Adoption and Use of Collaborative Technologies for Project-Based Learning

Ronnie Chu Ting Cheung

Ph. D. Thesis

Supervisor: Prof. Doug Vogel

External Examiners: Prof. Dubravka Cecez-Kecmanovic, UNSW, Australia
Prof. Bruce Reinig, San Diego State University, USA

University of South Australia
International Graduate School of Business

2013

TABLE OF CONTENTS

TABLE OF CONTENTS ..... **ii**
ABSTRACT ..... **xi**
DECLARATION ..... **xiii**
ACKNOWLEDGEMENTS ..... **xiv**
Chapter 1 Introduction **1**
1.1. Introduction to the Chapter 1
1.2. Background 1
1.3. Research Motivation 4
1.4. Research Questions and Objectives 8
1.5. Research Scope and Environment 9
1.6. Significance and Contributions 12
1.7. Outline of the Thesis 15
Chapter 2 Literature Review **17**
2.1. Introduction to the Chapter 17
2.2. Internet Technology 18
2.2.1. The Digital Age 18
2.2.2. Web 2.0 Technology 21
2.2.3. Cloud Computing 22
2.3. E-Learning 24
2.3.1. Learning Management Systems 24
2.3.2. Social Software Approach 27
2.3.3. Evaluation of Social Networking Platforms for Learning 28
2.4. Open Educational Resources 35
2.5. Theoretical Foundations for Collaborative Learning 36
2.5.1. Theories of Learning 37
2.5.2. Project-based Learning 42
2.5.3. Collaborative Learning 43
2.5.4. Computer-Supported Collaborative Learning 44
2.5.5. Challenges of CSCL in Project-based Environments 46
2.5.6. Educational Design for Learning 48
2.5.6.1. Design Research for Collaborative Learning 48
2.5.6.2. Activity Theory... 49
2.6. Technology Adoption 50
2.6.1. Theories of Innovation 51
2.6.2. Theory of Planned Behaviour 53

2.6.3. User Acceptance of e-Learning Technology 55
2.6.4. Extensions of the Technology Acceptance Model 56
2.6.5. Adoption of Technologies for Collaborative Learning 57
2.7. Chapter Summary 58
Chapter 3 The Research Process 60
3.1. Introduction to the Chapter 60
3.2. The Context 60
3.3. The Research Stages 63
3.4. Philosophical Underpinnings 65
3.4.1. Established Research Paradigms 66
3.4.2. The Theoretical Perspective Adopted by the Researcher 68
3.4.3. Research Paradigms and Research Method 70
3.5. Research Approach 71
3.5.1. Candidate Research Methods 71
3.5.1.1. Information Systems Development Research 71
3.5.1.2. Action Research 72
3.5.1.3. Design Research. 72
3.5.1.4. Selection of Research Method for CSCL Design 74
3.5.2. Qualitative, Quantitative and Mixed Paradigms 74
3.5.2.1. Qualitative Approach 75
3.5.2.2. Quantitative Approach 76
3.5.2.3. Mixed Paradigm Approach 77
3.5.3. Research on Technology Adoption 79
3.6. Data Gathering Techniques 80
3.6.1. Ethnographic Perspective 81
3.6.2. Focus Group Interviews 82
3.6.3. Surveys 83
3.7. Human Ethics Process and Ethical Research Practice 84
3.8. Summary of the research process 85
Chapter 4 Development of a Technological Design Solution for Computer-Supported Collaborative Learning 86
4.1. Introduction to the Chapter 86
4.2. The Need for Project-based Learning 86
4.3. Issues in Teaching Marketing Research 88
4.4. Theoretical Framework 91
4.5. Design Elements of Authentic Learning 92

4.6. Guiding Principles for a Web-based CSCL Platform 95
4.6.1. Design Considerations for Selecting Social Networking Platforms 99
4.6.2. Pedagogical Design for Collaborative Learning with Web 2.0 Environments 101
4.7. A Technological Design Solution for CSCL 105
4.8. Chapter Summary 116
Chapter 5 An Activity Perspective for Computer-Supported Collaborative Learning 118
5.1. Introduction to the Chapter 118
5.2. Development of Solutions for Learning: The Pedagogical Design of Learning Activities for Project-based Learning 119
5.2.1. An Activity Perspective 120
5.2.2. The Advanced Marketing Research Course 122
5.2.3. The Project Task Assignments 124
5.2.4. Designing Authentic Activities for Knowledge Construction 127
5.2.5. Tools and Resources to Guide Practices 128
5.3. Analysis of Activities 129
5.3.1. Activity-Oriented Design Method 130
5.3.2. Toward the Long-Term Development of Knowledge Artefacts 137
5.3.3. Contributions from an Activity Perspective 138
5.4. Planning for Implementation 140
5.5. Chapter Summary 141
Chapter 6 Implementation and Testing of the CSCL Platform 142
6.1. Introduction to the Chapter 142
6.2. Implementing the First Design Iteration of CSCL 143
6.2.1. Design Intentions 144
6.2.2. Learning Groups 145
6.2.3. Technology and Activities 147
6.2.3.1. Units of Activities in Google Sites 147
6.2.3.2. Learning and Scaffolding through Collaborative Tools 151
6.2.3.3. Assessments on Participation 153
6.2.4. User Adoption of the CSCL Platform 154
6.2.4.1. Focus Group Study 155
6.2.4.2. Quantitative Evaluation of the Collaborative Platform 161
6.3. Implementing the Second Design Iteration of CSCL 164
6.3.1. Design Intentions 165
6.3.2. Intervention Development 166

6.3.3. Evaluation of the Second Iteration of Implementation 168
6.3.3.1. Analysis of Web-based Activities 168
6.3.3.2. Focus Group Study 171
6.4. Chapter Summary 175
Chapter 7 Reflections to Produce Design Principles 177
7.1. Introduction to the Chapter 177
7.2. The Role of Design Principles 177
7.2.1. Use of Design Principles for Technology Enhanced Learning 179
7.2.2. Using Design Principles to Guide Practices 180
7.3. Documentation and Synthesis of Design Principles 181
7.4. Chapter Summary 190
Chapter 8 Subsequent Evaluation of Technology Adoption 191
8.1. Introduction to the Chapter 191
8.2. Background of the Study 191
8.3. Theoretical Frameworks for Technology Adoption 192
8.3.1. The Theory of Reasoned Action 193
8.3.2. The Technology Acceptance Model 194
8.3.3. Combining TRA and TAM for Technology Adoption 195
8.3.4. The Task-Technology Fit Model 196
8.4. Research Framework and Hypotheses 198
8.4.1. The Integrated Research Framework 198
8.4.2. The Traditional TAM Hypotheses 200
8.4.3. The Influence of Subjective Norms 201
8.4.4. The Influence of Task-Technology Fit 202
8.4.5. The Moderating Effect of Peer Influence 203
8.5. Research Methodology 204
8.5.1. Questionnaire Development 204
8.5.2. Data Collection 207
8.6. Data Analysis 207
8.6.1. Exploratory Factor Analysis 211
8.6.2. The Measurement Model 213
8.6.3. The Structural Model 214
8.6.4. The Explanatory Power of the Research Model 217
8.6.5. The Moderating Effect of Peer Influence 218
8.6.6. Evaluating the Final Research Model 220
8.7. Research Findings 225
8.8. Chapter Summary 227

Chapter 9 Discussion 228
9.1. Introduction to the Chapter 228
9.2. Recapulation of the Research Problem, Research Objectives and Research Process 228
9.3. Discussion of the Findings 232
9.3.1. Fingings from Phase I – Research Design and Development 232
9.3.2. Findings from Phase II – Technology Adoption 235
9.3.3. Salient Issues in Using the Design Research Approach 239
9.4. Implications of the Findings 241
9.5. Future Research Opportunities 244
9.6. Chapter Summary 245
Chapter 10 Conclusions 246
10.1. Introduction to the Chapter 246
10.2. Revisting the Research Questions 246
10.3. Research Contributions 250
10.4. Research Limitatons and Extensions for Future Work 254
10.5. In Conclusion 256
References 257
Appendix A Consent Forms and Information Sheets 284
Appendix B Approval to Conduct Research 294
Appendix C Structured Questionnaire for Technology Adoption 297

List of Figures

Figure 1-1 Research issues for collaborative learning 4
Figure 2-1 Contents from complex overlapping networks 21
Figure 2-2 The meditational triangle 50
Figure 2-3 Theory of planned behaviour 54
Figure 3-1 The research stages of design research 64
Figure 4-1 Stages one of the design research paradigm 86
Figure 4-2 Pedagogy 2.0 103
Figure 4-3 Development of a technological design solution in stage two 107

Figure 4-4 A Student project Web site implemented using Google Applications technology 108
Figure 4-5 A project discussion page 110
Figure 4-6 A problem definition wiki page 111
Figure 4-7 A document management page 113
Figure 4-8 Benchmark dates page of the Google site 114
Figure 4-9 Survey form page of the project Web site 115
Figure 4-10 A Google forum for sharing between students and teachers 116
Figure 5-1 Development of a pedagogical design solution 119
Figure 5-2 An outline of a learning activity 121
Figure 5-3 The activity system 122
Figure 6-1 The first cycle of testing: technology and pedagogy implementation 144
Figure 6-2 The project activity log record 148
Figure 6-3 Subscriptions to project web site contents 150
Figure 6-4 The Google forum discussion postings 151
Figure 6-5 Collaborative editing using Google documents 152
Figure 6-6 Collaborative editing of presentations 153
Figure 6-7 The second cycle of testing: technology and pedagogy implementation 165
Figure 6-8 A Google Plus page 167
Figure 7-1 Reflections to produce design principles 178
Figure 8-1 The theory of reasoned action 193
Figure 8-2 The technology acceptance model 195
Figure 8-3 The task-technology fit model 196
Figure 8-4 The Integrated TAM/TTF Model 197
Figure 8-5 Research framework: the integrated TAM/TTF/TRA model 199
Figure 8-6 The histograms for the manifest variables 208
Figure 8-7 The structural model and the path coefficients 215
Figure 9-1 Summary of the research process 230

List of Tables

Table 3-1 Research method for CSCL platform adoption 73
Table 4-1 Real-life versus in-school problem solving 87

Table 4-2 The draft guiding principles 106
Table 5-1 Learning activities for knowledge construction and collaboration 128
Table 5-2 The group project and the five assignments 129
Table 5-3 The overall activity system for the AMR class 132
Table 5-4 The activity system for peer collaborations and sharing 133
Table 5-5 The research issues for the activity system 135
Table 5-6 Identification of contradictions from peer collaborations 137
Table 6-1 The design objectives associated with the design implementations 143
Table 6-2 Profile of the students 146
Table 6-3 Summary of activities for project groups – 2010-11-S2 session 149
Table 6-4 Assessment criteria for participation 154
Table 6-5 Discussion guide for the first focus group study 156
Table 6-6 Summary of responses from the survey 162
Table 6-7 Summary of activities for project groups – 2011-12-S1 session 169
Table 6-8 A list of objects highlighted through shared discussion for group T6 170
Table 6-9 Discussion guide for the second focus group study 172
Table 8-1 The constructs, conceptual definitions, and source of literature 205
Table 8-2 The questionnaire items for the constructs 206
Table 8-3 Descriptive statistics for the manifest variables 210
Table 8-4 The factor loadings 212
Table 8-5 The measurement model 213
Table 8-6 Correlation matrix and discriminant validity 214
Table 8-7 The path coefficients 216
Table 8-8 Comparisons between the explanatory powers of the three models 218
Table 8-9 Hierarchical test 219
Table 8-10 Effect sizes for independent variables associated with behavioural intention 221
Table 8-11 Effect sizes for independent variables associated with system usage 222
Table 8-12 Communality and Redundancy 223
Table 8-13 Reflective measurement model evaluation 224
Table 8-14 Structural model evaluation 225
Table 10-1 Project phases and research questions 247
Table 10-2 The design principles and the associated implementations 249

GLOSSARY/ABBREVIATIONS

Abbreviation/ Glossary	Explanation
AMR	Advanced Marketing Research course delivered through project-based learning
CSCL	Computer-Supported Collaborative Learning
Collaborative platform	A computer-mediated platform to facilitate collaboration
Collaborative teams	Groups of students that interact with each other, with the goal of discussing and negotiating subject related issues, thus improving collective knowledge
Project Web site	Refers to the Web site for the collaborative platform designed for the AMR project groups
ICT	Information and Communication Technologies
TAM	Technology Acceptance Model
TRA	Theory of Reasoned Action
TPB	Theory of Planned Behaviour
TTF Model	Task-Technology Fit Research Model
AODM	Activity-Oriented Design Method
Guiding principles	The draft principles to guide the initial design of the computer-supported collaborative learning environment
DP	Design principles (DP) are generated as an output from design research to inform future development of CSCL

PLS	Partial least square technique
SmartPLS 2.0	SmartPLS 2.0 refers to the 2.0 version of the statistical software for performing partial least square analysis
Pedagogy 2.0	The pedagogy that exploits the capabilities of Web 2.0 technologies for learning McLoughlin and Lee (2007)
Adoption	A decision to make full-scale use of a new idea or a platform as the chosen course of action available (Rogers, 1995)
Technology acceptance	Refers to the effect of system characteristics on user acceptance of computer information systems (Davis, 1989)
Knowledge artefacts	Digitally represented objects that are developed iteratively and shared through a collaborative platform (Paavola & Hakkarainen, 2005)
Design artefact	The product/output from design research
IT artefacts	Computer-based artefacts such as software/hardware
Google Applications	A set of technologies providing Web 2.0 based facilities and social software tools (e.g. Google site, Google docs, Google forms and Google Plus)
Subsequent evaluation	The evaluation of the collaborative platform conducted after the design phase of the study
2010-11-S2 Session	A delivery of the AMR course during Jan 2011 to May 2011
2011-12-S1 Session	A delivery of the AMR course during Sept 2011 to Dec 2011
2011-12-S2 Session	A delivery of the AMR course during Jan 2012 to May 2012

ABSTRACT

This study examines the development, adoption and use of collaborative technologies in a project-based environment. It focuses on the requirements and opportunities to enable collaborative learning through Web 2.0 technologies. The multidisciplinary research was conducted through a design science research methodology by incorporating design and learning theories to inform the development of a computer-mediated learning platform. The research was conducted through the integration of multiple theories and multiple research methodologies in a design-based study that integrates pedagogical design principles and computer-supported collaborative learning to support collaborations and interactions among students.

The study was conducted through two phases of research: development of the learning environment and subsequent evaluation of the learning platform. During the first phase of the research, a computer-supported collaborative learning environment was developed. In the subsequent evaluation of the learning platform, a theoretical model was used to investigate the adoption behaviour of students for the computer-supported collaborative platform.

To develop the computer-supported collaborative learning environment, a design research approach was used to accommodate the learning interventions that were designed and implemented iteratively. Through the collaborative platform developed for this study, learning was supported through cultural practices that promoted participation, collaboration and self-reflections among students. Two iterations of learning interventions were designed to support project-based learning for an undergraduate course in marketing research. Data were captured via focus group interviews, surveys, online discussions, activity logs, and collaborative documents available from the learning platform. The multiple sources of data facilitated a mixture of quantitative and qualitative evaluations relating to the adoption aspects of the collaborative technologies among students. This helped to evaluate the efficacy of the interventions and provided data for further analysis. The evaluations showed that the collaborative platform helped the participants to share knowledge artefacts and knowledge creation processes taking place between individual and collective

activities, showing that these collaborative tools helped individuals and their communities to work jointly for advancement of knowledge for project-based learning.

In the subsequent evaluation focusing on user acceptance of the collaborative learning platform, a survey was conducted using a sample of 240 students. A theoretical model was developed to investigate the factors that influenced students' decisions to adopt the technology. The research results derived from a quantitative analysis showed that the determinants of the technology acceptance model, together with subjective norms, technology characteristics and task-technology fit were the major factors that influenced students' decisions to adopt a collaborative technology.

This research provides practical as well as theoretical contributions to the adoption and use of collaborative technologies for learning. By employing a design research approach that incorporates learning theories and pedagogical principles, this research contributes to the integration of Web 2.0 facilities in collaborative learning environments to support project-based learning. Based on the reflections and evaluations on the implementations, a set of design principles was developed to facilitate sharing among practitioners for future developments.

DECLARATION

This thesis presents the work carried out by myself and does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any university; to the best of my knowledge it does not contain any materials previously published or written by another person except where due reference is made in the text; and all substantive contributions by others to the work presented, including jointly authored publications, are clearly acknowledged.

Ronnie Chu Ting Cheung 11-3-2013



…….. …….

(Signature) (Date)

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my supervisor, Professor Doug Vogel, who has been a tremendous source of guidance, support, and understanding throughout my Ph.D. program. I am deeply appreciative of the time, dedication, and encouragement he has shown to the thesis and my professional development.

I am grateful to my thesis examiners Prof. Dubravka Cecez-Kecmanovic and Prof. Bruce Reinig for their valuable insights and constructive comments. This thesis, in its final form, has benefit greatly from their comments and critical evaluation.

I would also like to thank Professor Paula Swatman, who has helped to review the initial proposal for this thesis. Finally, I am thankful for the understanding of all members of my family. Without their faith and support, completion never would have been possible. This thesis is dedicated to them.

Chapter 1

Introduction

1.1. Introduction to the Chapter

This study examines the development, adoption and use of collaborative technologies in a project-based environment. It focuses on the requirements and opportunities to enable collaborative learning through Web 2.0 technologies. This chapter provides a background of the Web environment, and the significant shifts which have occurred in the nature of the Web that have facilitated a new mode of learning during the past decade. These new technological developments have prompted for research into a new generation of computer-mediated environments that can exploit the capabilities of the new technologies to support learning. The chapter continues by outlining the various aspects relating to the technological, educational and behavioural research issues associated with collaborative learning. Focusing on these research issues and the learning context, the research objectives and the research questions are presented. This chapter concludes by providing the significance and contributions, as well as the structure and outline of the thesis.

1.2. Background

The rapid developments of the Internet and the World Wide Web have profound changes in the way people learn and share information. The new kinds of resources, such as social networking sites, wikis and virtual communities have prompted for new ways of learning. Such developments are influenced by the popularity of Web 2.0 technologies that are characterized by Web-based facilities that foster user participation (Greenhow, Robelia, & Hughes, 2009), immediate feedback on the user interface, ease of use, and facilities that support user-generated content development.

An important contribution of the new generation of Web-based collaborative technologies is the ability to support ‘social learning’ (Brown & Adler, 2008), which is based on the premise that meaning is socially constructed through interactions with others. The emphasis on social learning stands in contrast with the knowledge

acquisition metaphor of learning, which is based on the traditional assumption of the linear transmission of knowledge to students, and emphasizes on the role of within-mind knowledge structures in learning. The social learning approach is also emphasized through the participation approach to learning (Sfard, 1998), where cognition and knowing are distributed over both the individual and the environments, and learning is seen as a process of growing up and socializing to a community (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991). Such kind of learning is characterized by the use of social software tools, where learners are engaged in the process of social interactions, dialogues and sharing. The development of Web 2.0 collaborative technologies is creating a new kind of participative media that supports the participation approach to learning through community building and social communications.

The adoption of Web 2.0 based collaborative technologies offers huge opportunities for connectivity and collaborations (Ferdig, 2006), scaffolding and peer tutoring (Kamel Boulos & Wheeler, 2007), publication, and sharing of contents (Ferdig, 2006). Research in Web 2.0 technologies also shows that these technologies also provide an effective medium for supporting long-term, student-centred, project-based learning. Web 2.0 technologies also facilitate knowledge acquisition and knowledge sharing processes for students to work in groups for project purposes, thus improving collaborative learning through a social environment for interactions within peers and tutors (Grippa, Secundo, & Passiante, 2009).

Recently, there has been an increasing research interest on the role of Web 2.0 collaborative technologies for learning. A number of studies have focused on the impact of social networking technologies on the behavioural aspects of collaboration among students (Lampe, Wohn, Vitak, Ellison, & Wash, 2011), highlighting the important impact of social networking tools on student motivation to learn, affective learning, and classroom climate (Mazman & Usluel, 2010). The adoption and use of social networking tools for academic purposes are also found to align with the theories of behaviour involving student attitudes, behavioural controls, subjective norms and behavioural intentions (Hartshorne & Ajjan, 2009). Although these researches contribute to the understandings on the adoption and use of social networking and collaborative technologies for education, they are developed based on

empirical investigations that emphasize on the development of theoretical models, without addressing the practical implementation aspects of learning. The issues relating to the applications of the theories are not being addressed, and are based upon the optimistic assumption that practitioners can directly apply these theories derived from the empirical investigations.

In order to address the practical aspects of integrating Web 2.0 technologies for course delivery, various researchers have investigated social networking technologies in formal classroom environments for information sharing (Baran, 2010) and community development (Kamel Boulos & Wheeler, 2007; Kaufer, Gunawardena, Tan, & Cheek, 2011). These researches have demonstrated the application of new technologies to solve practical problems in learning. However, by emphasizing on the practical implementation aspects of collaborative technologies, these researches provide limited contributions to construct theories, models, or principles that can be applied to a wider community of practitioners. To bridge the gap between theory and practice, researchers have called for research in collaborative learning that focuses on the dual objectives of developing creative approaches to address practical problems relating to learning, while at the same time constructing design principles and models that can guide future development efforts (McKenney & Reeves, 2012; Reeves, 2000, 2006).

In order to focus into the important aspects of employing Web 2.0 technologies for formal learning, this project is based on several research areas proposed by Conole and Oliver (2007) covering educational design and technological issues, behavioural issues as well as socio-cultural issues (as shown in Figure 1-1). Research on educational design and information technology issues involves the design and use of collaborative technologies for learning. Behavioural issues involve research on the use and adoption of Web-based technologies for collaborative learning. The last research issue described by Conole and Oliver (2007) concentrates on the social-cultural factors that cut across the pedagogical, technological and behavioural issues, focusing on the socio-cultural context within which the Internet-based collaborative learning activities are occurring.

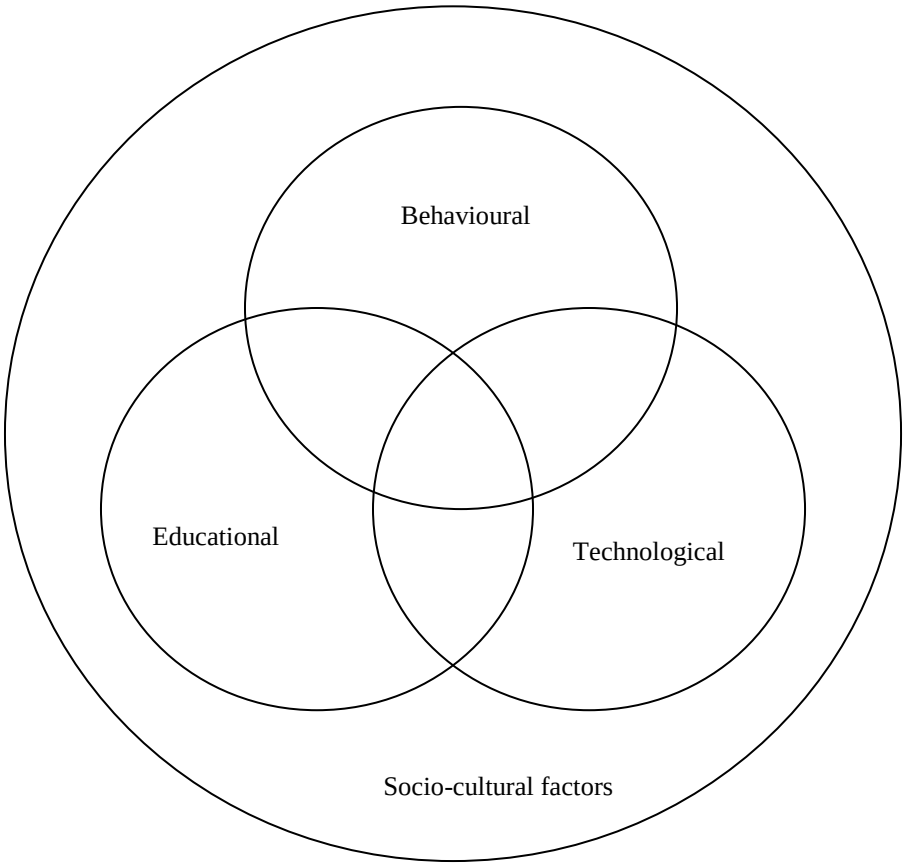


Figure 1-1 Research issues for collaborative learning (Adapted from Conole & Oliver, 2007)

1.3. Research Motivation

The development of Web 2.0 environments to support social learning is a growing field of research relating to the design of technologies for collaborative learning. As a research area, Internet-based collaborative learning is a multidisciplinary and interdisciplinary area covering the use of information and communication technology to support learning in groups, and has been an active research area for many years. According to Dillenbourg, Järvelä and Fischer (2009), computer-supported collaborative learning (CSCL) is concerned with studying how people can learn together with the help of computers. The computer is becoming an important tool for learning. Students and teachers are connected and through the use of computers with Internet access. Summarizing the past CSCL research in the past two decades, Dillenbourg et al. (2009) describe the key ideas that have emerged, namely the design of collaborations among 'peers', the affective and motivation aspects that influence

collaborative learning, and the integration of multiple CSCL activities that must be orchestrated in real-time by the teacher.

According to Laurillard (2009), the new technologies excite a creative explosion of new ideas for ways of doing teaching and learning, but they are rarely designed with formal teaching and learning in mind. In particular social networking, collaborative, and user generated-design-technologies provide exciting opportunities for supporting collaborative learning online, and education has not been the main source of user requirements analysis for exploring these new technologies. As these technologies and tools are developed and become easier to integrate, the boundaries between them are not clear. In order to develop a pedagogical framework that exploits the technology, a strong theoretical statement about the nature of learning and the requirements that impose on the learning design is required to meet the challenging requirements of formal learning in non-traditional ways. It is therefore important to integrate educational design research with research into social networking, collaborative, and user generated-design-technologies. To introduce these exciting technologies into formal classroom environments, it is also important to understand the motivation aspects (Dillenbourg, et al., 2009) and the adoption behaviour of students toward the new technologies for organizing collaborative learning activities (Lampe, et al., 2011). Furthermore the integration of multiple CSCL activities must take into consideration the socio-cultural issues that cut across the technological, behavioural, pedagogical aspects (Conole & Oliver, 2007).

Technological Research

Technologies that facilitate collaboration via the Internet have become an important component of our daily life. Recently, there has been a proliferation of collaborative tools on the Internet that are freely available through social networking platforms. According to Brown, Dennis and Venkatech (2010): ‘Collaborative technology is a package of hardware and software that can provide one or more of the following: (1) support for communication among participants, such as electronic communication to augment or replace verbal communication; (2) information-processing support, such as voting tools; and (3) support to help participants adopt and use the technology, such as agenda tools or real-time training. A variety of terms have been used to refer to collaboration technology over the years—such as group decision support systems,

group support systems, electronic meeting systems, groupware, computer-supported cooperative work, and negotiation support systems—but these, as well as specific systems, such as email, voice mail, and video-conferencing, are generally encompassed under the larger umbrella term of collaborative technology.'

A more detailed definition of collaborative technologies is provided by Qureshi & Vogel (2001), who distinguish between collaborative 'systems' and collaborative 'technologies', suggesting that the former focuses on the interaction required to achieve work, while the latter focuses on the technologies that support both face-to-face and distributed computer-mediated collaborative work. This research adopts Qureshi & Vogel's (2001) definition of collaborative technologies that covers support for both face-to-face and computer-mediated collaborative work. Collaborative technologies were introduced in the 1980s, but research into this area has only started in the past few decades. The developments of social networking, collaborative, and user generated-design-technologies offer new challenges to research in the design of collaborative technologies, and it is important to investigate how these technologies can be used to support computer-supported collaborative learning (CSCL).

Behavioural Research

Technology adoption is one of the richest streams of research in the information systems area (Sykes, Venkatesh, & Gosain, 2009). However most of the research models for the adoption and use of a technology have been conceived at an individual level and research on the adoption of collaborative technologies is relatively scarce. A major reason is that collaborative technologies as a key domain for research only started in the late 1980s (Brown, et al., 2010). With the rapid development of collaborative technologies that supports virtual teams and distributed work environments, it is important to tie the research in technology adoption to the behavioural aspects on the use of collaborative technologies, following the research direction described by (Venkatesh & Bala, 2008; Venkatesh, Morris, Davis, & Davis, 2003):

> '… There have been several models explaining technology adoption and use, particularly since the late 1980s. In addition to noting the maturity of this stream of research, … one of the most important directions for future research is to tie this mature stream (technology adoption) of research into other established streams of work [e.g. Collaborative Research]. '
>
> (Venkatesh & Bala, 2008)

Educational Design Research

A third area of research relevant to the development of Web-based learning is educational design research. Although the development of learning theories provides a rich research area, an important research agenda in educational research is to link theory with practice, rather than striving for knowledge in education. To improve practices in collaborative learning, educational designers need to develop theories that inform design practices and provide practical relevance. It is also necessary to employ theories that can exploit the capabilities of the new generation of socially-enabled technologies for collaborative tasks. The investigation of theories provides insights on learning, but it may not provide guidelines for teaching practices and the use of technologies for learning. A detailed investigation of learning theories and the associated pedagogical implications can provide theoretical statements on the nature learning and the requirements of the learning design, so that instructors can make best possible use of the capabilities of the new technology. To achieve this, it is necessary to develop principles and practices for developing learning interventions through Web-based facilities iteratively.

Although educational designers have devoted efforts to design solutions to deal with problems in education, their understandings made on the design decisions to support teaching are often implicit. It is therefore necessary to provide design frameworks that support explicit design of learning interventions that can further improve subsequent design efforts iteratively, in order to improve the robustness of design (Visscher-Voerman & Gustafson, 2004). Research from information system design methodologies (Nunamaker Jr, Chen, & Purdin, 1991) provides design frameworks for development of Web-based learning platforms. However these design frameworks are not able to link kernel theories (Wallis, Widemeyer, & El Sawy, 1992) with the

design. It is therefore necessary to investigate design frameworks from a design science perspective (Gregor & Jones, 2004, 2007; Hevner, March, Park, & Ram, 2004; Jones & Gregor, 2006) for linking theories into design practices, in order to support Web-based collaborative learning.

1.4. Research Questions and Objectives

The overlapping research areas in Web-based learning can be further developed to provide frameworks for a more focused research study. For example, from the educational design perspective, the development of effective pedagogical frameworks can support the design of learning activities that are delivered through a technology platform employing collaborative technologies. Research into the technological development of participative media and Web technologies is important for introducing new platforms for technology-enhanced learning. Furthermore, a study on the social-cultural factors associated with the introduction of collaborative learning technologies can provide insights on how learners learn with technology. Even with the significant amount of research in Web-based learning platforms, surprisingly, studies relating the adoption of technologies for collaborative learning are an under-researched area (Brown, et al., 2010). Focusing on students in higher education environments, this research focuses on the development, adoption and use of collaborative learning technologies, with the following objectives:

1. To assess the applicability of collaborative technologies for supporting collaborative learning in a Web 2.0 environment.
2. To develop design principles for the adoption and use of a CSCL platform using social networking tools.
3. To test the theoretical models that explain the adoption of a CSCL platform.

Research Questions

Although researchers have adopted learning technologies (Gong, Xu, & Yu, 2004; Sanchez-Franco, 2010) to support learning, most of the research models on technology adoption have been developed for individual use of a technology. There are a number of researches that investigate the adoption behaviour of e-collaboration technologies (Dasgupta, Granger, & McGarry, 2002; Jarvenpaa & Staples, 2000), but they are not developed for technology adoption in a Web 2.0 environment. Compared

with the rich stream of technology adoption in the information systems area, limited attention has been paid to technology-specific empirical research that may provide stronger guidance on the successful implementation of Web 2.0 technologies for learning. Furthermore, the application of collaborative technologies for e-learning requires the incorporation of learning theories to inform design and development. The application of these new technologies are complex and difficult because such systems need to incorporate a variety of administrative, pedagogical and technological components that are required to be integrated in a holistic manner (Jones & Gregor, 2006). The development of a CSCL platform also need to be based on research models offering explanations that can be used to design interventions that foster technology adoption. It is therefore necessary to investigate both the development of the CSCL platform and to test its applicability. Focusing on the learners' perspective, this research investigates the adoption and use of collaborative technologies for project-based learning. Three research questions were formulated to guide the study:

RQ1. How to design an effective CSCL environment using social networking, collaborative, and user-generated technologies for group-based collaborative learning?

RQ2. What are the design principles for developing a CSCL platform using collaborative technologies for project-based learning?

RQ3. What are the factors that influence students' decisions to adopt collaborative technologies?

1.5. Research Scope and Environment

It is important to note that the research issues associated with the CSCL environment described in this research do not apply to all teaching and learning environments. The objective is to provide design principles that can be fine-grained to specific teaching contexts, and illustrate the use of a research framework to inform future CSCL implementations. The CSCL environment described in this research was being evaluated in an undergraduate course for project-based learning at the Hong Kong Polytechnic University. In order to avoid over generalizations, this research focuses on the adoption and use of collaborative technologies in a specific undergraduate subject 'Advanced Marketing Research Project' (AMR) where the researcher is also an investigator and a subject lecturer.

This research does not aim at replacing the face-to-face interaction components of the course, but rather to develop a CSCL platform that incorporates the pedagogical design consisting of face-to-face and on-line components that support project-based collaborative learning. The research process covers two phases:

Phase I: CSCL Platform Design and Development

- To develop e-learning designs that address the specific issues for the implementation of social software as a kind of CSCL platform for collaborative learning, the design and refinements are evaluated to produce guidelines for future implementations.

For the technological research involving the design of a CSCL platform, the study involves evaluations of social networking and collaborative technology for learning. The development of CSCL technology for learning covers both technological research and educational design research. According to Barab and Squire (2004), educational design research is characterized by 'a series of approaches, with the intent of producing new theories, artefacts, and practices that account for and potentially impact learning and teaching in naturalistic settings.' A nature of educational research is that it is context-bound and researchers often focus on specific objects and processes in specific contexts (as an example: the tasks associated with collaborative learning in project-based environments). Therefore, it requires practitioners to be involved in the identification of real teaching and learning problems, the creation of prototype solutions based on design principles, and the evaluations of the solution based on a mixture of qualitative and quantitative techniques. In this context, this research focuses on the design and evaluation of a CSCL platform to support project-based learning.

A design research approach was used in this study to construct the computer-mediated learning platform, and to accommodate the learning interventions that could be implemented iteratively. Through the collaborative platform developed for this study, learning was supported through cultural practices that promoted participation, collaboration and self-reflections among students. Two iterations of learning interventions were designed to support project-based learning for marketing research. Through the development and adoption of the collaborative platform, the applicability of Web 2.0 based collaborative technologies for collaborative learning was evaluated.

Design research also offered the flexibility to accommodate various theories to guide the construction an effective CSCL environment using social networking, collaborative, and user-generated technologies.

The focus on a design research approach also benefited practitioners by providing design principles to increase developmental reliability and the likelihood of success in future implementations. Based on qualitative and quantitative evaluations of the collaborative platform and the reflections on the implementation experience in classroom environments, seven design principles were developed in this study to facilitate sharing among practitioners for future developments. These design principles were developed based on the reflections on the iterative implementations of collaborative learning using Web 2.0 technologies.

Phase II: Subsequent Evaluation

- Evaluation of student acceptance of collaborative learning technologies

In order to evaluate the critical factors that influence students' decisions to adopt a CSCL platform, a research framework was developed. The subsequent evaluation of the completed CSCL platform employed a quantitative approach, and a structured questionnaire was used for data collection. The questionnaire was distributed to students during the delivery of the AMR course. A research model was developed to investigate students' attitudes and behaviour toward the adoption and use of the CSCL platform.

To test the theoretical models that explain the adoption of a CSCL platform, it is necessary to integrate knowledge from technology adoption and collaboration technology research. Using the theoretical backgrounds from the theory of reasoned action, the technology acceptance model and the task-technology fit model, this study proposes a combined research model which identifies the several attributes as likely predictors of collaborative technologies. The combined multi-theoretical model was tested and assessed by a goodness of fit measure to evaluate the appropriateness of the proposed model for the collected data. This was used to examine the critical factors that affect students' decisions to adopt collaborative technologies for project-based learning.

1.6. Significance and Contributions

Researchers have called for the need to apply social software and Web 2.0 concepts to create new learning experiences in blended learning environments (Greenhow & Belbas, 2007; Greenhow, et al., 2009). Instructional and e-learning designers should make full use of social software employing Web-based collaborative technologies for project-based learning. This research addresses the need for the shift from top-down, knowledge-push models of traditional e-learning (such as WebCT) to collaborative learning technologies with a bottom-up approach that is driven by the learner, facilitating collaboration and sharing through Internet-based technologies.

The usage of social networking systems among college students is an important area of research (Coiro, Knobel, Lankshear, & Leu, 2008). However, there are few researches that investigate the introduction of social software tools in formal teaching and learning environments. In order to introduce these new technologies for learning, this research examines the design of learning environments that are supported by collaborative technologies through social software tools. It attempts to contribute to the body of knowledge in computer-supported collaborative learning, and addresses the need for designing learning environments to support project-based learning.

This research addresses the research gap in applying design theories (Gregor & Jones, 2004, 2007) for testing pedagogical designs (Herrington & Oliver, 2000; Mcloughlin & Luca, 2006) in a Web 2.0 collaborative learning environment using social software tools. By comparing with existing e-learning design theories for collaborative learning (Hakkarainen, et al., 2006; Paavola, Lakkala, Muukkonen, Kosonen, & Klas, 2011; Reeves, 2000), this research also addresses the need to provide design principles (Paavola, et al., 2011) for developing collaborative environments for project-based learning.

By employing a design research approach that incorporates learning theories and pedagogical principles, this research contributes to the integration of Web 2.0 facilities in collaborative learning environments to support project-based learning. Based on the reflections and evaluations on the implementations, a set of design principles is developed to facilitate sharing among practitioners for future developments. Findings from this study would contribute to providing insights on design principles that are implemented in a specific context, through the collective use

of collaborative teams, project-based assignments, well-designed authentic activities, and collaborative use of Web 2.0 based technologies.

Researchers have developed technology acceptance models (Davis, 1986, 1989; Davis, Bagozzi, & Warshaw, 1989) that are applied to a range of technologies, and these research models have been used for predictions of individual technology adoption and usage. However, there are limited research models that are developed for technology adoption in a Web 2.0 environment. By focusing on a technology-specific research model that can be applied to collaborative learning, this study develops a research model that offers more explanatory power compared to a general model that attempts to address many classes of technologies (Venkatesh & Bala, 2008). By developing extensions to the technology acceptance model for Web 2.0 based collaborative technologies, this study also addresses the need for developing research models that explain the adoption behaviours of collaborative technologies among students. Therefore, this research is significant in identifying the factors that influence students' decisions to adopt collaborative technologies for learning. The current work also contributes to research by developing and testing a technology-specific model of adoption in the collaboration context.

Excerpts from theoretical and practical contributions of this thesis have been published in peer-reviewed publications in research areas relating to social software evaluations (Cheung & Vogel, 2011; Cheung & Wan, 2010), theoretical models on the adoption of collaborative technologies (Cheung, in press; Cheung & Vogel, 2013), design of collaborative environments (Cheung & Vogel, in press) employing social software tools (Cheung & Vogel, submitted) and the socio-cultural aspects surrounding the blended learning environments (Cheng, Cheung, & Wan, 2010). The classifications of the research publications that are generated from this study (Figure 1-2) are listed as follows:

Journals

[1] Cheung, R. & Vogel, D. (2011b). Can Facebook enhance the communications between teachers and students? *International Journal of Learning*, *17*(11), 35-397.

[2] Cheung, R. & Wan, C. (2010). An evaluation and implementation of collaborative and social networking technologies for computer education. *International Journal of Cyber Society and Education*, *4*(1), 17-30.

[3] Cheung, R. & Vogel, D. (2013). Predicting user acceptance of collaborative technologies – An extension of the technology acceptance model for e-learning. *Computers & Education*, 63, 160-175.

[4] Cheung, R. & Vogel, D. (*submitted*). Designing Web 2.0 collaboration tools to support project-based learning: An activity-oriented approach. *International Journal of Systems and Service-Oriented Engineering.*

[5] Cheung, R. (*in press*). Predicting user intentions for mobile learning in a project-based environment. *International Journal of Electronic Commerce Studies*, *5*(1).

Book Chapter

[6] Cheung, R. & Vogel, D. (*in press*). Activity theory as a design framework for collaborative learning using Google Applications technology. *Lecture Notes in Computer Science*, vol. 7697, Springer.

Conference Publication

[7] Cheng, C., Cheung, R. & Wan, C. (2010, E-learning in higher education – A case study in Hong Kong. *Proceedings of the IEEE International Conference on Advanced Management Science*, pp. 79-85.

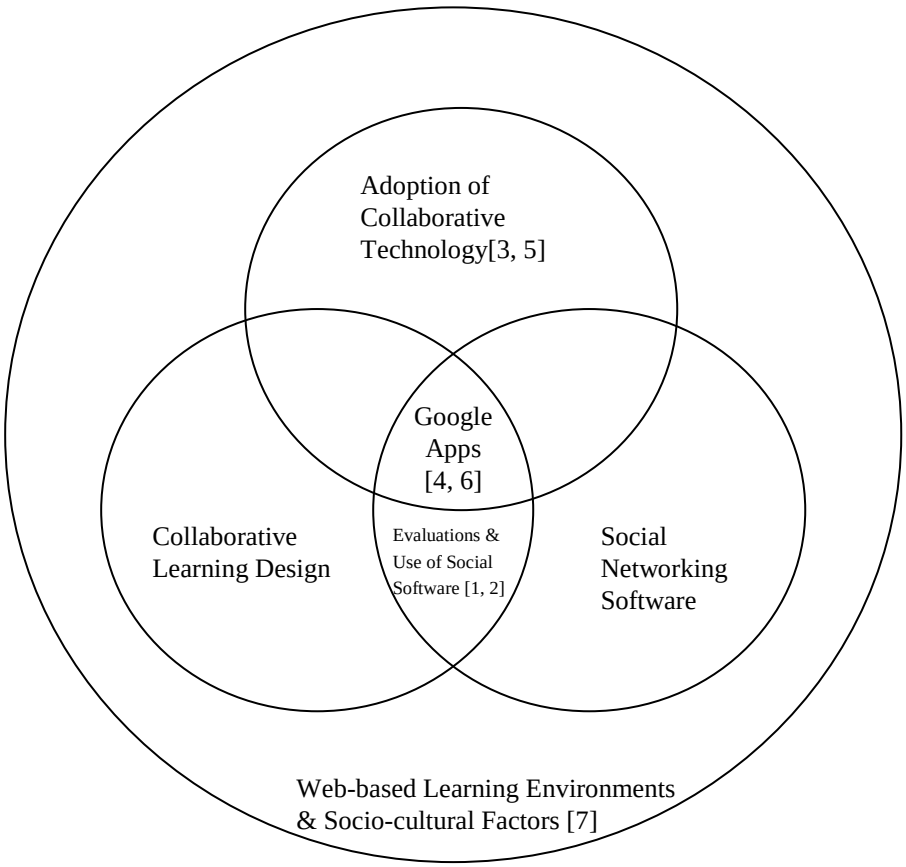


Figure 1-2 Classification of research outputs in major areas

1.7. Outline of the Thesis

This thesis is comprised of ten chapters: (a) introduction, (b) literature review, (c) the research process, (d) development of a technological design solution for CSCL, (e) an activity perspective for CSCL, (f) implementation and testing of the CSCL platform, (g) reflections to produce design principles, (h) subsequent evaluation of technology adoption, (i) discussion, and (j) conclusions.

Chapter One describes the background of the research, highlighting the research objectives, research questions, research significance, and research contributions.

Chapter Two presents the reviews of the literature covering the technological, pedagogical, and behavioural issues associated with the collaborative learning. The review provides the foundations for designing collaborative learning environments to support project-based learning.

Chapter Three presents the context of the research, the research approach and the philosophical underpinnings that guide the research methodology of the research process. It highlights the selected research approach that was used for the design of the CSCL platform and the associated activities for learning.

Chapter Four describes a technological design solution for computer-supported collaborative learning. The chapter begins by providing an analysis of the practical problems associated with project-based learning, followed by a review of existing literature to develop a set of guiding principles that inform the development of a design solution. A technological design solution for computer-supported collaborative learning employing Google Applications technology is presented in detail.

Chapter Five presents the pedagogical design solution comprising the design of learning activities, and the analysis of activities for implementation. The pedagogical design of authentic learning activities involves the development of assignments and tasks associated with learning. It also involves mapping the Web-based tools and resources of the CSCL platform to support collaborations and interactions among students. An activity perspective is being applied to the analysis of the socio-cultural issues associated with the introduction of the CSCL platform.

Chapter Six presents the details of the implementation and testing of the computer-supported collaborative learning environment. Two iterative cycles of implementations and testing of the collaborative learning environments are described. The evaluations of the implementations of the design solutions are presented to support the technology and pedagogy implementation refinements.

Chapter Seven presents the reflections from the iterative design and evaluation process. This chapter also presents a set of design principles that characterizes the main features of the computer-supported collaborative learning environment for project-based learning, in order to facilitate theoretical, pedagogical, and technological developments in the future.

Chapter Eight presents the subsequent investigation on user acceptance of the collaborative platform, which is confirmatory in nature. The evaluation was based on a theoretical framework derived from the technology acceptance model, the theory of reasoned action and the task-technology fit model. A quantitative approach was adopted in the evaluation. Hypotheses related to the proposed research framework were developed and statistical analysis was provided to test the measurement and structural models. The chapter concludes by providing a description of the interrelationship between the research variables and a summary of the findings that were derived from the statistical analysis.

Chapter Nine provides a discussion on the research process and the findings from the research. The implications for development of CSCL solutions for project-based learning in a Web 2.0 environment are discussed and future directions of research are presented to provide insights on future research into the implementations of CSCL platforms using social networking tools.

Chapter Ten summarizes the conclusions of the study, including the contributions and implications of this research, highlighting the limitations and suggestions for future research work.

Chapter 2

Literature Review

2.1. Introduction to the Chapter

This chapter presents a review of the literature covering the technological, pedagogical and behavioural issues associated with the collaborative learning. The review provides the foundations for designing collaborative learning environments to support project-based learning. The literature review aims at presenting a comprehensive critical evaluation of research relating to the new development of computer-supported environment to support learning and project work. A review of literature is also required as part of the design research process to identify significant research and development relating to the development of solutions for computer-supported collaborative learning. Following a review of the current developments in Internet technology, this chapter presents the literature relating to the current practices on the use of e-learning systems and evaluations of the common social software tools that can be employed to support project-based collaborative work. The purpose of the review is to identify the gaps as well as opportunities for educational use of Web 2.0 based collaborative technologies, in order to guide subsequent research efforts.

The literature review on theories of learning provides discussions on the pedagogical paradigms ranging from behavioural theories, cognitive learning theory to social constructivism, and socio-cultural approaches to learning. These developments are paralleled by the development of computer-supported collaborative environments to support project work. It is argued that CSCL development requires a cross-disciplinary research and a holistic methodological approach that allows the researcher to study computer-mediated learning environments from multiple perspectives. Therefore, a literature review on the methodological approaches for collaborative learning can benefit research in the design of computer-supported collaborative learning environments. Following a discussion on the challenges of computer-supported collaborative learning in project-based environments, a review of

the literature for technology adoption is presented. The following sections provide discussions on the influential contributions found in the literature relating to this study.

2.2. Internet Technology

To investigate the use of technologies for learning and collaborative work, it is important to understand the students' everyday use of Web 2.0 technologies. We are facing a digital age where social networking systems such as Facebook have increasing influence with increasing usage rate of over 95% among college students (Lampe, Ellison, & Steinfield, 2006). Therefore, learning, teaching and scholarship should exploit the potential of Web 2.0 technology, to provide opportunities for learners' participation and creative practices (Greenhow, et al., 2009). The development of Web 2.0 technologies also facilitates a new generation of collaborative technologies that are available through a cloud computing infrastructure. These technologies are freely available and can be accessed through a standard browser. The development of learning environments should examine the unique capabilities of Web 2.0 collaborative technologies and learning environments based on the new computing infrastructure, in order to meet the demand of teaching and learning in a digital age.

