboration (22.2)			Universality (22.2.1)	
		Communication (22.3)				
	Dimensions	**Comment**				

	Sociability (22.1)					
	Collaboration (22.2)					
	Communication (22.3)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
23	**Timeliness (23)**	Timeliness (23.1)				
		Currency (23.2)				
		Up-to-datedness (23.3)				
	Dimensions	***Comment***				
	Timeliness (23.1)					
	Currency (23.2)					
	Up-to-datedness (23.3)					
	List of synonyms					
	Overall comment on category					
			IP	***ST***		***RT***
24	**Motivating and Challengability (24)**	Motivating (24.1)				
		Challengability (24.2)				
	Dimensions	***Comment***				
	Motivating (24.1)					
	Challengability (24.2)					
	List of synonyms					

	Overall comment on category	

<u>Section B:</u> General evaluation

1. What are your top 5 most important categories? Use the **Category name** column, **Level 1**, in the given evaluation table. Rank them starting from the most important.

Ranks	Category (name or number)
1	
2	
3	
4	
5	

2. What are your 5 least important categories? Use the **Category name** column, **Level 1**, in the given evaluation table. Rank them starting from the least important.

Ranks	Category (name or number)
1	
2	
3	
4	
5	

3. What are your 5 most important individual dimensions? Use the **Main Dimensions** column, **Level 2**, in the given evaluation. Rank them starting from the most important.

Ranks	Dimension (name or number)
1	
2	
3	
4	
5	

4. What are your 5 least important individual dimensions? Use the **Main Dimensions** column, **Level 2**, in the given evaluation. Rank them starting from the least important.

Ranks	Dimension (name or number)
1	
2	
3	
4	
5	

5. Do you believe that there are any essential dimensions of e-SQUUX that have been omitted? If so, please list below.

6. What is your overall comment on the model?

Thank you for your participation – much appreciated!

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>End<<<<<<<<<<<<<<<<<<<<<<<<<<<

Evaluation of the e-Service, Usability and User experience (e-SQUUX) conceptual model for Web-based applications

Introduction and instructions

NB: Ideally you should use the soft copy of the file named *Main e-SQUUX Evaluation file* to perform this evaluation. However, if this is not possible, you can e-mail me to forward you a printable file for a hardcopy with enough spaces to fill in. If possible, print out this document for easy reference during your evaluation.

Objective of the evaluation

You have used the web at work and home environments for information retrieval or transactional-based applications in fields such as e-commerce, e-learning, education, shopping, teaching, games, social media or others, using traditional and/or mobile computing. Using your experience, the main question that I want you to address during this evaluation is **"What is the dimensionality of quality Web-based applications and how important are these dimensions to you**?"

How the model was synthesised

The model presented to you is a result of a study of over 250 publications related to the fields of e-Service, Usability and User experience (e-SQUUX). This led to an initial set of 632 dimensions with frequencies ranging from 1 to 85. This set was analysed to remove any duplicates and dimensions that did not seem relevant. This resulted in 565 unique dimensions.

The second phase of reduction was to take dimensions that were deemed to be similar, for example, easy to learn, ease of learning, learnability, learnable, and time to learn. Such sets of synonyms were reduced to one term, in this case to Learnability. This was done by taking the terms with the highest frequency among each set. Some dimensions were considered not to be relevant and in most cases had a frequency of 1 and were also removed. A few of them such as usability and ease of use had a high frequency but were considered to be one of the three areas of this study and were eliminated too. For example, many authors equate ease of use to usability which is a subset of *e-SQUUX*. This reduction phase resulted in 242 new dimensions.

In the third phase of the study, with reference to the three main theoretical models used for this study, namely TAM, UTAUT 2 and SERVQUAL, ISO standards, and other literature sources, similar dimensions were grouped, first, into 75 categories and then 24 of them, as provided in the model. Though frequencies were also used during this process, for example, in determining which dimension(s) to use to name a category, it was mainly a subjective exercise. Note that where two dimensions had nearly equal frequencies, two names were used as category identifiers (category names), with the dimension having the higher frequency appearing first.

To note

1. Because the three areas of study in this research, i.e. e-Service, Usability and User experience (e-SQUUX), are so entwined and inter-related, no effort should be taken to group the categories or dimensions into each of these three areas.
2. What is to be evaluated is a generic conceptual model that can be applied in different domains. For that reason, while it is acknowledged that in order to provide your opinions on matters like importance of a specific dimension, it is requested that you evaluate the model in general terms.
3. Although quantitative data is required in some instances, the main focus for you should be to provide qualitative data, in order to improve the model.

Instructions

The model consists of 24 categories:

- **Level 1** is numbered from 1 to 24, each of the 24 having a **Category name**,
- **Level 2** consists of the sets of **Main dimensions** associated with each category, and
- **A**t **Level 3,** some **Associated dimensions** are listed that are related to relevant Main dimensions.

You can also provide any comment you wish. It is not essential to comment on each main dimension but any feedback, advice, suggestion etc. will be appreciated.

For example, for each category (level 1), main dimensions (level 2) and associated dimensions (level 3) you can do the following:

a. Add, remove (strikethrough), combine/merge, modify or rename categories
b. Add, remove (strikethrough), combine/merge, modify or rename level 2 or level 3 dimensions
c. Suggest any other changes you feel necessary

Once you have completed the evaluation, please return the filled-up *Main E-SQUUX evaluation file* and a signed copy of the consent form to me, Samuel Ssemugabi, using the email ssemus@unisa.ac.za. I will appreciate if you could do this in the next two weeks.

Thank you for your participation.

Appendix C-3: Expert review: Consent form

CONSENT FORM

INTRODUCTION

Dear Prospective Participant,
My name is **Mr Samuel Ssemugabi** and I am doing research towards a PhD in the **School of Computing** at the University of South Africa (Unisa). **Prof Ruth de Villiers** is my supervisor. We are inviting you to participate in a study entitled **Development and validation of an integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications in the context of a University web portal**.

CONFIDENTIALITY AND PRIVACY

The research will be conducted in accordance with the Unisa Ethics Policy. Data collected from the study will be treated as private and confidential. The identity of participants and the college, school or department will not be in the published research report. Your personal details will not be made public. Data will be kept securely, but in line with Unisa regulations, it can only be disposed of after five years. After five years all materials used in this study will be destroyed. Please note that at any point in time during the course of the research, only the researcher and the supervisor will have access to the data collected.

WITHDRAWAL CLAUSE

You are free to withdraw your consent any time during the study without any consequences, in which event your participation in the research will cease and any information collected from you will not be used.

CONTACT INFORMATION OF THE RESEARCHER

For more information feel free to contact me, Samuel Ssemugabi, using the e-mail ssemus@unisa.ac.za or telephone number 082 xxx yyyy.

The evaluation should take approximately 45-60 minutes to complete. I would appreciate if you complete the form as soon as possible and return it immediately.

Please fill in the form on the next page.

CONSENT

I ____ (full name) have read and understood the information relating to this research project as provided in the previous page of this form. I hereby declare that I agree voluntarily to participate in the project. I am aware that findings will be anonymised and presented in a PhD thesis and that selected data might be published in academic journals or conference proceedings.

