Integration and Acceptance of Web 2.0 Technologies in Higher Education

by

Nauman Saeed

B.Sc. (Punjab University)

M.Sc. (Quaid-i-Azam University)

M.Eng. (Aalborg University)

A thesis submitted to

CS3 – Centre for Complex Software Systems and Services

Faculty of Information and Communication Technologies

Swinburne University of Technology

for the degree of

Doctor of Philosophy

July, 2010

To my parents…

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma, except where due reference is made in the text of the thesis. To the best of my knowledge, this thesis contains no material previously published or written by another person except where due reference is made in the text of the thesis.

Nauman Saeed

July, 2010

Acknowledgements

I wish to thank the following people:

My principal coordinating supervisor, *Professor Yun Yang*, whose guidance and support has been phenomenal throughout my PhD. His dedication and professionalism are exemplary, especially his agility in providing quick feedback and editing of publications and thesis material. I would also like to thank him for providing the financial support towards my conference trips and professional development activities.

My coordinating supervisor, *Dr Suku Sinnappan,* who introduced me to the world of *Second Life*. *Suku* is more like a friend and has been a keen promoter of my work among his peers.

My associate supervisor, *Professor Chris Pilgrim,* for his valuable discussion and professional advice during the later phases of my PhD.

Professor Chengfei Liu, Dr Jinjun Chen, Dr Alan Colman, Dr Vivian Ferrel and Dr John Loupe for allowing me to conduct user studies in their units. My special thanks go to the students of *Web Programming* and *Web Applications Development* units for their participation in the user studies. Without their feedback, this manuscript would not have completed. I would also like to thank the *Second Life* community for their participation in the user study.

Dr Jinjun Chen and *Dr Minh Hong Tran* for their friendly advice and encouragement, especially in the early stages of my PhD. I would also like to thank my office mates: *Kevin, Rui* and more recently *Khalid* for the joy, laughter and thoughts we shared with each other.

The *Faculty of Information and Communication Technologies* (ICT) and *Swinburne University* for offering a healthy research environment and adequate facilities to carry out my research work.

Gillian Foster, Mandish Webb, Li Sim Loh and *Nola McLean* for their kind support in managing my conference trips and other administrative tasks.

Last but not least, *my wife and kids*, whose love, dedication and constant support made this difficult task easier for me.

Abstract

Web 2.0 is a made up concoction of the second generation of Web-based applications powered by interactions and online communities. These include (but are not limited to) blogs, wikis, multi-media sharing services, content syndication, podcasts, content tagging services, and multi-user virtual environments. With the creation of such applications, the Web has been transformed into a fully interactive space allowing any user to collaborate, create, publish, subscribe, and share information.

More recently, Web 2.0 has become a buzz-word in education and academics around the world have been exploring the potential of Web 2.0 technologies in both online and classroom-based teaching. However, the opportunities presented via technologies are coupled with challenges: how to accommodate the diverse needs of students; to what extent is the technology useful; and, how to make right decisions for specific learning tasks. This thesis answers such questions by conducting two case studies involving popular Web 2.0 technologies in a classroom-based higher education setting, using a student-centred approach. This was accomplished by integrating a combination of blog, social bookmarks and podcasts in Web programming units, based on the match between students' learning styles and their preferences for using Web 2.0 technologies. The findings highlighted learning styles and technology preferences of the current generation of students; usage patterns of Web 2.0 technologies in higher education; student satisfaction for the use of incorporated technologies; and finally, well-balanced academic performances across all learner types. These findings can serve as a guideline for academics or practitioners looking to integrate Web 2.0 technologies in their unit designs.

There are also growing concerns about the gap between popularity and usefulness of Web 2.0 technologies and their adoption in higher education environments. These

concerns give rise to further questions like: what motivates people to use Web 2.0 technologies; how to encourage people to use Web 2.0 technologies or make full use of them; and, what the significant predictors of Web 2.0 usage are? Here, to answer these questions, we examined the user acceptance of some popular Web 2.0 technologies like blogs, podcasts, and *Second Life* (a 3-D multi-user virtual environment) and key predictors of their usage in higher education context.