2.2.1. The Digital Age

Recent studies describe today's young people as ‘digital natives’, ‘millennial learners’ who are constantly online, perceived themselves as Internet-Savvy, and prefer technology-enhanced communications (Greenhow, 2009). A recent study shows that 82% of high school students in USA go online regularly and 77% of the students have a profile on a social networking site (Greenhow & Robelia, 2009). These behaviours can be explained by the active involvement of teenagers in a form of 'participatory culture' described by Jenkins (2006). We are now entering a digital age, where a participatory culture is developed, which is characterized by low barriers to artistic expression, creation and civic engagement, and with a strong support for sharing within the online community. Through participation as members in online communities, some form of social connections is developed in the social network, and each member believes that their contributions in the online community matter.

With a participatory culture, it is convenient to exchange content between different systems and Internet services (such as Facebook, YouTube, instant messaging, Google Applications). Through various social media, the relations between friends and connections in social media become more visible. Buckingham (2007) posits that the new media is an important dimension in most young peoples' lives. They acquire the skills and competence in a digital world on their own by interacting with the popular culture. This is developed through interpersonal connections that enable them to publish about themselves through the social media. With the ability to communicate through a participative culture, appropriating and remixing digital materials, today's young people are able to reflect and transform the way they think about themselves, and communicate with a mass audience to extend their reach of influence.

The discrepancy between formal education perspective and young peoples' heavy involvement with the new technological rich media environment is creating a new form the digital divide. Today's university students come a 'Generation M' (Roberts & Foehr, 2005), also known as the Generation Media born between the 1980s and the late 1990s. They are heavily involved in social networking sites and online forums, and are often more technologically adept than their instructors. This problem is defined as the digital divide 2.0 (Vie, 2008), where instructors are facing problems with students who possess technological know-how, but lack information literacy skills to make use of the participatory media in the learning process. The problem of social exclusion is a major issue because the digital divide 2.0 is becoming deeper, while students' use of the participatory media is increasing at an alarming rate, their incorporation into the teaching environment is still being left behind.

Researchers are starting to investigate the impact of the new media on learning. There are a number of studies on the link between the use of social networking sites and personal development among college students (Boyd & Ellison, 2007). Hewitt and Forte (2006) investigate the feelings among college students about their professors' presence on Facebook. Mazer, Murphy and Simons (2007) investigate the influence of Facebook usage on students' perceptions about their professors. Cheung and Vogel (2011) investigate the impact of introducing Facebook in project-based communications in education. Yu et al. (2010) investigate the relationship between

the use of Facebook and social learning outcomes. The usage of social networking systems among college students is an important research area (Coiro, et al., 2008). However there are very few researches that investigate the introduction of social networking tools in the teaching environment and address the socio-cultural issues associated with its usage. According to Jenkins (2006), there are various benefits that can be achieved by developing a participatory culture in education:

> 'The potential benefits of these forms of participatory culture include opportunities for peer-to-peer learning, a changed attitude toward intellectual property, the diversification of cultural expression, the development of skills valued in the modern workplace … Access to this participatory culture functions as a new form of the hidden curriculum, shaping which youth will succeed and which will be left behind…'
>
> (Jenkins, 2006)

The large number of content management systems in tertiary education institutes results from a top-down view of contents relating to learning. Universities and faculties assume that there is a well-defined body of knowledge that should be passed on to students through the education system, and an e-learning platform is used to support the delivery and transmission of knowledge from teachers to students. With the hierarchical framework of knowledge defined by the top-down view, it is difficult to know about the research networks of the lecturers and it is also difficult to know about the learning styles and activities of students.

Students' use of participatory media is often seen as separate from formal teaching activities in schools. The Internet provides different entrance points into complex overlapping networks and contents that transcend through different boundaries (Figure 2-1). The different sources of information can be 'glued' together through networked environments. Information communicated through these networks are recorded and streamed to different individuals and groups. The streams of continuously evolving data and information can be manipulated easily. The sharing of interest and participation in different interest groups can provide a means for personal development and social learning. Knowledge construction can be seen as a diffusion of knowledge between different types of nodes in the networks. Although many scholars have investigated the potential of the new participatory media, only a few

researches have investigated the use of social networking platforms in a teaching and learning environment.

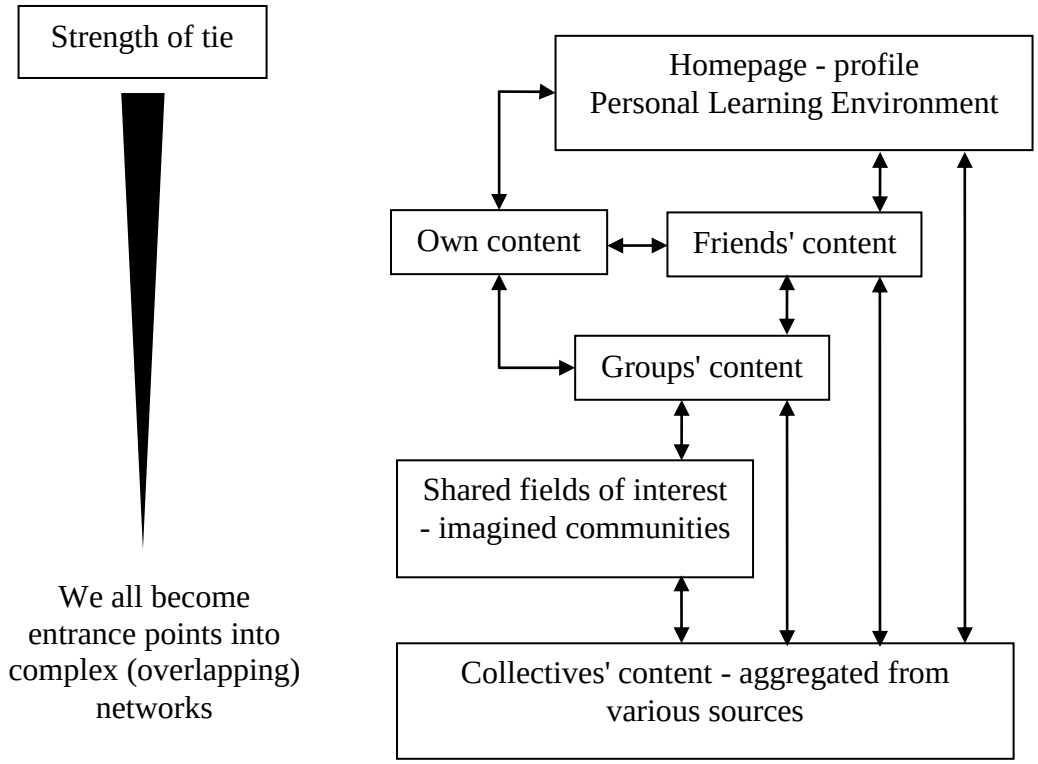


Figure 2-1 Contents from complex overlapping networks

2.2.2. Web 2.0 Technology

The latest development of the World Wide Web has blurred the line between producers and consumers of contents and has drastically undergone a shift from static Web content to connections between people and communities. The use of collaborative technologies provides facilities for people to form instant online communities to communicate rapidly and conveniently. Web 2.0 is commonly defined in terms of features incorporated in social software, social computing and the participative Web (O' Reilly, 2005). It also consists of social networking applications that exploit the Internet's connectivity dimension to support the networking of relevant people and content. Social networking systems such as Google Plus and Facebook have increasing influence on university students' lives with an increasing usage rate of over 95% at most campuses (Lampe, et al., 2006). Today, young people are spending a lot of their time online, using social networking systems to express

their views and share resources. The next generation of knowledge workers will therefore need to be educated to exploit the full potential of these technologies.

With the widespread use of Web 2.0 applications and Internet-based collaborative learning technologies, research investigating the relationship of these technologies to collaborative learning is starting to emerge. Web 2.0 is also described as an 'architecture of participation', which facilitates ease of usage, gives immediate feedback on the user interface and structural levels, and values each user's contribution. Recently, we have experienced a significant increase in the number of users who voluntarily engage in Web 2.0 activities. Examples of activities relating to Web 2.0 applications include blogs, wikis, tagging, RSS feeds, file and media sharing, social networking, and online messaging. These technologies are often associated with social communication as well as rich user experiences and opportunities for playfulness.

The widespread proliferations of online collaboration tools allow communities of common interest to share content and commentary via online participation with wikis, discussion forums, and through various file formats that can be shared or edited online. Educational institutes are starting to prepare students to collaborate in a world in which various tasks can be accomplished with an abundance of available collaborative tools through the Internet. Researchers in the areas of e-learning in Web 2.0 environments (Chatti, Dahl, Jarke, & Vossen, 2008) emphasize the importance of learner-centered approaches while considering the use of self-publishing, peer-driven online learning, and social networking. This suggests a greater focus on student-generated content, students' use of collaboration tools such as Web 2.0 applications, and modular tutoring. These innovative disruptions (Christensen, Anthony, & Roth, 2004; Christensen, Horn, & Johnson, 2008) are prompted by the development of Web 2.0 technologies that force us to think in new ways in preparation for the new challenges that are brought about by these changes.

2.2.3. Cloud Computing

Another development of Internet technology is cloud computing. The rapid development of cloud computing technologies changed the way applications are developed and integrated. It also facilitates ubiquitous access to files and applications

through a standard Web browser. Cloud computing facilitates the development of applications and services that are provided on the Internet through a scalable architecture. With cloud computing facilities, applications such as word processing, spreadsheet and presentations can be accessed through a standard Web browser, and application files can be accessed through cloud storage accessible through the Internet. Microsoft and Google are examples of vendors that provide cloud computing applications around the world. With the dominant share of office and word processing applications by Microsoft, Google is developing compatible office applications through a cloud computing infrastructure.

Cloud computing provides flexible computing services and applications independent of the underlying computing infrastructure. It enables institutions without technical expertise to get access to cloud computing services on demand without the need to support their own computing infrastructure. The end-users can access the cloud computing services anytime, anywhere, by collaborating through the Internet. For the academic institutions, cloud computing offers solutions for computing services, data storage, and computing power that are reliable, and scalable with the growing number of Internet users without significant investments in hardware and software. Academic institutions are starting to employ cloud computing services for developing e-learning applications (Al-Zoube, 2009; Casquero, Portillo, Ovelar, Romo, & Benito, 2008). In particular Google Applications technology is being employed by a number of academic institutions as a cloud computing wide-platform for hosting email documents and cloud computing services.

The rapid development of cloud computing services has a significant impact on the way end-users interact with the Web environment. With the new environment, students are active consumers of information, as well as active producers of information. They are confronted with a range of tools and media choices. Most cloud computing environments represent a set of loosely joined services that are utilized by the learner. For example, Google Docs technology is a kind Web-based office tool for users to share documents with peer learners. These technologies provide a personalized learning environment for the development of self-directed pedagogy, where members of a social network of common goals, get peer assistance, and exchange information with peer members. In the context of self-regulated learning, a

learner can choose the applications and services that constitute his/her own personal environment, and be able to add new services according to the basis of a grid layout.

Mashup personal environments provide facilities for the learners to glue up all components of the personal learning environments (Casquero, et al., 2008). The term mashup comes from the practices of combining parts of two of more music pieces to form a new song. It has implications for creativity when applied to cloud computing for combining different Web services and data sources. However, practices in the mashup of Web 2.0 technologies for education purposes are limited. According to McLoughlin and Lee (2007), the 'affordances' of these new technologies are not pre-defined by their functionality, which means that the design and functionality of a particular Web 2.0 tool do not define its particular pedagogical usefulness. The usefulness of these tools depends on the conceptualization of the tasks and problems to make use of Web 2.0 tools for participation and sharing. Therefore, it is important to design a teacher-led, self-regulated personal learning environment based on a sound pedagogical approach.

2.3. E-Learning

In response to the government's push toward a 'knowledge-based economy', the development and application of e-learning technologies have become more and more popular in Hong Kong (Cheng, et al., 2010). According to Leung and Li (2006), e-learning system is widely adopted as an approach to support face-to-face course delivery. All the universities in Hong Kong are employing e-learning platforms to support teaching and learning. E-Learning is the term most commonly used to represent the broad range of technologies that are used in education. These technologies cover both learning management systems and social networking platforms that support learning in a collaborative environment. The following sections provide the comparison and evaluation studies of different learning management systems and social networking platforms to support e-learning.

2.3.1. Learning Management Systems

Various learning management systems have been developed to support Web-based learning. A learning management system is an application that is used to support delivery of learning content to students through specific pedagogical principles. All

the features available in the learning management system are accessible through an Internet connection, and by making use of a Web browser. The Web Course Tools (WebCT), the Blackboard Learning System, and the Moodle e-learning system are the common learning management systems developed to support learning based on pedagogical principles. They provide Internet-based facilities for students to access learning content through various tools such as chat rooms, discussion forums, and course content management modules. The WebCT e-learning system has been used by over 2100 higher education institutes. In Hong Kong, a number of universities have been adopters of the WebCT e-learning system. Ngai, Poon, and Chan (2007) investigate an extended version of the user acceptance model (Davis, 1989) for the adoption of WebCT by university students. Their research results show that the technology acceptance model provides an appropriate model for explaining the adoption behaviour of students towards WebCT. In addition, technical resource support also acts as a predictor for usefulness and ease of use for the WebCT e-learning system.

The Blackboard learning management system is offered in 12 languages to over 2,200 learning institutions. Starting from the year 2004, Blackboard merged with the software company WebCT. Blackboard is offered to 12 million users in over 60 countries. It was designed to supplement traditional or distance learning with various components in the system. These include content management and content sharing, assessment management, assignment and portfolio management, collaboration and communication management. Blackboard can be considered as a traditional Web-based learning management system. With the rapid development of Web 2.0 technologies, other researchers have developed integration tools for Blackboard with Web 2.0 facilities. For example, researchers have developed a plug-in module for Blackboard to integrate with Google Applications technology. Users in Blackboard can access and share documents in Google Applications with a single account for login to the system. Liaw et al. (2008) investigate students' acceptance of the Blackboard e-learning system. The research results show that self-efficacy is the most important factor that influences learners' satisfaction with the Blackboard e-learning system. The results also show that the effectiveness of e-learning can be influenced by multimedia instruction, interactive learning activities, and e-learning quality. Therefore, the integration of Blackboard with the Google Applications technology

offers significant potentials to improve e-learning effectiveness by providing multimedia, interactive learning activities through Web 2.0 technologies.

The Moodle e-learning software is a learning management system that is developed based on the social constructivism pedagogy. Moodle stands for Modular Object-Oriented Dynamic Learning Environment, covering online content module, journals, quizzes, resources for promoting teacher student interaction and assignment management. It is an open source software that is available from the open source community free of charge. An open source software allows developers to enhance the features in a software themselves, instead of solely relying on proprietary systems like WebCT or blackboard to upgrade to new versions with specific features and enhancements.

With the use of open source software, the ownership and use of the software are governed by an Open Source License. Different from proprietary software systems, Open Source Software licenses allow users to freely modify, use, redistribute, or sell the software by maintaining the Open Source License. The basic principle of Open Source Software development is: 'Given enough eyeballs, all bugs are shallow'. By allowing user modifications to be incorporated into the main software project, the development of the software is incorporated by including the user community as developers. Furthermore, open source development is also one of the major factors that foster user community development, by embodying the values of the user community. Open source software development has proved to be a successful model for software development that is facilitated by the development of the Internet. There are large numbers of successful examples, and Moodle is a successful example of Open Source Software for education.

According to Machado and Tao (2007), there are 19,234 registered sites for Moodle in 2007. The development of Moodle is based on the social constructivism pedagogy, which focuses on interactions among students. Moodle provides various modules to support e-learning, including: activity and discussion module, assignment module, book module, chat module, dialogue module, exercise module, forum module, glossary module, hotpot module, journal module, lesson module, questionnaire module, quiz module, resource module, SCORM module, survey module, WebQuest module, wiki module and workshop module. It also offers integration facilities with

Google Applications technology, through third-party software developers (Alier, Casañ, & Piguillem, 2010; Baker & Rees, 2008; Jones & Sclater, 2010).

Sánchez and Hueros (2010) investigate the motivational factors that influence the acceptance of the Moodle e-learning software using an extended version of the technology acceptance model. Their study extends the technology acceptance model by including technical support as one of the factors that influence the adoption of a technology. They conduct a survey with 226 university students studying for a degree course that is supported by the Moodle e-learning software. Their research results show that technical support has a direct effect on perceived ease of use and usefulness of the e-learning software. The usage of the Moodle software is directly predicted by attitude and ease of use for the e-learning software.

2.3.2. Social Software Approach

Social networking systems are defined by Boyd and Ellison (2007) as Web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) create a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. The nature and nomenclature of these connections may vary from site to site (Boyd & Ellison, 2007). The memberships of online social networks, such as MySpace and Facebook, have grown exponentially in recent years. Many online communities have been created on these sites for college students to interact with people they already know offline or to meet new people. Currently, there are 7,300 members in the 'The Hong Kong Polytechnic Community' in Facebook, and most of them are students. In order to develop a framework for the design of social software-enabled learning systems, it is necessary to investigate the relationships between technical systems and socio-cultural theories.

Social constructivism (Sirca & Shapiro, 2007) also posits that knowledge is constructed in social communities when individuals engage in social sharing activities about tasks or collaborative problems. Although there has been agreement that learning occurs within a social context, current e-learning support environments, such as Blackboard and WebCT, still emphasize the aspects of static, packaged content delivery. The content-centric model of e-learning has failed to support the increasing

demand for a shift from the content-driven model to a people-driven model of learning in which a collaborative culture that could foster knowledge sharing and community building is emphasized (Chatti, et al., 2008).

Interaction is supported by collaborative learning theories (Engeström, 1987; Sirca & Shapiro, 2007; Vygotsky, 1978). A collaborative-based, instructional design model fosters community building. However, for conventional teaching environments, opportunities for the learner to collaborate with peers are problematic due to the spatial and temporal requirements associated with traditional lecture-based teaching. The design of computer mediated platforms provides individuals with the capacity to interact via the computer networks regardless of spatial and temporal limitations (Kreijns, Kirschner, & Jochems, 2002). Social networking software facilitates the development of collaborative activities and community building and participation, which is vital for the design of social educational software development.

Recently there is a shift toward research into the tacit knowledge sharing in higher education environments (Schmitz-Justen & Wilhelm, 2007). This requires a human-centered approach that focuses on the interactions in online activities with individual users as the focal points of knowledge. According to Alavi and Leidner (2001), conversion of tacit knowledge to new tacit knowledge takes place through social interactions and shared experience among members of a social network community. The high degree of structure that is dominant in current learning management systems often hinders their application in social interactions and self-directed behaviours among learners. Social networking systems offer an intriguing alternative to the traditional course management system to supporting learning. Implemented with Web 2.0 tools, social networking systems offer important attributes for knowledge sharing, such as trust, openness and self-organizing when applied in institutional contexts (Rollett, Lux, Strohmaier, Dösinger, & Tochtermann, 2007).

2.3.3. Evaluation of Social Networking Platforms for Learning

To evaluate the adoption of a technology, a Web-based approach is required for implementation in collaborative environments. This section reports on the previous studies conducted by this researcher involving the commonly used Web-based collaborative learning platforms. These platforms are freely available on the Web, and

provide a set of tools that can be used for community building and collaborative learning. In the remainder of the section, three different implementations of Web-based collaborative learning are reported. These include the use of Facebook (Cheung & Vogel, 2011), Elgg (Cheung & Wan, 2010), and Google Applications technology for project-based learning (Cheung & Vogel, 2013, in press).

Evaluation of Facebook for Collaborative Learning

Social networking systems such as Facebook and MySpace have become popular in the past few years. Today, young people are spending a lot of their time online, using social networking systems to express their views and meet with friends. Social networking sites are Web-based services that allow individuals to share connections with others, based on relations established with their public or semi-public profiles. The tools and techniques which enable social networking (Web 2.0/3.0, cloud computing, blogs, wikis, social tagging, etc.) are now gradually being adopted by the corporate sector as Enterprise 2.0 (McAfee, 2006), an approach which appears to be gaining momentum in at least the more far-seeing organisations.

Steinfield, Ellison and Lampe (2008) conduct a longitudinal analysis of 481 college students using an online social networking site, Facebook. The research concludes that the intensity of Facebook use has a positive impact on bridging social capital. Those who are able to bridge among social groups are most likely to benefit from the different skills that are required by creative knowledge workers (Coenen, 2005). Academic institutes like the University of Brighton are beginning to realize the potential to benefit from online social networking systems and applications to develop a Campus Wide Enterprise System for Social Networking (Dron & Anderson, 2009).

Previous studies (Coenen, Kenis, Van Damme, & Matthys, 2006) have shown that the structure of social networking sites such as MySpace facilitates communications and sharing. It is therefore important to find out how these technologies can be extended to support learning through communication between the teachers and students. The following discussions report on the descriptions of a previous study (Cheung & Vogel, 2011) to investigate the effectiveness of using Facebook to enhance the communication between teachers and students for project-based collaborative learning.

The research was conducted through evaluations that are conducted with a class of 75 students who were involved in the use of Facebook for project-based communications. The results of the quantitative study showed a significant negative relationship between privacy concerns and students' willingness for academic-related communications with teachers through the use of the Facebook platform. Therefore, the research results have significant implications on the adoption of social networking environments for project-based communications.

Case Description: A Case Study on the Use of the Facebook for Collaborative Learning[1]

Theoretical Framework: this research investigates the effectiveness of using Facebook to enhance the communications between teachers and students. Thirteen project groups from an advanced marketing research course were supported through the use of the Facebook platform to communicate via the Web-based facilities. Social capital theory was used for investigating students' usage and commitment to Facebook activities. Social capital can be described as the benefits that one receives from one's relationships with other people. Ellison et al. (2007) suggest that intense Facebook use is closely related to the formulation and maintenance of social capital. Prior research also suggest that young people with more social capital were more likely to engage in behaviours that lead to better health, academic success and emotional development. Therefore, social networking platforms could be employed to enhance the communications in a collaborative learning environment.

Context: In this study, the Facebook social networking software platform was used as a platform for communication and sharing for project-based learning. This research was based on a case study with 75 students enrolled in an advanced marketing research course, which was conducted at the Hong Kong Polytechnic University. All students in a project-based subject were invited to participate in the data collection. A survey was conducted with students in the course using a structured questionnaire. A focus group study was also used to collect feedback from the students. The focus group discussion allowed the researcher to explore the motivation aspects of Facebook usage, and a quantitative study using a survey was used to test the hypotheses developed from the research framework.

---

[1] Results of this case study have previously been published in: Cheung, R., Vogel, D. (2011). Can Facebook enhance the communications between teachers and students? *International Journal of Learning*, *17*(11), 385-397.

Outcome: This research addresses the current trend of students' use of Facebook in their daily communications – whether such trend could improve the communications between teachers and students. Social capital theory was used for investigating students' usage and commitment to Facebook activities. The research results showed that there was a positive relationship between Social Capital and Facebook Intensity, which provided explanations on the increasing network links as students' daily use of Facebook increases. They also showed that students with a high Facebook Intensity would be more willing to use Facebook to communicate with their teachers for academic and project-related matters. Information relating to personal relationships and photographs were the major privacy concerns for students while they communicate with the teacher. There were significant negative relationships between privacy concerns and students' willingness for academic related communications in Facebook. The evaluations from the survey and focus group discussions also showed that Facebook can be implemented for project-based communications, but students preferred academic life and social life to be separated.

Evaluation of the Elgg Social Networking Software for Education

The Elgg online learning environment (Curverider, 2012) provides a wide range of features, including blogging, file sharing, profile building, news feeding, individual customisation, and peer networking. In addition, the Elgg system is an open-source software, which enhances the extensibility of the learning platform and provides the flexibility to develop new system features and to customize the software to meet the needs of various schools and project stakeholders for community building (Garrett, Herrera, Thoms, & Ryan, 2008).

Another important feature of the Elgg social networking platform is that the system supports the idea of a stakeholder-controlled, online learning community. It allows individuals and communities to restrict access to information across a number of levels. The Elgg social networking platform also provides facilities for individuals to establish customized access levels to restrict or grant access to a wider audience, including other users on the Internet. The following summary provides the context, theoretical framework and research outcome of a case study (Cheung & Wan, 2010) that employs the Elgg social networking environment for education at the Hong Kong Polytechnic University.

Case Description: A Study on the Use of the Elgg Social Networking Platform for Education[2]
Theoretical Framework: this study employed a pedagogical design that explored the theory of situated learning through project-based course implementation. The theory of situated learning (Brown, Collins, & Duguid, 1989) emphasizes the need for authentic learning tasks to achieve meaningful collaboration within specific conditions. This is regarded as an effective instructional design that includes real-life, collaborative group projects as the major component of the course. Knowledge could be acquired in social communities when individuals engage in the social sharing of activities about tasks or collaborative problems.
Context: In this study the Elgg social networking software platform was used as a platform for communication and sharing for project-based learning. To learn multimedia presentation and development skills, students work for a real company in groups to develop a multimedia tour for a selected application for a selected company in Hong Kong. Self-reflection, communications in 'real-world' settings and situation-specific knowledge-sharing activities constitute the major assessment components of the course.
Outcome: the completed assignments, projects, and self-reflection reports demonstrate that students were able to meet the required learning outcomes of a computer literacy course in multimedia development. Students were able to assess the effectiveness of a variety of media through the development of media presentations in a web-based social networking environment. Through the social networking environment, students were able to collaborate and communicate with their team members to solve problems, resolve conflicts, make decisions, and work as a team to complete tasks. As shown by the high usage statistics from the platform, our implementations showed that social networking environments are effective for computer literacy education, and the development of the new social media environment can provide an effective platform for project-based learning involving the new media. However, supporting evidence on the use of the platform for collaborative learning activities is limited.

Evaluation of the Google Applications Platform

Collaborative learning technologies refer to a set of tools for task-specific collaborations, and are associated with goal and work-oriented activities. Collaborative technologies such as Google Applications - the so-called 'Applications of the Web' (AoW) - have triggered a new wave of free online wikis, word processing,

[2] Results of this case study have previously been published in: Cheung R., Wan C. (2010). An evaluation and implementation of collaborative and social networking technologies for computer education. *International Journal of Cyber Society and Education*, *4*(1), 17-30.

spreadsheets, presentations and discussion forum software since they were introduced in 2005 (Rienzo & Han, 2009). They bring a level of functionality originally associated with desktop applications to a Web browser, introducing ubiquitous possibilities for content creation, editing, and sharing. Consequently, the integration of Google Applications as a kind of AoW for project-based collaborative learning has become an important topic for academic institutes. However, there are limited studies focusing on predicting user acceptance of e-learning technologies in Web 2.0 teaching and learning environments.

Collaborative environments in education involve small groups of students working together to solve problems for the purpose of learning. Google Applications consist of a set of tools developed by Google to facilitate collaboration. They incorporate features found in traditional office applications, as well as providing a common, shared space for collaborative work. There are three main applications provided by Google that facilitate collaboration: Google Docs, Google Forms, and Google Sites. The Google Docs technology offers a common platform for sharing documents in Google accounts. The Google Forms technology provides spreadsheet facilities that can be used for developing online forms and surveys. The Google Sites technology facilitates the development of Web sites for collaborative work, handling documents, managing updates and wikis, and hosting forums for discussions. It can be to be used for courses involving collaborative projects in a computer-mediated learning environment.

The following summary provides the context, theoretical framework and research outcome of a case study on Google Applications technology for collaborative learning at the Hong Kong Polytechnic University (Cheung & Vogel, in press). The research results demonstrate the use of an activity-oriented approach for the implementation of computer-supported collaborative learning using Google Applications technology. It also demonstrates the application of activity theory as a theoretic lens to analyse project-based activities, in order to inform the design of a collaborative platform to support learning. The study also contributes to research relating to the socio-cultural issues associated with collaborative learning.

Case Description: A Study on the Use of the Google Applications Platform for Education[3]

Theoretical Framework: Collaborative learning involves small groups of students working together to solve problems for the purpose of learning. There are a large number of researches that focus on the technical aspects of computer-mediated environments for collaborative learning. Research that focuses on the social approach to learning has been scarce. In this research, activity theory was used as a design framework for collaborative learning in a Web 2.0 environment using Google Applications technology. By employing an activity-oriented design method, a collaborative platform was developed to facilitate social learning activities that are mediated by artefacts and collaborative tools using the Google Applications environment.

Context: This study focuses on the development of a design framework for Web-based collaborative learning for the subject "advanced marketing research" taught at the Hong Kong Polytechnic University. In this subject, students employed the Google Application technology for project collaboration for group-based projects. The evaluation was based on collaborative activities, which consisted of five project-based assignments. The assessment components included participation in Web-based activities, sharing of information and collaboration using the Google platform for project work.

Outcome: Activity theory was used as a design framework for collaborative learning in a Web 2.0 environment using Google Applications technology. An activity system was used to analyse the relationship between the basic components, which include: the identified object of the activity system, a particular actor (e.g., subject, Community), and a mediator (e.g., tools rules, division of labour). These components are used in the activity-oriented design method for collaborative learning. By employing an activity-oriented design method, a collaborative platform was developed to facilitate social learning activities that are mediated by artefacts and collaborative tools using the Google Applications environment.

This research distinguishes from other technically-oriented collaborative researches because a social learning approach was used in the research framework. The socio-cultural approach adopted in this research facilitates the understanding of the relationships between the components in a collaborative learning environment from a community-building perspective.

[3] This case study is to be published in: Cheung, R. & Vogel, D. (in press). Activity theory as a design framework for collaborative learning using Google Applications technology. *Lecture Notes in Computer Science*, volume 7697, Springer.

Comparison of Different Social Networking Platforms

The research conducted with the three social network platforms for collaborative learning has shown that these Web-based platforms offer various facilities that can be used for education. By selecting the appropriate platform and associated tools, all the three platforms can be deployed for educational purposes. Facebook is the most common platform used by students for daily communications. However, the research result reported from the case study has shown that students may be reluctant to communicate with teachers through Facebook. They want academic and social life to be separated. The Elgg platform offers a completely separate social networking environment. It provides an environment for community building and collaborative work. However, the study shows that the use of the Elgg platform for sharing and collaboration through the Web are limited because students mainly use the platform as Web area for organizing and storing project work. The Google Applications platform offers a comprehensive environment for designing collaborative activities. The employment of an activity-oriented approach facilitates the understanding of the relationships between the components in a collaborative learning environment from a community-building perspective. However, the pedagogical design of learning activities with the associated is important for designing an effective learning environment.

2.4. Open Educational Resources

The development of the World Wide Web has enabled learning materials to be accessed anytime and anywhere. Advances in technology also enable educators to reproduce and re-purpose teaching materials electronically and publish teaching materials online at minimal cost. These developments are acting as the key enablers for universities to publish their course contents online to promote universal education as a fundamental right. OER (Open Educational Resource) refers to the open provision of educational resources, enabled by ICT for consultation, use, and adaptation by a community of users for non-commercial purposes.

OER includes different kinds of digital assets, including learning content, software tools that supports the creation and management of content, implementation resources, and materials on best practices such as publications, techniques, methods, processes and distribution. With a vision to enable free access to educational resources as a

fundamental right, the OER movement is a technology-empowered effort to promote free educational resources that can be shared and reused on a global level independent of nationality and social dimensions. The influence of the OER movement on education institutions is demonstrated by MIT's Open Courseware (OCW) initiative with over 200 universities worldwide and over 2,500 open access courses that are freely available. Research has shown that over one third of the freshmen from MIT are aware of the MIT OCW prior to attending the university (Caswell, Henson, Jensen, & Wiley, 2008). The growing awareness of OER from educational institutions has driven the need to extend the reach and impact of the OCW concept.

Although the MIT OER project has successfully demonstrated a digital publishing model for high-quality static materials, the developments do not match the widespread use of new social and participatory media facilitated by the increasing technologically rich environment in which learners and teachers are immersed in their daily activities. Researchers are exploring new approaches and platforms to promote the creation and use of OER, especially for new approaches that promote explicit learning design practices and reflection for collaborative activities rather than sharing of content. New social and participatory media provide a range of facilities for learning contexts.

The popularity of Google Applications and related tools for education (Atkins, Brown, & Hammond, 2007) presents a new challenge for educators to design learning interventions through these freely available educational resources. In particular, the Web 2.0 tools for education facilitated by Google Applications (Rienzo & Han, 2009) provide an opportunity for developing a new generation of OER that promotes a participatory culture. A Web 2.0 based OER platform facilitates the development of project-based collaborative environments for sharing project activities through collaborative resources and teaching Web sites that are available from published design templates.

2.5. Theoretical Foundations for Collaborative Learning

In order to develop a framework for the design of social-software enabled e-learning systems, it is necessary to study the relationship between computer-mediated collaborative learning and social learning theories, such as the theory of authentic learning, the theory of situated learning and activity theory. This section identifies the

theoretical foundations that are used to support collaborative learning. A discussion on theories of learning covering behaviour approach, cognitive approach, social constructivism, situated learning, distributed cognition and socio-cultural approaches are provided, together with a discussion of their implications for the design of computer-mediated learning environments. The characteristics of project-based learning and collaborative learning are provided, together with a discussion of the literature relating to this area. Following a description of the various approaches to the development of computer-supported collaborative learning environments, the challenges of developing collaborative learning in project-based environments are highlighted. The theoretical foundations are further supported by a discussion of the design research approach, together with a review of the activity theory for supporting a socio-cultural perspective to learning.

2.5.1. Theories of Learning

The nature of learning, and what characterises it, is a subject of research for educators. It also involves a process where those who are involved in education try to design teaching and learning activities to cope with the needs of the students. Most teachers hold a theory of learning (Jonassen & Hernandez-Serrano, 2002), which consists of principles and assumptions about learning. These principles guide the teachers in the preparation of the teaching activities and learning activities. It is therefore important to identify the role of learning theories and provide an understanding of how different learning theories can inform the design of teaching and learning activities.

Teachers adopt learning theories from time to time, and the adoption of one learning theory does not require the rejection of other theories. According to Mayes and De Freitas (2006), learning theories can be grouped into three categories: associative (learning as activity through structured tasks), cognitive (learning through understanding) and situative (learning as a social activity). This section also seeks to explore learning theories that may have an impact on the design of Web-based system to support learning.

Behavioural Approach

Learning, from the behaviourist's point of view, is 'a function of building associations between the occasions upon which the behaviour occurs (stimulus events), the behaviour itself (response events) and the result (consequences)' (Burton, Moore, & Magliaro, 2003). Therefore, the teacher should aim at designing structured tasks that provide stimulus (for example, students may be questioned during a tutorial), so that students can provide a response (by remembering the contents) in order to obtain a good grade (if the results are close to an expected answer). The behavioural approach assumes that complex learning objectives can be decomposed into simpler ones, and it is possible to provide instructions directly to achieve simpler objectives, so that they can be combined afterwards to solve complex problems. From a teaching perspective, behaviourism maintains that the role of a teacher is to correct learner's behaviour. The behavioural theorists believe the instructor should establish an environment that reinforces desired behaviour from their learners. The instructor should predetermine all the knowledge and skills they think are necessary for the learners and present them in a sequenced manner.

Cognitive Approach

Cognitive learning is based on the information processing metaphor that allocates learning in the minds of the brain (Burton, et al., 2003). The central research theme for cognitive learning theorists is the internal representations of the knowledge and the kind of change that is made through learning. According to this perspective, in order to learn, an individual must change their cognition. By receiving information, learning involves reorganizing the information, and adapting it through a cognitive construction process to provide insights and understandings. According to cognitive theory, while external environments are important inputs to learning, the mind has the ability to synthesize, analyze, formulate, and extract information and received stimuli. Different from behaviourists, cognitive theorists argue that it is possible to draw inference about the nature of the cognitive process that produce the response from the external stimuli. Therefore, by understanding the internal adaptation process for cognitive structures, it is possible to design learning processes that promote understanding.

Social Constructivism

Cognitive theorists have been challenged by various theories of learning which consider learning a social process (Salomon & Perkins, 1998; Vygotsky, 1978; Wenger, 1998). By conceptualize learning as a socially-mediated process, various social theories of learning are developed, including social constructivism, situated learning, and distributed cognition. These theories stress the importance of learning through social interaction (Jonassen & Hernandez-Serrano, 2002). Unlike the cognitivist view that focuses on learning outcomes that can be achieved individually, a social constructivist view emphasizes on learning as a form of socialization. Social constructivism includes attention, encoding and retrieval of knowledge processes. However, there is no single accurate representation of knowledge, but only interpretations of experience. Knowledge is a collection of concepts which fit with the experience of the individual. Learning becomes a change in meaning constructed from social experience. Learners actively take knowledge and build up the knowledge based on previous knowledge and social experience.

Based on constructivism, the instructor should try to encourage students to discover principles by themselves. The instructor and learner should communicate from time to time. The role of the instructor is to transform information into an appropriate format according to the current state of the learner. In a constructivist approach, the course curriculum should be organized so that the learner continually builds on what they have already learned. Therefore, the role of the instructor shifts from the central role of transmitting information to that of facilitating learners to construct their own understandings. Collaboration, interaction, discussion and reflection all facilitate the acquisition and assimilation of knowledge. In the context of e-learning, learning environments that are built explicitly on constructivist principles include knowledge building communities (Scardamalia & Bereiter, 1991) and communities of learning (Brown & Duguid, 1991).

Situated Learning and Distributed Cognition

Cognitive theorists have been challenged by various theories of learning which focus on the individual. Situativist argues that people learn through participation in communities of practice, through which the learners progress from novice to experts, through reflection, mentorship and legitimate peripheral participation in activities

within the community of practice. Distributed cognition is associated with the work of Hutchins (Hutchins, 1995; Salomon, 1993), which posits that cognition is not a localized individual phenomenon. According to Salomon (1993), distributed cognition means that cognitive processes are distributed across the members of a social group. Therefore, distributed cognition should be understood by investigating the cognitive processes that are distributed across the individuals, artefacts and representations.

Socio-cultural Approaches and Implications for E-Learning

The study of learning theories helps to identify the role of theories for the design of collaborative platforms. Cronjie (2006) points out that the learning paradigm has historically shifted focus from behavioural to cognitive to social aspects. Many researchers have adopted the theory of learning from a social-cultural perspective (Vygotsky, 1978), which assumes that learners construct what they know through activities that engage learners with their social and physical environment. Therefore, a study of environments for collaborative learning should include the physical and social environment of the learners (Savery & Duffy, 1995).

According to Vygotsky, learning is mediated by cultural artefacts. Knowledge is contained within the culture, the discourse between people, the cultural artefacts, and the history of activity of a community (Lave & Wenger, 1991; Vygotsky, 1978). To conceptualize learning through a social process, Vygotsky introduces the concept of zone of proximal development (ZPD). The zone of proximal development is defined as the distance between a learner's current level of understanding and the tasks that could be achieved under the guidance of another more knowledgeable person (Vygotsky, 1978). A child's cultural development appears first through an external social process by the guidance and support from others between people (inter-psychological), and then inside the child and become internalized as mental processes (intra-psychological). Learning can be originated from the collaboration between people as they interact in cultural environments. Building upon (Vygotsky, 1978) concepts of ZPD, other scholars have developed theories that conceptualized learning as a social process relating to collaboration, and is used in the apprenticeship learning model (Lave & Wenger, 1991) and Wenger's (1998) communities of practice.

The development of learning management system is influenced by the traditional view of learning, which conceives knowledge as a state that can simply be acquired

by individuals. Traditional learning management systems support the 'top-down' view of content management, which is influenced by the traditional view of academic institutions as to define the relevant body of knowledge in the curriculum to be acquired by the learners. Wenger (2005) suggests that the notions of centrally (or universal) defined curriculums are becoming problematic:

> '… We will have to shift from an industrial model of education as the mass production skills towards a knowledge-era model of education as the customized production of individualized learning trajectories. … Trends would suggest that finding a universal curriculum beyond a few basic skills of literacy is going to become increasingly difficult and less useful … '
>
> (Wenger, 2005)

Relating to the design of computer mediated collaborative learning environment in a Web 2.0 era, the challenge which underlies institutional adoption of computer mediated collaborative learning is not of a magnitude, nor the radical pedagogical redesign of all courses. Rather, it lies in the needs to provide individualized learning trajectories for students. According to Dalsgaard (2006), academic institutions' adoption of learning management systems seems to have focused too much on the transmission modes of learning, where the major consideration is to standardize and manage learning in a cost-effective manner. Dalsgaard (2006) proposes that we should move beyond traditional learning management system and position students in a more active role through social media. Therefore, there should be additional roles that need to be fulfilled by e-learning support. With a new e-learning infrastructure, the learning management system should play a more background role that supports administrative and basic pedagogical task like structuring course descriptions, lesson plans and contents. The students' self-governed and problem-oriented activities should be supported by social software tools. The current development of social software is characterized by an open architecture and it is possible to integrate social software tools and facilities into a number of learning management systems. For example, the social software tools available from Google Applications can be integrated into the Blackboard learning management system, and it is also possible to integrate Google Applications technology into the Moodle e-learning system (Alier, et al., 2010; Baker & Rees, 2008; Jones & Sclater, 2010).

2.5.2. Project-based Learning

The practices that focus on the traditional model of the teacher-centered knowledge model have little effect on developing critical skills for learners to participate successfully in the knowledge-based economy. Educators are arguing for learning to be situated in rich contexts and appropriated by engaging in tasks and situations that are authentic (Brown, et al., 1989). This kind of learning can be supported by project-based learning that involves students in small groups engaged in investigating practical problems through collaborative activities. Project-based learning involves students in problem solving, decision making and investigative activities over extended periods of time. Students pursue solutions to authentic problems by defining approaches, debating ideas, making predictions, designing plans and solutions, gathering information, collecting and analyzing data, drawing conclusions, and communicating their ideas and findings to others (Blumenfeld, et al., 1991). Through project-based learning, students are presented with opportunities to use multiple learning styles, practice communication skills, and engage in critical thinking through peer critiquing, collective aggregation and collaborative learning. The effectiveness of implementing project-based learning through group-based activities is also supported by researchers in the area of transformational teaching (Slavich & Zimbardo, 2012).

Project-based learning also provides opportunities for collaborative learning. Van der Veen (2001) defines project-based learning as 'the series of activities in which groups of learners work together in order to complete a task'. As collaborative learning in project groups requires sharing of knowledge, learning can be facilitated by discussion, conversation, and comparison (Proserpio & Gioia, 2007). Collis & Moonen (2001) describes the possibilities to stimulate collaborative project-based learning with information and communication technology through online discussions, activities, shared workspace functionality and online interaction in different ways. There is a considerable amount of information systems research on how information technologies can help project-teams handle complex tasks (Weiser & Morrison, 1998). In a Web 2.0 environment in which the learners are immersed in their daily activities, the design of computer-supported collaborative learning (CSCL) is more complicated. Today, the young learners are used to Web 2.0 tools and social networking facilities. The design of a Web 2.0 based technology enhanced environment for collaborative learning presents a new challenge to educators.

There are several challenges in the design of computer-supported collaborative learning for project work. First, the structuring of project tasks and activities for learning is different from lecture-based teaching. These activities are usually interrelated and there are dependencies among project members. Second, project work is action-oriented and relies extensively on applied knowledge, which also has a high tacit component. Articulation of such kind of knowledge requires individual reflection on one's own role in a project, one's theory in use, and assumptions that guide one's action (Ayas & Zeniuk, 2001). Third, project-based learning requires large amounts of communications beyond normal teaching hours, and the increasing trend of communications among the new generation of learners is through social media rather than through emails with instructors.

Conventional CSCL platforms provide support for collaborative activities and handling the dependencies among task, but they are not able to handle the reflective and social communication aspects. Social networking systems such as Facebook provide new facilities for communications and sharing with collaborative tasks, but they are not designed for educational purposes, and it is not possible to structure the Web-based environment to cope with learning designs and pedagogical frameworks. A new learning environment is required to support collaboration for project-based learning.

2.5.3. Collaborative Learning

A broad definition of collaborative learning is provided by Dillenbourg (1999) as a situation in which two or more people learn or attempt to learn something together. Since there are many different research approaches to collaborative learning, any detailed investigation needs to specify collaborative learning in terms of different scales: the *size the team for interaction, the learning situations*, the *mechanisms* for collaboration and the *measurement of effects*. For instance, the *size the team for interaction* involving two people in a pair is different from learning from a class or a community with a few hundreds of people. Different *learning situations* can be characterized as more or less collaborative. Learning to solve a small problem for tutorial exercises in pairs is different from collaborating on a term project in groups. The *mechanisms* for collaboration may involve different levels of collaboration and

different effects can be measured. Dillenbourg (1999) points out that all these measures can be interpreted differently.

Collaborative learning is based on the principle that learning occurs best when the tasks are performed in groups and that working with others is more motivating than working alone. Most empirical researches on the effectiveness of collaborative learning are concerned with a small scale with a few students in a project group. In order to encourage students to reorganize their own knowledge and understandings, recognize the gaps in understandings and promote effective problem-solving strategies, a learning community can be developed through Web-based facilities that are facilitated by peers in interaction.

The pedagogical design of collaborative environment is supported by Piaget's (1970) constructivist theory, which posits that learning is a result of knowledge construction through collaboration. Vygotsky (1978) posits that learning is achieved through social interactions, such as interactions through learning communities and peer tutoring. Learning is achieved through collaborations because the process allows the learners to operate within one another's zone of proximal development (ZPD) through social interactions. Peer tutoring has a distinct advantage over conventional teaching because members of the peer group have a close level of proximal development. Therefore, collaborative learning with project teams and learning communities is an effective means to develop students' abilities in learning.

2.5.4. Computer-Supported Collaborative Learning

Computer-supported collaborative learning (CSCL) relates to studying how people can learn together with the help of computers. The computer is becoming an important tool for learning. Students and teachers are connected and through the use of computers with Internet access. The design of learning environments for a group of student to learn together is an important research in the area of learning science. To combine the two research areas in the use of computers for supporting collaborative learning is a major challenge to researchers. Computer-supported collaborative learning does not emphasize on the use of computers for accessing information in isolation. Instead, CSCL stresses collaboration among students, where learning takes place through discussions, making inquiries and developing the ability to learn and

develop skills to benefit from other student groups. Computer support of learning does not always take place through online communications. Such communications may occur through face-to-face collaboration, where students may be collaborating on a working a computer document together. Students may be browsing information through the use of a computer connected through the Internet, and may be sharing documents and information through a storage area on the Internet.

Stahl (2006) investigates the role of CSCL in learning science and argues that learning sciences as a whole shifted from a narrow focus on individual learning to an incorporation of both individual and group learning, and the evolution of CSCL has paralleled this movement. The emphasis of CSCL is shifting toward the shared construction of knowledge among group members through interaction rather than the process taking place within individual learners. According to Koschmann (2002), CSCL is a field of study centrally concerned with meaning and the practices of meaning making in the context of joint activity, and the ways in which these practices are mediated through design artefacts. Stahl (2006) contents that small groups are effective means of studying group-based learning. The major reason is that through small groups with five or six students, the methods of group cognition among members can be observed and investigated in detail. With small collaborative groups, the shared construction of meanings is more visible compared with large groups. Small groups allow full range of social interactions to play out, but are not so large that participants and researchers may lose track of the group activities. Therefore computer-supported collaborative learning environments can be effectively implemented for small student groups in a project-based environment.

The shift toward the group unit of analysis in CSCL is also in line with research that focuses on the community as the agent of situated learning (Lave & Wenger, 1991) or collaborative knowledge building (Scardamalia & Bereiter, 1991). Lave and Wenger (1991) argued that knowledge sharing exists (and is situated) in the social and physical environment, and is difficult to be separated from its context. To bring the context and knowledge together, a community of practice is developed. According to Lave and Wenger (1991), ‘Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly.’ Much of the knowledge resides in the shared context within a

community of practice. Lave & Wenger (1991) suggest that tacit knowledge can be shared, and developed in an appropriately situated context through online communities. Some researchers define such online learning communities as communities of practice 'focusing on learning' (De Rezende, Da Silva, De Souza, & Ramirez, 2005).

2.5.5. Challenges of CSCL in Project-based Environments

The integration of Web 2.0 facilities and social software opens up new areas for the next generation of CSCL environments that facilitate collaboration and interaction among students. With the need to prepare students for lifelong learning, it is necessary to develop the skills for effective participation in group-based projects (Grabinger, Aplin, & Ponnappa-Brenner, 2007). The development of Web 2.0 technologies and software technologies has provided online platforms for students to share information establish and maintain relationships online through a participatory culture. However, the introduction of social platforms for formal learning is still rare (Greenhow, 2009). Researches in CSCL environments have reported low degree of collaboration among students, showing that CSCL environments do not completely fulfill the expectation of education and learners (Kreijns & Kirschner, 2001).