Signature of participant: _________________________ Date ________________

Appendix D: Documents for Study 2A: Pilot study

Appendix D-1: Pilot study: Questionnaire

UNISA web portals survey questionnaire for evaluation of e-service quality, usability and user experience (e-SQUUX)

(For current students and/or staff only)

Dear Participant,

I am conducting a survey to evaluate the **e-service quality**, **usability** and **user experience** (e-SQUUX) of University web portals of the University of South Africa (UNISA). I request you to kindly participate and provide me with your valuable feedback. Participating in this study is **voluntary** and you are under no obligation to consent to participation. In addition, you are **free to withdraw** your consent and participation any time during the study without any consequences. I assure you that, the information provided by you will be **confidential** and your identity will be **anonymous**.

This research relates to my PhD (Information Systems) studies under the supervision of Prof. M.R. de Villiers of UNISA. Your contribution will be greatly appreciated.

Kind regards

Sam Ssemugabi (UNISA staff)

Section A: Demographic information

A1. Which one of the following do you study with or work for at UNISA? (*Select ONLY ONE option,* ***when there are small empty circles like below*** *– use a tick✓.*)

- o College of Accounting Sciences (CAS)
- o College of Agriculture & Environmental Sciences (CAES)
- o College of Economic & Management Sciences (CEMS)
- o College of Education (CE)
- o College of Graduate Studies (CGS)
- o College of Human Sciences (CHS)
- o College of Law (CL)
- o College of Science, Engineering & Technology (CSET)
- o School for Business Leadership (SBL)
- o Support Department/Directory/Division (but not in any college or SBL)
- o Administrative Department/Directory/Division (but not in any college or SBL)
- o Other (specify) ____

A2. What is your status at the UNISA? (*You can select MORE THAN ONE option,* ***when there are small empty boxes like below*** *– use tick(s)✓.*)

- ☐ Academic staff
- ☐ Administrative staff
- ☐ Support staff
- ☐ Librarian
- ☐ Research assistant
- ☐ E-tutor or Teaching assistant (TA)
- ☐ Full-time student
- ☐ Part-time student
- ☐ Other (specify) ____

A3. What is your MAIN role at UNISA? (*Select ONLY ONE option.*)

- o Academic staff
- o Administrative staff
- o Librarian
- o Research assistant
- o E-tutor or Teaching assistant (TA)
- o Full-time student
- o Part-time student
- o Other (specify) ____

A4. Which one of the following UNISA portals do you use? (*You can select MORE THAN ONE option.*)

- ☐ MyUnisa (my.unisa.ac.za)
- ☐ Staff (staff.unisa.ac.za)
- ☐ Library (library.unisa.ac.za)
- ☐ Other (specify): ___________________.unisa.ac.za

A5. When you think about using UNISA web facilities for your work, studies or other activities, which of the following sites do use as your MAIN starting point (point of entry to UNISA)? (*Select ONLY ONE option.*)

- o MyUnisa (my.unisa.ac.za)
- o Staff (staff.unisa.ac.za)
- o Library (Library.unisa.ac.za)
- o UNISA main site – UNISA home page (unisa.ac.za)
- o Other (specify): ___________________.unisa.ac.za

A6. Which one of the following UNISA portals do you use MOST frequently? (*Select ONLY ONE option.*)

- o MyUnisa (my.unisa.ac.za)
- o Staff (staff.unisa.ac.za)
- o Library (Library.unisa.ac.za)
- o Other (specify): ___________________.unisa.ac.za

NB: I shall refer to the site you have just selected in A6 above (your most frequently used UNISA portal) as WWWX. You will FOCUS on this site or portal when answering most questions in this questionnaire.

A7: Provide me with more information about **yourself** and the use of WWWX, the site you use most frequently. #### represents a blank space and should not be filled in.

#	Item	***For EACH ROW please tick (✓) ONLY ONE of the boxes for the option that best applies to you.***					
.1	**Age in years**	Less than 25	25 to 40	41 to 55	More than 55	####	####
.2	**Gender**	Male	Female	Other (specify)			

.3	**Level of education**	High school or less	Some college or under-graduate	Graduate (3rd level degree or Diploma)	Honours or other 4th level qualification	Masters degree	Doctoral degree
.4	**Length of WWWX use**	Less than 3 months	3 to less than 6 months	6 to less than 12 months	1 to less than 3 years	3 to less than 5 years	5 years or more
.5	**Frequency of WWWX use**	Once a semester	once a month	2-4 times a month	2-4 times a week	1-2 times everyday	More than 2 times a day
.6	**Years of using computers?**	0-1	1-3	3-5	5-7	More than 7 seven	####
.7	**Frequency of use of the Internet**	Never	Rarely (once a month)	Occasionally (once a week)	Frequently (once a day)	Very frequent (many times a day)	####
.8	**e-Skills level (computer skills)**	None	Below average	Average	More than average	Expert	####
.9	**Use a computer at work?**	No	Yes	Not employed	####	####	####
10	**Use a computer at home?**	No	Yes	####	####	####	####
.11	**Most common equipment used to access WWWX**	Desktop PC/Mac	Laptop	Tablet	Features phone	Smart Phone	Other (specify)
.12	**Use WWWX while at Home?**	No	Yes	####	####	####	####
.13	**Ever used a university/high**	No	Yes	####	####	####	####

	er education web portal other than that of UNISA?						
.14	**Ever used any other portal other than a higher education portal?**	No	Yes	####	####	####	####

A8: At which of the following locations do you access WWWX? (*You can select MORE THAN ONE option.*)

- ☐ Home
- ☐ Work
- ☐ Internet café
- ☐ UNISA campus
- ☐ UNISA centre
- ☐ On my mobile device (Phone, Tablet, PC/Mac with Internet mobile modem, etc)
- ☐ Other (specify) __________________

A9: Which of the following locations do you use MOST frequently to access WWWX? (*Select ONLY ONE option.)*

- o Home
- o Work (But NOT at UNISA)
- o Internet café
- o UNISA campus
- o UNISA centre
- o On my mobile device (Phone, Tablet, PC /Mac with Internet mobile modem, etc)
- o Other (specify) __________________

A10: Which of the following do you own? (*You can select MORE THAN ONE option.*)

- ☐ Desktop PC/Mac
- ☐ Laptop
- ☐ Tablet
- ☐ Smart Phone
- ☐ Features phone
- ☐ Mobile phone with NO Internet capabilities.
- ☐ None of the above

Section B: Evaluation

This is the main section of this study. Its aim is to determine (evaluate) the usability, user experience and electronic (online) service quality of the portal that you have selected, namely WWWX.   Provide your opinion by selecting ONE of the options from **1 to 5** which best describes the degree to which you agree with (**Rating**) each of the statements given, where:

- **1** shows that you **Strongly disagree (SD)** that WWWX possess this feature, and
- **5** indicates **Strongly agree (SA)**.
- **If** your opinion is in between, then select one of the other ratings. Use the table below as a guideline. The question you are answering is "**With reference to this portal, WWWX**, **how much do you agree with each of the following statements?"** There are no right or wrong answers. WWWX will sometimes be referred to as **the portal** or **the site**.

Summary of the Scales used (as displayed on top of each of the next pages)

Rating	Strongly disagree (**SD**)	Disagree (**D**)	Neither agree or disagree (**N**)	Agree (**A**)	Strongly agree (**SA**)
Value	**1**	**2**	**3**	**4**	**5**

NB:

1. Use a tick (✓) to show your choice.
2. If you have any comment(s) to make on any of the three categories, namely, e-Service quality, Usability and User experience (e-SQUUX), you may use the space provided, at the end, to do so.