The aforementioned issues were met by conducting two survey studies. In the first study, a theoretical model was formulated to examine the effect of students' cognitive styles on user acceptance of blogs and podcasts, based on the technology acceptance model (*TAM*) and adaption-innovation (*A-I*) theory. The empirical evaluation of the proposed model was performed in *PLS* (Partial Least Squares) using *PLS Graph 3.0* software. The findings provided full support for the proposed model and highlighted the technology usage patterns of adaptive and innovative cognitive styles. The data collected during the first survey study also helped in examining the effect of media richness on user acceptance of blogs and podcasts. This was done by formulating another theoretical model based on TAM and media richness theory (*MRT*) and treating perceived media richness (*PMR*) as significant antecedent of usage intentions of blogs and podcasts. The empirical evaluation of the model revealed significant effect of *PMR* on use intentions but defied dominance of rich medium (audio/video-based podcast) over lean medium (text-based blog) in terms of explaining user acceptance of blogs and podcasts.

The second survey study extended the research on Web 2.0 technologies by examining user acceptance of a popular 3-D virtual learning environment, *Second Life*. To do this, a theoretical model was formulated based on TAM and hedonic consumption behaviours from marketing research. The empirical evaluation of the proposed model underlined the highly significant effect of hedonic behaviours (in terms of emotional responses) on user acceptance of *Second Life*. The findings also exposed the inability of traditional technology acceptance approaches (such as TAM) to explain the user acceptance of today's highly interactive, multi-user, and entertainment-oriented technologies like *Second Life* thus triggered the need for more research on user acceptance of Web 2.0 technologies.

The contributions made by this thesis are multi fold: 1) It presents an overview of prominent learning theories which helped in explaining the notions of student-centred learning, e-learning and the role of Web-based technologies in e-learning. 2) It explains the notion of Web 2.0; describes the academic usage of selected Web 2.0 technologies; and, pinpoints the challenges of using Web based technologies in higher education settings. 3) It presents an overview of technology acceptance theory and an overview of key technology acceptance models / frameworks from Information Systems research. 4) It also investigates the fields of social psychology, marketing, communication and consumer behaviour in order to explore key predictors of Web 2.0 usage. 5) The two case studies reported in this thesis validate the importance of matching learning styles with instructional preferences and contribute toward the practice of Web 2.0 technologies in higher education. 6) The thesis also contributes toward the field of technology acceptance by formulating theoretical models on user acceptance of blogs, podcasts and Second Life and performing empirical evaluation of the proposed models. This would help in improving the Web 2.0 usage in higher education.

The Author's Publications

Book Chapter

- **Saeed, N.**, Sinnappan, S., (2009) "*Effects of media richness on user acceptance of Web 2.0 technologies in higher education*", Advanced Learning, In-Tech Publications, pp. 233-243.

Journals

- **Saeed, N**., Yang, Y., Sinnappan, S., (2010), "*Impact of hedonic consumption behaviours and user involvement on acceptance of Second Life*", Journal of Information and Management, Elsevier (Under revision).

- **Saeed, N.**, Yang, Y., Sinnappan, S., (2009) "*Emerging Web Technologies in Course Delivery: a case of incorporating blogs, podcasts and social bookmarks in a Web programming course based on students' learning styles and preferences*", Journal of Educational Technology and Society, 12 (4), pp. 98-109.

Conferences

- **Saeed, N.**, Yang, Y., Sinnappan, S., (2010), "*Effect of media richness on user acceptance of blogs and podcasts*", The 15th Annual Conference on Innovation and Technology in Computer Science Education (ITiCSE'10), Bilkent, Ankara, Turkey, 26-30 June 2010, pp. 137-141.

- **Saeed, N.**, Yang, Y., Sinnappan, S., (2009), "*User acceptance of Second Life: An extended TAM with hedonic consumption behaviours*", The 17th European Conference on Information Systems (ECIS'09), Verona, Italy, 8-10 June 2009, pp. 2963-2975.