The unwillingness of students to share knowledge in formal learning environments can be explained by the fact that assessment in formal learning is based on a competitive strategy. The individual components of assessment mean that a student is being assessed independently. The performance a student relative to the performance of other students may give the impression that knowledge sharing reduces one's competitive advantage. Furthermore, learners might be unwilling to participate in sharing due to the lack of incentives (Furst, Blackburn, & Rosen, 1999; Olson & Olson, 2000; Qureshi & Zigurs, 2001) and trust among a group of learners (Garrett, et al., 2008). Contributing to discussion forums and digital repositories takes additional time, and the use of Web 2.0 facilities might impose additional burden to students in mastering the technology. It is therefore important to study the factors that affect students' collaboration and sharing behaviour in online environments.

Previous researches have shown that the development of social capitals has significant influence on participation in social networking environments (Chiu, Hsu, & Wang,

2006; Ellison, et al., 2007; Wasko & Faraj, 2005). Students who are active in sharing through social networks show higher self-esteem and academic success. However, the communications aspects of participation in social networking environments are different from those in academic environments, and it is important to design Web 2.0 learning environments that can cope with these differences. Involving learners in small groups in project-based learning is one of the ways to provide incentives for students to engage in collaborative activities (Leidner & Jarvenpaa, 1995). However, the diverse background of individual group members might still hinder the processes of collaboration, and development of effective learning platforms for group-based learning might also need to address research issues relating to conflict resolution among group members (Qureshi & Vogel, 2001).

Although social networking tools provide various collaborative tools, they are not developed and designed for formal education. They offer flexibility in self-directed learning, but the usefulness of the tools depends on how these tools are adapted to educational purposes. Mashup environments provide the user interface to tie up various collaborative tools in a CSCL environment. However, the actual use depends on the how students appropriate the capabilities offered by the technology (Overdijk & van Diggelen, 2008). Although technology is considered as an enabler of human interaction, students might use Web 2.0 collaborative environment in different ways, which might influence the effectiveness of the technology for learning (Dwyer & Suthers, 2005; Overdijk & van Diggelen, 2008).

The various research issues show that the use of collaborative technologies for learning is complicated. It involves the pedagogical design and selection of appropriate set of tools to meet the specific requirements (Kock, Verville, & Garza, 2007). Therefore, flexible research methodologies and multiple theories are required for the design and development of Web 2.0 technologies for learning. The development of Web 2.0 and social media technologies, the requirements for a flexible research methodology, and the need to cope with different level of participation by students constitute the major opportunities and challenges facing researchers and practitioners in the area of computer-supported collaborative learning.

2.5.6. Educational Design for Learning

In order to design effective collaborative learning environments using social software technologies, educational design research can be employed to design computer-mediated learning environments. Approaches that can be employed for learning design include design research and activity-oriented approaches. Design research has been extensively used by researchers to design environments for learning. For example, Ma and Stephen (2009) employ a design research to develop a prototype of an online case library for education using the design research paradigm, and a design research approach is being employed by Drexler (2008) to design personal learning environments using Web 2.0 technologies. Learning design also involves the design of learning tasks that can be conceptualized using an activity theory approach. Activity theory has also been employed to develop learning environments for collaborative knowledge building (Greenhow & Belbas, 2007), authentic learning (Lebow & Wager, 1994), conceptualization of learning activities (Mwanza, 2002) and socio-cultural learning (Vogel, Davison, Shroff, & Qureshi, 2001).

2.5.6.1. Design Research for Collaborative Learning

Design-based research is an emerging methodology for the design of instructional software and information systems (Hevner & Chatterjee, 2010; Hevner, et al., 2004; Wang & Hannafin, 2005). According to Wang and Hannafin (2005), design-based research is defined as ‘a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories’. Information system design theory focuses on the creation and empirical assessment of an IT artefact, whose development is informed by a kernel theory. The IT artefacts embody assumptions about design principles and development methods that are hypothesized to respond to a set of user requirements (Gregor & Jones, 2007; Markus, Majchrzak, & Gasser, 2002). These artefacts thus encapsulate the theory that is then tested in iterative cycles.

Design-based research for e-learning considers the fact that it is not possible for a learning theory to take into account of all the intricacies of its applications. Design plays a critical role because the research on learning technologies needs to ‘include

the aspects of local contexts that affect how design interventions play out' (Sandoval, 2004). Through a continuous process of refinement, the design-based research methodology allows the researcher to monitor the e-learning environment, analyze the discrepancies between the intended design and the emergent revisions that make learning more effective. If some elements of the design are not working, it is necessary to modify the design and describe the reasons for making the modifications (Collins, Joseph, & Bielaczyc, 2004).

Design research has been used for collaborative educational software systems. An example is the iCamp project (Pata & Väljataga, 2007) that provides a collaborative and social networking system for higher education. The system is developed using a design-based approach incorporating activity theory (Engeström, 1987) in the design process, and taking into account of the requirements for a new way of social networking among students in higher education environments. Based on several research iterations for implementation in selected courses, refinements of the design are made to match the complexity of real world learning scenarios.

2.5.6.2. Activity Theory

There has been a large amount of literature on computer-supported collaborative work and group support systems (Nunamaker Jr, Briggs, Mittleman, Vogel, & Balthazard, 1996). However, research that focuses on the context of learners in the environment has been scarce. It has been recognized that a design framework can benefit from an understanding of the context in which users work (Nardi, 1996). In a computer-supported learning environment, a study of the context in which the technology is implemented helps in understanding the domain in terms of relations among individuals, artefacts, and social groups. Internet-based collaborative technologies are implemented with complicated interactions among participants and learning materials. It is therefore important to understand the collaborations and knowledge construction involved in collaborative activities.

Knowledge building refers to 'the practices of meaning-making in the context of joint activity' (Stahl, et al., 2006). Activity theory provides a theoretic lens to understand knowledge building, and activity-oriented design method (AODM) (Mwanza, 2002) offers a comprehensive method for capturing the relationships that are derived from

individual and group perspectives. Activity theory originates from the socio-cultural theories of Vygotsky and is articulated by Engeström (1999a). It provides an analytic lens to understand complex learning environments, especially those that are mediated by tools.

According to Vygotsky (1978), human subjects do not interact directly with their environments. They do so through interactions that are mediated by signs and tools, in order to interact with an object (as shown in Figure 2-2). According to Vygotsky's theory of mediated action, social activities articulate the developmental transformation of internalized cognitive structures. Engeström establishes a simple structural model of the concept of activity and cultural mediated relationships. According to Engeströrn (1987), 'activity is the smallest and most simple essential unit that still preserves the essential integral quality behind any human activity.'

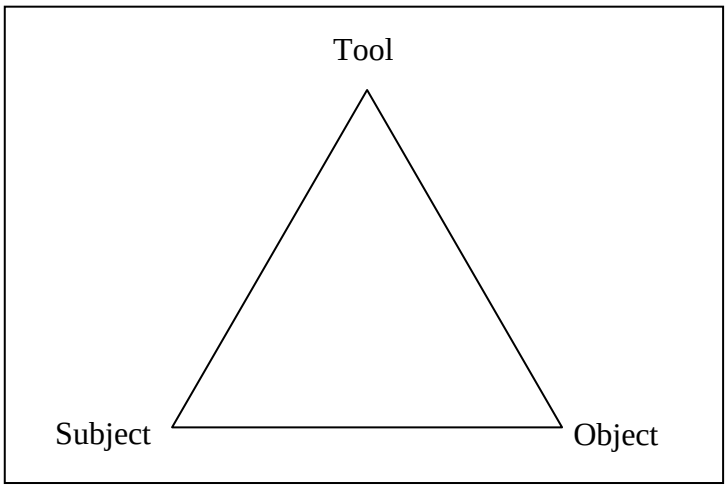


Figure 2-2 The meditational triangle (Source: Vygotsky, 1978)

2.6. Technology Adoption

Research into technological Web-based learning platform would be useful only if these platforms are being adopted by instructors and students. Therefore, the investigation of behavioural aspects of e-learning adoption has become an active research area. Research models for the behavioural aspects of e-learning adoption have been developed by various researchers in the information systems area. Throughout the years, various theories on technology acceptances have been developed and the most widely used theory on the behavioural aspects of technology

adoption is the technology acceptance model (Davis, 1989). The motivation model (MM) is another theory that is used to explain the factors that influence the use of a technology. Innovation Diffusion Theory (Rogers, 1995) takes into consideration the factors that affect the adoption of a new technology, addressing research issues such as compatibility, image, visibility and results demonstrability.

Venkatesh et al. (2003) integrate different theories in the literature by comparing eight theoretical models: Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980), Technology Acceptance Model (TAM) (Davis, 1989), Theory of Planned Behaviour (TPB) (Ajzen, 1991), Motivation Model (MM), Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT) (Rogers, 1995) and Social Cognitive Theory (SCT) (Chiu, et al., 2006). By integrating the eight theories, they develop the Unified Theory of Acceptance and Use of Technology (UTAUT). These integrated research models have a significant impact on research into technology adoption. However, researchers argue that the UTAUT is too complicated, and suggest that researchers should develop the research model from the basic psychological models TRA and TPB.

2.6.1. Theories of Innovation

Rogers (1995) defines innovation as 'an idea, practice, or object that is perceived as new by an individual or other unit of adoption.' An innovation can be a new technology that generates uncertainty. This kind of uncertainty motivates an individual or other unit of adoption to seek more information about the technology and possible alternatives. When an innovation is adopted by a large number of potential adopters in the community of adopters, it is said to have been diffused. According to Rogers (1995), research into Innovation Diffusion Theory (IDT) can be categorized into diffusion modelling studies and adoption studies, IDT research is concerned with the prediction of the likelihood of adoption and the investigation of the rate of adoption of an innovation.

The major contribution of IDT is that it provides a set of attributes that are perceived by individuals for explaining the adoption of a new technology. An innovation is accepted by users if it is relatively advantageous, compatible with the existing values and needs of potential adopters, and is simple to use. Rogers (1995) asserts that the factors that influence the adoption of a new technology include compatibility,

triability, observability, relative advantage and complexity. A large number of research studies relating to IDT research are related to technology innovations (Straub, 2009). Moore and Benbasat (1991) investigate the innovation characteristics that affect the use and adoption of information technology. They assert that the factors that explain the use and adoption of information technology include: relative advantage, complexity, compatibility, image, result demonstrability, visibility and triability.

An important research area relating adoption of new technologies is the study of disruptive innovations. According to Clayton Christensen (1997), a disruptive technology is the one eventually takes over the existing dominant technology, despite the fact that the disruptive technology initially has a lower performance (or functionality) than the leading technology, but over time the functionality of the new technologies will replace the existing technology. In the area of technological platforms to support e-learning, learning management systems allow the teacher to organize learning resources in a predetermined order. The structure of the Web-based materials mirrors the classroom practice, offering advantages in terms of management of learning resources, administration of course Web sites through economy of scale. A content management system such as WebCT or Blackboard supports a structured learning strategy for a large number of users or existing customer, and is not considered as a kind of disruptive innovation.

The Web 2.0 tools offered by social networking software such as Google Applications and Google Plus provide learners to take control of their choice of resources, providing new ways of representing ideas, and developing higher order learning strategies. In spite of the potential offered by these disruptive technologies, the adoption of these technologies requires a paradigm shift in the employment of ‘disruptive pedagogies'. According to Hedberg (2006), in order to exploit the capacities offered by the new technologies for developing student engagement, motivation and higher order thinking skills, disruptive pedagogical options (Hedberg, 2006) need to be adopted in support of learning activities:

- A shift from content management systems (LMS) to digital repositories;

- A shift from learning objects (mainly with content embedded) to learning activities that are shareable pedagogical sequences without content;
- A shift from information delivery to more interaction support, thus enabling the social construction of meaningful knowledge;
- A shift in focus from assessments of the end product to assessments of the learning journey, through keeping portfolios of en route products that indicate changes in understanding and reflection.

In order to offer disruptive technologies to support project-based learning, it is necessary for instructors to develop disruptive pedagogies that facilitate the movement of the learner from passive participants to active learners involved in collaborative construction of knowledge. Therefore, research into collaborative platforms need to cope with new designs in learning activities with appropriate interactions that are managed and supported by appropriate tools and facilities.

2.6.2. Theory of Planned Behaviour

The Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) suggests that an individual's intention to perform certain behaviours or not is the immediate determinant of that behaviour, and that behavioural intentions are influenced by two factors: attitude and subjective norms. Attitude generally refers to the favourability of an individual toward certain behaviours, while a subjective norm involves the perceived social pressure or acceptance of that behaviour. However, the performance of certain behaviours is usually deterred by the lack of appropriate opportunities, knowledge, skills, and time (Liska, 1984), and these circumstances limit the sufficiency of the TRA in explaining an individual's behaviour.

The Theory of Planned Behaviour (TPB) extends the TRA by including an additional variable - namely, perceived behavioural control (as shown in Figure 2-3), which refers to an individual's perception of his or her ability to perform certain behaviours (Ajzen, 1991). Mathieson (1991) explains that perceived behavioural control reflects two key dimensions: external conditions, and an individual's perceived ability. In the context of technology adoption, the former dimension can be explained in terms of the

ease and convenience of using the technology platform, while the latter depends on an individual's knowledge and ability to operate the technology platform.

The TPB has been widely adopted in attitude–behaviour studies, such as those that address technology acceptance (Mathieson, 1991), the dishonest actions of college students (Beck & Ajzen, 1991), smoking (Godin, Valois, Lepage, & Desharnais, 1992), driving violations (Parker, Manstead, Stradling, Reason, & Baxter, 1992) and student recycling behaviours (Wan, Cheung, & Shen, 2012). It also serves as the foundation of studies on technology adoption, so that researchers have adopted the TPB in this area (Mathieson, 1991; Pavlou & Fygenson, 2006; Taylor & Todd, 1995a). The constructs that are developed from the theory of planned behaviour are explained as follows:

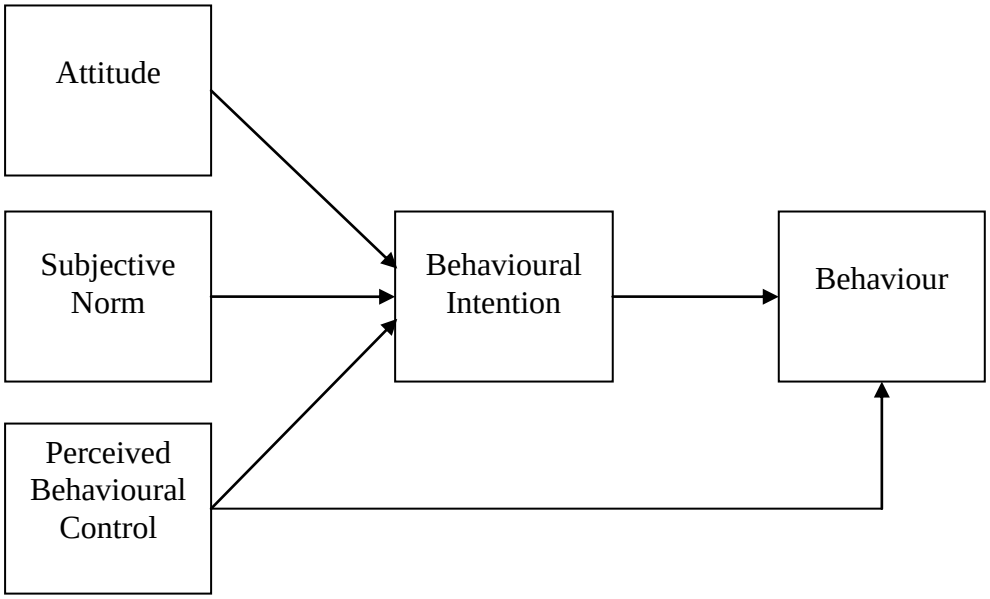


Figure 2-3 Theory of planned behaviour (Source: Ajzen, 1991)

Attitude

Attitude toward behaviour is defined as a function of an individual's beliefs toward a behaviour and a subjective evaluation of that behaviour (Fishbein & Ajzen, 1975). The belief component captures a person's knowledge and perceptions about certain behaviours. Many studies confirm the relationship between attitudes and behavioural intention (Agarwal & Prasad, 1997; Chau & Hu, 2002). This is also the most significant predictor of the intention to adopt a technology platform.

Subjective norms

A subjective norm or social pressure is a function of the perceived expectations by other individuals or groups who are important or close to a person, and the person's motivation to comply with these expectations (Fishbein & Ajzen, 1975). Social pressure has a significant relationship with intentions to adopt an e-learning platform (Lee, 2010). It implies that pressure from peers, family members and neighborhoods have a positive effect on the intention to adopt a technology platform.

Perceived behavioural control

Ajzen (1991) argues that, collectively, control factors that facilitate or inhibit the performance of a given behaviour provide a more accurate measure of perceived behavioural control. Hsu and Chiu (2004) operationalize perceived behavioural control by identifying in their study a set of traditionally perceived control variable and facilitating or inhibiting factors. The perceived behavioural control factors directly affect both the intention and behaviour associated with the use of a technology.

2.6.3. User Acceptance of e-Learning Technology

Several different theoretical models can be used to investigate the determinants that affect the acceptance and use of new information technologies (Venkatesh, et al., 2003). The theoretical models employed to study user acceptance and behaviour include the theory of reasoned action (TRA) (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) and, as previously mentioned, the theory of planned behaviour (TPB) (Ajzen, 1991; Mathieson, 1991), as well as the technology acceptance model (TAM) (Davis, 1989; Davis, et al., 1989).

According to the TRA (Ajzen & Fishbein, 1980), the immediate determinant of behaviour is the individual's intention to perform or not to perform a behaviour. Intentions, in turn, are influenced by two factors: attitudes and subjective norms. Attitude is defined as an individual's favorable or unfavorable feeling toward a behaviour to be performed. Subjective norm is defined as an individual's perception of social pressures to perform or not to perform a behaviour. Often, the performance of a behaviour is constrained by the lack of appropriate opportunities, skills, and resources. Even if a person is highly motivated by positive attitudes and norms, he or

she may not actually perform a certain behaviour because of the feeling of a lack of control over his or her own activities. For this reason, the TPB was developed in order to extend the TRA model to include an additional variable (Ajzen, 1991 ; Ajzen & Fishbein, 1980; Ajzen & Madden, 1986) - perceived behavioural control. Perceived behavioural control refers to an individual's perception of his or her ability to perform a behaviour (Ajzen, 1991). The three components of the TPB model (attitudes, subjective norms, and perceived behavioural control) collectively explain behavioural intentions.

The Technology Acceptance Model (TAM) has historically been the most influential model describing individual users' acceptance of information systems (Lee, Kozar, & Larsen, 2003). The model assumes that an individual's acceptance of a system is determined by two major factors: perceived usefulness and perceived ease of use (Davis, 1989). Perceived usefulness is defined as the extent of an individual's trust that a task will be better performed with the aid of technology, and perceived ease of use is defined as the degree to which a person believes using a specific kind of system to be 'free of effort' (Davis, 1989). Taking into the TPB model into account, researchers have extended the TAM with the unified theory of acceptance and use of technology (Venkatesh, et al., 2003). It has been also widely adopted by researchers to investigate behaviours relating to e-learning.

2.6.4. Extensions of the Technology Acceptance Model

A number of studies have used both the original and extended version of TAM to explore students' acceptance of virtual learning environments (Arteaga Sánchez & Duarte Hueros, 2010; Limayem & Cheung, 2011; Ngai, et al., 2007; Ong, Lay, & Wang, 2004; Saade & Bahli, 2005; Selim, 2003, 2007; Venkatesh, et al., 2003). The extension of TAM could indicate that, within the realm of virtual learning environment research, the original model is insufficient for explaining all aspects of user acceptance.

Ngai et al. (2007) propose that perceived access to technical support also positively influences perceived ease of use and usefulness. Karahanna et al. (2006) extend the TAM with the construct of compatibility that was originally developed as part of innovation diffusion theory (Rogers, 1995). The construct of compatibility is divided

into four smaller categories: compatibility with preferred work style, existing work practices, prior experience, and values. In the context of e-learning research, TAM has also been extended to address constructs of computer self-efficacy (Ong, et al., 2004). Limayem and Cheung (2011) enhance the TAM model to explain the continued usage of Internet-based learning technologies, based on the fact that frequently performed behaviours tend to be automatic over time. They posit that habit has a moderating effect on determining students' continued use of Internet-based learning technologies.

TAM was conceived at the individual level when it was originally developed, and research into the influence of subjective norms is considered to be one the major directions for enhancement of TAM. Davis et al. (1989) purport that a more multi-personal application, such as group decision support systems, will increase social influence on individuals' behaviour. Recently, researchers have examined the effects of social ties on the adoption of information technologies in the virtual environment. Hossain and de Silva (2009) explore user acceptance of technology by considering social ties in social networking systems. They investigate the effect of strong ties and weak ties on the user acceptance of a community capacity building network. TAM is enhanced by investigating the influence of different types of social ties on the user acceptance of a social networking system. Their research shows that peer influence in the form of strong ties has significant influence on behavioural intention, and that the influence of weak ties on behavioural intention is not significant. Therefore, different components of subjective norms need to be considered for investigating their distinct influences on the adoption of computer-supported collaborative learning environments.

2.6.5. Adoption of Technologies for Collaborative Learning

Collaborative technology is defined in terms of the support provided by two or more people working together on a common task using either a single tool or an integrated set of technology (Zigurs & Munkvold, 2006). There are two major aspects that need to be considered in developing theoretical models that can predict the adoption of collaborative technologies. First, the technology acceptance model was conceived at the individual level rather than being considered at the group level. Second the attitude/behavioural model depicted by TAM assumes that the users' believe and attitude toward a particular IT determines whether users exhibit the behaviour of

using the technology, which might not be true for collaborative technologies that are employed for learning. To address the influence at group level, the extension of TAM is achieved by incorporating elements of subjective norms in the research model. To address collaborative learning aspects it is necessary to note there are additional aspects other than TAM variables that might influence the attitude/behavioural aspects of technology adoption, and the TAM variables are not the sole determining factors that affect adoption.

The task-technology fit model provides another model that considers task technology fit (TTF) aspects, which is defined as the matching of the capabilities of the technology to the demands of tasks. The Task-technology fit model is suggested by Goodhue (1995) and Goodhue and Thompson (1995) within the user task domain of IT-supported work and related tasks. It helps to understand the linkage between information systems and individual performance. It also assumed that if the features provided by a technology can fit the requirements of a task, the utilization of the technology increases.

The technology characteristic or tool functionality is one of the main constructs of the TTF model. Technologies are considered as the tools used by individuals in carrying out their tasks. Tool functionality is associated with the technology used by individuals to perform their tasks. Task characteristic refers to 'the actions carried out by individuals in turning inputs into outputs' (Goodhue & Thompson, 1995). For collaborative learning, task characteristic might include the activities and learning tasks that are perform by students through project-based learning. It might also involve the use of a collaborative platform to make decision and share information. Both task characteristic and tool functionality have influences on the task-technology fit of a technology platform, which in turn, predicts the utilization of a technology.

2.7. Chapter Summary

This chapter provides a discussion of the important literatures relating to the technological, educational and behavioural aspects of CSCL development. It also highlights the role of Web 2.0 collaborative platforms, social networking technologies, learning theories, and theoretical frameworks for collaborative learning. The review of literature suggests that computer-supported collaborative learning requires a sound

methodological approach that allows the researcher to employ multiple perspectives and multiple theories in the design process. The following chapter provides the details of the research approach that was employed for conducting this study.

Chapter 3

The Research Process

3.1. Introduction to the Chapter

This chapter begins with a discussion on the research context – the design of a computer-supported collaborative learning platform to support project-based learning. Section 3.3 provides an overview of research stages. In section 3.4, the philosophical underpinnings that guide the research methodology of the research process are discussed. It also provides the arguments to establish the pragmatic orientation of this research. Section 3.5 provides the justification for the research approach that is being adopted for this study, and discusses the reasons for employing qualitative and quantitative research approaches for the evaluation of the collaborative learning platform. Section 3.6 describes the various data gathering techniques that facilitate data analysis using a mixed paradigm approach. Finally, section 3.7 includes a description of the ethical research process that was employed for conducting this study.

3.2. The Context

Problem and project-based learning has become a widely adopted method in higher education (Kolmos, 2002). Educators are arguing for learning to be situated in rich contexts and appropriated by engaging in tasks and situations that are authentic (Brown, et al., 1989). This kind of learning can be supported by project-based learning that engages the learners in problem solving through collaborative activities over extended periods of time. Students pursue solutions to authentic problems by defining approaches, debating ideas, making predictions, designing plans and solutions, gathering information, collecting and analyzing data, drawing conclusions, and communicating their ideas and findings to others (Blumenfeld, et al., 1991). Through project-based learning, students are presented with opportunities to use multiple learning styles, practice communication skills, and engage in critical thinking through peer critiquing, collective aggregation and collaborative learning.

The development of computer-supported collaborative learning platforms to support student projects is a major objective of this research. To address this objective, this research explores the educational, technological and behavioural issues associated with the introduction of CSCL environments. The prevalence of social networking and Web 2.0 environments in informal educational environments has prompted researchers to look into Web 2.0 and social networking environments to support project collaboration (Greenhow, 2009; Prilla & Ritterskamp, 2010). CSCL platforms designed with social media can provide a useful medium for students to explore ideas similar to real-world practices. Through the rich media features, social networking environments put students to work on situated activities. An effective instructional design should include real-life collaborative group projects as the major components of a course. To align students' activities with the intended learner outcomes, instructional designers have developed strategies to address project-learning outcomes with outcome-based learning. However, the pedagogical issues associated with collaborative tasks are rarely addressed with outcome-based teaching practices. To move beyond current practices in outcome-based learning, a central theme of this research is to introduce collaborative technologies for teaching and learning in a CSCL environment, addressing research issues associated with the collaborative tasks and activities of the learning process.

An effective platform to support project-based learning requires testing with educational design and learning theories. For learner-centred designs, interaction is an important element. Interaction is supported by collaborative learning theories, such as social constructivism (Sirca & Shapiro, 2007; Vygotsky, 1978). With social-constructivism, the classroom needs to be seen as a community for interaction. Learning grows out of interaction among learners with different knowledge levels. The theory of situated learning (Brown, et al., 1989) emphasizes on the need for authentic learning tasks to achieve meaningful collaboration within specific situation conditions. Such kind of situated knowledge can be developed through experience accumulation in project work (Hardless, Lindgren, & Schultze, 2007; Prencipe & Tell, 2001), and legitimate peripheral participation (Lave & Wenger, 1991).

In this study, the research problem focuses on the application of project-based learning at the Hong Kong Polytechnic University. The main pedagogical principle in

the design of undergraduate programmes at the Hong Kong Polytechnic University (PolyU) is shaped around project-based learning. Each subject in the undergraduate programmes at the Hong Kong Polytechnic University also includes a significant group project as part of the coursework assessment. In this study, we introduce a CSCL platform through a pedagogical design that explores learning theories through a project-based course implementation. The research is based on the Web-based environment for supporting the subject 'Advanced Marketing Research'. Through a subject that is assessed solely on project-based coursework, students develop inquiries into consumer behaviours as part of their entire learning process. Furthermore, they need to form groups with four to six students to understand and develop a solution to the problem. Through the project-based learning process, students go through different stages of systematic investigation, problem formulation, theoretical and methodological considerations, investigations, analysis and reflection:

> 'The subject Advanced Marketing Research (AMR) aims at facilitating students to solidify and acquire a firm understanding of the fundamental concepts in advanced marketing research and to apply them to develop a marketing research proposal and to conduct real world marketing research projects, including actual data collection and data analysis using relevant statistical tools to support marketing decisions. It also provides students with the opportunity to practice report writing and to refine their presentation skills which will be useful in business environments. Self-reflection and communications in ‘real world’ settings and situation-specific knowledge sharing activities constitute the major assessment components of the course.'

The subject AMR was taught by this researcher in the BA in Marketing and Public Relations programme at the Hong Kong Polytechnic University through a face-to-face mode of delivery, which was previously supported by the Blackboard learning management system. In this research, the Blackboard learning management system was not considered as a social-enabled collaborative platform for e-learning because it was managed as a kind of traditional e-learning software for management of subject contents. Furthermore, the Blackboard software was managed by the university central computing services so that it was not possible to provide the necessary setup

required for a CSCL platform. In this research, different social learning environments were evaluated as a CSCL platform for supporting collaborative learning in project-based environments. E-learning designed and implemented with social media can provide a useful medium for students to explore ideas similar to the real world. Through the rich hypermedia features, social networking environments put students to work on situated activities.

In order to exploit the potentials of different technologies for collaborative learning, different kinds of social networking software were evaluated, including Facebook (Lampe, et al., 2011), Elgg (Cheung & Wan, 2010) and Google Applications technology (Cheung & Vogel, in press). The range of features provided by the software and the customizability of the software facilitated the refinement of the instructional design for the selected subject under consideration. The collaborative technologies that were available from the social networking software also facilitated the development of collaborative activities and community building, which were vital for project-based learning.

3.3. The Research Stages

In order to investigate the adoption and use of collaborative technologies, this study was conducted in two phases of development and evaluation: Phase (I) - Design of a CSCL platform that incorporates the technological and pedagogical components to support project-based collaborative learning. The development of the computer-supported collaborative learning environment covers both technological research and educational design research. Phase (II) – Subsequent evaluation of the adoption of collaborative technologies.

Research into computer-mediated learning environments have shifted from the development of functional elements of computing architectures to CSCL research that investigates the processes, activities of the learning and the adoption behaviours associated with the use of technology. Summarizing the past CSCL research in the past two decades, Dillenbourg et al. (2009) describe the key ideas that have emerged, namely the design of collaborations among 'peers', the affective and motivation aspects that influence collaborative learning, and the integration of multiple CSCL activities that must be orchestrated in real-time by the teacher. This shift also

highlights the importance of incorporating theories and pedagogical designs in CSCL research.

Researchers in the areas of design research (Collins, et al., 2004) and developmental research for education (Richey, Klein, & Nelson, 2004) have provided the frameworks for performing instructional design, development and evaluation of the activities while studying the process at the same time. To deal with the complexity of real-life problems, design research employs multiple research methodologies and designs for different stages of the research. To introduce a CSCL environment for project-based learning, the research stages can be conducted in an iterative manner (as shown in Figure 3-1) according to the research stages suggested by Reeves (2006). In this way, the researcher functions both as a designer and researcher through iterations of the process.

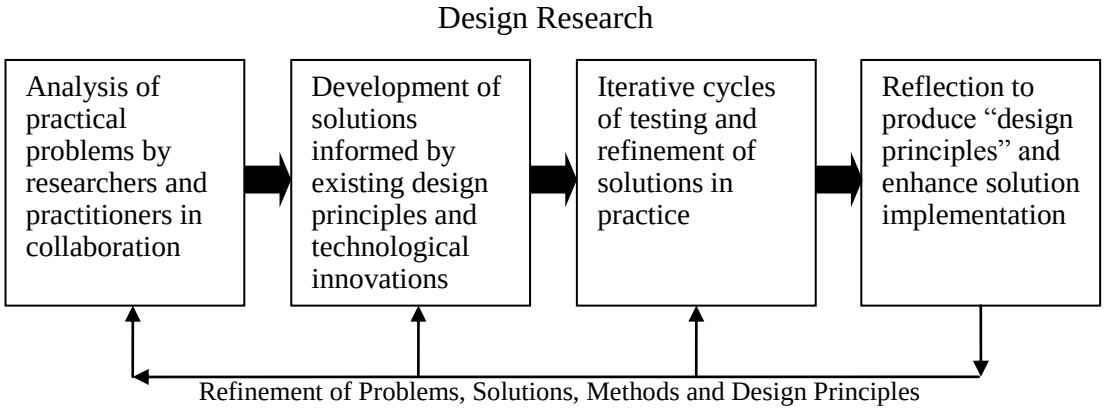


Figure 3-1 The research stages of design research (Source: Reeves, 2006)

The reason to position this research in the tradition of design research is that introducing social learning environments for project-based learning is a complicated process. It requires the instructor to identify real teaching and learning problems, create a prototype solution based on sound principles, test and refine prototype solutions until satisfactory outcomes have been reached. The research problems in education practices are characterized by the uniqueness of the problem situation, the focus on purposes and solutions, and the application of theories in the solution seeking process, which includes the following motivations (diSessa & Cobb, 2004; Gravemeijer, 1998; van den Akker, Gravemeijer, McKenney, & Nieveen, 2006):

(1) A desire to increase the relevance of the research for educational practices;

(2) The importance of enhancing grounded theories through combined study of both the process of learning, and the CSCL that supports the process;

(3) A desire to increase the robustness of design practices.

Educators are constantly developing approaches to solve educational problems and their understandings and decisions to provide learning interventions remain implicit throughout their teaching practices. From these perspectives, it is necessary to provide explicit learning interventions and decisions to increase the robustness of design practices and subsequent efforts to provide CSCL platforms for project-based learning.

3.4. Philosophical Underpinnings

Following the path described by Crotty (1998), a researcher need to start the research by asking three questions namely 'What shall be researched?', 'Why shall it be researched?' and 'How shall it be researched?' To address these questions, this research investigates the introduction of collaborative technology as a kind of CSCL platform, by positioning the research in the tradition of development research in education. It is also necessary to develop research methods that provide the blueprints for guiding the research process. However, research methods are not simply neutral tools. They are shaped by the beliefs which underpin them (Bryman, 2004). An understanding of paradigms is important in establishing a research methodology for conducting a research project. Mingers and Brocklesby (1997) provide the following definition of a paradigm.

> 'A paradigm, is a construct that specifies a general set of philosophical assumptions covering, for example, ontology (what is assumed to exist), epistemology (the nature of valid knowledge), ethics or axiology (what is valued or considered right), and methodology.'
>
> (Mingers & Brocklesby, 1997)

In other words ontological, epistemological and methodological beliefs associated with the researchers are 'packaged' into paradigms, which influence directly on the language of research and the methods used in the research process.

3.4.1. Established Research Paradigms

A paradigm is 'a set of propositions that explain how the world is perceived' (Sarantakos, 2005). Before choosing a particular kind of research methodology, the researcher is influenced by the particular way in which the world is viewed. Accordingly, this kind of philosophical underpinnings influence the researchers in terms of the particular way of knowing and also directly impact on the choice of a particular research methodology for conducting the research process. In order to understand how the researcher views knowledge, its nature, and what is valued, it is necessary study the ontological, epistemological and axiological stances of a research paradigm.

Crotty (1998) uses the term ontology to define the study of being, the nature of existence and the structure of reality. Ontology refers 'one's beliefs about what comprises the real world' (Lee, 2004). It is concerned with how the belief about the real world would affect the kind of reasoning process to apply to a research. Researchers in social science often debate whether the understandings of the world can be based on the same principles of the natural sciences, and consider a two way division of ontological belief: objectivism and constructivism (Bryman, 2004; Sarantakos, 2005). Objectivism is a belief that assumes that reality is fixed, and exists independently from human consciousness. It assumes that a uniform meaning can be generated for all people through the research process (Sarantakos, 2005). Constructivism refuses the assertion that the reality is fixed, and exists independently of the researchers. The constructivist argue that reality is constructed by people and comes into existence when they engage with the world (Crotty, 1998; Sarantakos, 2005). Crotty (1998) also emphasizes on the social dimension of constructivism in shaping reality: 'All knowledge, and therefore all meaningful reality as such, is contingent upon human practices, being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context.'

Epistemology is associated with the nature of valid knowledge and the grounds through which knowledge can be justified. A two way classification of the epistemological stance can be identified: positivism and interpretivism. Positivism refers to the epistemological position that draws upon empirical experiments on what

can be recorded, measured and reproduced. Positivism is often associated with scientific methods that test and verify hypotheses. One important aspect of logical positivism is that the data is verifiable: since there is a single truth, once a truth is known, others can verify it. The positivist approach asserts that knowledge is an external, quantifiable object that can be verified through experiments. On the other hand, interpretivism is based on the assumption that the nature of knowledge is based on 'systematic analysis of socially meaningful action through the direct detailed observation of people in natural settings in order to arrive at understanding and interpretations of how people create and maintain their social world' (Neuman & Kreuger, 2003). Jonassen (1990) stresses the importance of the mind's interpretation of the external world and that knowledge is a personal and is grounded in physical and social experiences. He argues that the mental models are produced by the mind are used to explain, predict or infer phenomena in the world. Therefore, the interpretive stance assumes that knowledge originates from studying subjective meanings, and is based on the understandings of how the subject makes sense of the world they experience. The major differences between positivism and interpretivsm are the different choices in research method by employed by positivists and interpretivists, and the different criteria employed for evaluating the research using different research methods (Weber, 2004).

In contrast to positivism and interpretivism, the pragmatism paradigm is not tied to any single system of reality. Pragmatism is defined as a paradigm that emphasizes on the utility and practical value of results (Teddlie & Tashakkori, 2003). Pragmatists are not interested in choosing between a binary view of positivism (which holds that there is only one truth that can be verified through experiments) and interpretivism (which argues that everything is subjective and that context-free generalization is not possible). Instead, pragmatists try to include a combined approach which emphasizes on workable and application theories and explanations. This approach also emphasizes on cultural values and collaborative research actions (Johnson & Onwuegbuzie, 2004). In this study, the emphasis is on the use of pragmatism as a research paradigm and the application of pedagogical frameworks in authentic and computer-mediated educational settings to solve practical research problems.

Axiology is the philosophical study of the value of knowledge, what is considered right in terms of ethics and aesthetics. It is concerned with studying what we desire and value, and whether these values are really valuable or desirable. Relating to the human desire to seek knowledge, it is concerned with the seeking of an appropriate goal for getting to truth (Kvanvig, 1998). Such psychological issues relate to the axiological stance in terms of the value of knowledge and what makes knowledge better than mere true belief. It has important implications on the considerations for research purposes, means of analysis, the possible alternatives for approaching the research problem, and the utility of the research on CSCL platforms.

3.4.2. The Theoretical Perspective Adopted by the Researcher

One way to address research in CSCL is to position the research work in the information systems research framework, covering technological, educational (the research context) and behavioural aspects. From the information systems perspective, it is the goals, tasks, problems and opportunities that define the needs of a CSCL platform perceived by educators. Given such needs, research on the use of CSCL platforms can be conducted in two phases. The first phase employs research frameworks from design science through the building and evaluations of artefacts to meet the identified needs of the research problem. The second phase employs research frameworks from behavioural science, which address the research through development and justification of theories that explain or predict the phenomena related to the identified problem.

Design science is a problem-solving paradigm, and the understanding of a problem domain and its solution are achieved through the development and application of a design artefact. The creation of the design artefacts employs existing kernel theories that are applied, tested, modified, and extended through the experience, creativity, and problem solving capabilities of the researcher. The human phenomena associated with such artefacts can be investigated using the laws of behavioural theories. Behavioural science research focuses on finding truth, representing principle explanations of the phenomena. The goal of design-science research is utility and the goal of behavioural science is truth. Truth and utility are inseparable. This researcher adopts the view by Hevner, March, Park and Ram (2004) for design science, which argues that 'truth (justified theory) and utility (artefacts that are effective) are two sides of the same

coin and that scientific research should be evaluated in the light of the practical implications.'

This researcher argues that the investigation of theories does not lead to practical guidelines for CSCL design directly. From a problem solving perspective, the theoretical lens helps in understanding the problems, but they may still need to be further developed so that the truth relating to the theories can be directly incorporated into the design of the CSCL platforms. A contribution of CSCL research can be gained from further development of theories that can inform design decisions to solve practical problems for designing CSCL environments to support project-based learning.

The design of CSCL environment is a field of research in educational technology, which can be fundamentally classified as research to employ technology to enhance teaching and learning. As the theories of learning have shifted from behavioural to cognitive learning theories, and currently to social constructivism, new technologies have also emerged through Web-based environments. A number of studies have demonstrated that educational technologies have not even begun to reach the widely promoted potential that technologies have promised, and research in this area is facing big challenges (Reeves, 2006). The advancement of science and technologies in the past decades has benefited human beings by improving the quality of life in various aspects. Compared with other areas of research in science and technology, educational technology research did not provide significant improvements to teaching and learning during the past decades. Most researches on educational technologies focus on media and instructional delivery comparisons and the effectiveness of current research on educational technology to fundamentally enhance teaching and learning has been questioned (Reeves, 2006). Therefore, this research is based on the argument that educational technology research should provide both practical and scientific contributions, which is supported by van den Akker (1999):

> 'In the search for innovative “solutions” for educational problems, interaction with practitioners… is essential. The interrelation between theory and practice is more complex and dynamic: is it possible to create a practical and effective intervention for an existing problem or intended change in the real world? The innovative challenge is usually

> quite substantial, otherwise the research would not be initiated at all. Interaction with practitioners is needed to gradually clarify both the problem at stake and the characteristics of its potential solution. An iterative process of "successive approximation" or "evolutionary prototyping" of the "ideal" intervention is desirable. Direct application of theory is not sufficient to solve those complicated problems.'
>
> (van den Akker, 1999)

3.4.3. Research Paradigms and Research Method

The justification about the choice and particular use of methodology and methods relates to the assumptions about the reality of the researcher. The assumptions about reality relate to the researcher's theoretical perspective. It is based on the understandings about human knowledge, what it entails, and what status can be ascribed to it. The nature and characteristics attained by the research relates to epistemology – a way of understanding what we know and how we know. Michael Crotty (1998) describes four elements of a research process including: methods, methodology, theoretical perspective and epistemology. For academic research, it is necessary to justify the choice of research methods and methodology. The study of epistemology and theoretical perspective provides a means for justifying the choice of research methods and methodology.

Crotty argues that in order to present research as academic contributions, it is necessary to be acquainted with the broader theoretical perspective of the inquiry, and investigate the big epistemological questions about how we know and what we know. For the question about what we know, ontology defines the study of being, the nature of existence and the structure of reality. When introducing the framework the research, it is important to be certain about the theoretical perspective that embodies understanding about ontology. By referring to the nature of knowledge and the epistemology of the research, the researcher has to make sure that the methodology, method, and the instruments used in the research are based on sound theoretical perspectives. Research approaches based on positivism is usually understood as the scientific paradigm and research approaches based on individual subjective experience is usually referred to as the interpretive paradigm. The study of

epistemology also helps the researcher to understand the limitation of the research and the nature of the research findings.

3.5. Research Approach

This section discusses the arguments for proposing a mixed paradigm research approach in the research process. The introduction of collaborative platforms for education involves both design and evaluation aspects in the development. Therefore, different candidate research methods are evaluated, in order to justify the use of a sound research method to address the practical and theoretical aspects of development. Following the arguments for a research method that addresses a pragmatic view to support practical as well as scientific contributions, a discussion on qualitative, quantitative, and mixed paradigms is provided.

3.5.1. Candidate Research Methods

A sound research method guides the activities to gather, organize and interpret the research activities. Following a discussion of the theoretical perspectives, the following sections provide the details of the three candidate research methods for CSCL design: information systems development research, action research, and design research. This is followed by the justifications for the choice of design research for development of a solution for computer-supported collaborative learning.

3.5.1.1. Information Systems Development Research

A computer-supported design solution for project-based learning can be investigated through an information systems development perspective. The information systems development research framework described by Nunamaker et al. (1991) consists of five stages: conceptual design, constructing the architecture of the system, analyzing the design, prototyping (or product development) and evaluation.

Through the conceptual design, meaningful research frameworks, questions and the functional requirements are documented. An overall architecture of the system is developed based on the functional requirements, which also define the functionalities of the system components and the interrelationships between the functional components. This is followed by the design of the information system. It consists of the design of the processes to carry out the system functions, design of the database

and knowledge base, and the analysis of the design by choosing among the alternative design solutions. A prototyped solution is then developed through the system building process, in order to gain insights into research frameworks and the complexity of the targeted system. Finally, the system is evaluated based on field studies, in order to develop models based on the field experiments. Although, the five stages of the information systems development process are conducted separately, these five stages are conducted iteratively until a satisfactory outcome or product is produced.

3.5.1.2. Action Research

According to Elliott (1991), action research aims at improving practices rather than creating or enhancing knowledge. It aims at improving the quality of practices and the quality of the outcome of the process and product. It is based on the cyclical model of diagnosing, action planning, action taking, evaluating, and specifying learning (McKay & Marshall, 2001).

Action research is initiated by the researcher based on the feeling that something needs to be changed or enhanced, so that it might lead to a better situation for the problem domain of study. Action research involves collaboration with the practitioner or clients to solve practical problems. Through the collaboration, the researcher identifies the problem, identifies the gaps, and leads the practitioner to identify the course of actions. Action research is grounded and based on the actual experience with the situation and the case being considered. With action research, the involvement and understanding of the situation for relating to the problem domain is more important than theoretical contributions. The process of action research is involved in action-reflection cycle, through which the reflection of the experiences during the research process is instrumental for making changes to the situation.

3.5.1.3. Design Research

Design research is generally used for a research paradigm described using different names in the literature, such as design experiments (Brown, 1992), design research (Collins, et al., 2004) development research (van den Akker, 1999) and developmental research (Richey & Nelson, 1996; Richey, et al., 2004). In this research, design research is defined as the systematic but flexible method that aims at improving educational practices through iterative analysis, design, development and

implementation (Ma & Harmon, 2009; Wang & Hannafin, 2005). Design research follow iterative cycles represented by the research stages described by Reeves (2000, 2006) which include: analysis of the practical problems by researchers, development of a design solution, iterative cycles of testing and refinement, and reflections to produce design principles (as shown in Figure 3-1 of Section 3.3). The characteristics that can be used to describe design research include: pragmatic, grounded, iterative and flexible, integrative and contextual (Wang & Hannafin, 2005).

The advantage of employing design research is the use of multiple theories during implementation and testing of design solutions. After each iterative cycle, new issues can emerge and new changes in the existing design can be implemented. This flexible approach to the incorporation of new theories differentiates design research from more traditional research methodologies. The approach undertaken by design research is supported by the 'problem-driven' shifts in the research process, where a design solves a problem, but simultaneously discovers new issues that requires the researcher to extend the theoretical basis to explain the circumstances that work well for the design. The design research approach also facilitates both qualitative and quantitative research methodologies because of the need to develop design principles to improve future iterations of the research. Therefore the research is not limited to a single methodology. Mixed research approaches comprising both qualitative and quantitative techniques were employed in this research to evaluate students' adoption of the CSCL platform. Different research techniques listed in Table 3-1 were used in the mixed research approach for technology adoption:

Table 3-1 Research method for CSCL platform adoption

Research Approach	**Research techniques for the adoption of the CSCL platform**
Quantitative	Survey using structured questionnaires
Qualitative	Focus group study using a discussion guide
	Analysis of messages and student work in the CSCL platform
	Analysis of log records of student activities

3.5.1.4. Selection of Research Method for CSCL Design

The major theme of this research is on the design and adoption of social software tools for collaborative learning. The research methods introduced in the previous sections fit in the requirements for facilitating development and evaluation of computer-mediated environments for learning. All the three development methods, namely information systems development research, action research, and design research include a development cycle that facilitates the design, development and evaluation of computer-mediated platforms in the learning environment.

Design research was chosen as the research approach for conducting this study because design research offers several benefits. First, design research facilitates theory-driven development, accommodating complex interventions in teaching and learning environment that can be implemented iteratively, and offer multiple research methods for conducting the research. Second, the adoption of collaborative technologies for collaborative learning in a Web 2.0 environment is an emerging field of research, and most of the previous studies are either developed from a theoretical point of view, or being implemented at as an exploratory stage. Design research accommodates the emerging issues that could arise during the design stages, thus, ensuring the feasibility of implementing a completely new learning environment for computer-supported collaborative learning. Finally, design research links theory with practice, facilitating practical as well as theoretical contributions.

Information system development research and action research were discarded because they lack the emphasis on contributions to knowledge through an iterative development process. The former approach emphasizes on technological development, ignoring the educational and social cultural issues surrounding the use of CSCL environment, and the latter approach represented by action research emphasizes mainly on improvement of practice and processes, rather than the important aspects of design principles and knowledge in the design (Elliott, 1991).

3.5.2. Qualitative, Quantitative and Mixed Paradigms

The previous sections have highlighted design research as a research method for the design of a CSCL platform. In order to evaluate design features, different research methodologies can be employed to investigate that factors that influence the use and

adoption of a CSCL design. Based on the context of the research problem, the process of establishing a coherent methodological framework includes the evaluation of different research approaches and deciding on the particular research method and data collection method for the research study. The research methodologies that can be employed to investigate the factors affecting the design and adoption of a CSCL platform include qualitative approach, quantitative approach and a mixed paradigm approach. The consideration of the various approaches is to ensure that the research is rigorously designed, methodological choices are justified and research design decision made transparent, in order to ensure the reliability and validity of the research findings (Creswell, 2007).