Category 1: e-Service quality (e-SQ) dimensions						
		Rating				
1	**Information quality**					
		SD	**D**	**N**	**A**	**SA**
1.1	The portal's (WWWX) information is accurate.	1	2	3	4	5
1.2	The portal's information is current since it is continuously updated.	1	2	3	4	5
1.3	The portal's information is appropriate (suitable for its intended use).	1	2	3	4	5
1.4	The portal's information is adequate.	1	2	3	4	5
		Rating				
2	**Availability**					
		SD	**D**	**N**	**A**	**SA**
2.1	The portal is reliable since it remains operational over time.	1	2	3	4	5
2.2	I can access the portal quickly wherever there is Internet access.	1	2	3	4	5
2.3	The portal quickly recovers from its failures.	1	2	3	4	5
2.4	I can easily contact the people I need by means of the portal (e.g. by portal's email facility).	1	2	3	4	5
2.5	It is easy to access content (items/things I need) on the portal.	1	2	3	4	5
		Rating				
3	**Responsiveness and helpfulness**					
		SD	**D**	**N**	**A**	**SA**
3.1	The queries I submit online are responded to promptly.	1	2	3	4	5
3.2	The responses I get for online queries help me to solve the problems at hand.	1	2	3	4	5
3.3	The portal provides feedback where I require it.	1	2	3	4	5
3.4	The portal enquires whether I am satisfied with the feedback I receive for my queries.	1	2	3	4	5

			Rating			
4	**Security and privacy**					
		SD	**D**	**N**	**A**	**SA**
4.1	I feel safe to make transactions on the site (portal or WWWX).	1	2	3	4	5
4.2	The site protects my personal information.	1	2	3	4	5
4.3	I have confidence in the organisation that owns the site.	1	2	3	4	5
4.4	The site has access control mechanisms to allow only authorised users to perform authorised tasks.	1	2	3	4	5
			Rating			
5	**Assurance and Credibility**					
		SD	**D**	**N**	**A**	**SA**
5.1	The site provides promised services within reasonable time.	1	2	3	4	5
5.2	The process for carrying out transactions (e.g. making payments) is transparent.	1	2	3	4	5
5.3	The site gives me a sense of loyalty in the sense that I will reuse it in the future.	1	2	3	4	5
5.4	I can recommend this site to other people.	1	2	3	4	5
			Rating			
6	**Support**					
		SD	**D**	**N**	**A**	**SA**
6.1	The site offers support to problems that arise.	1	2	3	4	5
6.2	The support provided to me is informative and meets my needs.	1	2	3	4	5
6.3	The support I receive is timely.	1	2	3	4	5
6.4	The site provides me with options for online self-services.	1	2	3	4	5

Category 2: Usability (U) dimensions

			Rating			

7	**Learnability**					
		SD	**D**	**N**	**A**	**SA**
7.1	It is easy to learn how to use WWWX on the first time of use.	1	2	3	4	5
7.2	When I return to WWWX after some time of non-use, I find it easy to use without having to relearn how to use it.	1	2	3	4	5
7.3	The language on the site is clear and easy to understand.	1	2	3	4	5
7.4	The site's content is legible (easy to read).	1	2	3	4	5
				Rating		
8	**Effectiveness**					
		SD	**D**	**N**	**A**	**SA**
8.1	WWWX works correctly.	1	2	3	4	5
8.2	WWWX enables me to complete my tasks.	1	2	3	4	5
8.3	The site functions in a logical in the way.	1	2	3	4	5
8.4	Using the site improves my work performance.	1	2	3	4	5
				Rating		
9	**Efficiency**					
		SD	**D**	**N**	**A**	**SA**
9.1	Once I have learned how to use WWWX, I take minimal time and energy to complete tasks successfully.	1	2	3	4	5
9.2	It is quick to find what I want on the site.	1	2	3	4	5
9.3	WWWX is quick to load.	1	2	3	4	5
9.4	I can rapidly move back and forth through the pages of WWWX.	1	2	3	4	5
				Rating		
10	**Navigation**					
		SD	**D**	**N**	**A**	**SA**
10.1	WWWX has an intuitive and consistent navigation structure.	1	2	3	4	5
10.2	WWWX has effective search facilities.	1	2	3	4	5

10.3	At any time, I know where I am and where I want to go next on the site.	1	2	3	4	5
10.4	The site provides suggestions or clues on how it should be used.	1	2	3	4	5

		Rating				
11	**Errors**					
		SD	**D**	**N**	**A**	**SA**
11.1	The site is built in such a way that it prevents me from committing many errors.	1	2	3	4	5
11.2	The site does not allow me to commit serious errors.	1	2	3	4	5
11.3	If I make errors, I can easily recover from them.	1	2	3	4	5
11.4	Fault tolerance: the site is robust since it does not fail to function due to system generated or user errors.	1	2	3	4	5

		Rating				
12	**Interfaces design**					
		SD	**D**	**N**	**A**	**SA**
12.1	The site has a well organised structure and layout.	1	2	3	4	5
12.2	The site has an attractive appearance.	1	2	3	4	5
12.3	The site uses colours appropriately.	1	2	3	4	5
12.4	The site's design portrays the corporate image of the organisation that owns it.	1	2	3	4	5

Category 3: User experience (UX) dimensions

		Rating				
13	**Suitability and Relevance**					
		SD	**D**	**N**	**A**	**SA**
13.1	The site is fit for the purposes it is intended to do.	1	2	3	4	5

13.2	The site provides me with only the necessary information or features to perform the tasks I require.	1	2	3	4	5
13.3	The services provided by the site match my current requirements.	1	2	3	4	5
13.4	The facilities on the site are in line with current information technology developments.	1	2	3	4	5
				Rating		
14	**Satisfaction**					
		SD	**D**	**N**	**A**	**SA**
14.1	I quickly adopted (accepted) the use of this portal.	1	2	3	4	5
14.2	The portal inspires a positive attitude in me.	1	2	3	4	5
14.3	The portal enables me to achieve my online goals satisfactorily.	1	2	3	4	5
14.4	I am not frustrated when I use this site.	1	2	3	4	5
				Rating		
15	**Flexibility and personalisation**					
		SD	**D**	**N**	**A**	**SA**
15.1	The site is portable since it can work well in different browsers.	1	2	3	4	5
15.2	The portal is interoperable since it can exchange and communicate information with other sites.	1	2	3	4	5
15.3	The site allows me to personalise (customise) it according to my preferences (personal needs).	1	2	3	4	5
15.4	When I use the site, I feel that I am in control.	1	2	3	4	5
15.5	The site enable me to collaborate with other users.	1	2	3	4	5
				Rating		
16	**Pleasure**					
		SD	**D**	**N**	**A**	**SA**

16.1	The site provides a pleasurable experience that invoke positive emotions in me.	1	2	3	4	5
16.2	The site is enjoyable to work with since it is interesting, stimulating, motivating, gratifying and fun to use.	1	2	3	4	5
16.3	I feel emotionally attached to the site.	1	2	3	4	5
16.4	I feel at ease when using WWWX.	1	2	3	4	5

Please use this space to list any comment (s) on **e-Service quality (e-SQ)** of WWWX, if any.

Please use this space to list any comment (s) on **Usability (U)** of WWWX, if any.

Please use this space to list any comment (s) on **User experience (UX)** of WWWX, if any.