- **Saeed, N.**, Yang, Y., Sinnappan, S., (2009), "*Effects of cognitive style on user acceptance of blogs and podcasts*", The 9th IEEE International Conference on Advanced Learning Technologies (ICALT'09), Riga, Latvia, 15-17 July 2009, pp. 293-297

- **Saeed, N.**, Yang, Y., and Sinnappan, S., (2008), "*Media richness and user acceptance of Second Life*", The ASCILITE Conference, Melbourne, Australia, Nov 30 – Dec 3, 2008, pp. 851-860.

- **Saeed, N.**, Yang, Y., (2008), "*Using learning styles and preferences to incorporate emerging e-learning tools in teaching*", The 8th IEEE International Conference on Advanced Learning Technologies (ICALT'08) Santander, Spain, July 1-5, 2008, pp. 967-971.

- **Saeed, N.**, Yang, Y., (2008), "*Incorporating blogs, social bookmarks, and podcasts into unit teaching*", The 10th Australasian Computing Education Conference (ACE'08), Wollongong, Australia, 22-25 January 2008, CRPIT 78, pp. 113-118.

Table of Contents

Declaration ..... **i**

Acknowledgements ..... **ii**

Abstract ..... **iv**

The Author's Publications ..... **vii**

Table of Contents ..... **ix**

List of Figures ..... **xiv**

List of Tables ..... **xvi**

1 Introduction **1**

1.1 Context of the research 3

1.2 Research problem 5

1.3 Aim of the research 6

1.4 Outline of the thesis 7

2 Background and Literature Review **10**

2.1 The nature of learning 10

2.2 Learning Theories 11

2.2.1 Behaviourism 11

2.2.2 Cognitivism 12

2.2.3 Constructivism 14

2.2.3.1 Personal constructivism 14

2.2.3.2 Social constructivism 19

2.3 Definition of e-learning 20

2.4 The role of (Web) technology in e-learning 21

2.5 Web 2.0 23

2.5.1 Web-logs (blogs) 26

2.5.2 Social bookmarks 29

2.5.3 Podcasts 31

2.5.4 Multi-user virtual environments (MUVEs) 32

2.5.5 Challenges in the use of Web 2.0 technologies in higher education 36

2.6 Theory of technology acceptance 36

2.6.1 Innovation Diffusion Theory (IDT) 37

2.6.2 Theory of Reasoned Action (TRA) ... 39
2.6.3 Theory of Planned Behaviour (TPB) ... 40
2.6.4 Technology Acceptance Model (TAM) ... 41
2.6.5 Rationale behind using TAM in this thesis ... 43
2.7 Summary ... 44
3 Methodology ... 46
3.1 Approaches to the investigation ... 46
3.2 Case study design ... 48
3.2.1 Case study plan ... 50
3.2.1.1 Data planning ... 50
3.2.1.2 Ethics clearance ... 50
3.2.1.3 Questionnaire development ... 51
3.2.1.4 Case study results ... 52
3.3 Survey design ... 52
3.3.1 Survey plan ... 53
3.3.1.1 Data planning ... 53
3.3.1.2 Ethics clearance ... 54
3.3.1.3 Instrument design ... 54
3.3.1.4 Survey results ... 55
3.4 Summary ... 56
4 Integrating Web 2.0 Technologies in Unit Teaching ... 58
4.1 Educational uses of Web 2.0 technologies ... 58
4.2 Learning styles and instructional preferences ... 60
4.3 Methodology ... 61
4.3.1 Case studies plan ... 61
4.3.2 Case studies participants ... 62
4.3.3 Measurements ... 62
4.4 Results of learning style and technology preference questionnaires ... 63
4.4.1 Demographics ... 63
4.4.2 Learning styles frequency distribution ... 63
4.4.3 Relationships within learning styles ... 64
4.4.4 Relationships within technology preferences ... 64
4.4.5 Relationships between learning styles and technology preferences ... 65
4.4.6 Matching learning styles with technology preferences ... 66
4.4.7 Suggestions on potential academic uses of Web 2.0 technologies ... 67