3.5.2.1. Qualitative Approach

Qualitative research approaches focus on understandings of how people interact and experience the world, through the meanings they have constructed and through the use of induction to build concepts and theories. This study is concerned with the learning platforms and the associated behavioural aspects of employing CSCL platforms for education. The evaluation of a design for the CSCL platform requires a variety of data collection methods, which transform the participants' experience into multi-layered descriptive representations, such as interview records, analysis of Web 2.0 tools, practices, activities and communication aspects. In order to investigate the social-cultural aspects associated with a CSCL design, it is necessary to employ a qualitative methodology to analyze the behaviours associated with learners for employing a CSCL platform for project-based learning within specific social-cultural contexts.

Qualitative research emphasizes on the importance of the participants' view and stresses on the setting and context in which the participants express their views, and highlights the meaning and issues people held about educational activities. It is therefore relevant to the study of computer-mediated activities for project-based learning, so that guidelines can be developed to improve subsequent designs of the collaborative environments. Rather than restricting to a few variables, qualitative research allows for a holistic understanding of the research area and facilitates understandings of the various design issues associated with a CSCL platform. Furthermore, qualitative investigations also provide a stepping stone for identifying

and isolating important variables, acting as building blocks for subsequent quantitative studies.

Interviews and content analysis are the most popular type of analysis for studying computer-mediated collaborative learning and online discourse (De Wever, Schellens, Valcke, & Van Keer, 2006). However, solely relying on content analysis cannot, and should not be used to answer all research questions (Lowenthal & Leech, 2009). Instead, researchers should employ different methods of studying computer-mediated learning for improving the rigour of the research results. To investigate the adoption and use of computer-mediated platforms, researchers have employed design research (Herrington, Reeves, Oliver, & Woo, 2004; Reeves, 2000, 2006) to improve the utility and vigour of the research results (Hevner, et al., 2004). Design research usually involves multiple methods in evaluating the utility of a design, but it does not specify the requirements for employing different approaches for evaluations. Researchers in computer-supported collaborative learning are arguing for using both qualitative and quantitative approaches in the study of computer-supported collaborative work (Goldman, Crosby, Swan, & Shea, 2005; Martínez, et al., 2006).

3.5.2.2. Quantitative Approach

Qualitative approach is based on an inductive analysis while quantitative approach is based on deductive analysis. As with other forms of research, it is useful to evaluate the design issues of CSCL platforms from different perspectives. A deductive approach is usually based on isolated independent and dependent variables, and is based on the conceptual framework. Quantitative research is based on the positivist's view of knowledge and the premise that the researcher has an accurate understanding of the research problem and the associated variables, which are usually derived from qualitative studies and literature review. It is based on the mode of inquiry that involves the identification, systematic collection, and analysis of data using statistical analysis (De Vaus, 1995).

Quantitative research has been extensively applied in the study of behavioural aspects of information systems (Davis, 1989; Davis, et al., 1989) and comparative studies in Web-based learning (Shen, Chung, Challis, & Cheung, 2007). Quantitative research can also be applied to design research for CSCL platforms to support design

guidelines, to justify theory, to improve the generality and external validity of the research results. Considering CSCL investigations as a kind of information system research, the application of technology adoption principles to CSCL platforms can improve the vigour of design research, thus enhancing the applicability of the research to other collaborative learning platforms.

Another advantage of introducing quantitative together with qualitative investigations is the application of triangulation. During the study CSCL implementations, there are various levels of participation in the collaborative system, and various methods of data collection can be chosen and applied. Triangulation is defined as the 'combination of methodologies in the study of the same phenomenon' (Jick, 1979). Triangulation assists in enhancing the reliability and internal validity of the findings. This is based on the assumption that the weaknesses in each of the single data source, method, evaluation, theory or data type will be compensated by the counterbalancing strength of another (Merriam, 1988; Miles, 1994; Patton, 2002). Employing triangulation in the research process strengthens the quality of evaluations and the internal validity of the research in this study. In particular, a more comprehensive approach is required because of the overlapping roles of the investigator, including the role of researcher, a CSCL platform designer and a practitioner in teaching research to undergraduate students. The application of a triangulation research strategy can also address the concern with the multiple roles associated with design researchers in the educational research area.

3.5.2.3. Mixed Paradigm Approach

Research on Web-based learning has been dominated by media comparisons (Reeves, 2006) or comparison between online and face-to-face studies (Lowenthal & Leech, 2009). Because of the complexity involving blended learning, which also includes face-to-face and online components, researcher are arguing for the importance of mixed research to handle the complexity of online learning, and to improve the rigour, quality and utility of CSCL research. The problems with media comparison studies is that these researches often rely only on survey data, and limited types of data collection and analysis, which may not be sufficient to handle all the complexity of online learning using a single research method. Even if content analysis techniques and user participation studies are included in evaluations of online support for

collaborative learning, they are not able to address all research questions in a study. To improve the quality computer-supported collaborative learning, researchers are emphasizing on researches that employs a mixed-approach to handle the complexities of computer-supported collaborative learning.

According to Creswell and Plano Clark (2003) mixed research is a research methodology with the philosophical assumptions that guide the direction and collection of qualitative and quantitative approaches in different phases of the project. It involves different methods for collecting, analyzing, mixing qualitative and quantitative data during a single or a series of studies. With design research, it is necessary to mix qualitative and quantitative data during different iterations of the design process. There are different kinds of mixed research designs, including partially mixed design that involves mixing quantitative and qualitative methods at a single stage of the research process, or fully mixed designs, which mix qualitative and quantitative methods at a multiple stages of the research process. Fully mixed designs with qualitative and quantitative analysis in combination provide a better understanding of the research problems than a single approach alone (Creswell, et al., 2003).

Researchers are providing guidelines for conducting mixed research approach. According to Onwuegbuzie and Leech (2004), a mixed research approach should develop both qualitative and quantitative research questions. Quantitative research questions are usually comparative or relationship based, while qualitative research questions are more open-ended. This research employs a mixed approach in developing the research questions for this study. In classifying the research questions as a kind of mixed study, consider the three research questions associated with this study:

RQ1. How to design an effective CSCL environment using social networking, collaborative, and user-generated technologies for group-based collaborative learning ?

RQ2. What are the design principles for developing a CSCL platform using collaborative technologies for project-based learning?

RQ3. What are the factors that influence students' decisions to adopt collaborative technologies?

To address research question RQ1, a mixed research method is required because design is an open-ended process. It includes both qualitative and quantitative components that spans across different stages and iterations of the design process. Design research involves the understanding of how people interact and experience with the CSCL environment, and how various issues affect the design. The Investigation of how people interact with the learning environment requires a qualitative approach, while addressing the adoption behaviour of groups of students requires a quantitative approach. It employs data that is collected and analyzed either concurrently, sequentially, or iteratively before the question is addressed (Onwuegbuzie & Leech, 2004).

For the research question RQ2, the development of design principle for CSCL platforms is a qualitative research question because it mainly involves reflection and synthesis of principles from the implementation experience of the CSCL platform. The process of synthesizing design principles from the reflections and experience is based on interpretations of experience from implementations. The analysis such kind of interpretations may involve the various types of phenomena that are analyzed through design research. The research question RQ3 is a quantitative research question because it involves identifying the relationships between the variables which affect students' decisions to adopt a technology.

3.5.3. Research on Technology Adoption

Evaluation of technology adoption in the classroom is a complex process, and the evaluation is influenced by the research paradigm which has been selected for this research. Through the design research process, the evaluation of technology adoption is conducted through multiple methods and multiples phases. The goal of evaluation is to study students' adoption behaviour of the CSCL platform in teaching and learning environments, which can be informed and improved using both unstructured exploratory studies as well as structured confirmatory studies. Dix (2007) contents that evaluations of information and communication technologies (ICT) in classroom environments involve the concept of moving from unstructured exploratory analysis to structured confirmatory analysis through educational changes that are introduced through the multiple phases of the research process (Keeves, 1997).

Dix (2007) also emphasizes on the product stage of design research and contents that ICT design research is also characterized by a product stage, where one of the outcomes of design research for information and communication technologies is the final design artefact. When the product of the computer-supported collaborative platform is completed and the features of the collaborative platform are stabilized, a subsequent evaluation of the completed ICT product is conducted using hypothesized research models. Therefore, the evaluation of the collaborative platform developed in this research is conducted through two main phases:

Phase I: Evaluation of the collaborative platform using a mixed study through design research approach.

Phase II: Subsequent investigation focusing on evaluation of technology adoption using a quantitative approach for the CSCL platform.

During the final stage of subsequent evaluation, a theoretical model was constructed to evaluate technology adoption associated with the collaborative platform, and was tested through confirmatory statistical analysis, in order to promote ongoing research and development of for future practices. The details of the subsequent evaluation of technology adoption are discussed in chapter eight of this thesis.

3.6. Data Gathering Techniques

Based on the use of design research for CSCL platform development, different methodologies can be employed for investigating the use and adoption of a collaborative platform. Design research is conducted in an iterative manner to refine the design to meet the requirement of the CSCL environment for project-based learning. By employing multiple methodologies, different data gathering and interpretation techniques can be used for this research in the iterative design process. Data collection for this study was based on the feedback from students attending the advanced marketing research course involving the use of a CSCL platform, which took place during the years from 2010 to 2012. During the delivery of the implementations of the CSCL platform, focus group studies and surveys were conducted to provide feedback on the adoption and use of the computer-supported collaborative learning platform by students. Focus group discussions were conducted with student project groups. It provided in-depth discussions on the use of the CSCL platform, allowing the researcher to probe on the specific issues that need to be

investigated in detail. The use of a survey also provided a method to collect data from a class of students during the study period. The analysis of the database of records that resulted from student participations in the CSCL platform also provided a means for understanding students' involvement in computer-supported collaborative learning. By combining the data collected through different methods, the validity of the research was improved through a process called 'triangulation' (Jick, 1979). The evaluation of the CSCL platform through a mixed method is also supported by researchers in computer-supported collaborative learning (Martínez, et al., 2006).

3.6.1. Ethnographic Perspective

In the study of CSCL experiences, the situated learning perspective (Lave & Wenger, 1991; Wenger, 1998) and the participation metaphor of learning (Sfard, 1998) provide the appropriate approaches to understand learning experiences. Through a computer-supported collaborative learning environment, various forms of participation are externalized by interactions among members of a project group, which are totally or partially mediated through the use of the Web-based platform. One of the advantages of computer-mediated communication is that all the activities leave an electronic trail and is turned into substance (Dillenbourg, 2005). Therefore the analysis of the learning activities taking place in the CSCL platform must take into account the records of the computer-mediated interactions that are captured through log files and the database records of the platform.

Ethnographic studies are often used to 'writing about people or culture' (Sarantakos, 2005) and used to study research settings such as workplaces and schools. Ethnographic approaches provide valuable tools to study a phenomenon through prolonged and intense interactions with the field, emphasizing on 'local meanings' (Ronkko, Lindeberg, & Dittrich, 2002). 'Virtual ethnography' is a kind of ethnography that is conducted in 'virtual settings' (Hine, 2000). A concern with virtual learning environments is that users in the online world may be presenting a different image than learners in the real world. This researcher argues that the study of the interactions through the online identity is important because this is the reality that learners and teachers are facing nowadays. Learning is not confined within the four walls of the classroom and could occur anytime, anywhere online. We are facing a digital age, where students are engaged in learning through multiple means and multiple

perspectives, engaging in formal and informal learning across a wide range of contexts, exercising considerable authorities on the different ways of learning. Learning in the digital age is described by Barron (2004) as a learning ecology, which is defined as 'the set of contexts in physical and virtual spaces that provide opportunities for learning.' Although ethnography is not considered a suitable approach for this study, because of the iterative nature of the research process through a mixed research method, an ethnographic perspective is considered in this study to understand the online learning activities in the CSCL platform.

3.6.2. Focus Group Interviews

In order to provide evaluations on students' adoption of the collaborative platform, focus group studies were chosen as the method for collecting and evaluating feedback from students. Focus group study is a method of data collection through face-to-face interviews that are conducted by a highly skilled moderator. As the Web 2.0 based collaborative platform is a new environment that was introduced to support learning, it is important to explore the perceptions of students toward these newly developed learning environments. Focus group studies provide a means of exploring the situation, and providing means for the researcher to develop in-depth investigation by conducting face-to-face interviews with a group of five to twelve respondents.

As the study involves the investigation of user experiences with a new technology, it is important to understand that the CSCL platform was being used for collaborations rather than just being used for individual work. This kind of adoption study involves how users experience with a new technology, which is one of the focuses of this research, and is suited for a qualitative investigation using focus group studies (McQuarrie & McIntyre, 1988).

Compared with surveys, focus group interviews are guided by semi-structured questions that are developed as a discussion guide by the researcher. The purpose of the discussion guide is to ensure that the important topics relating to the inquiries are being covered in the discussion rather than restricting the interviews to definite answers. According to Babbie (2004), 'qualitative interviewing design is flexible, iterative, and continuous, rather than prepared in advanced and locked in stone.' Moreover, the snowball group effect of group-based discussions allows the

participants to be probed into the details within a group, where the group members are usually selected with homogenous characteristics within the group. In the evaluation of the CSCL platform, project groups with five to six members were being selected during the focus group interviews, as student groups were collaborating through the use of the collaborative platform.

3.6.3. Surveys

Although focus group studies can provide in-depth evaluations with the collaborative platform, these evaluations are based on small samples and may not provide a representative view of the all the students involved in the study, and it is difficult to develop theories and theoretical contributions that can be generalized for future implementations. Therefore, surveys were conducted to evaluate the acceptance of the collaborative platform among students. It also serves as the methodological tools to investigate and extend theories that could be applied to study collaborative platforms so that the research results can inform future researches involving the use of collaborative learning technologies.

Survey research is a mode of inquiry that involves the systematic collection and organization of systematic data that are analyzed through statistical techniques. It involves collection of the information from a large number of respondents through the use of a structured questionnaire. It involves gathering of information from a large number of respondents, in order to gain understandings and/or predict some aspect of behaviour of the population of interest (Hawkins & Tull, 2002). It is one of the most common methods used for investigating the behavioural aspects on the use of management of information systems (Vogel & Wetherbe, 1984).

Survey research provides various advantages over other methodological alternatives for data collection involving the use of computer-mediated platforms for collaborative learning. By using surveys, it is possible to collect data from large samples which can cover most students who are involved in using the collaborative platform in this study. Survey research provides an effective means of measuring and investigating a large number of variables (Churchill, 1979). By employing large samples that are feasible using survey research, it is possible to improve the generalizability of the research

results (Kerlinger & Lee, 2000) and it offers an economical means of collecting a large amount of quality information (Kerlinger & Lee, 2000).

3.7. Human Ethics Process and Ethical Research Practice

In order to get approval for conducting research, an application was made to the Human Ethics Committee of the degree granting university. At the time of application, the process of ethics application process was computerized, a more rigid process during the application and approval stages was required. During the first submission of the application, minor amendments and clarification of details were requested from the Human Ethics Committee and the application was approved after the revisions.

The submissions during the first stage of the application included the details of the proposed research, the structured questionnaire for conducting the surveys, the focus group discussion guides, plans and schedules for data collection, together with the information sheet for participants (as shown in Appendices A, B and C). During the second stage, amendments were made based on the recommendations from the Ethics Committee and approval was granted to conduct research for three years after the revised submission.

The ethics approval process was to ensure that the steps for carrying out research were implemented according to the standards of ethical research practices. The rights of the participants were protected in terms informed consent, protection from harms, and were being assured of the confidentiality of information. All participants were informed about the researchers' thesis topic, and the students were also informed about what information was gathered and for what purpose. The participants' privacy and information rights were also protected. All information collected was kept confidential, and only the researcher and his supervisor had access right to the data. Participation in surveys and interviews were voluntary and anonymous. All respondents were asked to provide their written consent and respondents would not be in a disadvantaged position if they choose not to participate in the data collection process.

3.8. Summary of the research process

This chapter provides a discussion of the context of the research, the research approach and the philosophical underpinnings that guide the research methodology of the research process. Design research is selected the research approach for the design of the CSCL platform and the associated activities for learning. It also facilitates the development of design principles for introducing social software as a CSCL platform for project-based learning. By employing a design research approach, the design of the CSCL platform can be tested through cycles of implementations over different iteration cycles. The details of the development of the technological design solution for computer-supported collaborative learning are presented in chapter four of this thesis.

Chapter 4

Development of a Technological Design Solution for Computer-Supported Collaborative Learning

4.1. Introduction to the Chapter

This chapter focuses on the analysis of the practical problems for authentic learning in project-based environments, the theoretical frameworks for supporting a design solution, and the draft guiding principles that were used to inform the development of a design solution. The design solution described in this chapter supports a computer-mediated environment that moves away from traditional content-based teaching to a course where a single project becomes the entire focus of the course. This chapter provides a discussion on the analysis of the research problem, the guiding principles developed from literature, and the development of a technological design solution for computer-supported collaborative learning.

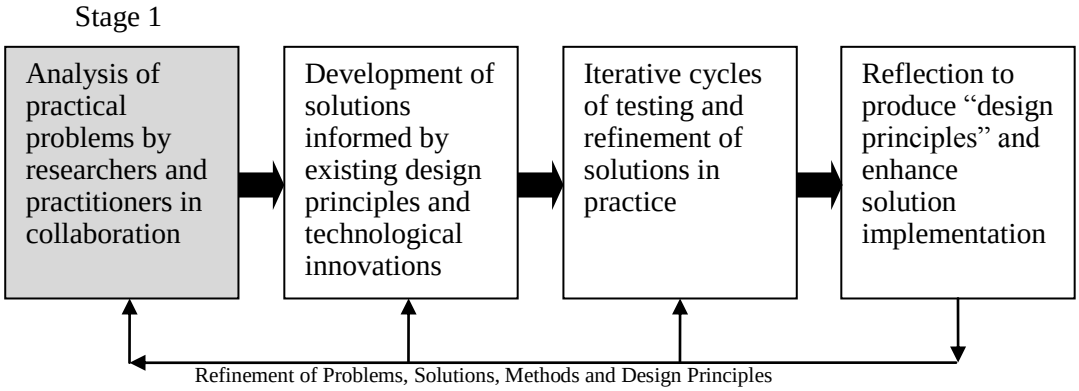


Figure 4-1 Stages one of the design research paradigm (Source: Reeves, 2006)

4.2. The Need for Project-based Learning

In the following sections, the analysis of the practical problems faced by the researcher and practitioners in higher education are presented. It also represents the analysis that constitutes stage one of the design research paradigm (as shown in Figure 4-1). The mission of the Hong Kong Polytechnic University is to nurture

graduates who are critical thinkers, effective communicators, innovative problem solvers and lifelong learners who can use the knowledge they have acquired in appropriate and adaptive ways. To achieve this mission, learning cannot be confined to the traditions of classroom teaching approach, in which the students have little control over the pace of their learning experience, thus limiting the opportunities for learners to be involved in deep learning (Biggs, 1993).

New developments in education should re-consider what should happen in the classroom and what the teachers should aim at during the delivery of a course. Resnick (1987) argues that school learning is basically different from practical learning. School learning largely promotes individual learning and cognition, where outside practical work is predominantly shared. School learning emphasizes on 'pure thoughts', while real-world learning emphasizes on the use of tools to develop solutions for situation specific problems. Compared with a purely academic approach, practical problems are characterized by: key roles of problem recognition and ill-defined nature of the problems, substantial information search, and multiple methods of obtaining solutions and high involvements in contingency planning. As shown in Table 4-1, the differences in school-based learning and real-life authentic activities have been reported by Lebow and Wager (1994):

Table 4-1 Real-life versus in-school problem solving (Source: Lebow &Wager, 1994)

	Real-life		**In-school**
1.	Involves ill-formulated problems and ill-structured conditions	1.	Involves text-book problems and well-structured conditions
2.	Problems are embedded in specific and meaningful context	2.	Problems are largely abstract and decontextualised
3.	Problems have depth, complexity and duration	3.	Problems lack depth, complexity and duration
4.	Involves cooperative relations and shared consequences	4.	Involves competitive relations and individual assessment
5.	Problems are perceived as real and worth solving	5.	Problems typically seem artificial with low relevance for students

One method of implementing authentic situation in learning is to arrange students to work on apprenticeships to work on real-life locations and practice. Although many

researchers support the use of authentic environments, there are limitations in terms of engaging students in apprenticeships in relation to situated cognition. Lave and Wenger (1991) note that the quality and consistency of apprenticeships vary enormously. They argue that apprenticeship does not inevitably result in learning in practice, but rather it is the values that 'legitimate peripheral participation' the apprenticeship allows. Some researchers argue that learning does not depend solely on the truly 'authentic learning experiences'. Barab, Squire and Dueber (2000) emphasize that 'authenticity occurs not in the learner, the task, or the environment, but in the dynamic interactions among these various components ... authenticity is manifest in the flow itself, and is not an objective feature of any one component in isolation'. Therefore, interactions, which occurs between authentic activities is a key element in the design of learning environments.

The argument of this thesis is that the value of authentic learning is not constrained to learning in real-life locations and environments, but the benefits of authentic activities that can be realized through the design of project-based activities supported by Web-based learning environments. Project-based learning is a model of learning that organizes learning around practical projects. The project-based learning paradigm facilitates learning around authentic tasks that centre on authentic content, authentic assessment, teacher facilitation, explicit educational goals, reflection, and incorporation of adult skills (Helic, Krottmaier, Maurer, & Scerbakov, 2005). By focusing on practical tasks that mirrors problem solving in real-life situations, it facilitates education in terms of critical thinking, problem solving and communications through group work. It simulates problem solving in real-life situations that involve interactions and collaborations within a group rather than solely depending on the problem solving capability of the individual.

4.3. Issues in Teaching Marketing Research

The course in marketing research delivered at the Hong Kong Polytechnic University is focused on methods and techniques in solving marketing research problems. As a core subject delivered for the Bachelor of Arts in Marketing and Public Relations programme, the course is based on a fourteen week semester consisting of lectures, seminar and laboratory sessions. Before the subject is being re-structured using project-based learning, examinations were the major type of assessment for the course.

This researcher has worked as an academic teaching the subject at the Hong Kong Polytechnic for many years. Although the subject contents were highly structured, students found difficulty in handling the subject matters because they needed to organize and memorize a variety of tools and techniques for handling marketing research problems. Although the examination results showed that most students satisfied the examination requirements, most students found the subject matter difficult to handle because of the need to understand the large amount of lecture contents.

In the year 2008, the subject 'Advanced Marketing Research' was being reviewed and re-developed. Although the syllabus of the subject matters remained unchanged, the subject was being changed from an examination based subject delivery to a project-based course where a single project in marketing research became the entire focus for the delivery and assessment of the course. The subject matter was being re-developed because learning-by-doing was generally considered to be the most effective way to learn. Students said that they were motivated by solving real-world problems. They often expressed a preference for doing rather than listening. With the changes, the subject matter was purely assessed based on a project conducted by collaborative teams with five to six students per group. The group project enabled students to apply their research concepts and skills through team-based activities, and to develop basic research design and problem-solving skills for marketing research using both qualitative and quantitative techniques. By employing statistical packages to analyze survey data, students were expected to demonstrate their understandings of the statistical methods that were used for data analysis. Students were also required to develop the project proposal in the beginning of the course and to complete a marketing research project at the end of the course.

This change in delivery of subject matter was in line with the emphasis on outcome-based learning at the Hong Kong Polytechnic University, which emphasized on aligning learning with students' activities. This researcher argues that the design of CSCL environments for project-based learning is a move beyond current practices in outcome-based learning. Although the spirit of outcome-based learning aims at alignments of learning with what the students do, the current practice emphasizes solely on the final student artefacts or outputs, ignoring the important elements of the

learning processes, interactions, collaborations and communications in the knowledge construction process to develop these outputs. By emphasizing on the interaction and collaborative knowledge construction aspects, a CSCL environment facilitates learning beyond current outcome-based learning practices.

Previous experience with mini-projects for marketing research revealed that group-based project learning was difficult to implement and monitor. Most students finished their project report during the last week of the course. Students were required to provide a summary of the division of labour for their contribution, but it was difficult or impossible to trace the collaborative activities and interactions during the last week of the course. The new set of collaborative tools that is facilitated by the 'participatory media' (Jenkins, et al., 2006) offers a more authentic learning experience based on experimentation and action. With the help of the Internet and collaborative tools, students are able to co-construct knowledge and make connections with other learners and professional researchers. With access to online research information and research communities, learners are able to gain a deeper sense of a discipline and develop a research 'culture'. Furthermore, the learning activities, communications, interactions, and collaborations are more visible through a computer-mediated collaborative platform. Students are able to exercise judgment and exploration through social communications with the peers and communities in their learning process, just as it is in an actual workplace.

Before investigating the adoption behaviour of a CSCL platform for teaching and learning purposes, it is necessary to develop a CSCL platform during the first phase of the project. The development of the CSCL platform also needs to be supported by sound pedagogical frameworks. To facilitate the design of effective learning environments, researchers have proposed guidelines on authentic learning to help practitioners implement improvements in their teaching and practices. To develop CSCL platforms using social software tools, researchers have provided guidelines for implementation of social learning environments. In the following sections, the theoretical framework and design characteristics of authentic learning are presented.

4.4. Theoretical Framework

In order to develop an authentic CSCL environment for project-based learning, it is necessary to define authentic learning in the context of project-based learning for marketing research. Authentic learning is synthesized by Brown, Collins, and Duguid (1989) into the theory of situated learning, which states that: 'the notion of learning knowledge and skills in context that reflect the way the knowledge will be useful in real life'. Brown, Collins, and Duguid (1989) argue that meaningful learning will take place only if it is embedded in the physical and social context with which it will be used. Much of the learning that has taken place in school is different from the kind of practice performed by practitioners in their everyday work. Therefore, the model of cognitive apprenticeships (Collins, Brown, & Newman, 1989) is proposed as a method to 'enculturate students into authentic practices through activity and social interaction'. Based on the traditional apprenticeship model, the cognitive apprenticeship model can be applied to implementing student activities, with the following characteristics (Herrington, Reeves, & Oliver, 2010):

1. Learners have continual access to model of expertise-in-use against which to refine their understandings of complex skills.
2. Apprentices often have several masters and have access to a variety of expertise leading to an understanding that there may be different ways to carry out a task, and no one individual embodies all knowledge and expertise.
3. Learners have the opportunity to observe other learners with varying degrees of skill.

The key aspect of this learning model is represented by the practices of the 'apprentice' observing the 'community of practice'. Lave and Wenger (1991) observe that learning can be developed from participating in a culture of practice, which starts from the boundary or legitimate peripheral participation. As the learner is immersed in the learning community, he/she moves from an observer to a fully functional participating agent in the community, which enables the learners to progress together with the culture of the group. The main function of peripheral participation is for the learner to benefit from the language and skills that are used within the communities of practice for problem solving in the domain of interest.

Although some researchers emphasize on a restricted criteria to define situated learning as authentic learning with standard apprenticeship (Tripp, 1993), it is argued that by providing abstract representation of knowledge, project-based teaching environments simulated with real-life situations is as effective as standard situated learning approaches (Brown, et al., 1989; Tripp, 1993). Herrington, Reeves and Oliver (2010) argue that authentic learning can be readily implemented in university and classroom environments. Brown and Duguid (1991) propose that the authentic learning can be further developed into a model that can be applied to practical teaching in the classroom.

Web-based environments are most suitable for supporting authentic learning. In particular computer-supported collaborative environments can be implemented to develop authentic learning models. Researchers argue that computer-mediated environments provide 'true' situated learning, and that 'true expertise is learned by being exposed to experts' (Tripp, 1993), the developments in virtual teams (Qureshi & Vogel, 2001) have shown that knowledge sharing among professional is achieved through Web-based learning communities (Wasko & Faraj, 2005). Reeves (1993) emphasizes that a computer-based environment 'have the opportunities for simulated apprenticeships as well as a wealth of learning support activities'. This research supports the idea that Web-based environments developed for CSCL can be used for authentic learning activities without sacrificing the important elements of authentic contexts. This argument is supported McLellan (1994) that authentic contexts can be based on actual work settings or based on a 'virtual' working environment.

4.5. Design Elements of Authentic Learning

Design research for CSCL environments requires the researcher to employ theory in the literature to design an initial solution for the problem. By employing a design approach, an initial prototype of the solution is implemented from guiding principles from the literature and innovative technologies. In this research, the principles that guide the initial development is based on the model of authentic learning (Brown, et al., 1989) for implementing effective learning environments. In order to apply the authentic learning model to classroom environments through a Web-based environment, researches in computer-supported collaborative learning need to capture the critical aspects of authentic learning. The guiding principles for the initial solution

for compute-supported collaborative learning takes into consideration the nine guidelines for authentic learning design proposed by Herrington, Reeves and Oliver (2010). The details of the design guidelines for authentic learning suggested by Herrington, Reeves and Oliver (2010) are listed as follows:

- Provide an authentic context that reflects the way the knowledge will be used in real life (Brown, et al., 1989; Reeves & Reeves, 1997)
- Provide authentic activities (Brown, et al., 1989; Reeves & Reeves, 1997).
- Provide access to expert performances and the modelling of processes (Collins, et al., 1989; Lave & Wenger, 1991).
- Provide multiple roles and perspectives (Honebein, Duffy, & Fishman, 1993).
- Provide collaborative construction of knowledge (Reeves & Reeves, 1997).
- Promote reflection to enable abstractions to be formed (Collins & Brown, 1988).
- Promote articulation to enable tacit knowledge to be made explicit (Edelson, Pea, & Gomez, 1996).
- Coaching and scaffolding by the teacher at critical times (Collins, et al., 1989).
- Provide authentic assessments (Reeves & Okey, 1996)

Authentic learning emphasizes on the design of authentic activities to support learning. The design of authentic activities is supported by Vygotsky's theory of learning from a social-cultural perspective (Vygotsky, 1978) where learning occurs through learners' activities within the social and physical environment. By considering the design characteristics of authentic activities, this study aims at constructing computer-supported collaborative learning environments that support the process of collaboration.

According to Herrington (2006), the kind of learning that aims at mirroring real-life situations do not necessarily mean to provide real experience, but rather to provide ‘cognitive realism’ (Herrington, Oliver, & Reeves, 2003) by implementing the essential characteristics of authentic learning environments that provide genuine learning opportunities for students. For example, when working on marketing research studies for companies, it is not necessary to place students in the ‘real organizations’. Teachers can simulate the learning environment for conducting marketing research within a company by creating ‘cognitively real’ learning environments. Research from Herrington, Oliver and Reeves (2003) shows that the

physical reality of the learning situation is less important than the characteristics of the task design and the learning facilities to engage students in the learning environment.

The design of the subject matter for the subject 'Advanced Marketing Research' is in line with the design principles for authentic learning. By focusing on the delivery of the subject for advanced marketing research through a group-based project that spanned across the delivery of the whole course, the course provided real-life marketing research problems that have real-world relevance. In the AMR course, student groups with five to six members were required to work on real-world problems, decide on a research topic and conduct an empirical research for a selected company. For example, a project group might work on a research topic that related to an online shopping Web site Taobao.com in China (Ng & Cheung, 2011), and worked as a group to conduct marketing research projects relating to online shopping behaviours. They were required to collaborate with their team members to deal with ill-defined research problems through project tasks that were needed to be investigated over several months throughout the semester. They were also required to investigate the problem from different perspectives, including secondary, primary, qualitative or quantitative information.

As students work in a group, there are plenty opportunities for collaborations and reflection. Through the project, students were required to integrate different techniques in marketing research. The assessment of the different stages and techniques for research were integrated seamlessly with assessment, rather than through separate artificial assessments that were removed from the nature of the authentic task. The research in marketing research also integrated subject matters in different disciplines and different subject areas, including marketing, statistical analysis and consumer behaviours. At the final stage of the course, students generated a marketing research report to demonstrate their understandings of the research issues involved in the marketing process. The created product in the marketing research project conducted by the students represented a product that is valuable in its own right and allowed competing solutions and diversity of outcome in the learning process. Therefore, the theoretical framework for authentic learning and the design

characteristics of authentic activities can be applied to the pedagogical design of learning activities for a project-based marketing research course.

4.6. Guiding Principles for a Web-based CSCL Platform

Researchers have criticized that investigations on Web-based learning environments assume that e-learning systems are self-contained and that the contents of the e-learning modules contains the majority of learning materials that can be evaluated or simply accessed on downloaded by students. There are large numbers of researches that focus only on the different types of delivery mechanisms or comparisons of media studies. By employing a CSCL approach, this research emphasizes on the design of learning platforms to motivating learners to form strong bonds that encompass in-depth collaboration and productive teamwork. Through a theory informed design approach, this research aims at supporting the next generation of knowledge workers who are able to make use of social platforms to achieve higher learning outcomes, improved communication skills and enhanced problem-solving capabilities.

Throughout this research, it is argued that Web-based environments can be used to support authentic learning through careful design of authentic tasks and activities for teaching either through face-to-face or blended mode of learning. However, the use of e-learning support also depends on the contexts for which the Web-based facilities are being used in the University. Currently the Hong Kong Polytechnic University is adopting Blackboard as the learning management system for supporting traditional lecture-based teaching. Although the facilities in Blackboard does not preclude the use of Web facilities to support social and authentic learning, the current practices in the implementation of learning management systems (LMS) emphasize the efficiency in managing a very large number of subject contents, rather than supporting the collaborative learning process.

There is a tendency for the university to employ implementation and management strategies for learning management systems that focus on information delivery rather than learning. The administrative setup for the LMS focuses on the templates for posting a weekly schedule with readings and assignments, rather than providing a platform for creating and engaging authentic activities for substantial learning in the

course. It is also not possible to alter the normal set up for the LMS without special administrator privileges. Therefore, the Blackboard LMS is not considered as a feasible design environment for designing a CSCL platform for authentic project-based learning for marketing research.

Social media can act as an enabler of self-organization (Fuchs, 2008) and self-help processes that transform weak ties into effective collective structures of engagement and participation. Social media also contribute to the development of cultural capital by broadening access to digital content and environments which facilitate informal learning processes (Ala-Mutka, et al., 2009). Mass self-communication can reach a potentially global audience through peer-to-peer networks. Advanced social software allows the reformatting of almost any content in almost any form. It is also 'self-generated in content, self-directed in emission, and self-selected in reception by many who communicate with many' (Castells, 2009). To develop effective learning platforms, it is necessary to employ social software technologies that are familiar to learners. Proprietary social software like Facebook, together with open platforms like Google Applications offers disruptive potential for implementing computer supported collaborative learning environments from Web 2.0 collaborative facilities. As explained by Hedberg (2006), the adoption of Web 2.0 collaborative technologies represents a paradigm shift in employing 'disruptive pedagogy' that needs to be incorporated in the learning platform. This change represents a shift from learning management systems for structuring lecture contents to learning environments that emphasize on sharing among students. Therefore, a guiding principle for the design of a CSCL environment for project-based learning is stated as follows:

> Guiding *Principle 1*: The CSCL platform should provide support for social construction of knowledge, sharing of user-generated contents and portfolios for reflections.

In addition to the specifications for guiding *principle 1* to support the pedagogical options associated with the paradigm shift for Web 2.0 collaborative technologies, collaborative construction of knowledge is also important because authentic tasks are usually conducted as a group, rather than through an individual. The CSCL environment should therefore, provide appropriate means of communication

technology to encourage collaboration (for example, through emails, chats, discussion forums, blogs, wikis etc). The CSCL environment also needs to support meaningful reflections on the authentic context, task and other aspects of the learning process so that a portfolio of students' work is provided (Boud, Keogh, & Walker, 1985; Collins & Brown, 1988). The provision of reflection facilities in various forms also means a non-linear organization of materials and resources in the CSCL environments. The reflection facilities should also provide opportunities for learners to compare themselves with other learners at various stages of development (Collins, et al., 1989).

The design of online learning environment is concerned with computer-mediated platforms to support learning. Many researches in online learning emphasize on performing tasks purely online and ignore the important elements of articulation. According to Lave and Wenger (1991), being able to speak the vocabulary of a culture of practice is fundamental to learning. Authentic activities like group and public presentation of arguments for a project proposal is also important to enable articulation and defence of learning (Lave & Wenger, 1991; Pea, 1991). The rich opportunities for articulation are described by Edelson, Pea, and Gomez (1996):

> 'The act of speaking requires an individual to place a structure and coherency on his or her understandings that may lead the individual to recognize gaps in their understanding or forge new connections between formally disconnected knowledge … The social act of attempting to share and reconcile the knowledge of the different individuals motivates learning in a way that is much rarer … among solitary learners.'
>
> (Edelson, Pea, & Gomez, 1996)

One of the values of articulation is facilitated by peer tutoring, which assumes that reasoning and problem solving is the results of 'cognitive reorganization induced by cognitive conflict' (Forman & Cazden, 1985). Pea (1991) emphasizes that cognitive conflict occurs when a group of students are required to make a public presentation that consolidates different views and arguments making a defence. The importance of articulation is demonstrated by Pea (1991) in project-based learning through multimedia project presentations by students. The formal presentations require

argumentation and persuasion of the products of student projects and such presentations are open to critique.

Articulation is also supported by the cognitive apprenticeship model, where learners have the opportunities to observe other learners with varying degrees of skills and models of expertise. Although public presentations and group defences are conducted face-to-face, they impose an important design decision for a computer-supported collaborative learning platform. Collaborative groups incorporate inherent opportunities to articulate. Articulation requires supporting tools to facilitate learners with diverse backgrounds and different levels of expertise to reflect on their learning. The activities relating to articulation can best be supported by a variety of Web 2.0 based collaborative tools, including wikis, digital repositories, mini-blogs and discussion forums, document management tools, and project management facilities. Therefore, the development of a CSCL platform is mainly structured around small learning groups with five to six students. The following guiding principle is proposed:

> Guiding *Principle 2*: The CSCL platform should address the requirements for collaborative activities within a project group rather than within a class of students; it should also support articulation through Web-based facilities for reflection and consolidation.

In CSCL environments for authentic learning, coaching and scaffolding are mainly provided by the teacher and more capable students. Scaffolding is supported by Vygotsky's (1978) zone of proximal development, which is described as 'the distance between the actual development level as determined by independent problem solving and the level of potential development through problem solving under adult guidance, or in collaboration with more capable peers.' In order to facilitate coaching and scaffolding (Herrington, et al., 2010), the online learning environment needs to support authentic learning through collaborative technology, where more able partners can assist with scaffolding and coaching, as well as the means for the teacher to support learning via appropriate communication technologies. Another guiding principle is therefore proposed as follows:

Guiding *Principle 3*: Coaching and scaffolding assistance within a project group should be available by teachers, experts and more able partners and should be facilitated by the CSCL platform in a timely manner.

4.6.1. Design Considerations for Selecting Social Networking Platforms

The first stage for developing a design solution using social software tools follows the guidelines for design research (Reeves, 2006). A comprehensive literature review was conducted and is reported in chapter two of this thesis. Based on the requirement for developing a CSCL platform for project-based learning, the theory of situated learning was employed in testing with different implementations in the pilot studies. From the literature relating social software support for professional communities, the Elgg social networking software (Curverider, 2012) was found to be the most popular platform supporting communities of practice in different areas such education, law and medical education. An implementation of the Elgg social networking platform was tested by this researcher in the year 2009 with a multimedia based project course. The implementation of the software for project-based learning was reported by this researcher in a journal publication (Cheung & Wan, 2010).

Although Elgg is suitable for supporting sharing among communities of interest, the user interface provided by the software is too complicated and the software lacks the configurations to support group-based projects involving a large number of project groups (with over 20 project groups in the implementation). The user interface of Elgg enables efficient navigation within a social networking group in a community. However, as a teacher, there is a need to monitor closely the activities of each of the small groups closely (each small group forms a separate community), and it was very inefficient for the teacher to browse through various pages to identify a particular group for providing feedback. Furthermore, they lack the facilities to support scaffolding and coaching of over twenty project groups in an efficient manner. Since coaching and scaffolding assistance within a project group is important for project-

based learning, the social networking software Elgg is considered not suitable for the implementation for this research.

A pilot study involving the use of Facebook for supporting project-based communications was conducted in 2010 for the advanced marketing research course. Facebook was chosen as the social software for implementation because students were familiar with the social software and almost all students have a Facebook account (except one mature student in the class). In addition, Facebook provided a simple user interface to set up separate project areas for group-based communications.

The study was conducted using both quantitative and qualitative approaches. It was based on a case study with 75 students who were studying an advanced marketing research course conducted at the Hong Kong Polytechnic University. All students in a project-based subject were invited to participate in the data collection. The study employed a survey as well as a focus group discussion to collect data for analysis. The SPSS statistical package was used to analyse the data collected from the survey. At the beginning of the course, a Facebook interest group called 'Marketing Research' was developed in Facebook for communication and sharing relating to the subject matters.

In order to test students' adoption of the social software for project-based communications, a structured questionnaire was used to collect information about the students' attitude toward project communications on Facebook. The questionnaire included basic demographic information about the students, various aspects relating to the use of Facebook as well as four major constructs: 'social capital', 'Facebook intensity', 'privacy' and 'intention' to communicate with the Facebook project group. Different aspects of privacy were also considered in the questionnaire, in order to test their relationship with project-based communications. The variables that were being considered include: private relationships, Facebook intensity, previous experience, current status, video postings, date of birth information, contact information, blogs, friends list, group list, and privacy relating to photographs and pictures.

A multiple regression analysis on the survey data was conducted using the SPSS statistical package. The results showed that heavy users of Facebook would be more willing to use Facebook to communicate with their teachers. In addition, there were

two factors that are found to significantly affect students' intentions to communication with their teachers in Facebook: personal photographs were the major privacy concern for students while students communicated with the teachers; and there was also a significant negative relationship between the release of personal information (such as personal relationships) and students' use of Facebook for project communications.

The results of qualitative studies using a focus group interview also confirmed the conclusions from quantitative research. Although students were curious to know about the profiles and daily communications of the teachers, some of the students were reluctant to establish a communication channel with the teachers through Facebook. In particular, students mentioned about the private information that were released to 'friends' in Facebook, and some of the students just preferred to participate in private communication groups in Facebook without including the teacher as 'friends' in their daily communications. For the use of social software for project-based communications, the following guiding principle is established:

> Guiding *Principle 4*: When social software is employed for project-based communications, students prefer social and academic communications to be separated.

The development of this guiding principle is also in line with previous studies by other researchers concerning the use of social networking software in academic environments. Recent studies show that the majority of Facebook users are students and many students feel that teachers who use Facebook are lacking credibility as they may be presenting a different kind of self-image through online social networking sites, and this may have a negative impact as students may perceive instructors as attempting to interfere with their social space through such kind of social software technologies (Mazer, et al., 2007).

4.6.2. Pedagogical Design for Collaborative Learning with Web 2.0 Environments

Before implementing a solution for Web supported project-based learning, the CSCL platform needs to be developed with guidelines from technological innovations. The

development of Web 2.0 technologies presents a new challenge for designing CSCL environments. Web 2.0 is broadly defined as the second generation of the World Wide Web, or 'Read-Write Web' (Price, 2006; Richardson, 2006) that is developed with a more personalized communication technology providing active participation, connectivity, collaboration and sharing of knowledge among users. The features of Web 2.0 technologies are often characterized by social networking systems that provide collaborative facilities for people to communicate and collaborate through the Web. Because of the pervasive nature of these communications, the use of social networking tools is often not limited by a particular kind of social networking software systems implementation. In this research, the term 'Social Software' is used to define the software that supports group interaction (Shirky, 2003) facilitated by Web 2.0 technologies. In this study, collaborative technologies are defined as the set of tools for collaboration facilitated by social software. Therefore the pedagogical design of CSCL environments needs to consider the affordance offered by Web 2.0 and social software-based collaborative technologies.

In the context of Web 2.0 learning environments, the affordance of a technology is the action that an individual can potentially perform in the environment with the use of a particular technology (Gibson, 1977). In other words, the affordance is not predefined by the functionality of the technologies. Rather, it depends on the possible context and application that enable the users to perform the tasks associated with the environment. For collaborative learning in project-based environment, researches in Web 2.0 practices (McLoughlin & Lee, 2007) have identified the affordances offered by social software tools as: connectivity and social rapport, collaborative information discovery and sharing, content creation, knowledge and information aggregation and content modification. It is therefore important to ensure that the characteristics of the learning tasks should be defined clearly to enable learners to shape the possibilities that the learner is able to interact with the technology.

The adoption of social and collaborative technologies for supporting project-based learning must be based on understandings of the learning context supported by learning theories. In the case of project-based learning for marketing research, the underlying framework for the design of learning activities is defined by the theory of authentic learning, where the teacher plays the important role of a facilitator. In order

to facilitate learning in a Web 2.0 environment, the design of learning must be supported by a sound pedagogical framework that exploits the affordance and connectivity offered by the social software technologies. The pedagogy 2.0 framework developed by McLoughlin and Lee (2008) provides guidelines for designing effective learning environments, such as choice of resources, tasks, learning support and communication modalities. The characteristics of the Pedagogy 2.0 framework are described by McLoughlin and Lee (2008) as a pedagogical framework that enhances learning through the use of Web 2.0 technologies.

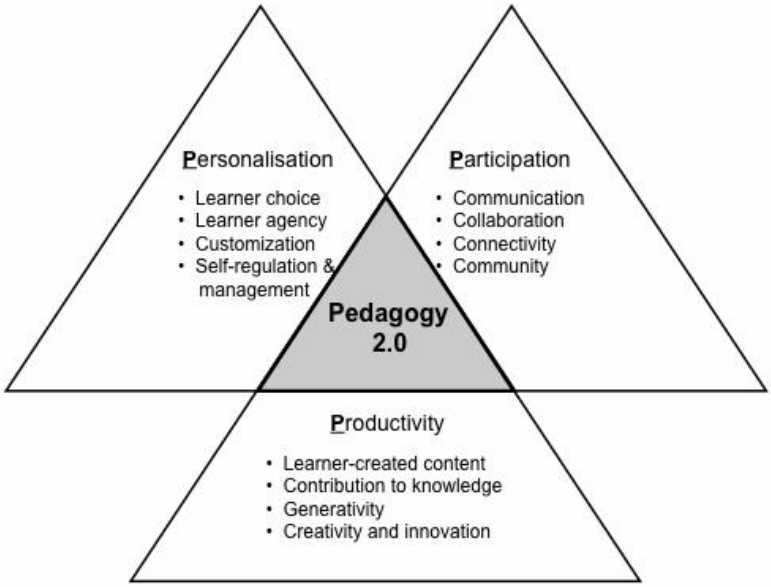


Figure 4-2 Pedagogy 2.0 (Source: McLoughlin & Lee, 2008)

Pedagogy 2.0 focuses on the design of learning resources that exploits the affordances of Web 2.0 technologies. It consists of the guidelines to be used to develop learning environments to support a student-centred approach. With a networked society, learners are able to participate and access to ideas, resources and communities. This type of learning is driven by needs and choices (personalization), and students should be able to develop skills management the project activities and develop self-regulatory skills. The pedagogies should engage learners in the social processes of knowledge creation (productivity) rather than just acting as consumers of information. The core principles of Pedagogy 2.0 are represented by the overlapping elements of participation, personalization and productivity (as shown in Figure 4-2). Therefore, a design guideline relating to the learning outcomes associated with the use of a Web 2.0 CSCL environment is:

Guiding *Principle 5*: Design of Web 2.0 CSCL environments must address the important elements of Participation (Communication, Community, Connectivity and Collaboration), Personalization (Learner Choice and Informed Decisions, Learner Agency, Customization, Self-regulation and Management) and Productivity (Learner-created Content, Contribution to Knowledge, Generativity, Creativity and Innovation).

Participation: By employing social software and collaborative technologies, it is important to engage learners in communications with their peers, lecturers and domain experts. Through the communication facilities available in Web 2.0 environments, students can participate in learning communities (Lave & Wenger, 1991) that mirror the practices of professionals in marketing research. They are able to make strong connections with peer learners and communities of interest. Learning and participation can also be enhanced through collaboration with their peer group members.

Personalization: In an authentic project-based environment, it is important for learners to take responsibility and have control over their own learning process (Dron & Anderson, 2009). Therefore, through the implementation of Pedagogy 2.0 principles, learners have the freedom to engage in learning that is meaningful to them. Social software enables users to make their own choice on tools that best meet their goals and needs for connections and interaction. The pedagogical design must make sure that learners are capable of making informed educational choices. In this kind of learning environment, learner agency (learners are responsible for their own learning) becomes an important element to ensure efficiency in learning and students need to develop self-regulation and project management capabilities. In addition to facilitation of self-direction and learner control, the pedagogical design must also supply the necessary structuring and scaffolding.