Thank you for your participation

Appendix D-2: Pilot study: Consent form

CONSENT FORM

INTRODUCTION

Dear Prospective Participant,
My name is **Mr Samuel Ssemugabi** and I am doing research towards a PhD in the **School of Computing** at the University of South Africa (Unisa). **Prof Ruth de Villiers** is my supervisor. We are inviting you to participate in a study entitled **Development and validation of an integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications in the context of a University web portal.**

CONFIDENTIALITY AND PRIVACY

The research will be conducted in accordance with the Unisa Ethics Policy. Data collected from the study will be treated as private and confidential. The identity of participants and the college, school or department will not be in the published research report. Your personal details will not be made public. Data will be kept securely, but in line with Unisa regulations, it can only be disposed of after five years. After five years all materials used in this study will be destroyed. Please note that at any point in time during the course of the research, only the researcher and the supervisor will have access to the data collected.

WITHDRAWAL CLAUSE

You are free to withdraw your consent any time during the study without any consequences, in which event your participation in the research will cease and any information collected from you will not be used.

CONTACT INFORMATION OF THE RESEARCHER

For more information feel free to contact me, Samuel Ssemugabi, using the e-mail ssemus@unisa.ac.za or telephone number 082 556 7448.

The evaluation should take approximately 15-20 minutes to complete. I would appreciate if you complete the form as soon as possible and return it immediately.
Please fill in the form on the next page.

CONSENT

I ______________________________________ (full name) have read and understood the information relating to this research project as provided in the previous page of this form. I hereby declare that I agree voluntarily to participate in the project. I am aware that findings will be anonymised and presented in a PhD thesis and that selected data might be published in academic journals or conference proceedings.

Signature of participant: ________________________ Date ____/____/2017

Appendix D-3: Pilot study: Reliability of the dimensions

	Dimension	Item (Qn)	N	Mean	S.D	loading	Alpha if Item is removed	Alpha
e-Service quality								
1	**Information quality**	Qn1.1	26	4.08	.688	.882	.743	.854
		Qn1.2	26	4.04	.774	.788	.775	
		Qn1.3	26	3.88	.816	.723	.802	(n=25)
		Qn1.4	25	3.88	.833	.449	.917	
2	**Availability**	Qn2.1	25	3.32	.988	.242	.692	.670
		Qn2.2	25	3.48	1.194	.476	.594	
		Qn2.3	26	2.96	.958	.658	.516	(n=25)
		Qn2.4	26	3.23	1.275	.567	.543	
		Qn2.5	26	3.73	.667	.215	.690	
3	**Responsiveness and helpfulness**	Qn3.1	26	2.88	1.071	.787	.812	.872
		Qn3.2	26	3.08	.977	.798	.810	
		Qn3.3	26	3.23	.951	.756	.827	(n=26)
		Qn3.4	26	2.88	1.107	.590	.894	
4	**Security and privacy**	Qn4.1	26	3.42	1.065	.528	.821	.807
		Qn4.2	26	3.85	.784	.718	.720	
		Qn4.3	26	3.77	.951	.679	.729	(n=26)
		Qn4.4	26	3.92	.744	.626	.763	
5	**Assurance and Credibility**	Qn5.1	26	3.58	.945	.446	.349	.541
		Qn5.2	25	3.28	1.021	.337	.472	
		Qn5.3	25	3.72	.678	.390	.434	(n=25)
		Qn5.4	26	3.88	.653	.171	.573	
6	**Support**	Qn6.1	26	3.27	1.116	.812	.830	.886
		Qn6.2	26	3.58	.987	.661	.887	
		Qn6.3	26	3.38	1.023	.799	.835	(n=26)
		Qn6.4	26	3.65	.936	.744	.858	

Usability								
7	**Learnability**	Qn7.1	26	3.62	1.023	.779	.827	.874
		Qn7.2	26	3.92	.891	.798	.811	
		Qn7.3	26	4.00	.849	.679	.859	(n=26)
		Qn7.4	26	4.19	.634	.733	.853	
8	**Effectiveness**	Qn8.1	26	3.62	.898	.422	.259	.478
		Qn8.2	26	3.73	.827	.549	.147	
		Qn8.3	26	3.65	.797	.446	.259	(n=26)
		Qn8.4	26	3.73	1.041	-.110	.775	
9	**Efficiency**	Qn9.1	26	3.81	.849	.323	.523	.571
		Qn9.2	26	3.96	.824	.439	.440	
		Qn9.3	26	3.46	1.174	.252	.619	(n=26)
		Qn9.4	26	3.81	.849	.459	.422	
10	**Navigation**	Qn10.1	26	3.54	.811	.514	.403	.584
		Qn10.2	26	3.81	.749	.224	.605	
		Qn10.3	26	3.85	.925	.605	.297	(n=26)
		Qn10.4	26	3.38	1.061	.196	.672	
11	**Errors**	Qn11.1	26	3.50	1.068	.732	.843	.876
		Qn11.2	26	3.42	1.027	.797	.816	
		Qn11.3	26	3.58	.987	.687	.859	(n=25)
		Qn11.4	25	3.48	1.005	.723	.846	
12	**Interfaces design**	Qn12.1	26	3.92	.744	.577	.740	.785
		Qn12.2	26	3.88	.864	.596	.730	
		Qn12.3	26	3.85	.834	.677	.685	(n=26)
		Qn12.4	26	4.04	.774	.521	.766	
User Experience								
13	**Suitability and Relevance**	Qn13.1	26	3.96	.824	.466	.630	.689
		Qn13.2	25	3.72	.936	.221	.809	
		Qn13.3	26	3.81	.634	.661	.532	(n=25)
		Qn13.4	26	4.00	.693	.679	.503	

14	**Satisfaction**	Qn14.1	26	4.19	.849	.658	.778	.826 (n=26)
		Qn14.2	26	4.08	.744	.654	.782	
		Qn14.3	26	3.92	.628	.703	.777	
		Qn14.4	26	3.88	1.033	.673	.789	
15	**Flexibility and personalisation**	Qn15.1	26	3.92	1.129	.500	.856	.842 (n=26)
		Qn15.2	26	3.62	1.023	.711	.793	
		Qn15.3	26	3.38	1.023	.693	.798	
		Qn15.4	26	3.81	.849	.769	.785	
		Qn15.5	26	3.73	1.002	.614	.819	
16	**Pleasure**	Qn16.1	26	3.69	.788	.777	.713	.814 (n=26)
		Qn16.2	26	3.58	.857	.664	.754	
		Qn16.3	26	3.54	1.067	.651	.764	
		Qn16.4	26	3.69	.970	.496	.832	
		BI.2	26	4.00	.894	.680	.645	
		BI.3	26	4.35	.562	.650	.657	

Appendix E: Documents for Study 2B: Main questionnaire survey

Appendix E-1: Main questionnaire survey: Questionnaire

UNISA web portals survey questionnaire for evaluation of e-service quality, usability and user experience (e-SQUUX)

(For current students and/or staff only)

Dear Participant,

I am conducting a survey to evaluate the **e-service quality**, **usability** and **user experience** (e-SQUUX) of University web portals of the University of South Africa (UNISA). I request you to kindly participate and provide me with your valuable feedback. Participating in this study is **voluntary** and you are under no obligation to consent to participation. In addition, you are **free to withdraw** your consent and participation any time during the study without any consequences. I assure you that, the information provided by you will be **confidential** and your identity will be **anonymous**.

This research relates to my PhD (Information Systems) studies under the supervision of Prof M.R. de Villiers of UNISA. I request you to answer ALL questions. Your contribution will be greatly appreciated. It should take you 15-20 minutes to complete the questionnaire.

Kind regards

Sam Ssemugabi (UNISA staff)

Section A: Evaluation

Before you start the evaluation, I request you to answer the following three questions.