4.5 Integrating blog, social bookmarks and podcasts / vodcasts in an introductory Web programming unit 68
4.5.1 Swinblog 68
4.5.2 Swinbookmark 69
4.5.3 Lecture podcasts / vodcasts 70
4.6 Results of the feedback questionnaire 71
4.6.1 Feedback on *Swinblog* 72
4.6.2 Feedback on *Swinbookmark* 73
4.6.3 Feedback on lecture podcasts 74
4.7 Analyses on academic performance 75
4.8 Results of the second (follow-up) case study 76
4.8.1 Correlations within learning style scales 77
4.8.2 Correlations within tools preferences 77
4.8.3 Correlations between learning styles and tools preferences 77
4.8.4 Integrating blog, social bookmarks and podcasts / vodcasts in advanced Web programming unit 78
4.8.5 Results of the feedback questionnaire 78
4.8.6 Analyses on academic performance 80
4.9 Key contributions, implications and limitations of the two case studies 80
4.9.1 Theoretical contributions 80
4.9.2 Practical implications 82
4.9.3 Limitations of the two case studies 83
4.10 Summary 83
5 Effect of Cognitive Styles on User Acceptance of Blogs and Podcasts 85
5.1 Background and hypotheses development 86
5.1.1 Educational uses of blogs and podcasts 86
5.1.2 Technology acceptance model (TAM) 87
5.1.3 Effects of cognitive style on technology acceptance 89
5.2 Methodology 90
5.2.1 Survey participants and data collection 90
5.2.2 Measures 91
5.3 Empirical evaluation of the proposed hypotheses / model 92
5.3.1 Demographics 92
5.3.2 Data validity and reliability 93
5.3.3 Hypotheses and model testing 95

5.4 Discussion 98
5.4.1 Key findings and contributions 98
5.4.2 Research and practical implications 99
5.4.3 Limitations 100
5.5 Summary 101
6 Effect of Media Richness on User Acceptance of Blogs and Podcasts 102
6.1 Background and hypotheses development 102
6.1.1 TAM 102
6.1.2 Media Richness Theory (MRT) 103
6.2 Methodology 106
6.2.1 Data collection and survey participants 106
6.2.2 Measures 106
6.3 Empirical evaluation of the proposed hypotheses / model 107
6.3.1 Data validity and reliability 107
6.3.2 Hypotheses and model testing 109
6.3.3 Significant indicators 112
6.4 Discussion 113
6.4.1 Key findings and contributions 113
6.4.2 Research and practical implications 116
6.4.3 Limitations 116
6.5 Summary 117
7 User Acceptance of Second Life in Higher Education 118
7.1 Background and hypotheses development 119
7.1.1 Educational uses of Second Life 119
7.1.2 TAM 120
7.1.3 Hedonic consumption behaviours 122
7.2 Methodology 125
7.2.1 Survey participants and data collection 125
7.2.2 Measures 125
7.3 Empirical evaluation of the proposed hypotheses / model 126
7.3.1 Demographics 126
7.3.2 Data validity and reliability 127
7.3.3 Hypotheses and model testing 129
7.3.4 Significant indicators 131
7.4 Discussion 132

7.4.1 Key findings and contributions 132
7.4.2 Research and practical implications 134
7.4.3 Limitations 135
7.5 Summary 135
8 Conclusion and Future Work 137
8.1 Summary of the thesis 137
8.2 Key contributions of this thesis 141
8.3 Future work 142
Bibliography 145
Appendices 163
Appendix A: Form of Disclosure and Informed Consent 163
Appendix B: Index of Learning Styles (ILS)* Questionnaire 169
Appendix C: Tools Preference Questionnaire 174
Appendix D: Feedback Questionnaire 177
Appendix E: Form of Disclosure and Consent Information Statement 182
Appendix F: User Acceptance of Blogs and Podcasts - Questionnaire 186
Appendix G: Un-rotated PCA results for Extended TAM with KAI 190
Appendix H: Un-rotated PCA results for Extended TAM with MRT 193
Appendix I: User Acceptance of Second Life in Higher Education - Questionnaire 195
Appendix J: Un-rotated PCA results for User Acceptance of Second Life 198