Productivity: The Pedagogical 2.0 model argues that the ultimate goal of learning is to enable creativity and productivity of knowledge. Therefore, the social software environment should facilitate the discovery of knowledge, user-generated contents

rather than emphasizing on instructor-supplied contents. Social media makes it easy for users to generate ideas and contents, promoting creativity and innovation.

The core principles of Pedagogy 2.0 (Participation, Personalization and Productivity) serve as guidelines for the design of learning environments using social and collaborative technologies. These guidelines also serve as the desired learning outcomes that are enabled through a Web 2.0 CSCL platform because the Web 2.0 facilities provide a record of participation, reflection and knowledge creation among the learners. According to McLoughlin and Lee (2008), student productivity can be measured in addition to completed project/assignment work or deliverables. It may also incorporate 'evidence of the process of learning that is representative of the complexity and "messiness" of an authentic, problem-based learning experience, such as successive drafts of solutions, descriptions of mistakes made, or difficulties encountered. Student-generated content may also include synchronous and asynchronous computer-mediated communication (CMC) discourse such as chat logs and discussion board postings, reflective writing in the form of blog-based diaries, summaries, and reviews, created by students working individually or in teams. It may also include "found" content, including the results of students' own wide reading, digital repositories gathered from websites, journals, magazines, and news articles that are brought to, and shared with others in, the learning environment'.

4.7. A Technological Design Solution for CSCL

The previous sections provide the review of literatures to develop a theoretical framework for designing a CSCL platform to support project-based learning. The purpose of the review is to conceptualize a proposed solution within the theoretical frameworks, and to identify the critical elements of computer-mediated environments to support project-based learning in marketing research. Based on the literature review, five guiding principles are proposed to aid the development of a CSCL platform to support teaching and learning in a project-based environment. The details of the guiding principles are summarized in Table 4-2, together with the source of literature for the guiding principles.

It is important to note that the characteristics of the five guideline principles listed in Table 4-2 are neither finite nor fixed. Further research will provide refinement and enlightenment on the guiding principles that can inform the development of a CSCL platform employing collaborative technologies for project-based learning. To develop an initial design solution, the five guidelines developed for this research are essential for reflecting the essence and important characteristics of a CSCL environment to support project-based learning. These guidelines will be developed with additional research iterations to develop generalizable design principles.

Table 4-2 The draft guiding principles

	Guiding Principles	**Supporting Literature**
1.	The CSCL platform should provide support for social construction of knowledge, sharing of user-generated contents and portfolios for reflections.	Hedberg (2006)
2.	The CSCL platform should address the requirements for collaborative activities within a project group rather than within a class of students; it should also support articulation through Web-based facilities for reflection and consolidation.	Pea (1991); Lave & Wenger (1991); Stahl (2006); Edelson, Pea, and Gomez (1996)
3.	Coaching and scaffolding assistance within a project group should be available by teachers, experts and more able partners and should be facilitated by the CSCL platform in a timely manner.	Vygotsky (1978); Herrington, Reeves, & Oliver (2010)
4.	When social software is employed for project-based communications, students prefer social and academic communications to be separated.	Cheung & Vogel (2011b); Mazer, Murphy, & Simons (2007)
5.	Design of Web 2.0 CSCL environments must address the important elements of Participation (Communication, Community, Connectivity and Collaboration), Personalization (Learner Choice and Informed Decisions, Learner Agency, Customization, Self-regulation and Management) and Productivity (Learner-created Content, Contribution to Knowledge, Generativity, Creativity and Innovation).	McLoughlin & Lee (2008)

Before any data is collected to address the research questions relating to the adoption and use of collaborative technologies facilitated by social software, it is necessary to develop a CSCL environment in stage two of the design research process (as shown in

Figure 4-3). Before the learning activities can be supported by a computer-mediated environment, it is necessary to develop a technological solution comprising a Web-based platform to support collaborative learning.

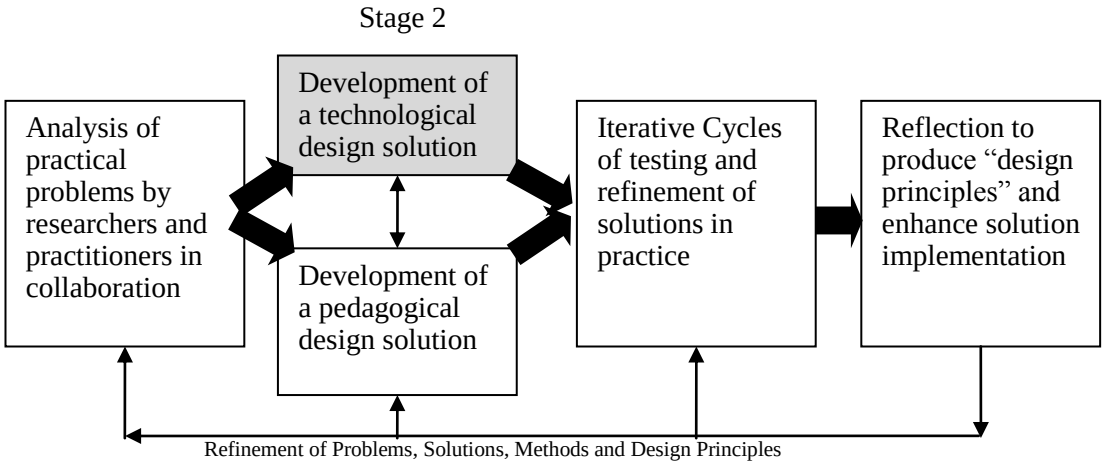


Figure 4-3 Development of a technological design solution in stage two (Source: Reeves, 2006)

An example of the CSCL platform for project-based learning is shown in Figure 4-4, where the collaborative environment integrates Google Sites, Discussion Forums, Google Docs and a shared file space for group projects. The project Web site reported in this study was generated from social software tools employing the use of a Google site template that was published for educational purposes. It was designed as a CSCL platform to support an 'Advanced Marketing Research' course for undergraduates. In this subject, students participated as researchers in a marketing research project for selected companies.

This kind of authentic learning scenario allows students to collaborate with their team members to investigate research frameworks, develop research reports, and demonstrate their understandings on the research issues involved in the marketing process through the use of the CSCL collaborative platform. The social and cultural impact of this kind technology is that they offer a new form of communication realm, where the learners involved in the participative media are globally interactive. Any user with a Google account has the potential to participate in the learning process and access the user-generated contents through the social connections offered by the participative media available in the Google Applications platform.



Figure 4-4 A Student project Web site implemented using Google Applications technology

Description of the CSCL platform for project-based learning

In the CSCL platform, there were various facilities for students to communicate and work with group members, such as discussions in Google forums, uploading and downloading documents for sharing, Web site updates, and collaborative editing of Web pages. Students used a gmail account to collaborate on their project activities through a project Web site. Teachers can also comment on students' project work through the Web site. Social software tools from Google Applications technology were used for developing the CSCL platform for project-based learning. They include: (1) Google site, (2) Google forms, (3) Google documents, and (4) Google forums. Although the CSCL platform was mainly developed using social software tools, a design decision was to develop a collaborative platform separated from students' private communications for social networking (according to guiding *principle 4*). As students were using Facebook as a communication channel for private

communications, the problems associated with privacy of information were avoided while students were using the Google account to work on the collaborative activities.

The project Web site served as a common workspace for organizing tasks and accumulating various sources of information for making project-based decisions. The CSCL platform employed various components of the social software tools that were organized using a menu structure. Through the project Web site, students worked collaboratively in a group, handle their project documents, manage updates with wikis, and host discussions among group members. Various functions were provided in the Web site, including project definition, project update, files, benchmark dates, survey form and time trackers. As shown in Figure 4-5, the project Web sites showed various levels of activities within a project group, highlighting the recent updates, shared resources, comments and activities within a project group.

The development of the computer-mediated environment was based on the pedagogical approach that takes advantage the affordance of Web 2.0 technologies for knowledge sharing. Based on guiding *principle 2*, the collaborative platform was designed to address the requirements for group-based collaborations. The various functions provided by the project Web site facilitated project-based learning in an interactive environment. The design decision was to develop the project Web site to focus on collaborations among small project teams with five to six students. In this example, students collaborated on a marketing research project relating to the tourism industry.

The Web 2.0 supporting tools in the CSCL platform facilitated learners with diverse backgrounds and different levels of expertise to reflect on their learning through the marketing research project. With project-based learning in small teams, the collaborative platform allowed students to share ideas among the project team members. By employing the Google Applications account to access the CSCL platform, the access privilege of the project resources within a project group was limited to peer group members. By designing the CSCL platform according to guiding *principle 3* for coaching and scaffolding assistance timely within a small project group, project group members can share the resources with their peers and instructors.



Figure 4-5 A project discussion page

The pedagogical design of the learning environment was to move away from the knowledge acquisition metaphor of learning to the participation metaphor of learning (Sfard, 1998), where learning is seen as a process of participation in various cultural practices and shared learning activities. The social software tools implemented in the CSCL platform allowed learners to engage in the processes of social interaction, dialogue and sharing. By employing a participation metaphor of learning, students make connections with their peers, and make new insights and ideas in the process of inquiry into the research topic.

As example to encourage participation in project-based learning, the project discussion page of the CSCL platform was implemented to facilitate learning in marketing research activities that were located in communities of practices (Wenger, 1998). As shown in Figure 4-5, through the project discussion page, students can communicate with team members by subscribing to new posts. They were alerted by email when new messages were posted by the team members. Each member of a project group participated by commenting and uploading files to support their participation. Through the Web-based facilities, the peer group members collaborated on their research project to develop as a community of interest, by interacting with peer members in a timely manner, and sharing knowledge and learning resources within their project group.

By employing Web 2.0 tools that were facilitated through the CSCL platform, students become producers as well as consumers of information. Such kinds of student-generated contents may also include literature sources and peer evaluations of the work of other group members. The students-generated contents were also recorded as activities that appeared in the log file of the CSCL platform. The various types of information can be represented as e-Portfolios (Love, Mckean, & Gathercoal, 2004) that incorporate evidence of the process of learning through reflections on students' work.

The Web 2.0 tools and facilities also supported collaborative reflections (Prilla, Knipfer, Degeling, Cress, & Herrmann, 2011) by supporting individual reflection through sharing understanding of the marketing research problems within a project group. Articulation was also supported by the need for learners to observe and work with other learners with varying degrees of skills and models of expertise to reflect on their research activities (according to guiding *principle 2*). Through the CSCL platform, the activities relating to articulation were also supported by a variety of collaborative tools, including wikis, digital repositories, and discussion forums, document management tools, and project management facilities.

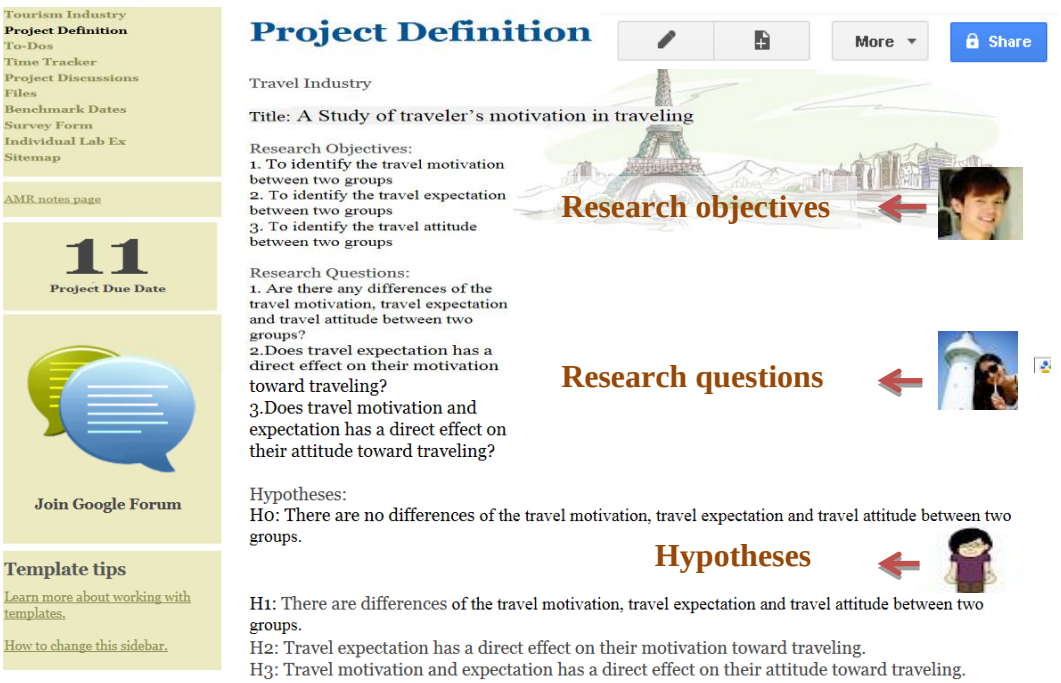


Figure 4-6 A problem definition wiki page

The design of the various Web 2.0 tools and facilities was in line with the guiding *principle 1* for providing interaction support for social construction of knowledge, sharing of user-generated contents, and portfolios for reflections. An important element in the design of the collaborative platform was the use of wiki in the project Web site pages. Each page in the project-based platform was developed using wiki tools for collaborative editing (as shown in Figure 4-6). The benefits provided by wiki tools were that these wiki pages were easy to create and modify. As depicted in Figure 4-6, all project group members can construct the problem definition collaboratively by different members editing on different sections in the wiki page relating objectives, research questions and hypotheses. An advantage offered by the wiki tools was the positive interdependence offered in the design so that the success of individual work could be linked to the group collaborations for the project. Furthermore, the activity log also showed the contributions of all group members, allowing the instructor to assess the quality and quantity of the contributions from different project team members.

In a project-based environment, scaffolding is defined as the assistance to enable a learner to accomplish a task that is otherwise not possible without such help. The concept of scaffold is described by Vygotsky (1978) as 'the distance between the actual developmental level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers'. Scaffolding was supported by collaboration in groups through a CSCL platform as shown in Figure 4-5 and Figure 4-6. When students subscribed to the Web pages of the collaborative platform, students were able to access the comments from other's work in a timely manner, providing coaching and scaffolding assistance for significant portions of the project-based activities.

The subscription and group access facilities can be managed by students to include the instructor and subject matter experts to participate in the peer group discussions. Therefore, the design of the collaborative platform was implemented in line with the guiding *principle 3* for articulation and reflection within a small project group to support for coaching and scaffolding. Furthermore, the document sharing facilities and 'Web-based storage' facilities (in the document management page) provided support for version control for both Microsoft and Google documents (as shown in

Figure 4-7). Coaching and scaffolding can be centred on these shared knowledge objects, resulting in different versions of the project documents through subsequent changes. Such kind of coaching by referring to the shared knowledge objects would not be possible otherwise without the use of a computer-supported learning environment for project-based learning.

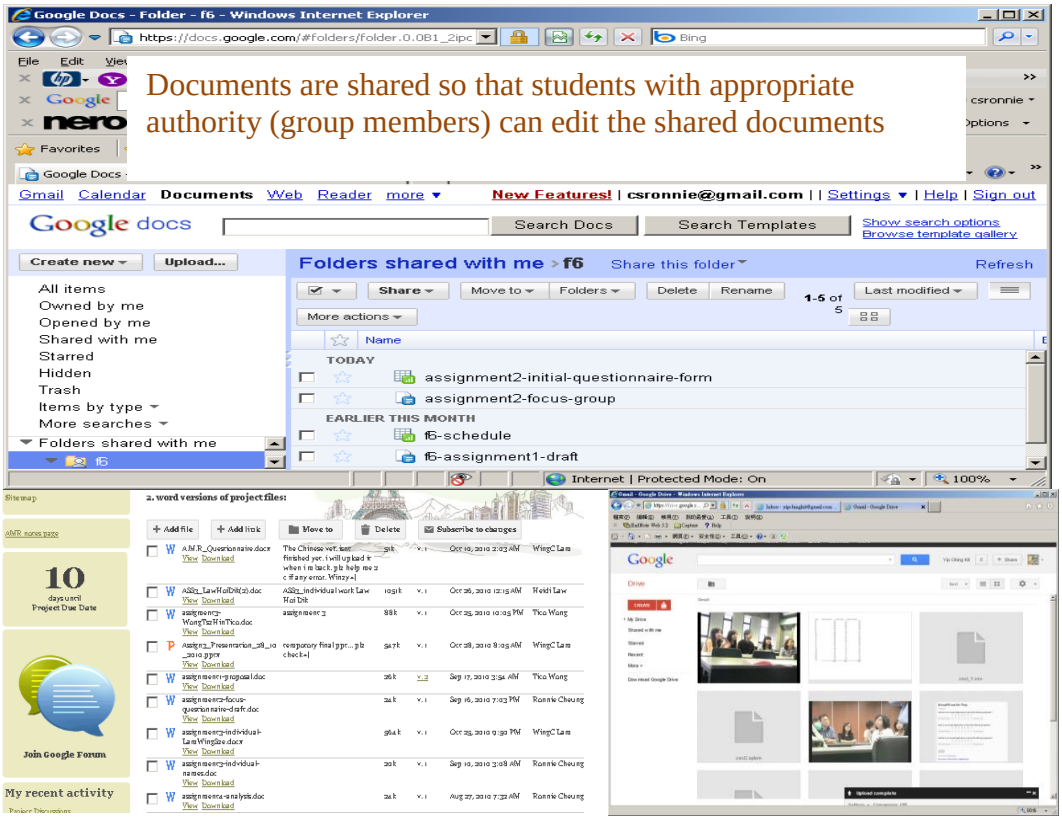


Figure 4-7 A document management page

This kind of dialogical approach to learning facilitated by the collaborative learning environment was supported by the participation metaphor of learning (Sfard, 1998). The various tools offered by the collaborative platform facilitated learning as a process of growing up and socializing to a community of interest through active participation. The various types of participation within a project group were facilitated through different types of activities, including communication, collaboration, connectivity and community (McLoughlin & Lee, 2008). According to guiding *principle 5*, elements of participation, personalization and productivity constitute the major learning outcomes of the Web 2.0 pedagogy for implementation in the CSCL environment.

The personalization aspects of the Web 2.0 pedagogy include elements of learner choice, learner agency, customization, self-regulation and management. The implementation of social software tools in the CSCL platform enabled choices and allowed the learners to make decisions on the best tools that suit their learning goals and stay connected with the project group members for social interaction. This flexibility allows learners' to control over their learning processes, and be responsible for their own learning is a core element of the Web 2.0 pedagogy. Such kind of environment promote learner agency, where learners were responsible for their own learning experience. The project Web site facilitated personal learning environments through customizable facilities. The project Web site also provided facilities (as shown in the template information in the lower left corner of Figure 4-4) for students to customize the Web-based template to cope with individual learning needs. Finally, the elements of self-regulation were supported through the use of project planning tools. Students were responsible for planning their key milestones through the use of Google Calendar implemented in the project Web site (as shown in Figure 4-8).

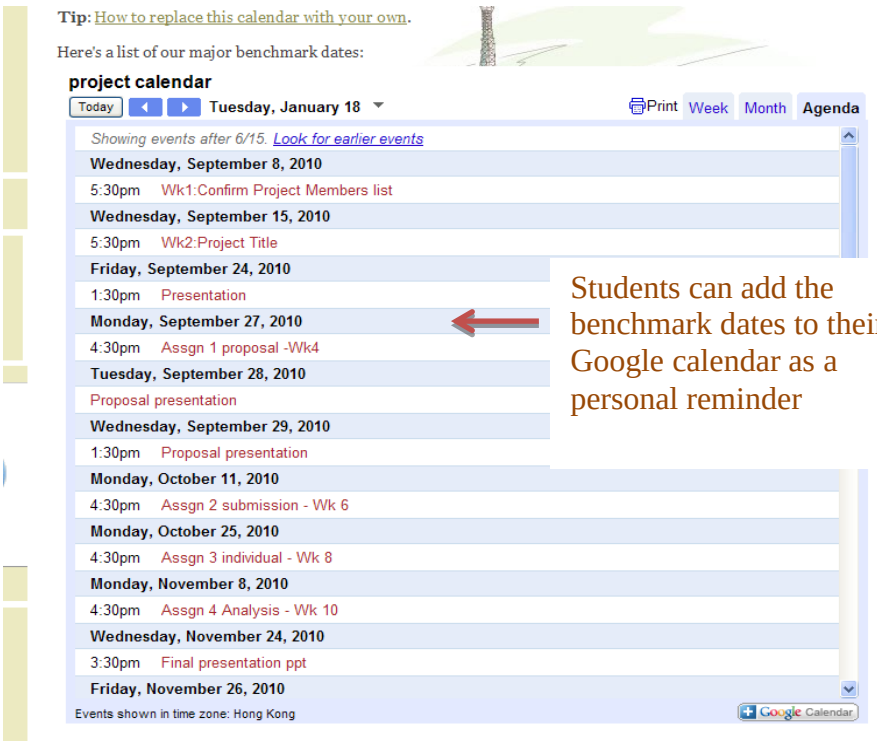


Figure 4-8 Benchmark dates page of the Google site

In terms of productivity, the Web-based environment facilitated user-generated contents, promoting creativity and innovation through processes of joint knowledge creation. The Web 2.0 environment was used to foster learners' abilities in term of

generativity in a Web environment to create, generate, or produce new contents from the Web supported learning environment.

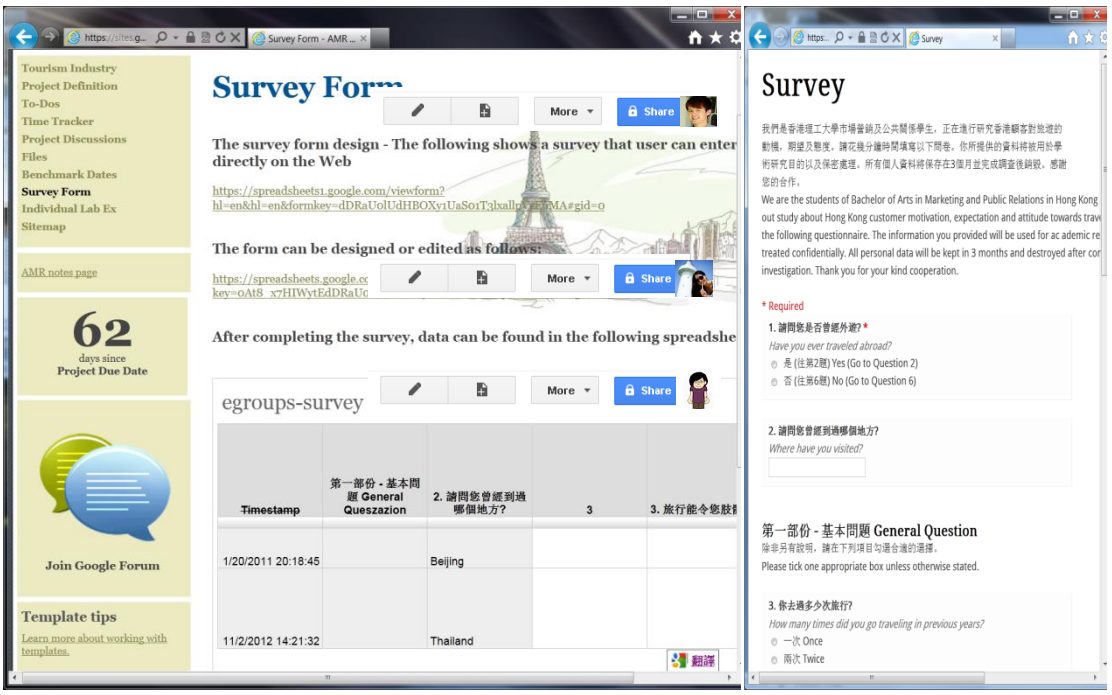


Figure 4-9 Survey form page of the project Web site

All the features of the five guiding principles were implemented through the various facilities provided by the CSCL platform to support the marketing research projects. Through the collaborative platform, students were able to generate new knowledge through a research process to support marketing decisions. These activities were also supported through the use of survey forms in the project Web site (as shown in Figure 4-9). Through the online questionnaire editing facilities, students can collaborate to construct project questionnaires online through the project Web site. Different project group members can contribute to questionnaire items by editing the questionnaire form using their Google accounts. The quantitative data collected from the Web-based survey can be downloaded from the students' Google account for subsequent data analysis. The Web-based facilitates provided a central area for gathering, storing and managing marketing research information, in order to support the processes of knowledge creation and advancement.

Most of the facilities in the collaborative platform were used to support learning in small groups. Additional facilities were provided to facilitate learning at multiple

social levels, and to investigate the sharing of information among different project groups during the delivery of the marketing research classes. As shown in Figure 4-10, a Google forum was implemented to facilitate communication with a class of students, in order to experiment with more global types of interactions among students in the class.

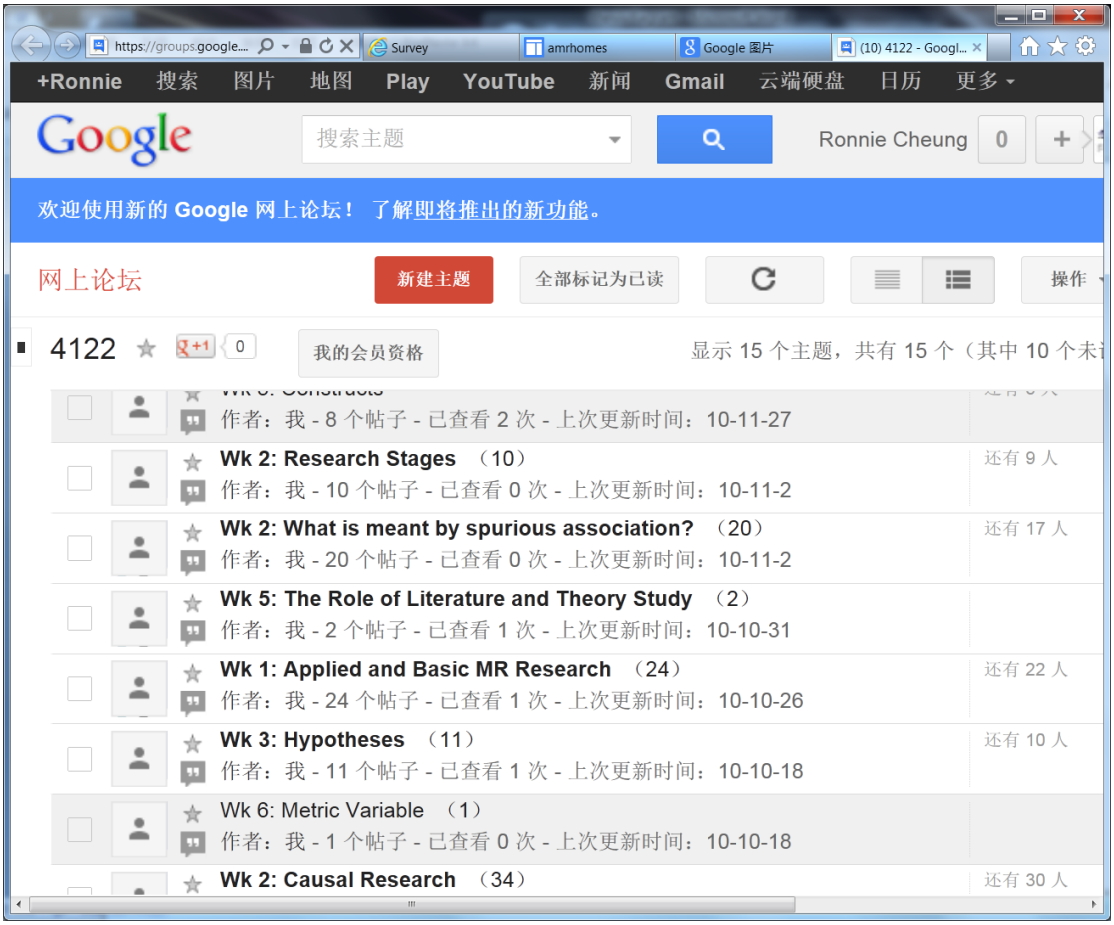


Figure 4-10 A Google forum for sharing between students and teachers

4.8. Chapter Summary

This chapter presents the development of a technological design solution employing facilities from Google Applications technology. The significance of the problem with reference to the learning context is presented. This is followed by a literature review relating to authentic learning, project-based learning, Web 2.0 learning environments, and a review of the literature relating to the pedagogical designs of learning environments that exploits capabilities of social software tools. The review consolidates the principles that were used to develop effective learning environments

by various researchers and a set of guiding principles are used to inform the development of a technological design solution. This chapter also provides the details of a technological design solution for collaborative learning. The CSCL platform presented in this chapter represents the technological component of the design solution for collaborative learning. Another component of the design solution consists of the pedagogical design of authentic learning activities for project-based learning. The development of the pedagogical design for learning is based on an activity perspective and is presented in the following chapter.

Chapter 5
An Activity Perspective for Computer-Supported Collaborative Learning

5.1. Introduction to the Chapter

The previous chapter describes a technological design solution consisting of a CSCL platform to support authentic learning in a Web supported environment. The technological component of the design solution is informed by the guiding principles from literature and technological innovations. In order to develop a solution for the practical problem relating to the introduction of collaborative technologies for project-based learning, the major design solution is composed of two components (as shown in Figure 5-1): the technological solution consisting of the CSCL platform, and the pedagogical design solution comprising the design of learning activities and the analysis of activities for implementation.

The pedagogical design of authentic learning activities relates to the development of assignments and tasks associated with learning. It also involves mapping of the Web-based tools and resources in the CSCL platform to support collaborations and interactions among students. The analysis of activities provides understanding of the collaborative tools in the CSCL platform that can be employed to support project-based learning among students. An activity perspective (section 5.2.1) enables the research to position the pedagogical solution within a theoretical framework, and facilitates the analysis of the socio-cultural issues associated with the introduction of the CSCL platform. The following sections describe the pedagogical design of learning activities that are being employed to support learning (sections 5.2.2, 5.2.3, 5.2.4), together with the application of the activity-oriented design method (section 5.3) for project-based learning. It also serves as the second component of the design solution, consisting of the pedagogical design solution for learning.

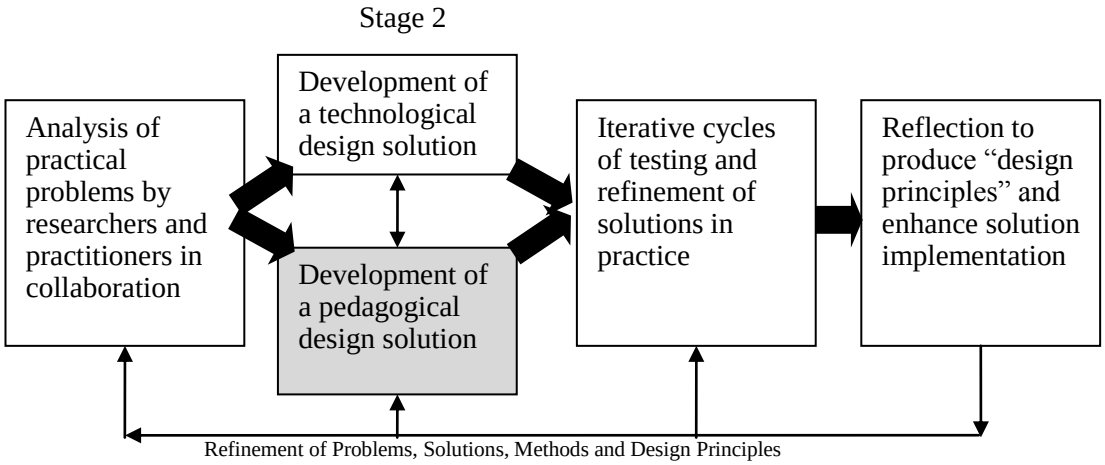


Figure 5-1 Development of a pedagogical design solution (Source: Reeves, 2006)

The Web-based platform described in the previous chapter serves as a design component for computer-supported collaborative learning. However, e-learning support for project-based learning is different from conventional content-based courses. In order to design an effective learning environment, the pedagogical design solution and the learning activities need to be carefully analyzed before a computer-mediated platform is implemented to support students' learning. In particular, the various components of the design solution need to exploit the capabilities of the Web 2.0 tools for supporting user-generated contents that are offered by the collaborative technologies in the Google Applications platform, in order to address the following research question:

> RQ1: How to design an effective computer-supported collaborative learning environment using social networking, collaborative, and user-generated technologies for group-based collaborative learning?

5.2. Development of Solutions for Learning: The Pedagogical Design of Learning Activities for Project-based Learning

According to guiding *principle 1*, a design solution to support project-based learning represents a paradigm shift from supporting content delivery to learning environments that emphasize on interaction and support for social construction of knowledge, sharing of user-generated contents and portfolios for reflections on learning. This represents a shift of dimension from the institutional emphasis on standardization of

learning contents to another paradigm where learners are responsible for their own learning and choices in the personalization of the learning process. By empowering learners to take responsibility in control of learning in their projects, students gain ownership of their learning activities to achieve effective learning outcomes. However, such approach still requires a certain amount of structuring to ensure that collaboration and sharing takes place through careful design of the learning activities. In the following sections, the pedagogical design solution from an activity perspective is described in detail.

5.2.1. An Activity Perspective

A learning activity is defined as 'a specific interaction of learners(s) with others using specific tools and resources, oriented towards specific outcomes' (Beetham, 2007). It represents a way to support a design solution for learning and a way of providing relevant information for the learning design, including its principles and theories. An activity can be initiated by a marketing research project conducted to gain understandings of consumer behaviours. It can also emerge from a project task to collect data from a survey from research participants or a specific kind of interaction among learners to collaborate with each other to construct knowledge.

The concept of activity is derived from the principle that knowledge is constructed from the practices of meaning-making in the context joint activity. It provides a theoretical lens to understand the collaboration among practices in knowledge building. Activity theory is originated from the social-cultural theory of Vygotsky (1978) and is articulated by Engeström (1999a). According to Vygotsky, human beings do not interact directly with the environment. They do so through the use of tools or mediating artefacts. According to Vygotsky's theory of mediated action, a subject interacts with an object through the use of tools. Activity-oriented design method provides a useful framework for the design of collaborative learning environments because it posits that learning takes place as learners engage in activities. The goal of activity systems is to transform the object (objective) into an outcome through a mediating tool or artefact. It is through the use of tools or mediated artefacts that human subjects develop socio-cultural perspectives in the learning process. Activity-oriented design method offers a comprehensive method for capturing the relationships that are derived from group and individual perspectives. In

order to analyze the adoption of a CSCL platform, it is necessary to ensure that the platform and collaborative tools are being used through sharing and collaborative activities.

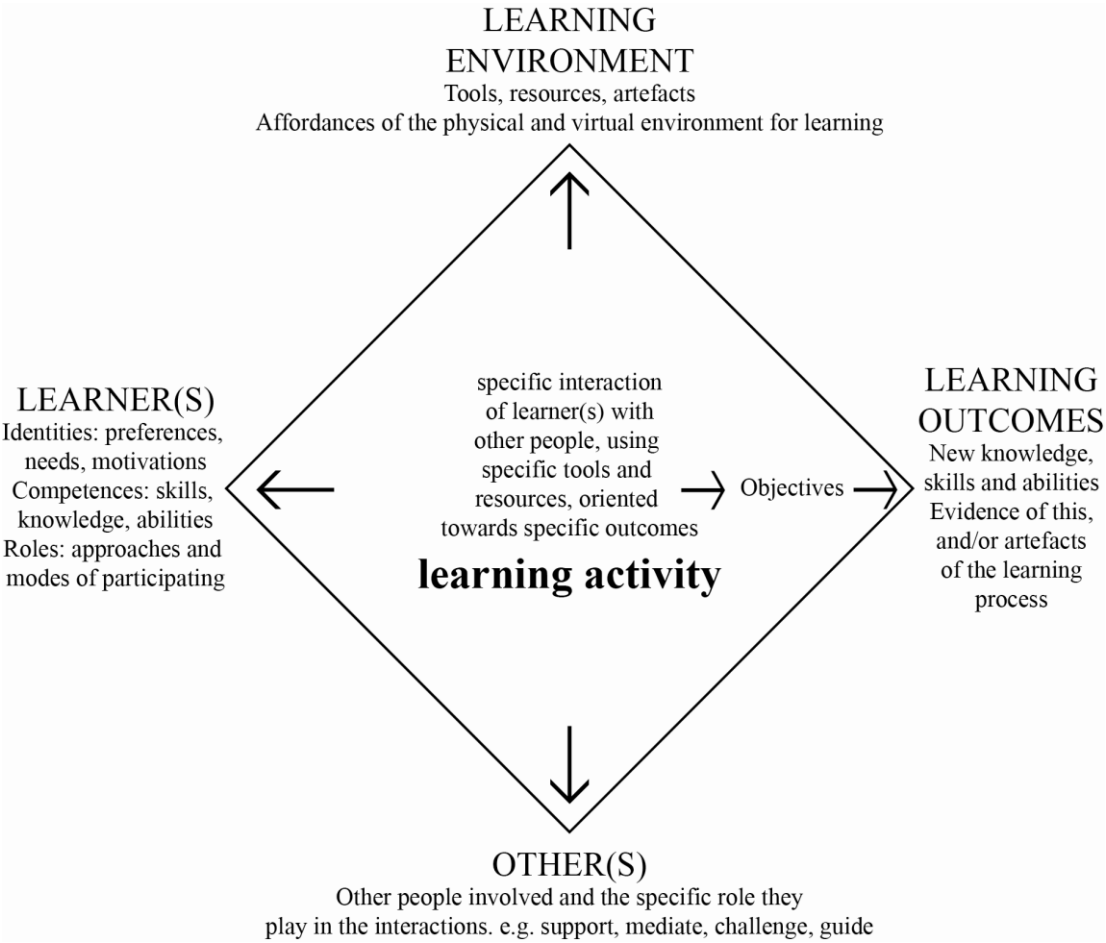


Figure 5-2 An outline of a learning activity (Source: Adapted from Beetham, 2007)

An outline of a learning activity (Beetham, 2007) is shown in Figure 5-2, with its component elements that are derived with a similar concept from activity theory. This kind of approach has proved to be useful to technology researchers in analyzing learning technologies that are used for collaborative learning. As a kind of learning activity, an interaction emerges as the learner engages in a task. The elements identified in the learning activity can be highly interdependent and can only be defined when the activity is being completed. Therefore, practitioners have defined ways to consider elements separately for considering sub-activities in the analysis. In order to provide an understanding of the collaborations that exist in the learning activities, this study employs an activity perspective for understanding collaborations among students through the use of tools or mediated artefacts.

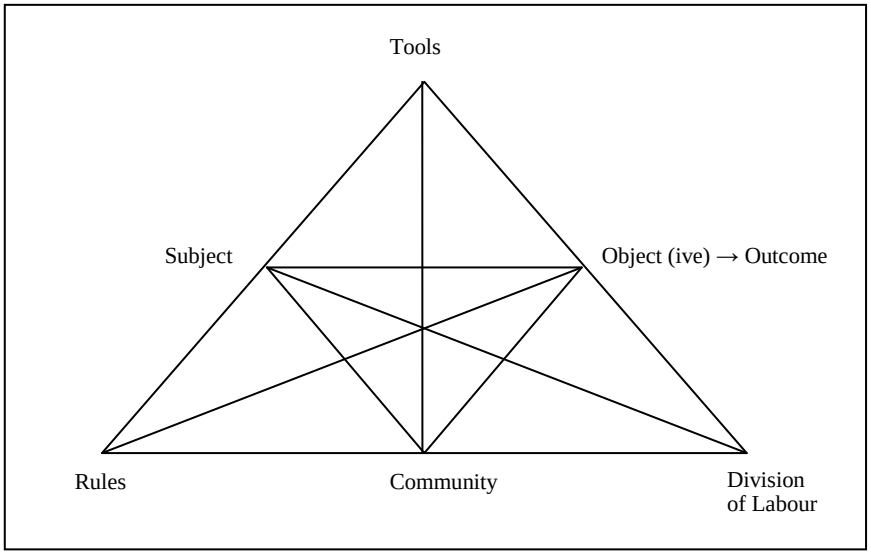


Figure 5-3 The activity system (Source: Engeström, 1987)

The activity system established by Engeström (1987) is shown in Figure 5-3. It contains components that are organized to accomplish the activities of the activity subsystems, including subjects, objects and their associated outcomes, tools, rules, community and division of labour. The subject represents the individual or groups of members engaged in the activities. The object represents the motive or problem space and the goal of the activity system to transform the object (objective) into a useful outcome. The tools represent the artefacts used in the human activity, including physical objects and other resources. Rules represent the explicit regulations, policies, norms, expectations and conventions that constrain the means by which the activity is carried out. The community consists of individuals and groups of members who engage their efforts on the object. Division of labour refers to the construction of roles and responsibilities among the members of the community. The activity system shown in Figure 5-3 can also be considered as an expanded form of the basic mediational triangle developed by Vygotsky. In the activity system, the relationship between subject and object is mainly mediated by tools; the relationship between subject and community is mainly mediated by rules; and the relationship between community and object is mainly mediated by division of labour.

5.2.2. The Advanced Marketing Research Course

The following sections describe the design solution for the learning activities in the advanced marketing research course. The subject ‘Advanced Marketing Research’

(AMR) is a subject taught at the Hong Kong Polytechnic University for the BA in Marketing and Public Relations programme. As a core subject, it aims at facilitating students to solidify and acquire a firm understanding of the fundamental concepts in advanced marketing research and to apply them to develop a proposal to conduct a marketing research project, including actual data collection and data analysis using relevant statistical tools to support marketing decisions. It also provides students with the opportunity to practice report writing and to refine their presentation skills which will be useful in business environments. The learning outcome of the course is defined by the following skills that students will be able to achieve at the end of the course:

- To explain the concepts and techniques for conducting both qualitative and quantitative research;
- To identify the information requirements for conducting research projects and Marketing Information System;
- To develop a marketing research proposal;
- To design a questionnaire, conduct field work for an empirical survey, employ relevant statistical tools for quantitative analyses, and write a research report;
- To recognize the ethical and social responsibilities inherent in the market research project.

In the AMR course, collaborative teams with five to six members were required to work on real-world problems, decide on a marketing research topic and conduct an empirical research for a selected company. For example, a student group may work on a research topic relating to an online Web site Taobao.com in China (Ng & Cheung, 2011), and work as a group to conduct empirical marketing research projects. They were required to collaborate with their team members to conduct a real-world research, generate a market research report and provide presentations to demonstrate their understandings of the research issues involved in the marketing process. The AMR subject was based on project-based learning. Structuring the course around an authentic project on marketing research provided excellent opportunities to promote collaborative knowledge construction required for problem solving. The contact hours consisted of 42 hours of face-to-face class teaching, including lectures, tutorial and

project-based laboratory sessions. The subject followed the school calendar with a semester consisting of 14 weeks. The assessment of the subject was mainly based on project work. The group-based project component accounts for 70% of the assessment, with 15% of the assessment based on quizzes on marketing research concepts, and 15% of the assessment is based on participation during project work, Web-based activities and reflections on learning.

During the delivery of the subject, the instructor employed a variety of collaborative assignments and activities to provide opportunities for students to develop a marketing research plan, to set up data collection methods (including questionnaire designs), to collect real market data, and to apply problem-solving skills to solve real world marketing problems collaboratively. The design, adoption, and use of social-enabled collaborative technologies would therefore provide exciting opportunities for supporting collaborative learning online. In this research, computer-supported collaborative learning was also concerned with face-to-face collaborations. Computer support of learning does not always take the form of remote, online communications. The use of CSCL support may involve the use of shared digital depositories, peer evaluation documents, collections of project-based shared documents and students might use a computer to browse through the information, and to discuss, debate, gather and present what they found collaboratively. Computer support can take the form of distant or face-to-face interaction, either synchronously or asynchronously.

5.2.3. The Project Task Assignments

According to Conole (2007), learning activities are achieved through completion of a series of tasks in order to achieve intended learning outcomes. A learning activity is defined by the context within which the activity occurs, the pedagogy and the tasks undertaken. For example, the learning context includes the projects undertaken for marketing research, the level of difficulty, the intended learning outcomes and the environment with which the activities place. In case of the AMR subject, the course is focused around the project assignment – to conduct marketing research in a 'real world' environment so that students can acquire the skills to become professional market researchers. The pedagogy included the teaching and learning approach adopted, which could be associative, cognitive or situative. For the AMR subject, the pedagogy was based on a situated environment for working as a team to solve

practical marketing research problems. Situated environments were based on the authentic tasks undertaken by students.

In order to provide a design solution for learning, it is necessary to plan a series of activities and tasks, which are characterized by successive productions of the design in different kind of representations. In outcome-based learning, one of the key assessments of learning resulting from the design is the artefacts produced during the delivery of the course. These artefacts may result from the student experiences in learning through the marketing research projects. It could be represented in the form of project reports, assignment submissions, presentation powerpoints, literature review summaries, survey questionnaire, statistical outputs, discussion records, reference sources, research resources collected by students. Based on the design principles developed in the previous chapter, a technological CSCL platform also provides artefacts from students' online activities such as digital repositories, reflective journals, discussion forums, mini-blogs, online discussion records and comments, wikis, successive assignments draft versions, powerpoint presentation materials, project schedules, online questionnaire versions and drafts. The new tools offered by the online learning environment are presented in a non-linear manner. They only represent a 'dispersed' representation of the activities designed for learning.

In order to develop a design solution for learning, the relationships between the various authentic tasks are important for understanding the effectiveness of the design. Therefore the design of the solution for project-based learning for the AMR subject was structured around five project-based assignment tasks, so that students learning activities were centered on the project task assignments corresponding to the different stages of the marketing research process. Students were required to form collaborative teams (with five to six students) to complete the assignment tasks associated with the marketing research project. They were required to submit their project assignments and collaborative activities through the Google Applications collaborative platform. Details of the five assignment tasks are listed as follows:

The Group Project

The group project aims at facilitating students to solidify and acquire a firm understanding of the fundamental concepts in advanced marketing research and to

apply them to develop a marketing research proposal and to conduct real world marketing research including actual data collection and data analysis using relevant statistical tools (i.e. SPSS package) to support marketing decisions. It also provides students with the opportunity to practice report writing and to refine their presentation skills which will be useful in business environments. The objective of the group project is to enable students to develop a marketing research plan, to set up data collection method (including questionnaire designs), to collect real market data, and to apply problem-solving skills to solve real-world marketing problems.

Assignment Task1: Project Proposal (Teamwork)

During the first month of the course, students are required to develop a marketing research proposal for conducting marketing research relating to environments that targets at investigating consumer behaviours in a specific industry. They are required to develop the skills for writing a proposal for marketing research, and demonstrate the ability to applying relevant concepts and theories, in order to communicate and demonstrate logical thinking in developing a marketing research proposal. They are also required to apply research skills and teamwork in working at the proposal stage of the group project. They are required to work in an authentic context, acting as the role of a consultant or a researcher in a marketing research department.

Assignment Task 2: Literature Review and Focus Group Study (Teamwork)

Following the proposal stage, students are required to conduct a literature review on the current marketing environments and previous studies relating to the target industry. They are required to investigate the literature and previous research relating to the demographic, psychographic, and behavioural aspects of the targeted consumers and provide a consolidated research framework for the proposed research study. The students also need to integrate qualitative research in the research framework by conducting focus group studies to identify and consolidate the key variables from the focus group study and the related literatures.

Assignment Task 3: Questionnaire Design and Survey (Teamwork)

Based on the proposed research framework, students are required to design and develop a structured questionnaire for conducting a quantitative study using a sample of 100 respondents for the targeted industry. The various aspects of conducting real-

world research in marketing and consumer behaviours are also required to be addressed by students at this stage, including the issues relating to research design, sampling design, research ethics, validity and reliability.

Assignment Task 4: Data Analysis Report (Teamwork)

In this project task assignment, students are required to apply data analysis techniques to the research data (both qualitative and quantitative) collected during the previous stages of the research process. They are also required to apply the data analysis concepts discussed in the lectures, seminar discussions and laboratory sessions. Students are required to produce an overall summary of the data analysis results and demonstrate the research skills in data analysis.

Assignment Task 5: Final Project Report (Teamwork)

In this project task assignment, students are required to apply the skills developed through the various stages of the research process in preparing a marketing research report. They are required to demonstrate an effective, precise and concise presentation of the written report. At the end of the course students are required to provide a presentation to communicate the results of the research to target audiences, and they are required to demonstrate logical thinking in presenting the results of the research.