A1. Which one of the following UNISA portals do you use? (*You* ***can*** *select* ***MORE THAN ONE*** *option when* ***there are small empty boxes like below*** *– use cross (es)* ✗.)

- ☐ MyUnisa (my.unisa.ac.za)
- ☐ Staff (staff.unisa.ac.za)
- ☐ Library (library.unisa.ac.za)
- ☐ Other (specify): ___________________.unisa.ac.za

A2. When you think about using UNISA web facilities for your work, studies or other activities, which of the following sites do use as your MAIN starting point (point of entry to UNISA)? (*Select* ***ONLY ONE*** *option* ***when there are small empty circles like below*** *– use a cross* ✗.)

- o MyUnisa (my.unisa.ac.za)
- o Staff (staff.unisa.ac.za)
- o Library (Library.unisa.ac.za)
- o UNISA main site – UNISA home page (unisa.ac.za)
- o Other (specify): ___________________.unisa.ac.za

A3. Which one of the following UNISA portals do you use MOST frequently? (*Select* ***ONLY ONE*** *option.*)

- o MyUnisa (my.unisa.ac.za)
- o Staff (staff.unisa.ac.za)
- o Library (Library.unisa.ac.za)
- o Other (specify): ___________________.unisa.ac.za

NB: I shall refer to the site you have just selected in A3 above (your most frequently used UNISA portal) as WWWX. You will FOCUS on this site or portal when answering most questions in this questionnaire.

This is the MAIN part of this study. Its aim is to determine (evaluate) the usability, user experience and electronic (online) service quality of the portal that you have selected, namely WWWX.

Provide your opinion by selecting ONE of the options from **1 to 5** which best describes the degree to which you agree with (**Rating**) each of the statements given, where:

- **1** shows that you **Strongly disagree (SD)** that WWWX possess this feature, and
- **5** indicates **Strongly agree (SA)**.
- **If** your opinion is in between, then select one of the other ratings. Use the table below as a guideline. The question you are answering is "**With reference to this portal, WWWX**, **how much do you agree with each of the following statements?"** There are no right or wrong answers. WWWX will sometimes be referred to as **the portal** or **the site**.

Summary of the Scales used (as displayed on top of each of the next pages)

Rating	Strongly disagree (**SD**)	Disagree (**D**)	Neither agree or disagree (**N**)	Agree (**A**)	Strongly agree (**SA**)
Value	**1**	**2**	**3**	**4**	**5**

NB:

NB:

1. Use a tick (✓) to show your choice.
2. If you have any comment(s) to make on any of the three categories, namely, e-Service quality, Usability and User experience (e-SQUUX), you may use the space provided, at the end, to do so.

Category 1: e-Service quality (e-SQ) dimensions						
		Rating				
1	**Information quality**					
		SD	**D**	**N**	**A**	**SA**
1.1	The portal's (WWWX) information is accurate.	1	2	3	4	5
1.2	The portal's information is current since it is continuously updated.	1	2	3	4	5
1.3	The portal's information is appropriate (suitable for its intended use).	1	2	3	4	5
1.4	The portal's information is adequate.	1	2	3	4	5

	Rating					
2	**Availability**					
2.1	The portal is reliable since it remains operational over time.	1	2	3	4	5
2.2	I can access the portal quickly wherever there is Internet access.	1	2	3	4	5
2.3	The portal quickly recovers from its failures.	1	2	3	4	5
2.4	I can easily contact the people I need by means of the portal (e.g. by portal's email facility).	1	2	3	4	5
2.5	It is easy to access content (items/things I need) on the portal.	1	2	3	4	5
	Rating					
3	**Responsiveness and helpfulness**					
		SD	**D**	**N**	**A**	**SA**
3.1	The queries I submit online are responded to promptly.	1	2	3	4	5
3.2	The responses I get for online queries help me to solve the problems at hand.	1	2	3	4	5
3.3	The portal provides feedback where I require it.	1	2	3	4	5
3.4	The portal enquires whether I am satisfied with the feedback I receive for my queries.	1	2	3	4	5
	Rating					
4	**Security and privacy**					
		SD	**D**	**N**	**A**	**SA**
4.1	I feel safe to make transactions on the site (portal or WWWX).	1	2	3	4	5
4.2	The site protects my personal information.	1	2	3	4	5
4.3	I have confidence in the organisation that owns the site.	1	2	3	4	5
4.4	The site has access control mechanisms to allow only authorised users to perform authorised tasks.	1	2	3	4	5
	Rating					
5	**Assurance and Credibility**					
		SD	**D**	**N**	**A**	**SA**
5.1	When I am promised a service, it is fulfilled (carried out) as promised within realistic time (in reasonable or in good time).	1	2	3	4	5

5.2	The process for carrying out transactions (e.g. making payments) is transparent since it is clear to me how it is done step by step.	1	2	3	4	5
5.3	The site gives me a sense of loyalty in the sense that I will reuse it in the future.	1	2	3	4	5
5.4	I trust WWWX.	1	2	3	4	5
5.5	I have confidence in WWWX.	1	2	3	4	5
			Rating			
6	**Support**					
		SD	**D**	**N**	**A**	**SA**
6.1	The site offers support to problems that arise.	1	2	3	4	5
6.2	The support I get is informative and meets my needs.	1	2	3	4	5
6.3	The support I receive is timely.	1	2	3	4	5
6.4	The site provides me with options for online self-service.	1	2	3	4	5

Category 2: Usability (U) dimensions

			Rating			
7	**Learnability**					
		SD	**D**	**N**	**A**	**SA**
7.1	It is easy to learn how to use WWWX on the first time of use.	1	2	3	4	5
7.2	When I return to WWWX after some time of non-use, I find it easy to use without having to relearn how to use it.	1	2	3	4	5
7.3	The language on the site is clear and easy to understand.	1	2	3	4	5
7.4	The site’s content is legible (easy to read).	1	2	3	4	5
			Rating			
8	**Effectiveness**					
		SD	**D**	**N**	**A**	**SA**
8.1	WWWX works correctly.	1	2	3	4	5
8.2	WWWX enables me to complete my tasks.	1	2	3	4	5
8.3	The site functions in a logical way.	1	2	3	4	5

				Rating		
9	**Efficiency**					
		SD	**D**	**N**	**A**	**SA**
9.1	Once I have learned how to use WWWX, I take minimal time and energy to complete tasks successfully.	1	2	3	4	5
9.2	It is quick to find what I want on the site.	1	2	3	4	5
9.3	I can rapidly move back and forth through the pages of WWWX.	1	2	3	4	5
9.4	The site provides me with only the necessary information or features to perform the tasks I require.	1	2	3	4	5
				Rating		
10	**Navigation**					
		SD	**D**	**N**	**A**	**SA**
10.1	WWWX has an intuitive and consistent navigation structure.	1	2	3	4	5
10.2	WWWX has effective search facilities.	1	2	3	4	5
10.3	At any time, I know where I am and where I want to go next on the site.	1	2	3	4	5
				Rating		
11	**Errors**					
		SD	**D**	**N**	**A**	**SA**
11.1	The site is built in such a way that it prevents me from committing many errors.	1	2	3	4	5
11.2	The site does not allow me to commit serious errors.	1	2	3	4	5
11.3	If I make errors, I can easily recover from them.	1	2	3	4	5
11.4	Fault tolerance: the site is robust since it does not fail to function due to system generated or user errors.	1	2	3	4	5
				Rating		
12	**Interfaces design**					
		SD	**D**	**N**	**A**	**SA**
12.1	The site has a well organised structure and layout.	1	2	3	4	5
12.2	The site has an attractive appearance.	1	2	3	4	5