List of Figures

Figure 2.1: Curry's Onion Model (adopted from (Wolf, 2007)) 16
Figure 2.2: Meme Map of Web 2.0 (adopted from (O'Reilly, 2005)) 24
Figure 2.3: A screenshot of a sample blog page 27
Figure 2.4: A screenshot of a sample social bookmarks page 30
Figure 2.5: A screenshot of Swinburne's virtual campus in Second Life (on right) mimicking the actual campus (on left) 34
Figure 2.6: Innovation Diffusion Theory (IDT) 38
Figure 2.7: Theory of Reasoned Action (TRA) 39
Figure 2.8: Theory of Planned Behaviour (TPB) 40
Figure 2.9: Decomposed Theory of Planned Behaviour (DTPB) 41
Figure 2.10: The Technology Acceptance Model (TAM) 42
Figure 2.11: The extended Technology Acceptance Model (TAM2) 42
Figure 3.1: Classic research process model (adopted from (Vanderstoep & Johnston, 2009)) 46
Figure 4.1: An example of peer mentoring on *Swinblog* 69
Figure 4.2: An example of knowledge building and knowledge sharing in *Swinbookmark* 70
Figure 4.3: Podcasts / vodcasts of Web programming lectures 71
Figure 5.1: An extended TAM to examine effect of cognitive styles on user acceptance of blogs / podcasts 90
Figure 5.2: PLS results – Effect of cognitive styles on user acceptance of blogs 96
Figure 5.3: PLS results – Effect of cognitive styles on user acceptance of podcasts 97
Figure 6.1: An extended TAM to examine effect of media richness on user acceptance of blogs / podcasts 106
Figure 6.2: PLS results – Effect of media richness on user acceptance of blogs 110
Figure 6.3: PLS results – Effect of media richness on user acceptance of podcasts 111

Figure 7.1: An extended TAM2 to examine effect of hedonic consumption behaviours on user acceptance of SL..... 124
Figure 7.2: PLS results - Effect of hedonic consumption behaviours on user acceptance of SL..... 130

List of Tables

Table 4.1: Mean and standard deviation of four learning style scales 64
Table 4.2: Significant relationships among various technology preferences..... 65
Table 4.3: Matching learning styles with technology preferences..... 67
Table 4.4: Students' suggestions on academic uses of emerging Web technologies..... 67
Table 4.5: *Chi-Square* Tests for gender and academic performance variables..... 76
Table 4.6: Correlations within tools preferences (*Note: N = 127)* 77
Table 5.1: Construct reliability measures..... 94
Table 5.2: Discriminant validity of constructs..... 95
Table 6.1: Construct reliability measures..... 108
Table 6.2: Discriminant validity of constructs..... 109
Table 6.3: Significant indicators for interrelationship between behavioural intention to use blogs and podcasts and their antecedents 112
Table 7.1: Construct reliability measures..... 128
Table 7.2: Discriminant validity of constructs..... 128
Table 7.3: Significant indicators for interrelationship between behavioural intention to use SL and its antecedents..... 131
Table 7.4: Path coefficient values for interrelationships between behavioural intention and its antecedents..... 132
Table G.1: KMO and Bartlett's Test 190
Table G.2: Total variance explained 191
Table G.3: Parallel analysis results from 'Monte Carlo PCA for Parallel Analyses' ... 192
Table G.4: Comparison of eigenvalues from principal component analysis (PCA) and the corresponding criterion values obtained from parallel analysis..... 192
Table H.1: KMO and Bartlett's Test 193
Table H.2: Total variance explained 194
Table H.3: Parallel analysis results from 'Monte Carlo PCA for Parallel Analysis'.... 194
Table H.4: Comparison of eigenvalues from principal component analysis (PCA) and the corresponding criterion values obtained from parallel analysis..... 194
Table J.1: KMO and Bartlett's Test..... 198

Table J.2: Total variance explained 199
Table J.3: PCA results from 'Monte Carlo PCA for Parallel Analysis' 200
Table J.4: Comparison of eigenvalues from principal component analysis (PCA) and the corresponding criterion values obtained from parallel analysis..... 200