5.2.4. Designing Authentic Activities for Knowledge Construction

The skills in project-based learning are demonstrated through an advanced course in marketing research (AMR). With an approach that emphasizes authentic problem solving, the course consists of learning tasks that guide students to develop marketing research skills. These activities involve the use of Web 2.0 tools and practices. The learning activities for knowledge construction and collaboration are listed in Table 5-1. They include authentic activities, knowledge construction and collaboration (Hung, Manu, & Wong, 1999). According to guiding *Principle 1*, the CSCL platform developed in this research should provide interaction support for social construction of knowledge, sharing of user-generated contents, and portfolios for reflections. Therefore, students should be able to collaborate through the use of Web 2.0 tools in the learning process.

Table 5-1 Learning activities for knowledge construction and collaboration

Construction	**Authentic activities**	**Collaboration**
A group of students must construct knowledge by developing a research framework for marketing research through different literature and knowledge sources, construction of knowledge is developed through statistical analysis, findings and interpretation. Each student works on his/her task and consolidates with his/her findings with the peer groups through Web 2.0 collaboration tools and face-to-face meetings.	Students engage in similar activities as professional marketing researchers. Students collect research data for existing companies, and participate in research design, data collection, and analysis with the targeted respondents. Students conduct peer evaluations with each other's work and are accountable to each other.	Students work together in small groups consisting of five members to solve authentic problems in marketing research. Lecturers and instructors are available to students to facilitate learning mediated through Web 2.0 tools and face-to-face meetings. Students gradually develop local expertise on the assign task/topic of study.

To implement project-based instructions for authentic problems in marketing research, instructors need to help students in terms of conceptions, development, and use of appropriate learning strategies. Lecture-based instructions tend to focus on a recitation situation and stress on right answers, while project-based instructions tend to focus on problem formulation, hypothesis formulation, prediction, data collection, analysis and interpretation. To benefit from project-based instructions, students need to develop critical skills in problem solving. The instructor should emphasize on scaffolding and developing critical thinking capabilities rather than emphasizing on subject contents. In project-based learning, students can exercise control on the type of problem to be handled, what kind of approach to be taken, what resources to support the research tasks, and how the division of labour is handled among project members. Therefore the design of learning task should provide the learners with a range of tasks, problems and activities to stimulate thinking, discussion and learning.

5.2.5. Tools and Resources to Guide Practices

The design of Web-based educational resources to support learning should provide facilities to involve the learners in discussion, sharing, collaboration and participation. Furthermore, social software-enabled platforms such as Google Applications also offer the potential to transform weak ties into strong ties through social connections. Any learner with a Gmail account could be socially connected with Google Applications, and could be potentially motivated to participate in peer collaborations

and discussions. For the advanced marketing research course, the purpose of including five assignments is to break down the project stages into small manageable tasks, and to develop tools and technological resources to support sharing and collaborative activities. It is also used to build up the interdependence among student peers. Students are required to demonstrate effective division of labour from the planning phase of the project, up to the final stage of marketing research process. The details of the five assignments and the related information and communication technologies to support the teaching and learning process are listed in Table 5-2.

Table 5-2 The group project and the five assignments

	Grp Prj	**Assgn1**	**Assgn2**	**Assign3**	**Assgn4**	**Assgn5**
Task	Market Research Project	Project Proposal	Literature Review and Focus Group Study	Questionnaire Design (Survey)	Data Analysis Report	Final Project Report
Tools	Online Quizzes, Group Project Presentations Group Project Web site, Wiki, email and RSS feeds, mini-blogs, Google Docs, forums, and shared document space	Project Web site mini-blogs SPSS Google Calendar	Project Web site, mini-blog. research proposal, Google Scholar, Google Drive document sharing, Google PPT for presentation	Frameworks from literature, Google forms, Online survey tools from Google	Project Web site. Mini-blogs, SPSS, Google Doc	Project Web Site, mini-blogs Google drive as a digital repository for project documents

5.3. Analysis of Activities

The design solution for learning also covers the analysis of the activities for implementation. Socio-cultural theories posit that the proper unit of analysis for research in learning should be based on activities. The study of the context and learning environment also helps to understand how students act to collaborate to achieve their learning goals. Since learning and development cannot be understood without reference to the social context with which the activities occur, it is essential to study the technological tools in a CSCL environment. The new generation of collaborative tools facilitated by the Google Applications platform offers new channels of communication and apprenticeship among students and peer groups. In fact, collaborative technologies have already been widely used to support a constructivist and socio-cultural approach to education (Vogel, et al., 2001).

In a Web 2.0 environment, students are facilitated with various collaborative tools, such as blogs, discussion forums, planning tools, wikis, RSS feeds, survey tools,

project Web sites and digital repositories etc. To plan for the implementation stage of the CSCL platform to support learning, it is necessary to understand the context with which the various collaborative tools are being used. An analysis of the tools for CSCL from an activity perspective can ensure that these tools are being used for collaboration and sharing among the learners. In order to support a design solution for learning, the following sections provide a detailed analysis of the activity system for the AMR course, and an investigation of the issues associated the design solution for implementation to support project-based learning.

5.3.1. Activity-Oriented Design Method

Activity theory provides a theoretical lens to understand learner experience by examining the integration of learner activities with technology and the interactions with each other. The characteristics provided by activity theory to aid understanding include historicity, expansive learning, artefact-mediated activities and conflict-driven learning. Unlike cognitive approaches that allocate learning within the minds of the brain (Burton, et al., 2003), activity theory emphasizes acting as a precursor to learning. Instead of focusing on static relationships, activity theory emphasizes on learners' development over time historically, while focusing on how an activity is being approached and what problems have to be overcome subsequently (Engeström, 1999b).

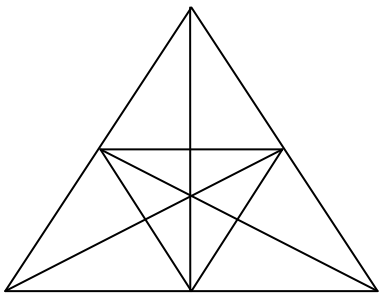
In a project-based environment, students work on their projects through collaborative teams. Through the learning activities designed for project-based learning, an individual develops the skills in problem-solving. However, to achieve high quality learning outcomes in project-based activities, the students need to collaborate on their project work as a collective effort. To gain advancements in learning through a project-based environment, a learner goes through transformations in learner practices as well as inciting similar changes in their peer groups. Activity theory emphasizes on expansive learning and expansive transformations, which positions learning in both individual and group contexts (Engeström, 1987).

The constant changes in learner needs, contextual influences, personal and group expectations make it difficult to predict future practices with practices in learning with a technology. Jones et al (2000) have reported that e-learning designers are often unsure about the effect of online course designs before the learning platforms are being put to use. Therefore, e-learning designers cannot assume that the collaborative platforms will be used by students for project-based activities. The use of the Web based tools to support project-based learning needs to be carefully analysed before implementation. This is especially true with the design of collaborative technologies in a Web 2.0 environment for project-based learning.

Although students are heavily involved in social networking sites and online forums, they lack the information and literacy skills to make use of the participatory media (Jenkins, et al., 2006) in the learning process. While students' use of the participatory media is increasing at an alarming rate, their incorporation into the teaching environment is still being left behind. Research into models and frameworks for learning that are supported by Web 2.0 based collaborative technologies are still evolving. There are limited researches on their use and adoption to provide understandings of learners' experiences with technology. Therefore an analysis framework for Web 2.0 collaborative technologies is important to ensure that these tools will be used by students for collaborative learning.

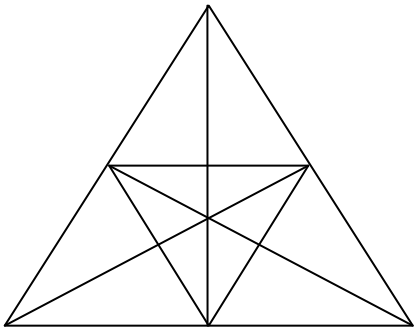
Activity theory also aids understanding of the interactions of students' experience with a technology through the use of artefact-mediated activities and conflict-driven learning, thus, facilitating understandings on how these collaborative tools will be used by students. Engeström's structure of the activity system for the class of advanced marketing research (AMR) class is depicted in Table 5-3. In this example, the activity system that is used to describe project-based learning is positioned within a class of AMR students, emphasizing on the importance of artefact-mediated activity. For example, collaborative learning is achieved through the use of various tools, including social tools, assignments, cognitive tools and technological tools such as wikis, discussion forums, project Web sites and document repositories to share practices.

Table 5-3 The overall activity system for the AMR class

<table>
<tr><td colspan="5">Artefacts, Tools & Practices</td></tr>
<tr><td>Social
-Collaborations with small group project work
- Individual literature review consolidated among group members to derive a research framework</td><td>Assignments
- Quizzes
- Group-based marketing research project
- 5 assignments
- Weekly discussions in forums
- Rubrics
- Quizzes
- Group Project Presentations</td><td>Cognitive
- Critical review of literature
- Data Collection Instruments
- Comparing project outcomes with other teams
- Peer critiquing, and collective aggregation</td><td colspan="2">Technological
- Group project Web site
- Wikis
- Gmail
- Google Docs for collaborative writing, and developing online surveys
- RSS feeds
- Mini-blogs
- Forums
- Shared document space
- Google sites sharing between different groups to share project practices
- Teaching Web site for downloading notes
- Google Calendar</td></tr>
<tr><td>Subject
Students</td><td colspan="2"></td><td colspan="2">Object
Develop knowledge of marketing research methods
→ Outcome
- Students become professional market researchers
- Integrate knowledge developed in the course to become researchers</td></tr>
<tr><td colspan="2">Values, Rules & Conventions
- Students define and work on the empirical research based on a research model from literature
- Students learn among their peer groups and from other group members through Web-based collaborative facilities
- Evidence of collaboration and participation in the Google Web site accounts for 15% of assessment</td><td>Community
- Student peers
- Research participants
- Lecturer and instructors</td><td colspan="2">Division of Labour
- Project groups members are required to distribute responsibilities and learn from peers
- Students complete 5 group-based assignments collaboratively
- Groups complete final report together
- Leader is responsible for the focus of the research and the lecturer guides the direction of research and provides scaffolds</td></tr>
</table>

Project-based learning is also characterized by conflict-driven learning, which requires students to balance their multiple individual interests and the objective of the overarching collective activity. The various characteristics of learning technology include the use of appropriate tools, values, rules, conventions, interaction with community and division of labour, but they are not blended automatically. The rules and norms that finally shape the activity system are the results of negotiations through internal conflicts or contradictions that exist with an activity system, between activity systems and conflicts between individual and group level activity systems.

Table 5-4 The activity system for peer collaborations and sharing

<table>
<tr><td colspan="4">Artefacts, Tools & Practices</td></tr>
<tr><td colspan="2">Collaborative Project
- Writing of collaborative research documents
- Group discussion, comments and messages in mini-blogs/forums</td><td>Assignments
- Collaborate to work on an integrated research framework for consolidated data analysis, interpretation and conclusion</td><td>Technological
- Group project Web site
- Google Calendar
- Google Scholar
- Wikis
- Collaboration tools for online survey
- Gmail
- Google Docs for collaborative writing,
- Mini-blogs
- Forums
- Shared document space</td></tr>
<tr><td>Subject
Student group member (5 to 6 per group)</td><td colspan="2"></td><td>Object
Collaborative knowledge building
→ Outcome
- A deep understanding of the skills and conceptual knowledge required for marketing research</td></tr>
<tr><td>Values, Rules & Conventions
- Students learn among their peer groups through Web-based collaborative facilities
- Evidence of collaboration and participation in the Google Web site and activities logs accounts for 15% of course assessments</td><td>Community
- Student peers</td><td colspan="2">Division of Labour
- Project group members are required to distribute responsibilities and learn from peers
- The group leader is responsible for the focus of the research and the lecturer guides the direction of research</td></tr>
</table>

The activity perspectives, namely, historicity, expansive learning, artefact-mediated activities and conflict-driven learning requires designing and analyzing activity systems at different levels, and analyzing different units of activities. An important element resulted from the analysis of the overall AMR class activity system is the activity of interest. The overall activity system of the AMR class positions students in the learning context in a class with over 20 project groups. Learning is situated with practical research activities that are mediated through social tools, assignments, cognitive tools and collaborative technologies. The learning agendas of student members, the cultural norms and rules are shaped by the final results of internal

negotiations, tacit power struggles within the class and project groups. Further analysis of the overall activity system of the AMR class helps to identify the activity of interest in project-based learning. For example, a cultural norm for project-based assessment of the AMR course was to focus on learning outcome of a project group rather than based on assessment of individual knowledge (as depicted by division of labour, values, rules and conventions in Table 5-3). Therefore, peer collaboration and sharing within a project group (with about six students) is identified as an important aspect of collaborative learning in a project-based environment employing Google Applications technology. Subsequent analysis of the learning situation would focus on the activity of interest - which is identified as the peer collaborations among the members within a project group.

The Activity-Oriented Design Method (AODM) (Mwanza-Simwami, 2011) provides a comprehensive method to capture the relationship between the activities of interest (peer collaborations) involved in the integration of technology, collaboration, and learning in a project-based environment. AODM provides explicit guidelines by operationalizing the activity triangle proposed by Vygotsky and Engeström, putting activity theory in practice for supporting collaborative learning. Furthermore, AODM provides a method to operationalize the procedures to identify the conflicts which exist in the activity system. By employing AODM, learner activities are analyzed through:

- Structuring the activities by producing an activity system (Table 5-4) of the activity of interest (peer collaborations).
- Analysing the relationships among the various components of an activity system (activity of interest, object, subjects, tools, rules, division of labour, community of interest and the desired outcomes).
- History of the development and use of collaborative technologies in facilitating the activity of interest.
- Analysis of the contradictions that exist in the system (Table 5-6) relating to the activity of interest (peer collaborations).

By focusing on the activity of interest as the key element for a student (the subject of study) to achieve the objective of advancing project knowledge, an activity system for

the activity of interest is constructed. As depicted in Table 5-4, peer collaborations involve student groups with 5-6 students, with the objective of advancing project knowledge through collaborative assignments that are facilitated by project Web sites, wikis, collaborative tools for online surveys, digital repositories, shared spaces and discussion forums. The division of labour is achieved through the project work allocations distributed among the students themselves. The requirements to develop learning with their peer group members through collaborations in the project Web accounts for 15 % of assessment, and they also represent the rules and norms of the activity system for peer collaborations.

Table 5-5 depicts the research issues that can be analyzed through interaction at the subject level and the community level with the object (objective). These interactions are mediated through the use of tools, rules, and division of labour. The issues that need to be addressed at the subject-object level are those interactions that are mediated through tools, rules, and division of labour. The issues are also considered at a community-object level through the tools, rules, and division of labour mediation paths as well. This six research issues relating to the learner interaction in the activity system are listed in Table 5-5. They can be used to analyze the contradictions that exist in the activity system for peer collaborations.

Table 5-5 The research issues for the activity system

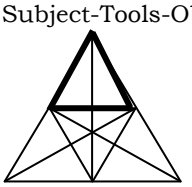
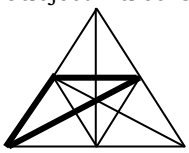
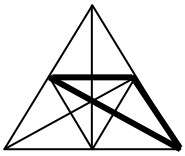
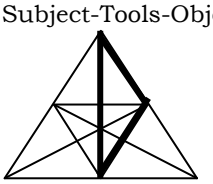
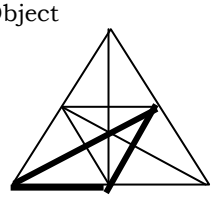
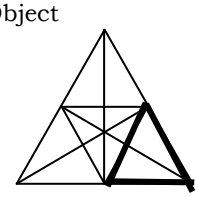
The Technique of Generating General Research Issues
1) What Tools do the Subjects use to achieve the Objective (collaborative knowledge building) and how? 2) What Rules affect the way the Subjects achieve the Objective (development of collaborative knowledge building practices) and how? 3) How does the Division of Labour influence the way the Subjects satisfy the Objective (development of collaborative knowledge building practices)? 4) How do the Tools in use affect the way the Community achieves the Objective (development of practices in collaborative knowledge building)? 5) What Rules affect the way the Community satisfies the Objective (development of practices in collaborative knowledge building) and how? 6) How does the Division of Labour affect the way the Community achieves the Objective (development of practices in collaborative knowledge building)?

The application of AODM provides a thorough understanding the activity components in the system. Finally, contradictions that might exist between the different components of the sub-activity system are identified and a technique for mapping operational processes is used for communicating the findings. Table 5-6 shows the links between the generated research issues and the identified area of contradiction. For example, by having the division of labour allocated among students themselves (Community-Div. Labour-Object), some students may become free-riders and do not participate actively. With a Web 2.0 environment, peer collaboration activities are more explicitly demonstrated through the use of collaborative documents, discussion forums and activity logs. Therefore, tutors should monitor the online discussions closely, and provide timely feedback in the discussion forums.

Another source of contradiction results from the rules (Subject-Rules-Object) for online participation (contributes to 15% of the assessment). Considering the assessment required for active participation in the Google Applications platform, students expect tutors to guide them in the knowledge construction process. This contradicts with the learning design, where students are expected to learn from each other through peer collaborations. If students are expected to develop their project knowledge through peers, they may think that the instructors are not able to participate timely and provide feedback for all the groups in the Web-based environments.

The AODM representational approach does not solve all the problems of the contradictions in the model. By employing the activity-oriented design method (AODM), it is possible to provide a clear indication on the number of contradictions identified in a sub-activity. The analysis of the activities and sub-activities for the activity of interest (peer collaborations for knowledge building) shows that teaching and learning in a Web 2.0 environment involves a significant amount of instructor time and effort. To implement a Web 2.0 environment for collaborative learning, extra resources are required to cope with the online activities associated with various student project groups.

Table 5-6 Identification of contradictions from peer collaborations

Sub-Activity Triangle	**Research Issues Generated**		**Identified area of contradiction**
Subject-Tools-Object 	What Tools do the Subjects use to achieve the Objective (peer collaborations for knowledge building) and how?	→	Google Docs is used to compile research documents, but the students think that compatibility with MS Office is important.
Subject-Rules-Object 	What Rules (online participation contributes to 15 % of assessment) affect the way the Subjects achieve the Objective (peer collaborations for knowledge building) and how?	→	A 15% assessment is for an individual, but need to be assessed in terms of peer collaborations (peer collaborations need to be monitored).
Subject-Div.Labour-Object 	How does the Division of Labour influence the way the Subjects satisfy the Objective (peer collaborations for knowledge building)?	→	Some group members do not participate actively.
Subject-Tools-Object 	How do the Tools in use affect the way the Community achieves the Objective (peer collaborations for knowledge building)?	→	Grp members may not be aware of the new versions of shared documents in Google site (compared with direct email notifications).
Community-Rules-Object 	How does the requirement that project groups participate in peer collaborations for project work and assignments (Rules) support students' development (in small groups) in achieving the Objective (peer collaborations for knowledge building) and how?	→	Student concerns of peer knowledge versus instructor feedback through the Google Web 2.0 platform. Group-based tasks may lead to unfair workload distributions.
Community-Div.Labor - Object 	How does the Division of Labour (which is allocated within among student group themselves) affect the way the Community achieves the Objective (peer collaborations for knowledge building)?	→	Dealing with low participation by some group members.

5.3.2. Toward the Long-Term Development of Knowledge Artefacts

With the support of information and communication facilities, project-based learning involves collaborating among participants, sharing of information, and elaborating on project documents to solve ill-defined, authentic problems. Based on activity perspectives, novel practices and new ways of advancing knowledge practices are facilitated by the new generation of Web 2.0 based collaborative technologies. An activity perspective to learning is based on the view that social interaction is facilitated by a learning platform. In a shared problem-solving process students who have partial, but different information about the problem can improve their understanding through the sharing of 'conceptual artefacts'. 'Conceptual artefacts' (Paavola & Hakkarainen, 2005) can be represented by practices, ideas, models and representations through digitally represented objects such as online discussion records, research frameworks and research designs. Such kinds of concrete shared objects can be created collaboratively through a CSCL platform. They are being used for knowledge advancement as a collective within a project group.

Paavola and Hakkarainen (2005) extend Engeström' activity theory (1999a) to develop principles for developing CSCL platforms that facilitates knowledge creation activities that are mediated through conceptual artefacts and practices, which are required to be jointly developed and co-constructed:

- Focus on shared objects of activities which are developed collaboratively.
- Facilitate knowledge-creation processes taking place in mediated interaction between individual and collective activities. Individual participants may have a key role in knowledge creation but their efforts are embedded on a fertile ground of collective activity.
- There must be appropriate technologies that help the participants to create and share as well as elaborate and transform knowledge artefacts.

Knowledge artefacts (Bereiter, 2002; Paavola & Hakkarainen, 2005) are digitally represented conceptual objects that are developed iteratively and shared through a collaborative platform. They go through constant revision, remixing and versioning,

with the long-term objective of advancing project knowledge in a project group. They are being used as mediating artefacts for the activities involved in knowledge construction for the marketing research projects.

For example, for the activities relating to a marketing research project to investigate consumer behaviours, a project leader may organize the activities of inquiry around different digitally represented objects, such as problem definition, literature reviews, research frameworks, analysis frameworks and research findings. Two (or more) members with a common interest may create digitally represented conceptual frameworks for their project, which is a document in the form of an artefact that can be created and shared in the collaborative platform. As other members proceed with the analysis and provide further insights, they may further revise their research framework in light the insights provided by the analysis framework. It also serves as the mediating artefact for the activities involved in project knowledge advancement as a collective. These artefacts are developed jointly and subsequently used for collaborative development of project documents.

5.3.3. Contributions from an Activity Perspective

Activity theory facilitates understandings of the way that collaborative tools are being used to support project-based learning. It provides a participatory unit of analysis to exploit the socially-situated and culturally-mediated nature of learning through the support of collaborative technologies, focusing on the specific circumstances of an activity that are essential to understandings on how students act in their attempt to reach their learning goals. To achieve the learning outcomes through the project-based activities, collaborative technologies can foster shared spaces between the learning participants, and develop multiple perspectives in problem solving. In order to investigate the adoption and use of collaborative technologies, the CSCL platform was designed to support the various learning activities for project-based learning.

The study of mediating artefacts that are built on the cultural historical activity theory help users to make informed decisions and choices on the use of collaborative technologies in a CSCL environment. Furthermore, an activity perspective for learning design makes explicit choices on the technological resources that are designed for learning that is of potential value to teachers and learners. It can also

serve to capture the essence of the learning design, and communicates possible choices of tools for learning activities, and the associated learning outcomes that might be enhanced through the tools more clearly.

Activity-Oriented Design Method was used as a framework for understanding learner experiences with Web 2.0 technologies and appropriate use of tools for learning. In order to ensure that the Web-based platform can be used to support learning, it is necessary to provide an interpretation of how activity-oriented design method can be used to facilitate a comprehensive understanding of the collaborative practices for project-based learning. In the absence of universally accepted methods for applying activity theoretical perspectives to Web 2.0 environments, this research describes a systematic scheme for identifying the essential activities and mediating tools for collaborative tasks. By employing an activity perspective for analysis, it can be concluded that the design solution facilitates the development of a CSCL platform that promote a participative culture for project-based learning in a Web 2.0 learning environment.

5.4. Planning for Implementation

In the previous chapters, it is argued that an iterative, design focused method such as design research is suitable for research into the adoption and use of collaborative technologies in a teaching and learning environment. Based on theories from extant literature, a design solution was developed. The theory of authentic learning, theory of situated learning and activity theory are being applied to the interpretation, analysis and learning design involving the use of technologies for project-based learning. As a kind of disruptive technology that is offered to students in a new learning environment, it is important to understand the adoption behaviour among students on the use of the technology as a collaborative platform. The introduction of the collaborative technologies in the teaching and learning environment is different from the traditional e-learning support from the university. Therefore, the investigation of the adoption behaviours among students is the most important factor for successful implementation of collaborative technologies for project-based learning.

Following the design stage, iterative cycles of implementations and testing of the design solution are required to make sure that the design works well in practical

teaching and learning environments. As the CSCL platform is different from conventional learning management systems, students need additional efforts to cope with the new learning environment. Research into Web 2.0 environments involving the use of collaborative technologies is a relatively new area of research. It is important to ensure that the CSCL platform facilitates learning. Through an evaluation of the learning platform, feedback can be collected from the students for improving the design solution. An important element for the evaluation of a technology platform is the user acceptance of the technology. As a new kind technology to support learning, the CSCL platform might not be useful if the collaborative platform is not being adopted by students. The evaluations were conducted through iterative cycles of testing during the implementation stage. Both qualitative and quantitative approaches were employed in the evaluation process. The details of the evaluations are reported in the next chapter.

5.5. Chapter Summary

This chapter presents the pedagogical design solution comprising the design of learning activities and the analysis of activities for implementation. The pedagogical design of authentic learning activities involves the design of the learning tasks and project-based activities. This chapter describes the various tasks and activities in the advanced marketing research course, with a description of the marketing research project and group-based assignments. This chapter also describes the mapping of Web-based facilities in the CSCL platform to support collaborative activities. An activity perspective is described, which is based on a pedagogical model for organizing learners' activities around shared artefacts. Finally, this chapter summarizes the contribution of an activity perspective to project-based learning. The next chapter presents the details of the implementation, testing and evaluations of the computer-supported collaborative learning environment.

Chapter 6

Implementation and Testing of the CSCL Platform

6.1. Introduction to the Chapter

To support project-based learning, new competences are required for students to developed collaborative problem-solving skills. The development of these competences relies on the implementation of collaborative digital technologies for advancing knowledge objects and collaborative resources (Bereiter, 2002). Implementation and testing of the CSCL learning environment is an important stage of the design research process. This chapter reports on the testing of the design solution that was conducted through iterative cycles of implementations for project-based learning.

The implementation of the CSCL environment consisted of two iterative cycles, which were conducted during the years 2011 to 2012. The goal of the implementation and testing stage was to test theories, pedagogical practices and the collaborative tools implemented in the CSCL platform to support project-based learning. Table 6-1 shows the identifiable research and development cycles. Each implementation and design cycle was conducted to address specific issues relating to computer-supported collaborative learning.

The first design iteration was based on a pedagogical model for authentic learning incorporating an activity perspective for project-based learning. It was evaluated based on the use of a CSCL platform that supports collaborative activities for project-based learning. The second design iteration was intended to facilitate the sharing of artefacts for sustained advancement of conceptual knowledge artefacts for project work, and to test with the introduction of the Google Plus social networking facilities in the CSCL platform.

Table 6-1 The design objectives associated with the design implementations

Design Iteration	Semester Session	Design Objectives	Description
1st	2010-11-S2	Application of authentic learning and activity theory.	Implementing a pedagogical model, and applying an activity perspective to support project-based learning – testing the adoption of the various features of the CSCL platform.
2nd	2011-12-S1	To facilitate the sharing of artefacts for sustained advancement of project knowledge, and to test with the use of Google Plus.	To ensure that the CSCL platform could enhance project collaborations by facilitating the development of knowledge artefacts that can be shared through the CSCL platform.

6.2. Implementing the First Design Iteration of CSCL

The first design iteration followed stage three of the design process (refer to Figure 6-1) described by Reeves (2006). The CSCL platform was tested during the delivery of the 2010-11-S2 session of the advanced marketing research course in Jan 2011. The course was conducted in a fourteen week semester to students at undergraduate level. In the beginning of the course a briefing session was provided to students on the use of the CSCL platform developed using Google Applications technology. Although it was possible to enable access to the Google platform to all students, it was important to establish the system access privileges of the CSCL platform privately within a project group. Therefore, each student was required to make use of a Google account to login to the CSCL platform. Laboratory sessions were also conducted to help students to practice on the Web 2.0 CSCL environment and the use of collaborative tools. Students also have access to other facilities provided through the Google account, such as email service, a Google drive for Web-based storage, private calendars and other facilities such as search engines, Google scholar, and facilities for creating personal profiles through the Web-based learning environment.

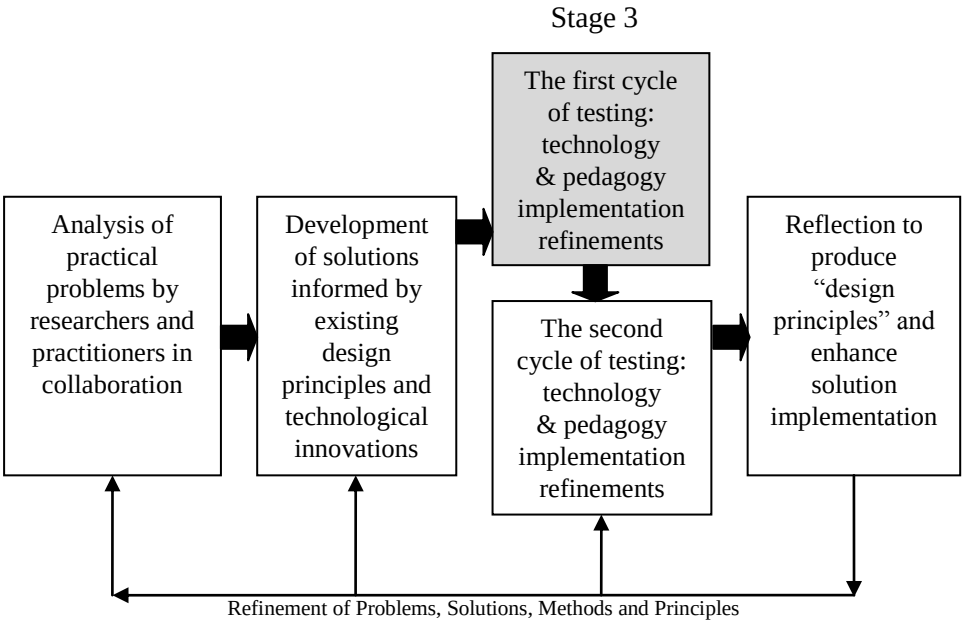


Figure 6-1 The first cycle of testing: technology and pedagogy implementation (Source: Reeves, 2006)

6.2.1. Design Intentions

The objective of the implementation and testing stage was to test the design solution consisting of the technology platform and the pedagogical model. The implementation in the first iteration was most important in testing of the learning design and the adoption of the technology platform for computer-supported collaborative learning. During the first iteration of the design, it was important to test various design features of the CSCL platform - whether the platform was being adopted by the students, and which of the design features would be most useful to support the various stages of project-based learning. As the guiding principle for the design emphasized on user-generated contents, it was not possible to predict in advance the extent that students would use the platform for sharing. As Jones et al. (2000) have reported that instructional design practitioners are often unsure about the full effect of e-learning designs before the implementation, it was important to collect feedback from the delivery of the classes. One direct means of evaluating the adoption of the CSCL platform was to analyse the usage information from the project Web site. In addition, interviews and surveys were conducted during the implementation stage to investigate the adoption of the CSCL platform for collaborative work.

The design intention also linked back to the pedagogical framework and how learning activities were formulated, assessed and supported. Interviews with students helped the researcher to focus on specific features of the design and discovered new issues that could arise out for the implementations. By gaining experience with a CSCL platform through iterative implementations, the design intentions could focus on investigating particular aspects of computer-supported collaborative learning. Furthermore, new issues might arise during subsequent iterations and it was possible to focus the investigations on the emerging issues through a design research approach.

6.2.2. Learning Groups

The students involved in the implementations were enrolled in the advanced marketing research course, which was offered through the final year of the Bachelor of Arts in Marketing and Public Relations programme. As the course has a business orientation, most students have basic backgrounds in marketing, consumer behaviour and public relations. The course was being offered to both full-time and part-time students and the majority of the participants in this research were full-time students. There were 140 students enrolled in the subject and most of them were Chinese in terms of nationality. Table 6-2 shows the profile of the students from the data collected from a survey. Six-four percent of the students were female and thirty-six percent of the students in the class were male. Demographic variables included gender, age, and average weekly hours spent on social networking websites. The average age of the students was 22 years old and the age range was between 20 years to 26 years. For the time spent on social network sites, about 60% of the students spent more than 10 hours on social networking sites each week. Furthermore, 25.9% of the students spent 16 to 20 hours per week on social networking websites per week, 11.9% of the students spent 21 to 25 hours per week on social networking sites and 3% of the students spent more than 25 hours per week on social networking sites.

In the advanced marketing research subject, students explored both quantitative and qualitative methods and defined specific methodological research questions for their research project throughout the fourteen week schedule for the semester. During the first lecture, students were grouped into project groups with 5-6 learners according to their research interest in project areas, resulting in a total of 23 project groups from a class of 140 students. Each project group focused on a specific research area relating

the issues that a company would face in solving marketing problems. The project areas included online shopping, service marketing for banking industries, brand building and education services. They might select a company to work on an authentic situation to solve marketing research problems for specific companies. For example, students could work as a marketing team to investigate the factors affecting consumer intentions to purchase Häagen Daz ice cream moon cakes. The design of the course was to provide an authentic environment for students to work as marketing researchers to deal with real-life problems.

Table 6-2 Profile of the students

Demographic		**Percentage**
Gender	Male	36.0
	Female	64.0
Age	20-21	29.5
	22-23	52.9
	24-25	8.9
	>=26	0.7
Time spent on social networking sites (hours/week)	<1	7.3
	1-5	20.4
	6-10	14.8
	11-15	16.7
	16-20	25.9
	21-25	11.9
	>25	3.0

During the delivery of the class sessions, the lectures and seminar sessions were conducted relating to the techniques used in the marketing research process. In particular, the SPSS statistical package was covered in detail during the laboratory sessions. A number of lectures and seminar sessions were constructed around student group presentations in week 4, 6 and 13 of the course. During these sessions, students presented their project work corresponding to the project proposal (assignment 1), literature review and consolidated research framework (assignment 2) and project report (assignment 5). During the periods between these presentations of project work, the students prepared their project materials in groups, shared materials relating to project tasks in the Web-based CSCL platform. In between these project presentations, students were also required to construct research tools corresponding to the Web-

based questionnaire required for conducting a survey with a hundred respondents (assignment 3), followed by the data analysis associated with the data collected from the respondents (assignment 4). The sharing of artefacts and practices in the project stages represent a knowledge-creation approach that was supported by the CSCL platform for the long term goal of completing a collaborative final project document for the marketing research project.

6.2.3. Technology and Activities

The employment of solutions for learning was realized through the computer-mediated learning environment and the activities that were designed for project-based learning. The evaluation of the adoption of the CSCL platform included the analysis of activities in the collaborative platform. The implementation also facilitated scaffolding and learning through the collaborative tools, as well as assessments that were based on students' participation in the computer-mediated learning environment.

6.2.3.1. Units of Activities in Google Sites

Participation in activities was an important element in project-based learning. To deal with complex ill-defined problems in marketing research, different levels of activities were involved in the learning process. The term activity has been used in several contexts in this thesis and it is important to differentiate the different meanings that are being referred to throughout the discussion. From an activity perspective, the term activity has been used to refer to the collaborative activities that have taken place in the learning process. For the learning design, the learning activities broadly relate to the activities involved in the various project assignments: the project proposal (assignment 1), literature review (assignment 2), questionnaire design (assignment 3), data analysis (assignment 4), and project report (assignment 5). One of the advantages of introducing a CSCL platform was that the Web-based activities were recorded in the Google platform and were summarized in the log records in the CSCL platform. When attempting to investigate the adoption of the collaborative technologies in the CSCL platform, the data from the collaborative platform provided simple statistics for various usage aspects such as message posting, online discussions, file sharing and project work consolidations. Such kind of information provided a first impression of the range of participation and adoption of the CSCL platform.

The CSCL platform represented a kind of marshup environment for combining various collaborative tools through a project Web sites (facilitated by Google site). Therefore, when students used their project Web site to create contents, an activity was created in the log record of Google sites. In a Web 2.0 environment, participation refers to the creation of contents in a project Web site. For example, uploading a project document represented a kind of activity in the Google site platform. When referring to the learners' online activities, the summary figures referred to the level of activity recorded by Google site.

Considering that fact that the CSCL platform was a new development, the course included a reasonable amount of learner activities recorded in Google site (the project Web site). During the 2010-11-S2 session, the CSCL system reported a total of 5,312 activities in the log file of Google sites. It was important to note that *reading a Web page or downloading a file from the project Web site was not considered as an activity* because these actions did not contribute to the creation of contents for the project Web site. An example of the project activity log record is shown in Figure 6-2. It was also important to note that all activities in the log file were time stamped.

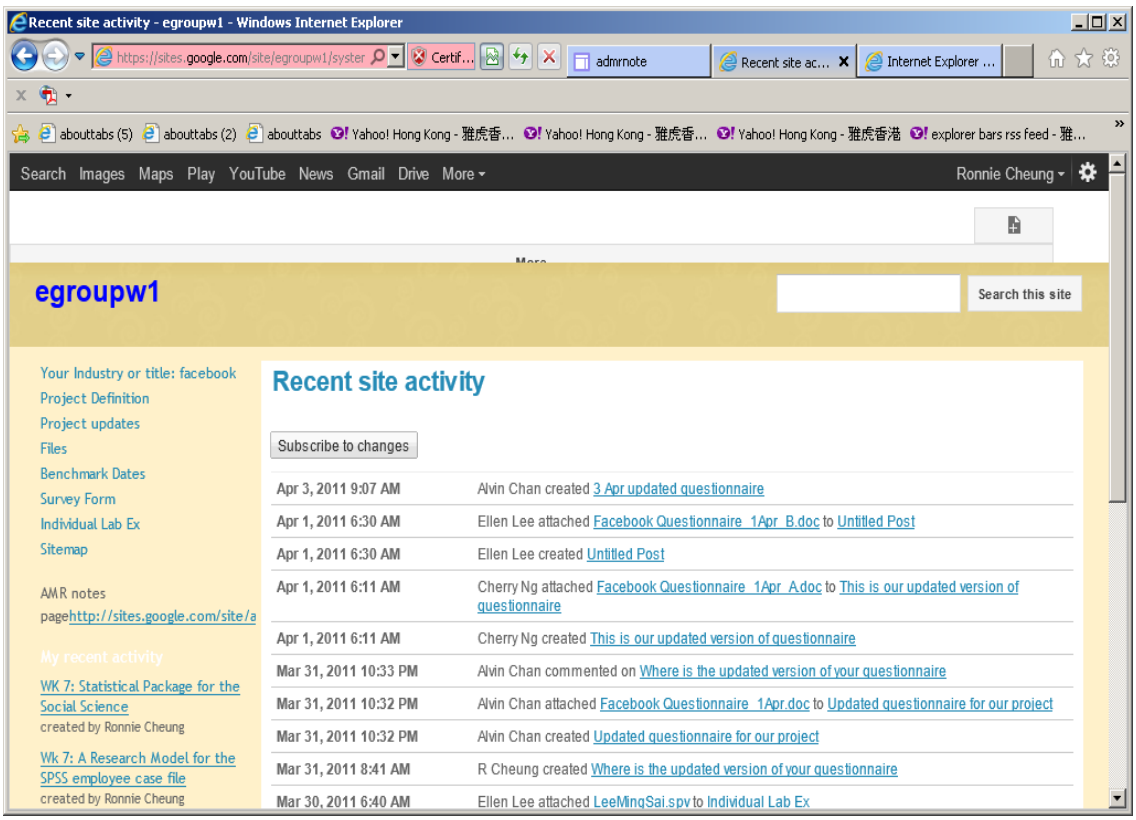


Figure 6-2 The project activity log record

Table 6-3 summarizes the number of activities in each project group and number of files that were uploaded and shared through the project Web site. It was also important to note that many of the files were revised iteratively by students, resulting in different versions of the same file. When these revisions were taken into account, the system resulted in a total of 3,731 revisions, which represented a significant number of objects created and revised by students. The average number of revisions per file was obtained by dividing the number of revisions with the total number of files in the project Web site. These figures represented an average of 2.07 versions per file. Therefore each file object in the project Web site had undergone at least one revision per file, which was a good indication that the file objects in the system were being shared and revised for sustained knowledge advancement for project-based learning.

Table 6-3 Summary of activities for project groups – 2010-11-S2 session

Group	Number of activities	Number of files	Number of revisions
F1	207	91	139
F2	358	102	327
F3	265	85	206
F4	246	100	203
F5	283	104	230
F6	305	58	209
F7	383	144	325
F8	160	66	114
F9	198	83	111
T1	196	63	103
T2	301	101	190
T3	345	85	206
T4	112	60	83
T5	209	57	146
T6	256	75	226
T7	272	62	81
W1	200	69	151
W2	151	69	104
W3	137	62	101
W4	118	71	111
W5	138	53	85
W6	95	68	82
W7	377	79	198
Total	5,312	1,807	3,731

The activities reported by Google site were generated through various sections of the project Web site: project homepage, project definition, files, project discussion, survey forms, lab sessions etc. The activity log file in Google site represented a stream of information generated through various activities. In the Web 2.0 environment such kind of streamed information was provided by a mechanism through RSS (Really Simply Syndication) feeds. When contents were created in the Web sites, users were also notified by email when they subscribed to these Web site contents. An example of the email notifications maintained by the instructor for monitoring student performance is shown in Figure 6-3.

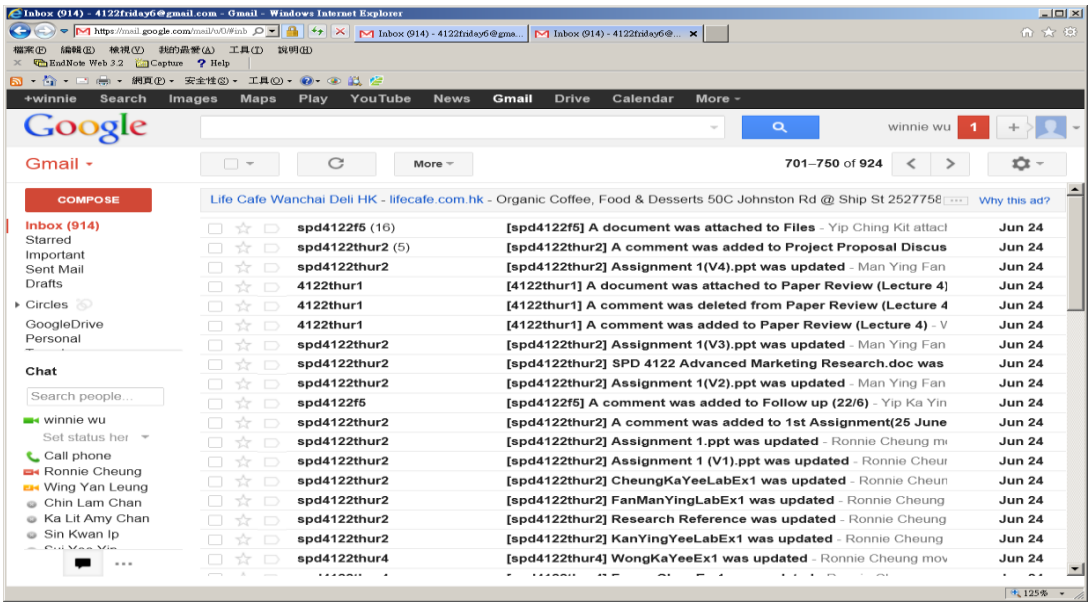


Figure 6-3 Subscriptions to project web site contents

In addition to the group-based project site activities, the subject also included a discussion forum for student to participate in weekly discussion topics in marketing research. An example of the discussion forum facilitated by Google groups is listed in Figure 6-4. During the delivery of the 2010-11-S2 session, the subject-based Google discussion forum attracted a total of 1,012 postings. As Google Groups Technology was not part of the student project Web site, these postings were not recorded in the activity log of the CSCL system. Furthermore, since the Google discussion forum was open to the whole class instead of a specific project group, these discussions did not provide significant contributes to project collaborations.

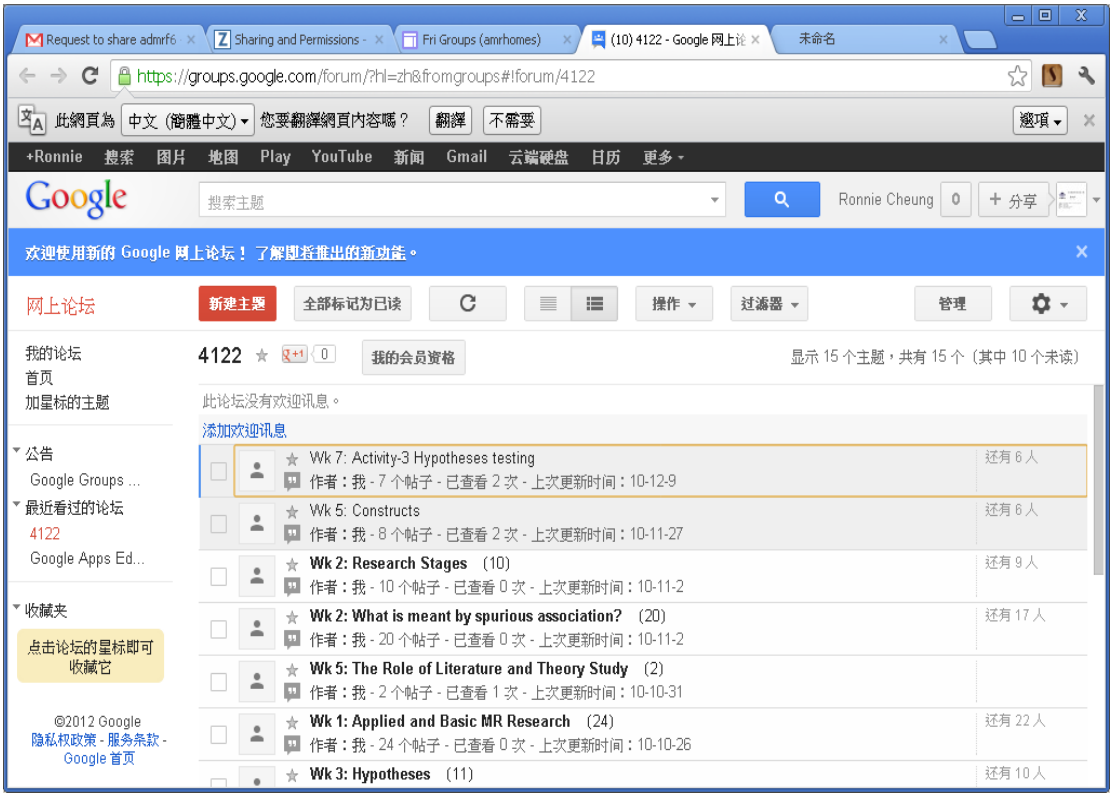


Figure 6-4 The Google forum discussion postings

6.2.3.2. Learning and Scaffolding through Collaborative Tools

The CSCL environment employed Google Applications for providing collaborative tools to facilitate learning. In addition to the facilities provided by the project Web site, the use of a Google account also provided access to Google documents, which consist of a set of tools for collaborative editing of documents and presentations through a Web browser. This section provides a discussion of these collaborative tools for project-based learning. Although the project Web site was a general purpose environment for handling documents, it also provided collaborative writing facilities through Google documents, which represent a different way to prepare project documents online through the Web-based facilities. During the delivery of the course, some of these tools were used by students and tested for implementation. For example, while preparing for the project proposal, students drafted their project proposals using Google documents to refine their ideas collaboratively through online editing. An example of the Google document browser is shown in Figure 6-5.