12.3	The site uses colours appropriately.	1	2	3	4	5
12.4	The site's design portrays the corporate image of the organisation that owns it.	1	2	3	4	5

Category 3: User experience (UX) dimensions

		Rating				
13	**Suitability and Relevance**					
		SD	**D**	**N**	**A**	**SA**
13.1	The site is fit for the purposes it is intended to fulfil.	1	2	3	4	5
13.2	The services provided by the site match my current requirements.	1	2	3	4	5
13.3	The facilities on the site are in line with current information technology developments.	1	2	3	4	5

		Rating				
14	**Satisfaction**					
		SD	**D**	**N**	**A**	**SA**
14.1	I quickly adopted (accepted) the use of this portal.	1	2	3	4	5
14.2	The portal inspires a positive attitude in me.	1	2	3	4	5
14.3	The portal enables me to achieve my online goals satisfactorily.	1	2	3	4	5
14.4	I am not frustrated when I use this site.	1	2	3	4	5

		Rating				
15	**Flexibility and personalisation**					
		SD	**D**	**N**	**A**	**SA**
15.1	The site is portable since it can work well in different browsers.	1	2	3	4	5
15.2	The portal is interoperable since it can exchange and communicate information with other sites.	1	2	3	4	5

15.3	The site allows me to personalise (customise) it according to my preferences (personal needs).	1	2	3	4	5
15.4	When I use the site, I feel that I am in control.	1	2	3	4	5
15.5	The site enables me to collaborate with other users.	1	2	3	4	5
				Rating		
16	**Pleasure**					
		SD	**D**	**N**	**A**	**SA**
16.1	The site provides a pleasurable experience that invoke positive emotions in me.	1	2	3	4	5
16.2	The site is enjoyable to work with since it is interesting, stimulating, motivating, gratifying and fun to use.	1	2	3	4	5
16.3	I feel emotionally attached to the site.	1	2	3	4	5
16.4	I feel at ease when using WWWX.	1	2	3	4	5

Please use this space to list any comment (s) on **e-Service quality (e-SQ)** of WWWX, if any.

Please use this space to list any comment (s) on **Usability (U)** of WWWX, if any.

Please use this space to list any comment (s) on **User experience (UX)** of WWWX, if any.

==

Section B: Demographic information

B1. Which one of the following do you study with or work for at UNISA? (*Select* ***<u>ONLY ONE</u>*** *option* ***when there are small empty circles like below*** *– use a cross* ✗.)

- ○ College of Accounting Sciences (CAS)
- ○ College of Agriculture & Environmental Sciences (CAES)
- ○ College of Economic & Management Sciences (CEMS)
- ○ College of Education (CE)
- ○ College of Graduate Studies (CGS)
- ○ College of Human Sciences (CHS)
- ○ College of Law (CL)
- ○ College of Science, Engineering & Technology (CSET)
- ○ School for Business Leadership (SBL)
- ○ Support Department/Directory/Division (but not in any college or SBL)
- ○ Administrative Department/Directory/Division (but not in any college or SBL)
- ○ Other (specify) ____

B2. What is your status at the UNISA? (*You* ***can*** *select* ***<u>MORE THAN ONE</u>*** *option when* ***there are small empty boxes like below*** *– use cross (es)* ✗*.*)

- ☐ Academic staff
- ☐ Administrative staff
- ☐ Support staff
- ☐ Librarian
- ☐ Research assistant
- ☐ E-tutor or Teaching assistant (TA)
- ☐ Full-time student
- ☐ Part-time student
- ☐ Other (specify) ____

B3. What is your MAIN role at UNISA? (*Select* ***<u>ONLY ONE</u>*** *option.*)

- ○ Academic staff
- ○ Administrative staff
- ○ Support staff
- ○ Librarian
- ○ Research assistant
- ○ E-tutor or Teaching assistant (TA)
- ○ Full-time student
- ○ Part-time student
- ○ Other (specify) ____

B4. At which of the following locations do you access WWWX? (*You can select MORE THAN ONE option.*)

- ☐ Home
- ☐ Work
- ☐ Internet café
- ☐ UNISA campus
- ☐ UNISA centre
- ☐ On my mobile device (Phone, Tablet, PC/Mac with Internet mobile modem, etc)
- ☐ Other (specify) _________________

B5. Which **ONE** of the following locations do you use MOST frequently to access WWWX? (*Select* ***ONLY ONE*** *option.)*

- o Home
- o Work (But NOT at UNISA)
- o Internet café
- o UNISA campus
- o UNISA centre
- o On my mobile device (Phone, Tablet, or PC /Mac with Internet mobile modem.)
- o Other (specify) _________________

B6. Which of the following do you own? (*You can select MORE THAN ONE option.*)

- ☐ Desktop PC/Mac
- ☐ Laptop
- ☐ Tablet
- ☐ Smart Phone
- ☐ Features phone
- ☐ Mobile phone with NO Internet capabilities.
- ☐ None of the above

B7. Provide me with more information about **yourself** and the use of WWWX, the site you use most frequently. #### represents a blank space and should not be filled in.

#	Item	***OPTIONS:*** *For* ***EACH ROW*** *please a cross (✕) inside* ***ONLY ONE*** *of the boxes for the option that best applies to you.* ***Remember; make ONLY ONE cross for each row.***					
.1	**Age in years**	Less than 25	25 to 40	41 to 55	More than 55	####	####
.2	**Gender**	Male	Female	Other (specify)			

.3	**Level of education**	High school or less	Some college or under-graduate	Graduate (3rd level degree or Diploma)	Honours or other 4th level qualification	Masters degree	Doctoral degree
.4	**Length of WWWX use**	Less than 3 months	3 to less than 6 months	6 to less than 12 months	1 to less than 3 years	3 to less than 5 years	5 years or more
.5	**Frequency of WWWX use**	Once a semester	once a month	2-4 times a month	2-4 times a week	1-2 times everyday	More than 2 times a day
.6	**Years of using computers?**	0-1	1-3	3-5	5-7	More than 7 seven	####
.7	**Frequency of use of the Internet**	Never	Rarely (once a month)	Occasional ly (once a week)	Frequently (once a day)	Very frequent (many times a day)	####
.8	**e-Skills level (computer skills)**	None	Below average	Average	More than average	Expert	####
.9	**Use a computer at work?**	No	Yes	Not employed	####	####	####
10	**Use a computer at home?**	No	Yes	####	####	####	####
.11	**The <u>ONE</u> most common equipment used to access WWWX**	Desktop PC/Mac	Laptop	Tablet	Features phone	Smart Phone	Other (specify)
.12	**Use WWWX while at Home?**	No	Yes	####	####	####	####
.13	**Ever used a university/higher education web portal other than that of UNISA?**	No	Yes	####	####	####	####
.14	**Ever used any other portal other than a higher education portal?**	No	Yes	####	####	####	####

Thank you for your participation

Appendix E-2: Main questionnaire survey: Consent form

CONSENT FORM

INTRODUCTION

Dear Prospective Participant,
My name is **Mr Samuel Ssemugabi** and I am doing research towards a PhD in the **School of Computing** at the University of South Africa (Unisa). **Prof Ruth de Villiers** is my supervisor. We are inviting you to participate in a study entitled **Development and validation of an integrated model for evaluating e-service quality, usability and user experience (e-SQUUX) of Web-based applications in the context of a University web portal**.