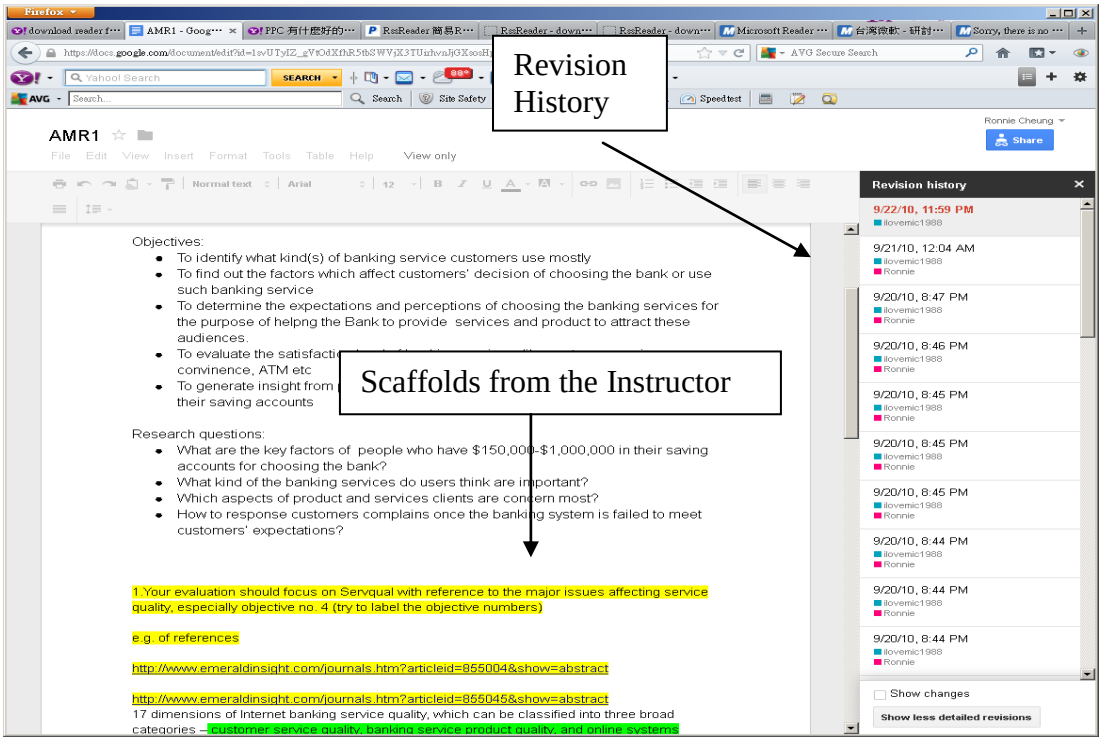


Figure 6-5 Collaborative editing using Google documents

In the above example, the Google document was displayed through a Web browser, and different versions of the documents from different collaborators are shown in the right column in different colours. In this example, the highlighted texts represented the comments provided by the instructor to provide scaffolds for project-based learning. In Figure 6-5, the different colours shown in the revision history in the right window also indicated that the document was prepared collaboratively by different group members.

Another collaborative tool offered by the Google collaborative platform was the collaborative editing of presentations. For the third assignment, students were required to perform an individual literature review and develop a consolidated research framework for marketing research among the six members in a group. By using the collaborative presentation tools in the CSCL platform, students prepared the presentation documents online collaboratively. The presentation document could be created online through a browser window (as shown in Figure 6-6), together with the revision histories that could be accessed through a Web browser. Articulation was an important aspect of project-based learning, where learners have the opportunities to observe other learners with varying degrees of skills and

models of expertise. The collaborative tools addressed the requirements for articulation and reflection that were developed through project-based activities.

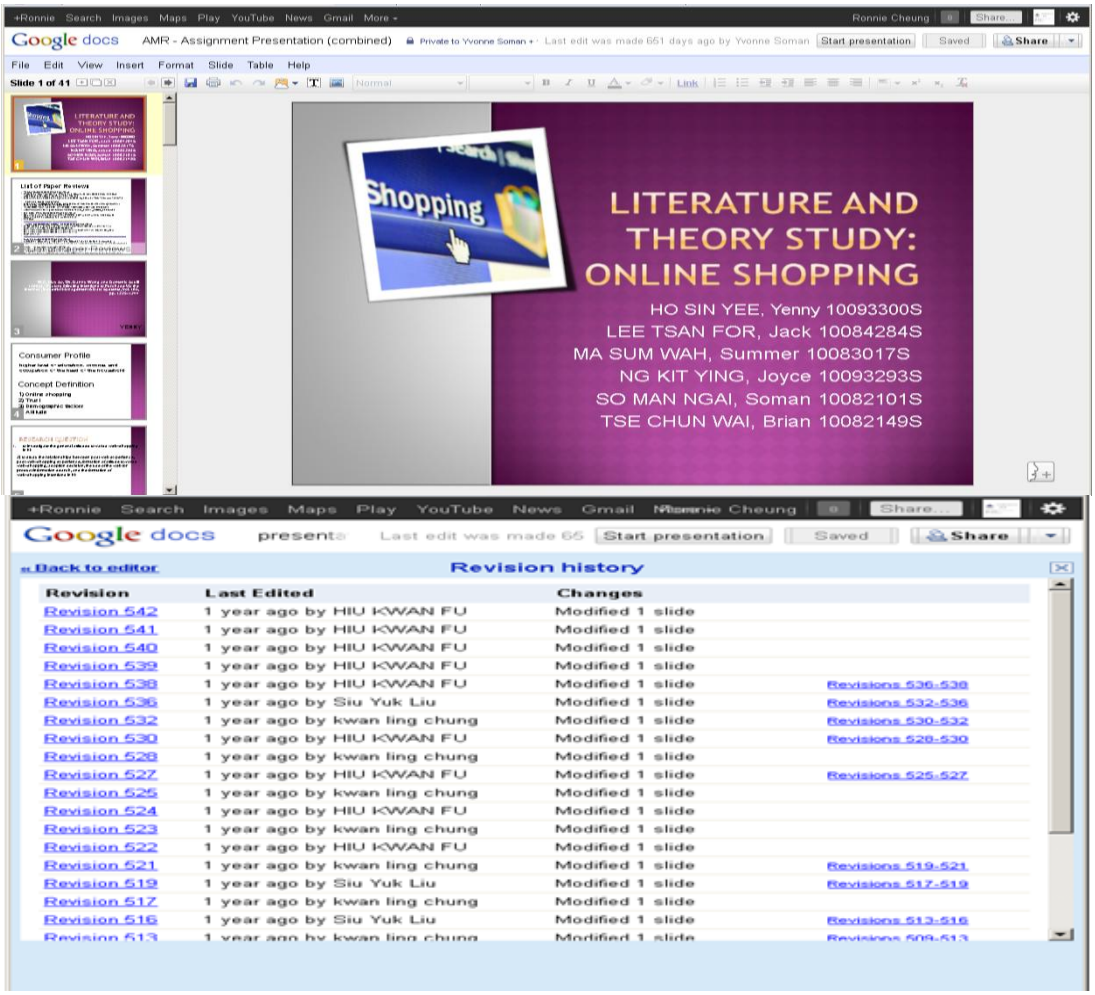


Figure 6-6 Collaborative editing of presentations

6.2.3.3. Assessments on Participation

The participation in various activities contributed to fifteen percent of the assessment for the course. The information for participation was provided by the CSCL platform, including participation in discussion forums, information sharing, project Web sites, records of project discussions, shared digital repositories and evidence of collaborative activities for addressing real-life marketing problems. All students were assessed through the individual portfolios of their work, which were reflected in the activities in the project Web site. The rubric for assessment of participation mainly focused on online activities, and is listed in Table 6-4.

Table 6-4 Assessment criteria for participation

Grade	Quality of Performance through Web-based discussions, online participation, and sharing
A	**Excellent**. The student goes beyond being responsible and listening respectfully; the quality and quantity of thoughts contributed is excellent, without taking up others' air time or interrupting others rudely. The student knows the art of building on peers' and instructors' comments, acknowledging the work of others and providing further insight in a way that builds morale and communicates a passion to learn from all sources, including email, project web site, digital repositories and collaborative documents. Although he or she almost always has something insightful that is supported by the Web-based collaborative activities. At timely moments the student also asks profound questions that motivate further discussion and thought. The student occasionally takes initiative outside of class time & online to ask for further information or assistance to deepen their learning or strengthen their skills beyond the B level.
B	**Good.** The student makes an effort to participate, and is responsible with accidental lapses in responding to Web-based activities, and contributes insight, or inspiration to peers in discussions, or activities online, or through emails. The student also asks for clarification and assistance in a way that assists other students who have similar questions and concerns. Alternatively, the student may have occasionally contributed at the A level but is in other respects at a C level.
C	**Satisfactory.** The student has been present with some evidence of online support, responsible and cooperative almost all of the time. However, he/she does not contribute often in a way that provides inspiration or insight to peers, or may not have been very attentive, or never asked significant questions or provide significant contributions to collaborative documents.
D	**Minimal pass.** The student has attended enough classes to keep up with the course concepts and assignments. However, the student did not show responsibility, minimal participation in the online project Web site or did not contribute much to the intellectual content of the course through discussion and participation in the project Web site.
F	**Fail.** Insufficient participation to demonstrate project contributions or sharing.

6.2.4. User Adoption of the CSCL Platform

Evaluation of the feedback on the user adoption of the CSCL platform was based on both qualitative and quantitative approaches. For the qualitative evaluation, a focus group discussion was conducted with a selected group of students. For the quantitative evaluation, a survey was conducted with the class of students who were using the collaborative platform for project-based learning.

6.2.4.1. Focus Group Study

To investigate students' acceptance of the collaborative platform, focus group interviews were chosen as the method to investigate students' adoption of the CSCL platform. The focus group study allowed a small group of participants to be interviewed by a moderator. In order to provide detailed explorations and a clear focus on the research issues through probing and clarification of answers, the discussion was based on a focus group discussion guide prepared by the moderator. With the use of focus group discussion as a kind of qualitative research technique, it was possible for the researcher to cover in detail the research issues through group discussions with the participants.

Sample Selection and Preparation

Before a focus group study was being conducted, a small group of respondents needs to be selected as a sample for the focus group discussion. For the study involved in this stage using focus group discussions, the sample was selected to assess the applicability of the CSCL platform to support collaborations, in order to explore the various factors that might be influential in the adoption process of the CSCL platform. Therefore, the purpose of selecting a sample was not to focus on the generalizability of the results, but rather to explore the situations faced by students on the use of the CSCL platform.

In terms of sample selection, a focus group study is usually based on a small group with characteristics that are homogeneous within the group. Therefore, students within a project group with 5-6 students were appropriate for being selected as the participants in the study. In this study a purposeful sampling approach was adopted to select a typical project group with six members as the participants of the focus group study. During the 2010-11-S2 session of the course, a group of students in a project group was selected as the participants for the focus group study. The interview questions for the focus group study are listed in Table 6-5. The discussion guide covered the major questions and issues to be explored during the interview. It was used to ensure that the important issues were being addressed during the focus group interview.

Table 6-5 Discussion guide for the first focus group study

1. After using Google Applications for several weeks, please describe Google Applications by various adjectives.
2. What do you think about collaborative learning technologies?
3. What is/are the most important factor(s) associated with the use of Google Applications for being a collaborative platform?
4. How can Google Applications improve the quality of your collaborative work?
5. Among those functions of Google Applications, which one do you use most often? And what is/are the reason(s)?
6. When using Google Applications, do you face any obstacle? If yes, usually what kind of obstacles do you face?
7. Do you think Google Applications intensifies the collaboration among your group? If yes, please illustrate with example(s). If not, please tell the reason(s).
8. How can Google Applications match with your working style for project-based work? If not, please list out the reason(s).
9. What are the factors that influence you in adopting a collaborative platform for project-based learning?

Content Analysis Method for Focus Group Study

All the discussions in the focus group study were video recorded. Transcripts of the discussions were prepared based on the focus group interviews with students. Data collected from the interviews were analysed using content analysis method developed by Mayring (2000) to identify the key themes associated with the adoption of the CSCL platform. The purpose of content analysis is to take raw data from the transcripts of discussion and develop common themes and generate conclusions or develop meaning based on the common themes or patterns of ideas that were unfolded during the discussions. The analysis followed an inferential process of categorization, abstraction, comparison and refusion (Spiggle, 1994) that organize data, extract meaning, and arrive at conclusions. Based on the above processes, data from the focus group study were analysed. During the data analysis process, efforts were spent to analyse the data in an objective manner. An interpretative analysis of the interview transcripts revealed four major themes on the use and adoption of collaborative

technologies for project-based learning. The four themes, as taken from the interview transcripts were as follows:-

1. Use of collaborative technology for learning
2. Convenience and ease of use
3. Adoption and usage
4. Project-based Collaborations and Consolidations

Use of collaborative technology for learning

Regarding the role of collaborative technology, the respondents thought that a collaborative technology must be useful for stimulating people to accomplish their tasks together. Three of the respondents used the term sharing to describe the facilities provided by the collaborative platform and they used the term sharing to describe the sharing of learning resources on the collaborative learning platform. Most interviewees found Google Applications useful and practical. For example, the project Web site facilitated group collaborations among project members to share resources. As students uploaded files to the collaborative platform, it clearly showed various details on the platform, such as the owner of the file, edited versions of the file, the timestamp information and the number of versions. All these information indicated the contributions of each group member and facilitated collaboration among students for the marketing research project.

All interviewees thought that the collaborative platform performed better than their expectation after several weeks. It was because of the fact that they had no experience on the use of a collaborative platform previously and thought it was difficult. After a few weeks, they found that features of the collaborative platform were quite user-friendly. However, one of the interviewees still felt that the collaborative platform implemented using Google Applications was troublesome. This problem was due to the complicated layout of the project Web site with insufficient instructions. To solve this problem, the interviewee searched through the Internet for a solution. Regarding the instructions from the lecturer, two of the interviewees said that they did not receive sufficient instructions from the instructor, and the instructions provided by the instructor for the collaborative platform were too brief.

Convenience and Ease of Use

Most of the participants said that it was convenient to use the Web 2.0 platform for project-based collaborations. However, most of the respondents noted that the use of the collaborative platform also depended on the way that the collaborative tools matched with traditional tools like email, Microsoft Office and instant messaging systems. For example, one of the respondents considered that the ease of use for Google Documents was lower than expected because it was not fully compatible with Microsoft Office tools. Although the collaborative platform provided notifications for the latest updates from the project Web site, most respondents felt that these notifications should be able to link with other email accounts instead of linking with Gmail only. This was inconvenient for students because they might not be using the Gmail account for handling their daily communications. Also, by adding functionalities such as those applications implemented in smartphones would help collaboration among group members. If these applications worked in a similar manner to those Facebook applications used in smartphones, students could participate in collaborations more frequently anytime and anywhere.

Although participants agreed that they could explored the features of the collaborative platform themselves, most of the respondents felt that the usage could be improved if the lecturer provided more guidance on the use of the various features of the collaborative platform. Furthermore, most of the interviewees complained that there were too many pages to navigate on the project Web site. For example, when they started to share with their project resources, they could share items through different areas in the project Web site: the project definition area, the project discussion area, files sharing areas or task tracker areas. All these features facilitated commenting and file uploading for project collaborations and it was difficult to start using the platform without clear guidelines from the instructor. There were many features available in Google forms to facilitate collaborative editing and design of questionnaires for conducting surveys, but one participant found it difficult to use them at home without assistance from the instructor. One participant also questioned the need to learn a new platform if it was not being used elsewhere outside the classroom.

Adoption and Usage

Considering the influence of lecturer on the adoption of a collaborative platform, all of the participants agreed that the lecturer increased their intention to use the collaborative platform at the beginning of the course. They felt that their desire to use the collaborative platform was related to reputation advocated by the lecturer in the first lecture. Apart from these, some of the respondents were curious to find out the purpose of introducing Google Applications: whether Google Applications could benefit them for their future careers since they guessed that it was the reason why the lecturer advocated their usage. However, the adoption and usage of the platform was subsequently influenced by two other important factors: the ease of use of the platform and the usefulness for sharing project work among group members. The participants also revealed that the influence of their project group members was a decisive factor for achieving the ultimate usefulness of the collaborative platform. If some members did not participate actively in the collaborative platform, the usefulness of the platform would be downgraded and would subsequently affect its usage.

Project-based Collaborations and Consolidations

All respondents found collaborations and communications to be important elements of project-based learning. Collaborations involved division of labour among members and no one possessed all the knowledge and skills required for the various stages of the marketing research process. In the project, the division of labour was assigned by the students themselves. The interviewees commented that the divisions of labour among the project tasks were assigned according to the different strength of the project members. For example, one respondent was taking the initiative to focus on the source of literature and he used the project Web site as a digital repository for sharing the research materials and sources of literature for other group members. Another respondent focused on the data analysis aspects and used the project Web site to share the results with other members. Therefore, various types of information were required to be shared frequently and it was often necessary to consolidate different pieces of information to cope with project assignments and presentations.

The interviewees also discussed the requirement to communicate with their current work with other students. Email was previously used for project communications in other subjects, but it was difficult to know the status of current work through emails.

Their previous experience with other subjects showed that there were too many emails relating to project communications. It was difficult to search through emails to find appropriate attachments relating to project work, and it was difficult to sort out different pieces of communications and files by searching through emails. Therefore, all participants agreed that the use of technologies to support project-based communications would be useful.

The respondents also expressed the requirements to communicate and know about the real-time status of current work. Instant messaging systems and chat sessions in Facebook was used, but the students seldom use telephones to discuss project matters directly. All respondents agreed that there was a need to employ some kind of technology to support collaborative project work in real-time. An example of computer-mediated collaborative work using Google documents was described by the participants. In order to prepare project presentation documents, a student worked together with other students in real-time remotely through Google documents. Through the collaborative platform, they were able to see the changes in the documents in real-time, and were able to see all members who were online for editing. However, most of the respondents did not prefer editing Google documents together because Google documents were not fully compatible with Microsoft Office. When the Google documents were converted to Microsoft word for preparing the final project reports, there were formatting problems and this prevented the members from employing online the collaborative editing facilities.

Half of the respondents commented that the project Web site was most useful to support project work, although most of them felt that Microsoft documents was needed instead of Google documents to support project documentations. Through the project Web site, group members were able to follow up with the different versions of the project documents. Students shared project materials, discussions and comments for various activities in the project Web site, so that it was easier to see the latest status of their project work. All the respondents were also positive toward Google forms for the development of project questionnaires, and they used Google forms to edit the questionnaire items for their online surveys collaboratively.

6.2.4.2. Quantitative Evaluation of the Collaborative Platform

To assess the collaborative platform, it was necessary to investigate the various factors relating to the adoption of the technology. As the CSCL platform was introduced for the first time to a class with 140 students, a quantitative approach provided effective means of evaluating the various aspects of adoption by the students. The first cycle of implementation for the collaborative platform covered the various aspects of employing collaborative technology for project work. A quantitative evaluation ensured that feedbacks were provided by students on various aspects. It also ensured that the results of the evaluation can be generalized to guide future implementations.

After students have used the CSCL platform for nine weeks, a survey was conducted to collect feedback from students using a structured questionnaire. The items relating to student adoption behaviours were measured using a seven-point Likert scale, with answer choices ranging from 'strongly disagree' (1) to 'strongly agree' (7). The factors that were being investigated include perceived usefulness, perceived ease of use, subjective norms, sharing, guidance and support, satisfaction and behavioural intention to use the collaborative platform. For each factor, a number of questionnaire items were constructed to measure the attitudes associated with each factor.

The survey also reported that the students spent a lot of time using social network sites, with sixty percents of the students spending over ten hours per week on social network sites. Therefore, it was expected that students were familiar with the use of Web 2.0 technologies. About one-third of the students were male and two-thirds of the students were female. The feedback on the various aspects of technology adoption from students on the CSCL platform (as shown in Table 6-6) was positive, although the items reflected neutral score values relating to some aspects of technology adoption.

Regarding the usefulness ($\bar{x}$ = 4.82) of the CSCL platform for project-based collaborations, most students considered that the CSCL platform was useful and there were advantages that were offered by Google Applications as a collaborative platform. The attitude relating to ease of use of the collaborative platform was moderate ($\bar{x}$ = 4.23). Although the project Web site was structured around related project tasks, students still considered the ease of use of the CSCL platform to be moderate. This might be due to the highly interactive nature of Web 2.0 technologies and the large number of collaborative tools offered by the platform for different tasks.

Table 6-6 Summary of responses from the survey

Adoption Factors	Questionnaire Item	Mean
Perceived Usefulness $\bar{x}$ =4.82	Google Applications are of benefit to me.	4.91
	The advantages of Google Applications outweigh its disadvantages.	4.73
	Overall, Google Applications are advantageous.	4.83
Perceived Ease of Use $\bar{x}$ =4.23	Learning to operate Google Applications is easy for me	4.25
	It is easy for me to become skilful at using Google Applications.	4.19
	Overall, Google Applications are easy to use.	4.25
Subjective Norms - Media $\bar{x}$ =3.93	I read/saw news report that using Google Applications was a good way of learning.	3.93
	The popular press depicted a positive sentiment for using Google Applications.	4.07
	Mass media reports influenced me to try out Google Applications.	3.79
Subjective Norms - Lecturer $\bar{x}$ =4.23	My lecturer's participation in our Google Applications project Web site is high.	4.06
	My lecturer's online participation influences me to use the Google Applications platform for the project.	4.23
	My lecturer is very supportive in our project Web site for the use of Google Applications for my project.	4.40
Subjective Norms - Peers $\bar{x}$ =5.71	My team members expect me to use Google Applications for project collaboration.	5.72
	My team members are very supportive in the use of the Google Applications for project collaboration.	5.70
Sharing $\bar{x}$ =4.98	I can share my project work through the Google Applications platform.	4.87
	I feel confident to be able to share information to help others to solve their problems.	4.91
	I am able to share information through the Google Applications collaboration tools and project Web sites.	5.17
Intention $\bar{x}$ =4.25	All things considered, I expect to continue using Google Applications for the project.	4.27
	All things considered, it is likely that I will continue to use Google Applications for the project.	4.27
	If I could, I would like to continue my use of Google Applications for the project	4.20
Guidance and Support $\bar{x}$ =4.25	Guidance is available online or face-to-face during training sessions when I need help relating to Google Applications.	4.19
	The guidelines and demonstrations on using Google Applications are easily accessible.	4.14
	I can get support or help on using Google Applications from other fellow students.	4.42
Satisfaction $\bar{x}$ =4.47	I am satisfied with the performance of Google applications.	4.59
	I am pleased with the experience of Google applications.	4.37
	The decision to use Google applications is a wise one.	4.41

The attitude toward guidance and support was one of the lowest scored items ($\bar{x}$ =4.25) among the various adoption factors, which might be explained by the tight schedule of the project tasks and insufficient support was provided by the lecturer on the use of the

collaborative platform. Although students were actively using social networking sites, the requirements on the use of collaborative technologies in a Web 2.0 environment were different from students' daily use of social networking sites, additional tutorial supports were required to support the task-oriented nature of the CSCL environment. The high attitudinal score values associated with the usefulness of the CSCL platform were supported by the results of the focus group study, and the results also supported the need for additional tutors and guidance on the use of the new generation of collaborative technologies.

With regard to collaborative work using the CSCL platform, most students agreed that the CSCL platform facilitated sharing of project work ($\bar{x}$ =4.98), and students were able to share information to help others to solve problems. The sharing of information included the documents that are shared through the various collaborative tools. It was also noted that the attitude scores for sharing was significantly high with a mean value score of five, which indicated a high average score representing the students' agreement with the various aspects for sharing.

The collaborative platform was developed using a kind of social software from Google Applications technology. Therefore, evaluations on the influence of different reference groups on the adoption aspects were important. In evaluating the influence of different reference groups, three aspects of subjective norms were considered in the evaluation: subjective norms-media, subjective norms-lecturer and subjective norms-peers. Although the collaborative platform employed Google Applications technology, students were negative toward the influence of the mass media to try out with a new technology ($\bar{x}$ =3.93), indicating that the Web 2.0 technology induced very personal experience for users and students would tend rate the influence of the people they know with a higher score. Relating to the influence of subjective norms from peer members, the survey reported a very high score ($\bar{x}$ =5.71) rated by the students on the peer influence from project group members. On the other hand, student rated the lecturer relatively low ($\bar{x}$ = 4.23) in terms of directly participating to use CSCL platform collaboratively. The results showed that in order to introduce the new collaborative learning environment, instructors need to collaborate closely with students, instead of just releasing a learning platform and assume that students would use it by themselves.

The study has revealed that there were both advantages and disadvantages in introducing Web 2.0 based collaborative environments for project-based learning. The usage statistics showed that the introduction of the CSCL platforms was viable even with a large class with 140 students. There were also various psychological factors that might influence the adoption, which would subsequently influence future implementations of the platform. It was therefore necessary to evaluate the overall satisfaction level of the students, and to investigate whether the performance of the CSCL platform met students' expectation. The overall mean score ($\bar{x}$ = 4.47) for the satisfaction level of the CSCL platform was moderate, indicating that on the average, students were quite satisfied with their experience on the performance of the CSCL platform. It was also noted that when students were asked about their intentions to use the collaborative platform for project work, the average score for the intention aspects was 4.25 ($\bar{x}$ =4.25), which was relatively low. The reasons provided by students was based on the fact that most of the students were working toward their final year of study, their consideration for future usage was rather on the usefulness of the technology for their future jobs rather than for future projects. Students suggested that if the platform was introduced during the first year of their study, they would be more willing to learn with a new technology.

6.3. Implementing the Second Design Iteration of CSCL

The analysis for the first iteration of the implementation of the CSCL platform showed that collaborative technologies implemented in the CSCL platform supported students' participation in a project-based environment. The design solution was based on an activity perspective for authentic learning. This section focuses on the second iteration of implementation and testing (as shown in Figure 6-7). The second implementation of the CSCL design solution was conducted during the 2011-12-S1 semester for the delivery of the advanced marketing research course to a second batch of students with a class size of 50 students. The profiles of these students were similar to the previous implementation so that improvements on the design solutions were possible based on the previous experience. By implementing a second iteration of the design solution, it was also possible to focus on specific factors in the design and introduce more focused elements in the learning intervention. From the results of the evaluations for the first implementation, improvements on the design solutions could be implemented in the

second iteration. Furthermore, it was possible to focus on more complicated aspects of learning and use of collaborative technologies. This research focuses on the adoption and use of collaborative technologies and it was important to understand that the CSCL solution serves the purposes for collaborative work rather than just acting a conventional e-learning platform for delivering contents. Therefore, during the delivery of the advanced marketing research course in the second iteration, student collaborations for knowledge advancements were evaluated, taking into consideration the benefits of employing social educational software as a CSCL platform for project-based learning.

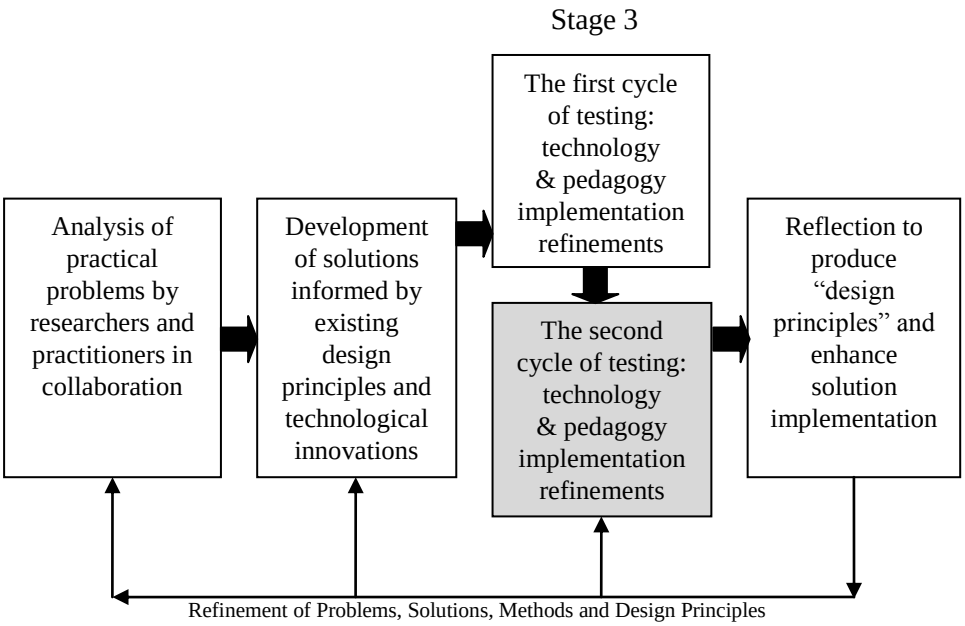


Figure 6-7 The second cycle of testing: technology and pedagogy implementation (Source: Reeves, 2006)

6.3.1. Design Intentions

There were several areas that need to be addressed to improve the design solution for learning, including the layout of the CSCL project Web site, the group-based communications and the collaborative aspects relating to the sharing of information for knowledge construction and advancement. The refinement of the design solution was guided by two major areas: employment of relevant theories that guided practice and reflections through evaluations conducted through the first implementation. In terms of theory, the design intention of this iteration was to ensure that the CSCL platform was used for project-based collaborations through the development of shared

knowledge artefacts that were developed during the various stages of project development. The results of the evaluations conducted with students suggested that the layout of the project Web site needed improvement and there was a need to focus on group-based communications to facilitate more complex interactions for project-based learning.

As the CSCL development was facilitated by social software tools, the features of the Google Plus social networking platform would have to be considered in the design solution for project-based learning. It was also noted that Google Plus enabled streams of information that were communicated through a social network. These features were embedded in the Google account and were introduced gradually by Google throughout the years. The design intention in this iteration was also to separate the CSCL interactions from students' private areas for social networking. Therefore, the design objective was not to replace the CSCL environment through Google Plus features, but rather to provide a CSCL platform that enabled students to make critical, meaningful, subject-related intelligent use of technologies. Such kind of platforms could be linked to social networking sites, such as Google Plus. The current CSCL implementation was to capitalize the collaborative technologies provided by Google Applications, recognizing the fact that these environments were able to provide facilities for social networking.

6.3.2. Intervention Development

The purpose of intervention development was to refine the technological and pedagogical design solution to address the new issues that arose from the first implementation. The iterative approach aimed at improving the robustness of the design, addressing the practical aspects of employing collaborative technologies for project-based learning. Furthermore, the design approach was characterized by the use of multiple theories through an iterative approach that enabled the researcher to focus on the specific aspects of a theory during the iteration.

Reflections and evaluations from the first implementation showed that the first prototyped version of the CSCL platform was too complicated beginners. There were too many items on the project Web site, and beginners needed to try out different options to explore the features. During the second implementation, the number of

items in the project Web site was reduced to improve navigation. Furthermore, guidelines on the usage of the CSCL platform were distributed to students at the beginning of the course, in order to improve students' confidence in dealing with a new platform.

To improve communication aspects, the Google plus system was introduced during the second cycle of implementation. The reasons to introduce Google Plus as a social platform for communications was based on the fact that students viewed their peers as making the most influence for adopting a collaborative platform for learning. Furthermore, the features available in Google Plus were conveniently linked to the CSCL platform developed using Google Applications technology. Google Plus also offered the possibility to overcome the privacy issues associated with social software educational tools by introducing personalized user groups. The various access privileges were implemented through the grouping of contacts into 'circles'. The fine-grained privacy controls available in the Google platform with defined 'circles' avoided complications that could arise from the overlapping of social and professional identities (Baran, 2010).

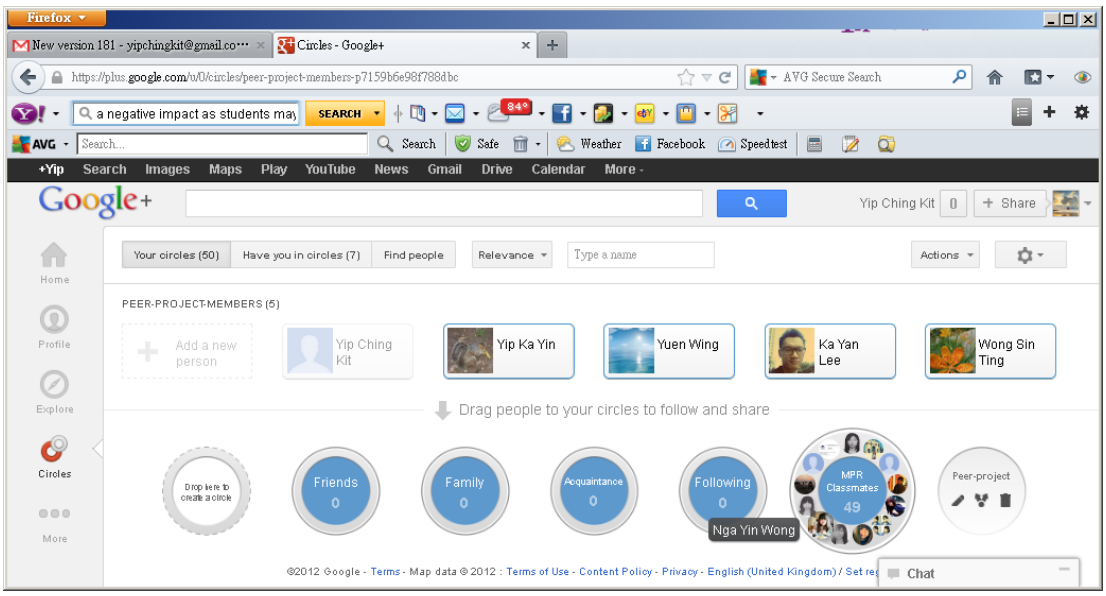


Figure 6-8 A Google Plus page

The major change with the use of Google Plus in the second implementation of the CSCL platform was that it was possible to set private communication groups through circles, which a feature that was in line with the guiding *principle 4* for CSCL platform development - to separate students' social networking and academic related

project communications. An example of the 'circles' project group for the Google Plus platform is shown in Figure 6-8. The access control in 'circles' was implemented through a 'drag and drop' user interface that combined the users in the user-defined project groups. These private project groups were defined so that contents relevant to a particular project group can be shared within the group.

6.3.3. Evaluation of the Second Iteration of Implementation

The evaluation of the second implementation was based on the analysis of the project activities, analysis of online discussions, and a focus group discussion from a selected group of project students. The analysis of project activities enabled the comparison of the usage statistics of the first and second implementations after the Google Plus social network was introduced. The analysis of students' online discussions provided an analysis of knowledge-construction process that was developed through various stages of project-based learning. Through a focus group study, a content analysis was conducted to evaluate the project-based collaborations in the CSCL platform.

6.3.3.1.Analysis of Web-based Activities

In the second implementation of the CSCL platform for the AMR class, the system reported a total 2,369 activities from a class of 50 students. There were a total of 584 files in the system and the system reported a total of 1,097 revisions. Table 6-7 summarizes the number of activities in each project group, and number of files uploaded and shared through the project Web site. It is also important to note that many of the files were revised iteratively by students, resulting in different versions of the same file. When these revisions were taken into account, the activities represented a significant number of objects created and revised by the students. The average number of revisions per file was obtained by dividing the number of revisions with the total number of files in the project Web site. These figures represented an average of 1.9 revisions per file, which was a good indication that the file objects in the system were being shared and revised for sustained knowledge advancement.

Table 6-7 Summary of activities for project groups – 2011-12-S1 session

Group	Number of activities	Number of files	Number of revisions
F1	199	52	81
F2	122	38	45
F3	196	51	83
F4	132	33	46
F5	425	94	195
T1	157	42	69
T2	238	52	122
T3	155	46	73
T4	178	42	70
T5	237	69	110
T6	330	65	203
Total	2,369	584	1,097

It was noted that Google Plus was formally introduced in July 2011 during the second implementation in 2011-12-S1 session. As students were using their Google accounts for accessing the CSCL platform, the participation of students was analysed by comparing the average number of activities per student during the two iterations. In the first implementation the average number of activities per student was equal to 38 ($\bar{x}$ =5,312/140=38), and the average number of activities during per student during the second implementation was equal to 47 activities per student ($\bar{x}$ =2,369/50=47). The figures reflected a similar level of participation, showing that linking the CSCL system to a social networking site such as Google Plus did not change the level of participation significantly among students. It was also noted that the activities in Table 6-7 represented only the activities recorded in the project Web site. They did not include students' private communications in Google Plus and students' participation in Google forums.

The current study focused on the long-term development of knowledge artefacts, which can be represented by practices, ideas, models and representations. They corresponded to the objects such as online discussion records, research frameworks and research design and draft project documents that were shared through the collaborative platform. They go through constant revision, remixing and versioning, with the long-term objective of developing the final project document for the project group. For the current study, the development of shared knowledge artefacts was

organized around the six stages of the marketing research process, corresponding to problem definition, literature review, project proposal, questionnaire design, data analysis, and reporting. These artefacts undergone extensive revisions through joint efforts and such kind of activities were recorded through the collaborative platform.

In order to establish the fact that the CSCL platform was used for collaborative activities, the related communications for project group T6 was selected for a more detailed analysis. Table 6-8 shows a summary of the number of messages relating to the six stages of the marketing research process. All these messages related to the detailed discussions on the collaborative activities of the six stages of the marketing research process. Through the discussion, the group members also shared Web documents, powerpoint documents and analysis results. These documents are also listed in Table 6-8. They represented concrete objects that were shared and revised through the CSCL platform.

Table 6-8 A list of objects highlighted through shared discussions for group T6

Discussion threads and files relating to Problem Definition (No. of messages = 4)
http://www.scribd.com/doc/22027744/Coca-Cola-Branding-Strategy (A) www.samplequestionnaire.com (A)
Discussion threads and files relating to Literature Review (No. of messages = 6)
http://www.trchome.com/white-paper-library/wpl-all-white-papers/212 (D) http://www.scribd.com/doc/22027744/Coca-Cola-Branding-Strategy (D) www.trchome.com (D), literature_summary.pptx (B)
Discussion threads and files relating to Proposal (No. of Messages = 8)
AMR[1].pptx (D), 1,2.pptx (E) 7&8.pptx (B), presentation.pptx (A), proposal, presentation.ppt (A), proposal.pptx (C)
Discussion threads and files relating to Questionnaire Design (No of messages = 43)
MRQuestionnaire.doc (B), MR_Project_Cafe_De_Coral_Questionnaire-1.doc (C), The_importance.pdf (C), Dragonnaire.docx (B), Questionnaire Sample for Dragonniare1.docx (E), Revised Dragonnaire.docx (B), Questionnaire and forms.docs (B)
Discussion threads and files relating to Data Analysis (No of messages = 90)
labelled data.xlsx (C), output2.spv (C), label1.sav (B), cover page.docx (D) labelchanged.sav (E)
Discussion threads and files relating to Reporting (No. of messages = 93)
Dragonnaire.docx (E), Output1.spv (E), Output.docx (E), Reliability.docx (E), T-test, Chi-square.docx (E), New Frequency + Descriptive statistics.docx (E), demo, descrip, relia, regress.docx (B), correlatioms.docx (B), research_objective_sampling (B), data.xlsx (B), New Frequency + Descriptive statisics + Reliability.docx (E), SPSS output t-test, Chi-Square.docx (E), SPSS output Regression.docx (E), tables.docx (E) part7.docx (B), diagram.jpg (C), discussion+conclusion2141.docx (C), amr_final_ppt2.pptx (D)

The brackets beside each object corresponded to the group members (A, B, C, D, E) who uploaded the shared file objects (and referenced these objects in the online discussions) in Google Site. Most of the objects were being revised and re-uploaded

by different project group members, and the records showed that all group members participated in discussions and uploading of different revisions of project documents. These objects represented important inputs for subsequent developments of the final project documents and assignments. It was also noted that the shared object documents that were referenced in group T6's online discussions (listed in Table 6-8) represented only a portion of the documents shared by the project members. Furthermore, the discussions among the project group members highlighted the importance of the shared learning activity structures and cultural practices through a community of participation.

Rather than employing a fragmented approach to learning, the various stages of project development engaged students in collaborative inquiry over long periods of time (through the problem definition, literature review, proposal, questionnaire design, analysis and reporting). The analysis has shown that the learning activities were mediated through concrete shared objects across long time scales, which was in line with the socio-cultural and cultural-historical theories of human cognition. The participation records also showed substantial interactions between individual and collective processes conducted through various stages of the marketing research process. The marketing research projects also mirrored the type of work that was conducted by marketing professionals, which relied on cross fertilization of knowledge practices. An important characteristic of this approach was that the creation of learning objects heavily relied on collaborative technologies, and these developments were realized through reflections across various forms of knowledge and expertise among the students. From the group of students selected for analysis, it was expected all the other student groups in the implementation showed similar learning patterns through the structuring of activities around the marketing research stages.

6.3.3.2. Focus Group Study

In order to investigate the behaviour of students in using the collaborative platform, a focus group study was conducted with a selected project group with five students. The objective of the study was to investigate how the collaborative platform was employed by a group of students for project tasks and whether the CSCL platform facilitated collaborations and communications among students within a project group for

purposes relating to the development of project knowledge. A discussion guide (as shown in Table 6-9) was prepared by a moderator for the focus group study. This was used to ensure that the major issues and questions relating to project collaboration were addressed during the focus group interview.

Table 6-9 Discussion guide for the second focus group study

1.	What are the functions of a collaborative platform for project-based learning?
2.	Is there a need for collaborative platform?
3.	How do members communicate through a collaborative platform?
4.	How to decide on the divisions of labour among students in a project group?
5.	How do you collaborate and share knowledge through a collaborative platform?
6.	What motivates you to use a collaborative platform for knowledge sharing?
7.	How can Google Applications match with your working style for project-based work? If not, please list out the reason(s).
8.	What are the factors that influence you in adopting a collaborative platform for project-based learning?

All discussions in the focus group were recorded and transcripts of the discussions were prepared from the recordings. Based on the transcripts, four major themes were identified. The analysis helped to evaluate whether collaborations in project work were related to the use of the technological platform, whether communications and sharing were facilitated through the use of social software tools, and whether the technological platform facilitated the long-term development of shared objects, such as conceptual artefacts, shared knowledge and project documents for project-based learning.

The Need for a Collaborative Platform

The participants suggested that a collaborative platform should provide facilities to support task-oriented communications, discussion of ideas through online discussions, as well as sharing of project documents. All of the five students had previously used Facebook for social communications, events scheduling and sharing of photographs. However, the messages in Facebook were delivered as a stream of messages and it

was not convenient to navigate through the communication history. Students have tried to use social software tools for project-based communications and indicated the need for such kind of collaborative tools to cope with project-based communications. Email was also used previously for formal communications and sending file attachments when there was a need to share important documents among project members. Most participants agreed that there was a need for a more organized platform for frequent sharing of information, discussion of ideas, sharing of project documents and the Google platform developed for this subject served these purposes.

Project-based Communications

A participant described project-based communications as task-oriented, work focused and often target toward long-term project goals. The participants perceived the Google Applications platform as a more dedicated separate area for project-based communications through collaborative tools. Project-based communications required more detailed communications among students and follow up with project details. For example, relating to project objectives for marketing research, students communicated online and a student quoted the following example of online communications:

> 'The research objective is to understand more about the current situation of Dragonair and to expand the market share in the air industry. Since the parent company of Dragonair is Cathay Pacific, travellers intend to pay more attention to CX rather than Dragonair. Besides, Dragonair is less competitive than other airline companies as its scale is relatively smaller. By conducting the research, we are going to measure the strengths of some factors to see what Dragonair has to do to improve its business. Consequently, recommendations will be suggested to help dealing with the problems'.

Another student described the project-based communications as being organised into separate sections according to the project stages. For example during the project proposal stage, they would organise the proposal-related communications and documents in the project Web site. These communications often required follow up and subsequent refinements from peer group members. For example, relating to the proposed research objectives, another student responded by proposing the following

alternatives in the project descriptions: 'To bring more understanding of the current situation of “Dragonair” successfully; to expand the market share in the air industry; to measure the strengths of some factors to see what “Dragonair” has to do to improve its business.' When students posted messages in online project discussions, they expected other members to contribute and respond to their postings in a reciprocal manner.

Collaboration and Project Sharing

A student also showed that they developed their project proposal through uploading of files and posting of related messages through online project discussions. This was necessary because students were used to working and communicating online anytime anywhere. For example, when a student uploaded a new version of the project objectives, other members would check whether the revised version was consistent with the other parts of the project document. Other students could contribute by providing comments and revisions. The advantages offered by Google Sites for file sharing were the abilities of the system to trace back old file versions. It was not necessary to browse through emails for file attachments because the project site was able to show all versions of the project files from different authors.

It was noted that project-based learning required frequent communications and collaborations. Through the online networking tools, these communications and collaborations were more explicit so that it was easier to balance the work among the peer members. Throughout the project, students exercised self-regulation by dividing the project work among themselves according to the strengths in the related areas. They updated the latest versions of their project work on the project Web site to facilitate sharing. Communications among project members occurred more frequently during the proposal and final presentation stages of the project, accumulating to more than ten times per day. However, students relied on other means to address the real-time aspects of communications because they need to be notified immediately at critical times. Four of the respondents would use the 'Whatsapp' mobile application to notify other members when important updates were available. The real-time messaging system 'Whatsapp' was used in combination with the project platform in a complementary manner. 'Whatsapp' was purely used for real-time notifications while

the project Web site was used for collaborative development of project documents and long-term development of artefacts to support their marketing research projects.

Motivating Factors for Adopting a Collaborative Knowledge Sharing Platform

Most of the participants found that the factors motivating them to adopt a collaborative platform would be ease of use, the influence from peer members, active involvement of the group members and the need for sharing through the Web-based platform. However, in order to use a collaborative platform, the users were required to log in using a Google account. This might prevent them from active use of the collaborative platform, because most of the participants were not using the Google email service for their daily communications. Therefore, they might not be logging on to the collaborative platform frequently, and this prevented them from actively participating in the collaborations.

The participants were positive on the use of social software tools for knowledge sharing, but there were some concerns among the students. Most students considered that sharing information globally through discussions involving a whole class of students was not preferable. They would be more concerned if their views were being criticized by other classmates. Students preferred to share knowledge and information within their project group members and they agreed that such practices could enable the advancement of knowledge with the marketing research projects. Furthermore, the respondents also mentioned that mixing social communications with project discussions were undesirable, and they prefer social and academic discussion to be separated. The facilities provided by the Google platform provided a more dedicated area for project discussions, document construction and sharing. Such environment offered the social tools to communicate with their peer members but students tried to keep the project area separated from their social communications.

6.4. Chapter Summary

This chapter presents the details of the implementation and testing of the computer-supported collaborative learning environment. Two iterative cycles of testing for the implementation of the collaborative learning environments are described. Evaluations of the implementations of the design solutions are presented to support the technology and pedagogy implementation refinements. Through the implementation and the

feedback collected from the students, the adoption of the collaborative platform was evaluated through qualitative and quantitative approaches. Reflections on the implementations revealed several important aspects:

- Student participation with the collaborative platform was reasonable, but as a new environment, the user interface aspects of the CSCL environment could be improved.
- The usage of the CSCL platform revealed that the students employed the CSCL platform for group-based activities, and the students considered the participation with peer members, ease of use, and usefulness of the collaborative platform as important factors affecting their use of the CSCL platform.
- The collaborative platform supported the long-term development of student artefacts and documents for project-based learning and students frequently updated and revised their project documents through the CSCL platform to facilitate knowledge creation and sharing.

The next chapter presents the reflections from the iterative design and evaluation processes to produce design principles that characterize the main features of the computer-supported collaborative learning environment, in order facilitate theoretical, pedagogical and technological developments in the future.

Chapter 7

Reflections to Produce Design Principles

7.1. Introduction to the Chapter

This chapter addresses the second research question SQR2: 'What are the design principles for developing a computer-supported collaborative learning platform using collaborative technologies for project-based learning?' An appropriate response to the research question should identify the design principles for developing and integrating a CSCL environment for project-based learning. This chapter presents the reflections on the implementation experience to produce guidelines for future developments. The role of design principles is discussed in section 7.2, which also includes a review of the literature on design principles for technology enhanced learning. The section also includes a discussion on the use of design principles to guide practice. Finally, section 7.3 presents the documentation and synthesis of design principles that were based on reflections from implementation experience.

7.2. The Role of Design Principles

To address the needs for teaching project-based marketing research courses, a design approach was used to develop a computer-supported environment for collaborative learning. A common feature of design research is that theory and practice are intertwined in the studies. In order to develop a design solution, a literature review was conducted to find relevant theories as well as existing design principles from other researchers that might have addressed a similar or a parallel problem. In order to develop an initial design solution, a set of draft guiding principles was developed from literature. The evaluations and reflections from the implementations provided further opportunities to refine these guiding principles, and subsequently they were documented as the design principles for this study. Therefore, the use of design research contributes to outputs in the form of both knowledge and products:

Knowledge - Design Principles

The output from design research differentiates from other research approaches in the development of design principles. The generic design principles help to explicate the central features of the pedagogical approach to guide future implementations of CSCL solutions for project-based learning. Design principles contain substantive information on the learning context, and evidence-based heuristics that can inform future developments and implementation decisions (van den Akker, 1999).

Practical Output - Design Artefacts

As a research in the design area, the research goal in educational technology is to solve practical problems in teaching and learning. The product of the design artefact is also considered as a major output of design research, which can be represented by the CSCL platform for project-based learning.

The collaborative platform developed using Google Applications technology has been implemented, evaluated and refined in two iterative cycles. During the last stage of the design research process (as shown in Figure 7-1), the design principles for the CSCL environment to support project-based learning were developed based on the reflections and refinements on the draft guiding principles developed in the early stages. They comprised the sharable, published output from the research, in order to inform future developments and implementation decisions.