CONFIDENTIALITY AND PRIVACY

The research will be conducted in accordance with the Unisa Ethics Policy. Data collected from the study will be treated as private and confidential. The identity of participants and the college, school or department will not be in the published research report. Your personal details will not be made public. Data will be kept securely, but in line with Unisa regulations, it can only be disposed of after five years. After five years all materials used in this study will be destroyed. Please note that at any point in time during the course of the research, only the researcher and the supervisor will have access to the data collected.

WITHDRAWAL CLAUSE

You are free to withdraw your consent any time during the study without any consequences, in which event your participation in the research will cease and any information collected from you will not be used.

CONTACT INFORMATION OF THE RESEARCHER

For more information feel free to contact me, Samuel Ssemugabi, using the e-mail ssemus@unisa.ac.za or telephone number 082 xxx yyyy.

The evaluation should take approximately 15-20 minutes to complete. I would appreciate if you complete the form as soon as possible and return it immediately.

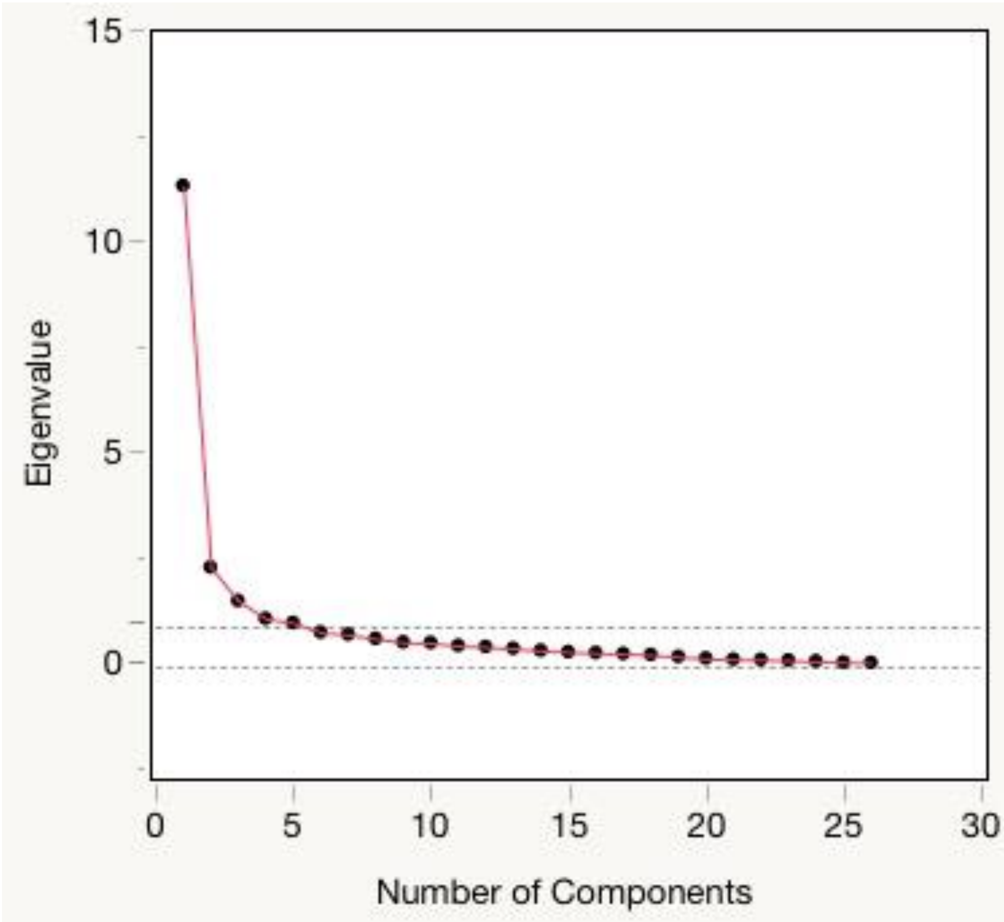
Please fill in the form on the next page.

CONSENT

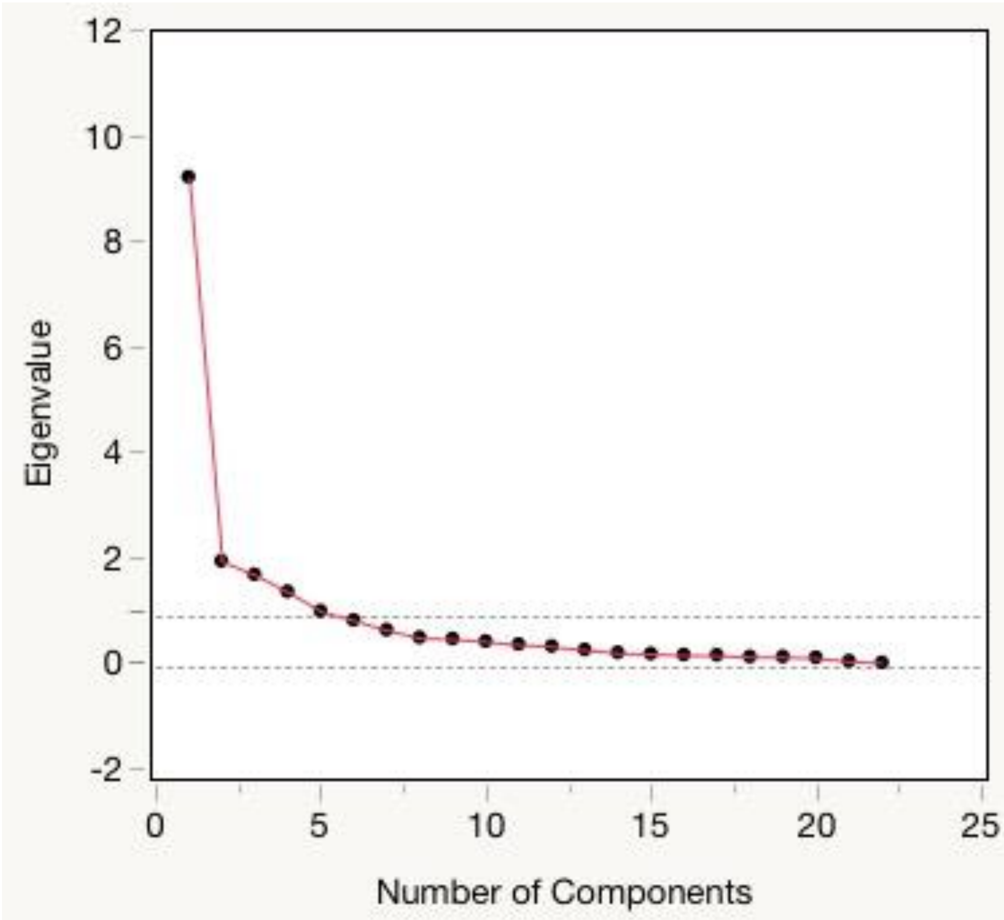
I ______________________________________ (full name) have read and understood the information relating to this research project as provided in the previous page of this form. I hereby declare that I agree voluntarily to participate in the project. I am aware that findings will be anonymised and presented in a PhD thesis and that selected data might be published in academic journals or conference proceedings.

Signature of participant: ________________________ Date ____/____/2017

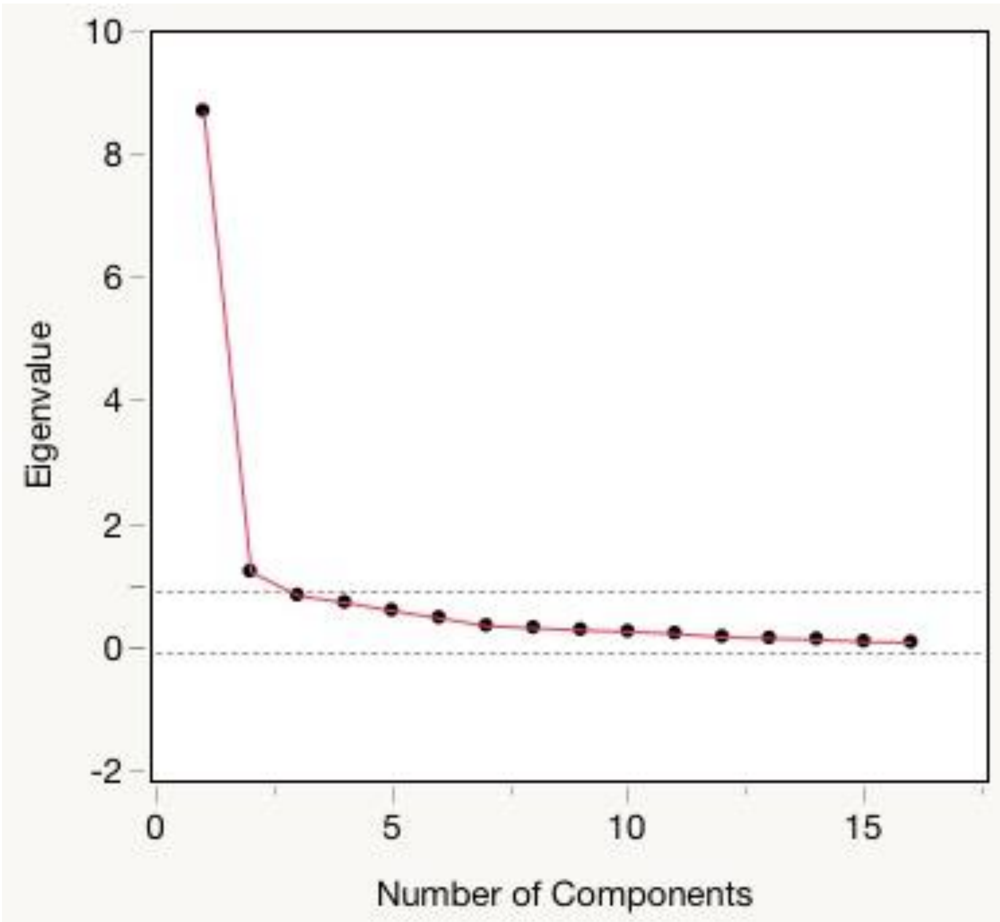
Appendix E-3: Screen plot for e-service quality (eSQ or e-SQ)



Appendix E-4: Screen plot for usability (UB)



Appendix E-5: Screen plot for user experience (UX)



Appendix E-6: Outer-loading of 55 indicators of the structural model

Loadings			
Item	**SQ**	**UB**	**UX**
Qn1.1	0.640	0.522	0.500
Qn1.2	0.628	0.447	0.479
Qn1.3	0.630	0.586	0.545
Qn1.4	0.478	0.390	0.369
Qn10.1	0.505	0.749	0.634
Qn10.2	0.623	0.795	0.690
Qn10.3	0.467	0.738	0.557
Qn11.1	0.510	0.634	0.564
Qn11.2	0.378	0.505	0.38
Qn11.3	0.500	0.645	0.489
Qn11.4	0.503	0.646	0.564
Qn12.2	0.516	0.648	0.596
Qn12.3	0.415	0.583	0.537
Qn12.4	0.336	0.537	0.481
Qn13.1	0.570	0.552	0.659
Qn13.2	0.618	0.670	0.752
Qn13.3	0.657	0.631	0.76
Qn14.1	0.506	0.657	0.671
Qn14.2	0.546	0.587	0.768
Qn14.3	0.637	0.683	0.776
Qn14.4	0.619	0.603	0.66
Qn15.1	0.647	0.634	0.751
Qn15.2	0.676	0.643	0.799
Qn15.3	0.474	0.431	0.643

Qn15.4	0.624	0.605	0.795
Qn15.5	0.512	0.557	0.674
Qn16.1	0.587	0.675	0.794
Qn16.2	0.666	0.649	0.825
Qn16.3	0.523	0.532	0.702
Qn16.4	0.674	0.667	0.791
Qn2.1	0.610	0.381	0.435
Qn2.2	0.679	0.458	0.522
Qn2.4	0.667	0.505	0.571
Qn2.5	0.713	0.55	0.659
Qn3.2	0.650	0.455	0.506
Qn3.3	0.679	0.476	0.502
Qn3.4	0.615	0.342	0.448
Qn4.1	0.439	0.309	0.326
Qn4.2	0.614	0.421	0.509
Qn4.3	0.734	0.517	0.602
Qn5.1	0.69	0.454	0.501
Qn5.2	0.613	0.431	0.531
Qn5.3	0.738	0.535	0.562
Qn5.4	0.705	0.516	0.578
Qn5.5	0.745	0.494	0.548
Qn6.1	0.721	0.599	0.613
Qn6.3	0.753	0.536	0.625
Qn6.4	0.701	0.639	0.713
Qn7.3	0.321	0.505	0.332
Qn7.4	0.404	0.546	0.413
Qn9.1	0.486	0.661	0.497
Qn9.2	0.573	0.757	0.635

Qn9.3	0.579	0.769	0.652
Qn9.4	0.495	0.702	0.567
Qn3.1	0.612	0.365	0.403
Total	**55**	**55**	**55**
max	**0.753**	**0.795**	**0.825**
Min	**0.321**	**0.309**	**0.326**

Appendix E-7: t-statistics values of the 39 indicators of the structural model

t-values statistics	
Relationship	**t Statistics**
Qn10.1 <- UB	20.693
Qn10.2 <- UB	29.434
Qn10.3 <- UB	14.134
Qn11.1 <- UB	14.464
Qn11.3 <- UB	9.932
Qn11.4 <- UB	11.404
Qn13.1 <- UX	10.377
Qn13.2 <- UX	14.554
Qn13.3 <- UX	15.49
Qn14.2 <- UX	14.08
Qn14.3 <- UX	14.544
Qn15.1 <- UX	20.082
Qn15.2 <- UX	25.786
Qn15.3 <- UX	13.118
Qn15.4 <- UX	22.643
Qn15.5 <- UX	11.196
Qn16.1 <- UX	22.71
Qn16.2 <- UX	31.858
Qn16.3 <- UX	18.764
Qn16.4 <- UX	18.087
Qn2.2 <- SQ	10.621
Qn2.4 <- SQ	13.965
Qn2.5 <- SQ	11.816
Qn3.2 <- SQ	13.392

Qn3.3 <- SQ	17.685
Qn3.4 <- SQ	14.596
Qn4.2 <- SQ	10.008
Qn4.3 <- SQ	15.341
Qn5.1 <- SQ	13.42
Qn5.3 <- SQ	14.192
Qn5.4 <- SQ	11.38
Qn5.5 <- SQ	14.594
Qn6.1 <- SQ	20.26
Qn6.3 <- SQ	18.695
Qn9.1 <- UB	7.868
Qn9.2 <- UB	24.062
Qn9.3 <- UB	20.953
Qn9.4 <- UB	12.111
Qn3.1 <- SQ	13.32
Minimum	**31.858**
Maximum	**7.868**