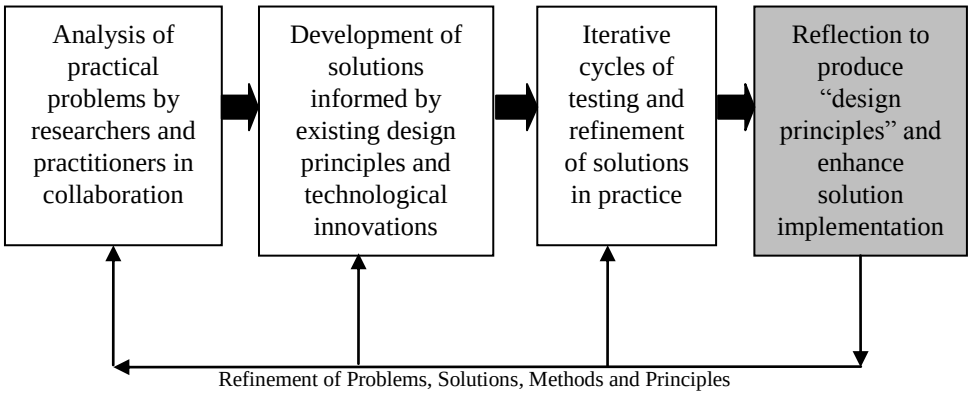


Figure 7-1 Reflections to produce design principles (Source: Reeves, 2006)

7.2.1. Use of Design Principles for Technology Enhanced Learning

Design principles have been used by practitioners to implement improvements in their teaching environments and pedagogical practices. They serve as guidelines that have been built on research through successful stories as well as failures. Design principles are not used as 'rules' that guarantees success in implementations but they are used 'to help others select and apply the most appropriate substantive and procedural knowledge for specific design and development tasks in their own settings' (McKenney, Nieveen, & van den Akker, 2006). Design principles can be represented in the form of heuristic statements (van den Akker, 1999) that can be presented as follows:

> 'If you want to design intervention X (for the purpose/function Y in context Z), then you are best advised to give that intervention the characteristics A, B, and C [substantive emphasis], and to do that via procedures K, L, and M [procedural emphasis], because of arguments P, Q, and R.'
>
> (van den Akker, 1999)

Design principles emerge from previous researches to inform future practices, operating as a bridge between theory and practice (Bell, Hoadley, & Linn, 2004). Various researchers have proposed guidelines for the design and development of Web-based courses employing new technologies for technology enhanced learning (Oliver, 2000; Reeves, 2005). In order to develop effective e-learning environments, Herrington and Oliver (1997) develop a set of guidelines for authentic learning. They report that their model is successful for guiding the development of an interactive multimedia programme. To provide the design of constructivist learning environments, instructional designers also develop guidelines that support the construction of knowledge through social negotiation and exploration of real-world environments (Honebein, 1996; Jonassen, 1994).

There are various researches in the literature relating to the development of guiding principles for developing computer-mediated environments to support learning. To foster a constructivist approach to learning, Oliver et al. (Oliver, Herrington, Herrington, & Reeves, 2007) develop guidelines and strategies for e-learning designers to move away from conventional content-based e-learning Web sites. Ma

and Harmon (2009) develop design principles for development of online teaching case libraries. To promote collaborative learning in higher education, Levin-Peled, Kali and Dori (2009) develop design principles for hybrid courses, which cover guidelines for engaging learners with their peers and reusing of student artefacts. In order to develop knowledge building communities involving students and teachers, Hewitt and Scardamalia (1998) design a set of design principles for distributed knowledge building processes through a communal database (Scardamalia & Bereiter, 1994, 1996). In order to employ computer-supported collaborative learning in higher education, researchers have developed a principle based instructional design approach emphasizing on pedagogical principles to foster innovation (Hong & Sullivan, 2009; Zhang, Hong, Scardamalia, Teo, & Morley, 2011), knowledge creation and advancement (Paavola, et al., 2011).

Hardless, Lindgren and Schultze (2007) develop a set of guiding principles for development of a technology-mediated platform for project-based learning. A set of Instructional design principles has been proposed by Light (2011) to build learning communities using Web 2.0 facilities. This was used for developing support for general lecture based classroom teaching. However, there are very few researches that investigate design principles for CSCL environments employing social software tools, and previous researches do not address the specific needs for project-based learning in an authentic learning environment. This research addresses the research gap associated with the design of new technologies for project-based learning.

7.2.2. Using Design Principles to Guide Practices

According to Reeves (2006), the use of design principles should include the learning context and the conditions for which the principles should be applied. This research develops a set of guiding principles for development of computer-supported learning environment for project-based learning. Design principles derived from this study were based on the instructional challenges of moving from content-based courses to learning platforms that support the social constructivist principle of locating learning in realistic contexts. The development of the Web 2.0 technologies and social software tools also coincided with the growing need for technology enhanced environments to support project-based learning. The interactive nature of Web 2.0 technologies and social software tools allows learners to explore a variety of resources

to establish connections with their peers. However, the adoption and use of these technological platforms for learning may not fit the specific learning context without the provision of a sound instructional model that fosters them.

In order to meet the specific requirements for teaching students to solve marketing research problems, research was conducted relating to principles from various researchers to support a socio-constructivist approach to learning. The basic design decision adopted in this research was to develop learning settings which provided authenticity based on the nature of the learning outcome to be achieved. The learning strategy was developed according to the intended learning outcomes based on project-based activities that reflect 'real-life' settings. Because of the need to design learning associated with meaningful contexts, the information that was used to support learning became artefacts of the learning process.

The context of learning based on real-life marketing research project facilitated a teaching and learning environment that developed students' problem solving skills, which were organized around learning tasks associated with the group-based marketing research project. According to guidelines for authentic learning (Herrington, 2006), implementation of authentic learning should be based on open and ill-structured tasks. They provided the learners with the capacity to explore, inquire and generate understandings associated with the learning context. Therefore, a computer-supported learning environment was required to support learning around the learning tasks and activities. One of the design challenges was to construct social learning environments using collaborative facilities for project-based learning. The following section describes the design principles developed in this research that can be used to inform the developments of CSCL environments using social software tools and collaborative technologies.

7.3. Documentation and Synthesis of Design Principles

Although the guidelines based on authentic e-learning provide the principles for the developing the learning tasks in an authentic learning environment, there is a lack of research in the development of guidelines and principles for use of CSCL platform employing collaborative tools. Design principles derived from this study were developed to deal with the challenges CSCL design using social software tools, the

lessons learnt from implementation experience, and the processes students gone through while employing the CSCL platform to support learning. These principles were initially developed as draft guiding principles that informed the initial development of a technological design solution to support project-based learning. The last stage of design research covered the documentation, reflection and synthesis of design principles. As a result, the following design principles were developed in this study to promote pedagogical practices as well as technological developments:

DP1 Embed learning within relevant and authentic contexts

DP2 Focus on sharing of meaningful knowledge

DP3 Develop opportunities for group collaborations

DP4 Support for coaching and scaffolding in a timely manner

DP5 Keep project-based communications separate from students' social networking sites

DP6 Promote participation, personalization and productivity

DP7 Support the long-term development of knowledge artefacts

These design principles were designed based on theoretical foundations. They captured the central characteristics of computer-supported collaborative platforms employing social software tools, and served as guidelines for the technological development of computer-mediated platforms to support project-based learning.

DP1 Embed learning within relevant and authentic contexts

The learning activities should be based on authentic contexts, focusing on ill-structured problems that reflect the way knowledge will be used in real-life.

The learning environment for project-based should embed learning within relevant and authentic contexts, in order to develop the problem solving capabilities for students. The implementation of the learning solution should engage students actively in problem situations that mirror the kind of experiences that naturally encounter in the field. The instructor should preserve the reality of the learning context by structuring ill-structured problems similar to those encountered by professional communities. The students should be given the opportunity to solve complex problems that requires students to work on tasks and sub-tasks, as well as dealing with

the main problem to be investigated over a sustained period of time. This way of organising experience increases the ability of students to transfer what they have learnt in the classroom to real-life situations. In this study, students worked on a practical marketing research project similar to those conducted by marketing research professionals. They performed literature review, collected primary data for analysis, and to develop a solution for the inquiry. Furthermore, problem solving is based on group collaborations rather than relying on individual problem solving capabilities, which was similar to real-life environments. Project-based learning environments should be developed based and based on social interaction among students using facilities for collaboration among students.

DP2 Focus on sharing of meaningful knowledge

The CSCL platform should provide support for social construction of knowledge, sharing of user-generated contents and portfolios for reflections.

The second design principle DP2 is the central one relating the technological platform, which indicates that a CSCL platform to support learning should move away from the highly centralized model of pre-defined contents to a platform for students to create, share and continuously improve ideas through collaborative tools. Such kinds of learning environments should be designed to reflect meaningful contexts, to support learning using tasks associated with real-life situations, and to replicate such kinds of activities. The learning tools for collaboration can be assembled to provide a range of sources and facilities to support such kind of tasks and activities. The role of the collaborative platform is to provide support for interactions to enable the social construction of knowledge. The wiki environment developed in the collaborative platform acts as a collaborative tool for students to structure the project definitions during the initial stages. The project discussion forum provides an area for free exchange of ideas relating to the marketing research projects. Learning in marketing research involves students engaging in defining the tasks, generating ideas, sharing resources, synthesizing thoughts and refining them on the basis of further insights and peer reviews. The file sharing area on the collaborative platform acts as a digital repository for the raw data, literature information and draft versions of project documents, providing an environment for reflection of the learning journey. Social platforms can be used for sharing, but students were not used to such kind of

environments for academic purposes. Through the surveys and interviews with students, a very high usage rate was reported by the students on social networking sites such as Facebook, but they might not have the knowledge of how to use the technology for academic purposes and might not see the values of social software tools for learning. The structuring of such kind of environments needs careful planning for the tools and activities that should be employed for the learning tasks.

DP3 Develop opportunities for group-based collaborations

The CSCL platform should address the requirements for collaborative activities within a project group rather than within a class of students; it should also support articulation through Web-based facilities for reflection and consolidation.

A collaborative platform provided opportunities for constructivist learning through provision of resource-based, student-centred settings, and by enabling learning relating to the practical aspects of marketing research. Sharing and collaborations were achieved through the various tools provided by the collaborative platform. For example students can collaborate to construct the project definitions for marketing research through the wiki tools and construct the survey forms collaboratively through the Google Applications platform. With Web-based facilities, the communications and collaborations were more explicit so that it was easier to balance the work according to individual expertise. When students were faced with confusion or conflict, they discussed the issues with one another through the project-based discussion facilities and try to negotiate to solve the problems. However students stated that they were not willing to sharing information online globally with a whole class of students. Therefore, access to the collaborative facilities should be focused within individual project groups.

The collaborations within a project group also provided opportunities to articulate, where members with different backgrounds and level of expertise were required to reflect on their learning through critical stages of their projects. Reflection is defined as the process through which an individual review his/her initial and consolidated interpretations about the marketing issues involved in learning. Though the considerations from other perspectives, it might be necessary to reframe the

interpretations by considering other perspectives to articulate the research issues. The analysis of the CSCL activities and student feedbacks showed that students collaborated intensively during week 4, week 6 and week 13 during the public presentations for their research frameworks, project proposals and final projects. Collaborations among a project group were supported by the CSCL platform through the wiki pages, digital repositories, min-blogs, survey development tools, discussion forums and document management tools.

Articulation is important because problem solving within the project groups relies on applied knowledge, which has a high tacit component. Such kind of articulation relies on the individual member's reflection. For example, members need to understand their own roles, individual contributions in terms of theory and practice, and how their contribution fits in with the overall target of the project team. The project presentations also required students to articulate by sharing and reconciling the project knowledge among their peer members.

DP4 Support for coaching and scaffolding in a timely manner

Coaching and scaffolding assistance within a project group should be available by teachers, experts and more able partners and should be facilitated by the CSCL platform in a timely manner.

The authentic learning environment was structured around ill-structured tasks relating to project-based learning in marketing research. Students needed different interpretation and different solution processes through evaluations of alternative solutions. The social software tools provided facilities for students to exchange information, contribute to discussions, share resources for their project, and provided opportunities for learner to acquire and examine alternatives in their project tasks.

The ability of the CSCL platform to facilitate knowledge sharing, and collaborations empowers the learners to shape their own learning contents. However, this does not mean leaving the students to develop understandings themselves within their project groups. In fact, social computing tools have cultivated a habit demand for instant answers. Students often have experience in posting questions directly to the instructors through online project groups, and they were disappointed to find that the instructor was not always online with every project group. Therefore, careful planning

of learning activities to engage authentic exchange and dialogue among students is important. The challenge is to enable self-directed and knowledge sharing culture by providing options and choices in learning, while at the same time structure the learning activities to provide scaffolding.

Scaffolding assistance is an important element in project-based learning. Feedback from the students revealed that as they share project information through the collaborative platform, they expected the teachers to provide scaffolding and assistance through the project Web site in a timely manner. Through the CSCL platform, the teacher can examine students work through various communication tools to provide guidance, advice, coaching and feedback. However, time implications for staff may well preclude a lecturer from providing guidance online for the project for every project group. Additional tutors may be required to perform coaching and assistance online. With a limited resource in terms of staff-student contact hours, a possible solution might be to develop students' skills in peer-tutoring and to enable peer assistance to be embedded in the technology-enhanced learning environment.

Collaborative learning through group-based project also promotes the opportunity for more able partners to provide scaffolding and assistance to their peer members. The design of the subject was centred on five collaborative assignments, requiring students to deepen their understanding by interacting and sharing the insights or critiques brought up by their peers, and to negotiate internally and socially to solve the problems. A collaborative platform should facilitate students, teachers and experts to participate in the project groups to provide scaffolding and assistance in a timely manner.

DP5 Keep project-based communications separate from students' social networking sites

When social software is employed for project-based communications, students prefer social and academic communications to be separated.

Although social software tools provide mechanisms for peer feedback using a collaborative model of learning, the project-based collaborative platforms should be separated from students' daily communications using social networking sites. From the survey conducted during the study, most students spent over ten hours per week

with social networking sites like Facebook. They considered social networking sites as a platform for social purposes and networking among students. They would like to keep academic and social life to be separated for privacy reasons. Students may not welcome teachers and instructors in their own online social networks and communities because students may perceive such kind of linkage as intrusions into their private space. The problem with mixing academic work with private social communications is more serious when online participation was taken into consideration in the assessment components. An example of student response from the second focus group study highlighted the students' feeling toward this issue:

> 'We would like to keep social networking sites separate from project-related communications. I use Facebook to get away from work, it is more for socializing, sharing photographs, and stories among friends. I would be reluctant to share and mix such kind of information through a project platform.'

Students used social networking sites to communicate with friends and classmates, but not with University staff. During the second implementation of the collaborative platform, Google Plus was also available as a social networking platform that could be connected with the project account. The introduction of Google Plus did not affect students' participation because Facebook was used for social networking among students. The feedback from students also revealed that the Google Applications collaborative platform was suitable because it was possible to separate project-based communications completely from the students' own social networking platforms.

DP6 Promote participation, personalization and productivity

Design of Web 2.0 CSCL environments must address the important elements of Participation (Communication, Community, Connectivity and Collaboration), Personalization (Learner Choice and Informed Decisions, Learner Agency, Customization, Self-regulation and Management) and Productivity (Learner-created Content, Contribution to Knowledge, Generativity, Creativity and Innovation).

The development of the learning environment should move away from the traditional organization of pre-packaged facts towards a social and participatory pedagogy, through development of learning communities to foster connectivity and collaboration. The technological platform needs to provide personalized learning experiences with options and choices about the use of various collaborative facilities to cultivate independent learning skills, so as to promote knowledge contribution, creativity and innovation.

Participation in learning communities within the project group is cultivated through structuring learning of sequences, and reflections through authentic contexts in problem-solving relating to marketing research. Through the practical marketing research projects, knowledge construction within the project group naturally. As a result, contributions and collaborations within the project groups are more explicit with the CSCL environment.

Provision of personalized learning experience is developed using appropriate technologies to cultivate independent learning skills. The design of the learning environment also needs to facilitate personalized self-regulated learning, enabling the learners to develop fundamental skills to manage their own learning. In the project-based learning environment, the division of labour and allocation of group work were implemented through self-managed learning and controls. The feedback collected from students revealed that problem-based learning environments imposed additional demands on the learners' independent learning abilities, as revealed from the following extract from the focus group study:

> 'We allocate the division of labour among the project tasks ourselves according to the expertise of individual members. As the tasks and activities in the marketing research projects are highly interdependent, frequent collaborations and communications are required to consolidate the findings. However, there are problems where we cannot resolve ourselves, especially with statistical analysis using SPSS. We rely heavily on the SPSS workshops, looking for scaffolds from the lecturer to complete the analysis for the research'

Student productivity in the collaborative platform can be measured in terms of the collaborative assignments. In addition, online contributions can be contributed to students' participation, which accounted for 15% of the assessment components, thus encouraging students to contribute to the collaborative platform. The assessment of student-generated contents may also include online discussions, reflections, and the portfolio of contributions that can be examined through the project Web site.

DP7 Support the long-term development of knowledge artefacts

The CSCL platform should foster the long-term process of knowledge advancement, so that work and learning are organized around the development of share, concrete objects in the form of conceptual knowledge artefacts (.e.g. ideas, frameworks and models) and practices (e.g. work practices in knowledge development).

Knowledge artefacts (Paavola & Hakkarainen, 2005) are digitally represented objects that are developed iteratively and shared through a collaborative platform. They go through constant revision, remixing and versioning, with the long-term objective of advancing project knowledge in a project group. They are being used as mediating artefacts for the activities involved in knowledge construction for the marketing research projects.

Through project-based learning, students develop concrete, usable solutions that address marketing research problems for specific organizations. Students engage in knowledge practices to solve applied research problems, such as branding, marketing, consumer behaviours and market segmentations, and work jointly as a group to advance knowledge through marketing research. Through the CSCL platform, learning should not only be confined to the development of shared activities and shared documents, it should emphasize on pursuing long-term knowledge advancement through collective efforts. The marketing research project represents the students' sustained efforts to advance community knowledge (within a project group) as the primary goal. The support provided by the computer supported-collaborative learning environment is very much like the practices of a professional marketing research team to engage in inquiries into marketing problems.

Knowledge artefacts are developed as digitally or textually represented conceptual objects, such as questions, theories, research frameworks, research designs, which could be used to guide the subsequent inquiries into marketing problems. The social software tools available in the CSCL platform facilitated the sharing of digital represented objects in the form of conceptual artefacts. These objects were shared through the collaborative platform and project Web sites. The documents and objects have undergone iterative development successively, through the process of revisions and remixing of contents. The design of the learning environment should exploit the affordance of these social software tools to foster a knowledge creating community to support the long term development of conceptual artefacts.

Evaluations results from the second implementation of the CSCL platform showed that the collaborative tools facilitated the sharing of files and documents. Most of the documents have been revised and shared by different group members. These documents related to the various stages of the marketing research process, showing that they undergone iterative development for knowledge advancement with a collective effort.

7.4. Chapter Summary

This chapter provides a description of the role of design principles, and a review of the existing design principles in the literature to support computer-mediated learning environments. The purpose of the review is to position the research within existing guiding principles from other researchers, and identify the significant research and practice in employing design principles to inform the development of CSCL platforms. This chapter also describes the synthesis of a set of design principles through reflections from implementation experiences. The design principles provide guidelines for those who would like to introduce social software tools as a computer-supported collaborative platform for project-based learning. These design principles are also represented as one of the outputs resulted from the first phase of this study through design research. The following chapter describes the second phase of the study for technology adoption, which also provides the subsequent evaluation of the collaborative platform based a theoretical framework derived from the technology acceptance model (Davis, 1989), the theory of reasoned action (Fishbein & Ajzen, 1975) and the task-technology fit model (Goodhue, 1995).

Chapter 8

Subsequent Evaluation of Technology Adoption

8.1. Introduction to the Chapter

After the completing the design of the CSCL platform, the subsequent evaluation of technology adoption was conducted during phase II of the research study. The subsequent evaluation employed a quantitative approach to develop a research model based on an enhanced version of the technology acceptance model. This chapter presents the background, theoretical framework, hypothesis formulation, data collection, data analysis and the development of a theoretical model for technology adoption. Finally, the research model was assessed in terms of a goodness of fit measure to evaluate the appropriateness of the proposed model for technology adoption in a collaborative learning environment.

8.2. Background of the Study

During the subsequent evaluation study, the Google Applications platform was used to support a total of 262 students in the 'Advanced Marketing Research' course during the 2011-12-S2 session. In order to enhance the effectiveness in using the collaborative platform, the current study investigated the adoption behaviours associated with the use of the technology. The investigation aims at evaluating the behavioural aspects associated with the adoption of the Google Applications platform for learning. It also aims at developing a theoretical model to facilitate understandings on the user acceptance aspects in a computer-mediated collaborative learning environment. To achieve this objective, a quantitative study was conducted to address the following research question:

RQ3: What are the factors that influence students' decisions to adopt a collaborative technology?

It is important to investigate the factors that influence students' decisions to adopt the technology because user acceptance is a prerequisite for future participation in the

CSCL environment. The research model developed in this study was empirically evaluated using survey data collected from 262 students enrolled in the 'Advanced Marketing Research' course during the 2011-12-S2 session. By developing a research model for Web 2.0 based collaborative technologies, this research also addresses the need for developing research models that explain the adoption behaviour of collaborative technologies for project sharing. The following sections describe the subsequent evaluation of technology adoption conducted during phase II of the study.

8.3. Theoretical Frameworks for Technology Adoption

Focusing on a project-based teaching environment that employs Google Applications, this study investigates students' acceptance behaviours toward collaborative learning technologies. A research model was developed by extending the technology acceptance model (TAM) (Davis, 1989), the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975) and the task-technology fit model (Goodhue, 1995) to explain the factors affecting user perceptions and acceptance of new technologies.

The technology acceptance model was conceived at the individual level for technology adoption when the model was developed. Collaborative technologies employing social software tools represent a kind of innovation where the influences among group members are important. The theory of reasoned action considers the importance of social influence on the acceptance of a technology, which is an important aspect of collaborative learning. While prior research has examined the use of a combined model using TAM and TRA for technology adoption at the individual level (Hartshorne & Ajjan, 2009; Padilla-Meléndez, Garrido-Moreno, & Aguila-Obra, 2008; Pavlou, 2003), there are limited studies that investigate the adoption of collaborative technologies using a combined theoretical model. There is also a need to tie the mature field of technology acceptance with collaborative research (Venkatesh, Dennis, & Brown, 2010), by using a combined model to investigate the adoption of collaborative technologies.

To develop combined models to investigate collaborative systems, the task-technology fit model provides the basic constructs for investigating the task and technology aspects of a collaborative system. The task-technology fit model has been combined with TAM models by various researchers to explain technology adoption,

including user acceptance of Internet services (Shang, Chen, & Chen, 2007), adoption of wireless technology (Yen, Wu, & Huang, 2010) and e-Commerce systems (Klopping & McKinney, 2004).

8.3.1. The Theory of Reasoned Action

The theory of reasoned action (TRA) is one of the most influential models from social psychology for studying the determinants of human behaviour (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). It is the most widely used models to predict goal directed behaviour, which specifies that a person's performance of a behaviour is determined by the behavioural intention to perform a behaviour. Behavioural intention is jointly determined by a person' attitude and the subject norm concerning the behaviour in question (Figure 8-1). The attitude toward the behaviour is defined as a person's positive or negative feeling about performing a specific behaviour, and is determined by the salient belief of an individual. The subjective norm is defined as a person's motivation to comply with what key people would or would not have. It is determined by the normative beliefs, which represent how significant others feel about the individual performing the behaviour.

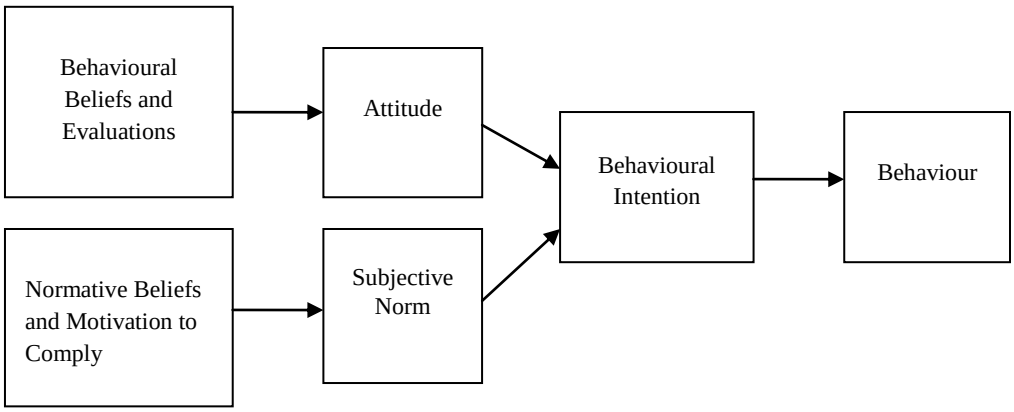


Figure 8-1 The theory of reasoned action (Source: Fishbein & Ajzen, 1975)

With the growing use of social networking tools and collaborative technologies, researchers have examined the effects of social ties on the adoption of information technologies in the virtual environment. Hossain and de Silva (2009) explore user acceptance of technology by considering social ties in social networking systems. They investigate the effect of strong ties and weak ties on the user acceptance of a

community capacity building network. The adoption behaviour of users is investigated by considering the influence of different types of social ties on the user acceptance of a social networking system. Their research shows that peer influence in the form of strong ties has significant influence on behavioural intention, and that the influence of weak ties on behavioural intention is not significant. Therefore, different components of subjective norms are considered in this study to investigate the influence of the distinct components of subjective norms on the adoption of the computer-supported collaborative learning environment. TRA is a general model that can be used for predicting behaviour across a wide area of domains. In order to develop a model that predicts, as well as explains the factors that influence the usage of computing technologies, researchers have developed the technology acceptance model for explaining the determinants of technology adoption.

8.3.2. The Technology Acceptance Model

The Technology acceptance model (TAM) is generally considered as the most influential and common theory in information systems area (Lee, et al., 2003). TAM is based on the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975), and was developed by Davis (1986) in 1986. The TAM is based on the information systems theory that models how users come to accept and use a technology, and was used to explain or predict the use of information technologies. According to Davis (1989), the goal of TAM is ‘to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behaviour across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified.' The TAM suggests that when users are presented with a new technology, a number of factors influence their decisions about how and when they will use it. It also considers how the external factors affect the users’ internal beliefs, attitudes and the intentions, thereby affecting information system usage (Davis, 1989).

According to Davis (1989), perceived usefulness and perceived ease of use are the important factors that influence the attitude toward the use of a particular technology. Perceived ease of use is the perception that a particular system or technology is easy to use, and perceived usefulness is the degree to which an individual believes that using a technology will enhance his or her performance (Davis, 1989). The TAM

posits that perceived ease of use and perceived usefulness have a direct effect on the attitude toward the use of a technology and perceived ease of use have a positive effect on perceived usefulness. Similar to TRA, the TAM postulates that the usage of a technology is affected by behavioural intention, which in turn, is predicted by attitude and perceived usefulness (as shown in Figure 8-2)

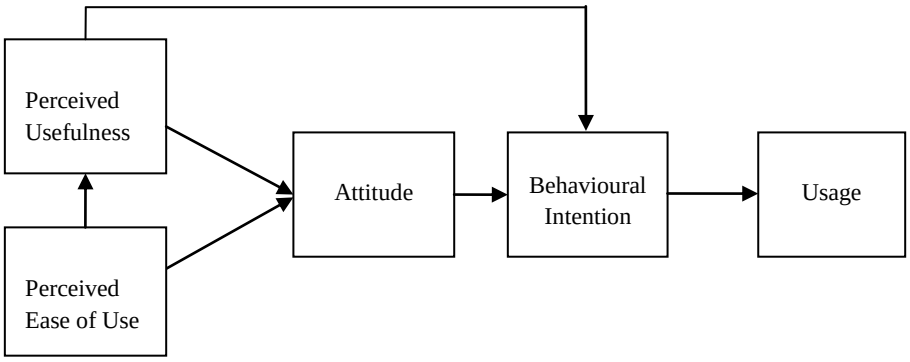


Figure 8-2 The technology acceptance model (Source: Davis, 1989)

8.3.3. Combining TRA and TAM for Technology Adoption

The technology acceptance model is developed for predicting technology acceptance. The use of a technology is usually considered individually on a voluntary basis (Swanson, 1974) and subjective norm was not included in TAM (Davis, 1986) when it was first developed in 1986. Davis (1989) also suggests that the influence on the intention to adopt a technology is determined by attitude and perceived usefulness, and other external influences should be based on their effects on the perceive ease of use and perceived usefulness of the technology. In order to handle the complicated effects of the various factors affecting technology adoption, a hybrid model was developed by Davis, Bagozzi and Warshaw (1989) by combining the TRA and TAM constructs. Their studies show that by combining the beliefs underlying user acceptance using the theory of reasoned action and the technology acceptance model, the combined TRA/TAM research model yields a better perspective than using a single model alone.

Various researchers have applied hybrid models to investigate user adoption of information technologies. Pavlou (2003) develops a research model to use both TAM with TRA in a study of e-commerce systems. The research results show that combining a study using TAM and TRA provide robust models in predicting user

intentions to adopt e-Commerce technologies. By employing both TRA and TAM, Al-Gahtani and King (1999) conduct a survey from university students on the use of a spreadsheet system. Their research results show that a combined TRA and TAM research model provides a better explanatory power than a single research model employing either TAM or TRA alone for technology adoption.

8.3.4. The Task-Technology Fit Model

The Task-technology fit (TTF) model (Dishaw & Strong, 1999; Dishaw, Strong, & Bandy, 2002; Goodhue, 1995) is based on a formal construct - the Task-technology fit, which is defined as 'the is the degree to which a technology assists an individual in carrying out his or her tasks' (Goodhue & Thompson, 1995; Goodhue, 1995). The TTF model includes four constructs, task characteristics, tool functionality, task-technology fit and utilization. The task-technology fit construct is predicted jointly by task characteristics and tool functionality. It also has a direct influence on actual tool usage. The conceptual framework for the task-technology fit model is depicted in Figure 8-3.

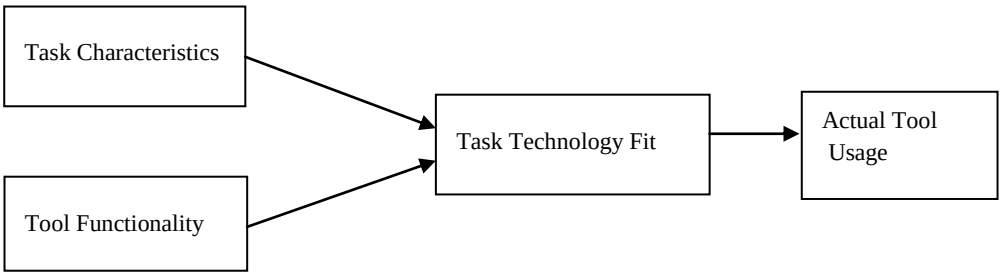


Figure 8-3 The task-technology fit model (Source: Dishaw & Strong, 1999; Goodhue, 1995)

The TTF model takes into consideration the specific situation for which the technology is being used to support the learning tasks, which is an important aspect of research that focuses on technology adoption of collaborative technologies (Venkatesh, et al., 2010). Task characteristics are depicted by the tasks that are performed by the users, and tool functionality represents the capabilities of the tools for project work. Both task characteristics and tool functionality directly influence task-technology fit. Since the focus of this research is on the adoption of technologies, the task characteristics construct is not considered in this research. Dishaw, Strong and Bandy (2002) explain the relationship between the TAM and TTF models by

considering the influence of these constructs on the external variables of TAM, which are represented by perceived ease of use and perceived usefulness.

According to Goodhue and Thompson (1995) the use of TAM to explain technology adoption is based on voluntary action. However many aspects of behaviour are not necessarily voluntary, but depend the situation for which the technology is being used to accomplish group work. An integrated TAM/TTF model (Yen, et al., 2010) offers additional constructs to model the situations for matching the tasks with the technology for collaborative learning by incorporating both beliefs of information technology and the task-technology fit aspects in a single model.

As shown in Figure 8-4, ease of use is predicted by tool functionality and task-technology fit. This is based on the assessment of a user on the tools and task-technology fit of a technology. If the tools have too much functionality, the tools are likely harder to use. As the user manages to use the tools to accomplish the demands of performing his/her tasks, a user's rational assessment of the user-friendliness of the tools also comes from the task-technology fit. Perceived usefulness is also predicted by tool functionality and task-technology fit, which means that a person believes a technological platform is useful because of the benefits that are offered by the functionality of the tools, and the way the technology helps in meeting the demand of the tasks for project work. It is noted that the task-technology fit construct is also predicted by tool functionality because functionality is one of the key elements that facilitates the tools to accomplish the demands of the tasks.

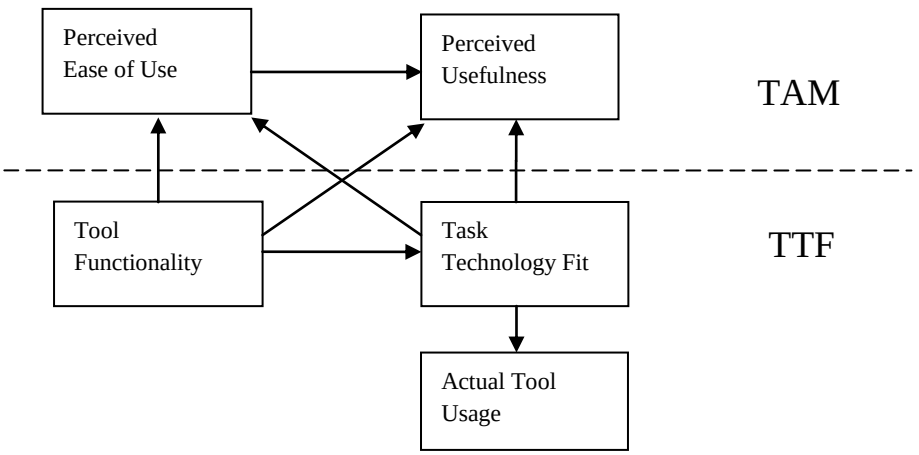


Figure 8-4 The Integrated TAM/TTF Model (Adapted from Yen et al., 2010)

In addition to providing an integrated TAM/TTF model that enhances the predictive capabilities, the model integration approach also provides a means to compensate the weaknesses of each model. The weakness of TAM is that it lacks the ability to address the aspects relating to the characteristics that the technology offer to meet the requirements of the tasks. On the other hand, the TTF model lacks the psychometric constructs to measure the users' belief toward the technology, which is provided through the TAM major constructs.

8.4. Research Framework and Hypotheses

In order to examine the adoption behaviours associated with the Google Applications platform as a kind of collaborative technology, a hybrid model was developed in this study during the subsequent evaluation stage of the project. The research framework was developed by combining the technology acceptance model (TAM), the theory of reasoned action (TRA), and the task-technology model (TTF). The details of the research framework and the hypotheses that are derived from the integrated model are discussed in the following sections.

8.4.1. The Integrated Research Framework

The research framework extends the technology acceptance model for collaborative learning by incorporating the important elements of the task-technology fit model and the theory of reasoned action (see Figure 8-5). It was employed in this research for evaluating the adoption of the CSCL platform developed using Google Applications technology. As this study focuses on the evaluations of the technological aspects, the task characteristics construct was not included in the final model. The TAM, TTF and TRA models are directly integrated through the eight major constructs: task-technology fit, technology characteristics, system usage, perceived usefulness, perceived ease of use, attitude, behavioural intention and subjective norm.

The integration between TAM and TTF incorporates two different aspects of IT usage. The TAM model postulates that the use of an IT system is based on the attitudes and beliefs of a user toward a system. On the other hand, the TTF model postulates that the use of an IT system is based on the improvement in work performance, regards of their attitudes (Goodhue, 1995). In this study, the constructs 'tool functionality' was not used in the task-technology model. Instead, the term

'technology characteristics' was used, which is the original construct name used by Goodhue (1995), and Goodhue and Thompson (1995).

TAM is different significantly from TTF on the assumptions that lead to IT usage. The TAM is developed from the users' beliefs about a system, namely perceived ease of use, and perceived usefulness. However, for the TTF model, beliefs are developed from the knowledge represented by the assessment of the tool functionality and task-technology fit. Davis (1989) also comments that other external influences affecting the TAM model should affect the TAM variables perceived ease of use and perceived usefulness. Therefore, users' perceptions on the user-friendliness and perceived usefulness of the system are linked to the technology characteristics and task-technology fit aspects.

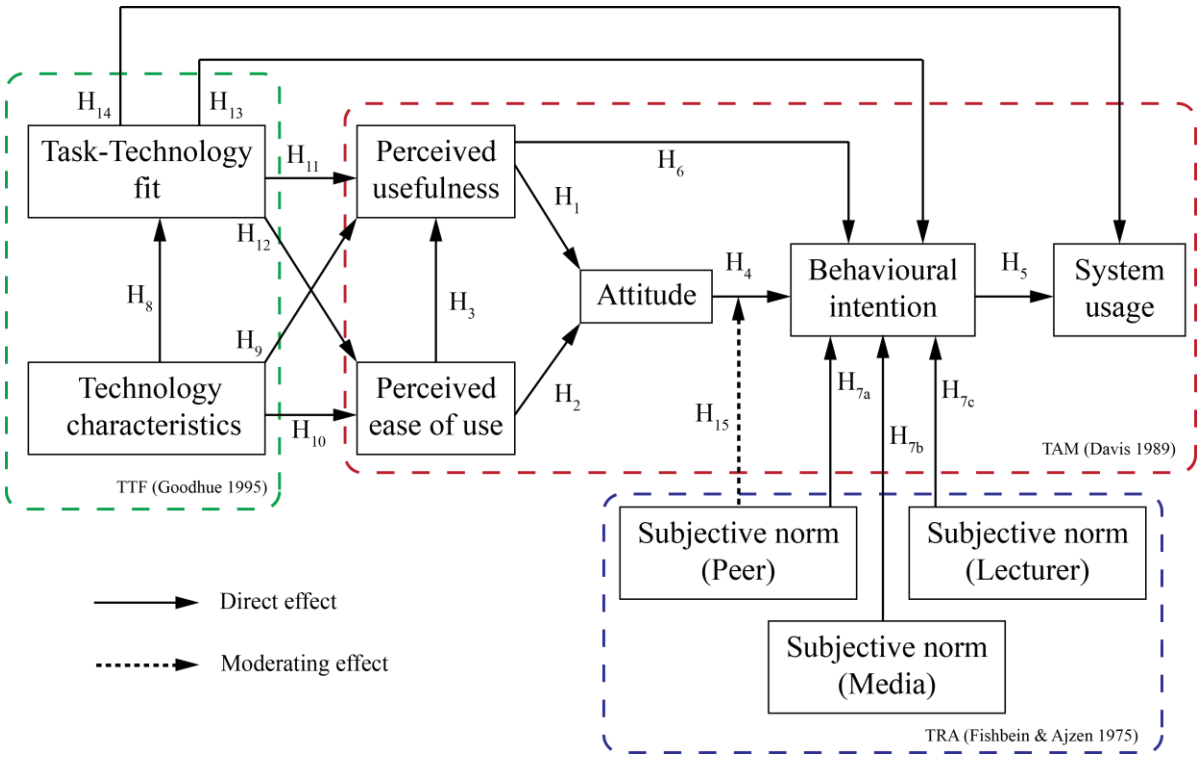


Figure 8-5 Research framework: the integrated TAM/TTF/TRA model

Another extension of the TAM model is the incorporation of subjective norms from the TRA model, which includes: peer influence, tutor influence, and external media influence. Various researchers have extended the TAM model to investigate the possible influence of subjective norm on behavioural intention. The subjective norm construct has also been in incorporated into the TAM2 model through theoretical

extension of the technology acceptance model by Venkatesh (2000). Since then, it has been investigated by various researchers. Legris et al. (2003) conduct a meta-analysis of TAM and conclude that the subjective norm should be included in the TAM model to investigate the effect of social influence. Schepers and Wetzels (2007) conduct a meta-analysis that includes twenty-two studies on the TAM constructs. Their research results revealed that out the twenty-two studies that employ subjective norm in the TAM constructs, ninteen of them show a significant relationship between subjective norm and behavioural intention. The subject norm construct was included in the integrated TAM/TTF/TRA model in this study to provide a comprehensive model to investigate the adoption of collaborative technologies for learning.

8.4.2. The Traditional TAM Hypotheses

TAM has been widely used to test the acceptance of e-learning technologies. Studies that use TAM have addressed perceived usefulness, ease of use, attitude, behavioural intention, and system usage as the major determinants that predict the acceptance (Davis, 1989) of a new technology. In this study, perceived ease of use is defined as the degree to which the user believes that using Google Applications would be free of effort, and perceived usefulness is defined as the degree to which the user believes that using Google Applications would enhance his/her project performance (Davis, 1989). According to Davis (1989) perceived usefulness and perceived ease of use are important factors that influence the attitude of individuals towards a particular technology. The TAM posits that perceived ease of use and perceived usefulness have a direct effect on the attitude toward the use of a technology, and perceived ease of use has a positive effect on perceived usefulness. Attitude is defined as the degree to which a user is interested in using the system, and attitude toward the system determines behavioural intentions, which, in turn, lead to actual system usage. A number of researchers have applied TAM to explain user acceptance of collaborative systems. The TAM has been applied to information technologies for group-based collaborations to provide an empirical research model to explain user acceptance toward groupware (Lou, Luo, & Strong, 2000). According to Padilla-Meléndez et al. (2008), the results of research into the factors affecting e-collaboration technology in education also indicate a good fit for TAM. Therefore, the following hypotheses based on TAM are proposed:

H_1: Perceived usefulness will positively influence attitudes toward the Google Applications platform.

H_2: Perceived ease of use will positively influence attitudes toward the Google Applications platform.

H_3: Perceived ease of use will positively influence perceived usefulness.

H_4: Attitudes toward the Google Applications platform will positively influence the intention to use the Google Applications platform.

H_5: Intention to use the Google Applications platform will positively influence system usage.

Furthermore, Davis (1989) contents that individuals will have higher intention to use a specific information technology if they believe that the technology will improve their job performance. Similarly, Davis, Bagozzi and Warshaw (1989) propose that behavioural intention is jointly determined by both attitude and perceived usefulness. Numerous researches also provided theoretical justification and empirical evidence on this relationship (Bagozzi, 1981; Brinberg, 1979; Triandis, 1977). Therefore, users are likely to form intentions to use the Google applications platform if they think that the platform will be useful for performing their work. Thus, the following hypothesis is proposed:

H_6: Perceived usefulness will positively influence the intention to use the Google Applications platform.

8.4.3. The Influence of Subjective Norms

TAM was derived from the TRA proposed by Fishbein and Ajzen (1975), asserting that both attitudes and subjective norms impact behavioural intention, which, in turn, affects an individual's actual behaviour when using a certain technology. Subjective norms are generated by individuals' perceptions that normative beliefs will influence their use of a technology. Arteaga Sánchez and Duarte Hueros (2010) incorporate subjective norms into TAM, showing that they have a significant impact on behavioural intention. Several researchers working in the area of IT usage (Ajzen, 1991; Davis, et al., 1989; Fishbein & Ajzen, 1975; Mathieson, 1991; Taylor & Todd, 1995b) suggest that normative beliefs should be multidimensional. In an e-learning environment in which Google Applications are used, the subjective norms that influence the behavioural intention to use a technology include instructor, peer, and

external influences. Since Google Applications facilitate a social networking environment, this decomposition is consistent with the classification of strong and weak social ties (Hossain & de Silva, 2009). Therefore, the following hypotheses are presented in order to test the relationship between the factors related to distinct subjective norms and behavioural intention:

H_{7a}: Peer group members will positively influence the intention to use the Google Applications platform.

H_{7b}: External media will positively influence the intention to use the Google Applications platform.

H_{7c}: The lecturer will positively influence the intention to use the Google Applications platform.

8.4.4. The Influence of Task-Technology Fit

TTF is integrated with TAM in this research to investigate how external variables influence the adoption of the Google applications platform. The original construct 'technology characteristic' used by Goodhue (1995) is adopted in the current research, instead of the construct 'tool functionality' used by Dishaw and Strong (1999). This is because the Google applications platform is the sole technology considered in this study, so technology characteristics are specifically referred to the functions of the Google applications platform. According to the TTF model, the technology characteristic (tool functionality) is defined as the technology used by individuals in carrying out their tasks (Goodhue, 1995), which is one of the antecedents of task-technology fit. Researchers also suggest that the technology characteristics determine perceived usefulness and perceived ease of use of a technology (Dishaw & Strong, 1999; Yen, et al., 2010). Therefore, the following hypotheses are proposed:

H_8: The technology characteristics of the Google Applications platform will positively influence task-technology fit.

H_9: The technology characteristics of the Google Applications platform will positively influence perceived usefulness.

H_{10}: The technology characteristics of the Google Applications platform will positively influence perceived ease of use.

Yen et al. (2010) propose that if the technology provides a good fit with the task, the users should believe that the technology is both easy to use and useful in terms of

enhancing work performance. Therefore, the intention to use a technological platform should also be influenced by the task-technology fit aspects. Utilization is one of the major aspects that are influenced by the task-technology fit of an information system. Goodhue (1995) defines utilization as the behaviour of employing the technology in completing tasks, which can be measured in terms of the system usage of a technology platform. According to the TTF model, there is a significant relationship between the task-technology fit and system usage (Goodhue, 1995). Consequently, the following hypotheses are proposed:

H_{11}: Task-technology fit will positively influence the perceived usefulness of the Google Applications platform.

H_{12}: Task-technology fit will positively influence the perceived ease of use of the Google Applications platform.

H_{13}: Task-technology fit will positively influence the intention to use the Google Applications platform.

H_{14}: Task-technology fit will positively influence system usage.

8.4.5. The Moderating Effect of Peer Influence

Many extended studies of TAM have investigated the effects of subjective norms on behavioural intentions to use a technology (Arteaga Sánchez & Duarte Hueros, 2010). In the studies concerning peer effects conducted by Lou et al. (2000) critical mass is considered a significant factor influencing collaborative technology which requires sharing and interaction among members. Therefore, once a sufficient number of peer members are participating in the collaborative platform, the use of a technology requires less explicit attention and often occurs unconsciously. We thus argue that subjective norms reduce the power of attitude to predict behavioural intention. At the introductory stage of a collaborative learning platform, the attitude toward a technology is an important factor that influences the intention to use it. As more peer members participated in the collaborative platform, intention becomes unconsciously directed by peers: the stronger the effect of peer influence, the weaker the relationship between attitude and behavioural intention. Therefore, we propose that peer influence has a negative moderating effect on the relationship between attitude and intention:

H_{15}: Subjective norms-peers will have a negative moderating effect on the relationship between attitude and intention to use Google Applications.

8.5. Research Methodology

The following sections describe the research methodology, including questionnaire development, which provides the source of the literature for the constructs and the research instruments that are employed for data collection.

8.5.1. Questionnaire Development

In this research, a structured questionnaire consisting of two parts was used to test the theoretical model. The first part of the questionnaire included the constructs that were used in the research model, while the second part covered the demographic information about the participants. The items for the constructs used in this study were measured using a seven-point Likert scale, with answer choices ranging from 'strongly disagree' (1) to 'strongly agree' (7). All constructs derived from the literature, primarily from previously tested survey instruments, were meant to take advantage of well-tested psychometric measures (Straub, 1989). Most of the constructs were operationalized by modifying previously validated scales. The scale items for perceived usefulness, attitude, and perceived ease of use were adapted from Davis (1989); the scale items for technology characteristics and task-technology fit were adapted from Goodhue and Thompson (1995); the scale items for subjective norms was adapted from Taylor and Todd (1995b); self-reported measures for system usage was adapted from Fishbein and Ajzen (1975); and, finally, the scale items for behavioural intentions were adapted measures from Bhattacherjee (2001). Each construct was measured using multiple indicators in order to capture the underlying theoretical dimensions effectively (Premkumar & Ramamurthy, 1995). The conceptual definitions and the source of literature for the constructs are shown in Table 8-1.

The constructs of this study that are derived from the research framework include: perceived usefulness, perceived ease of use, attitude, behavioural intention, system usage, subject norm, technology characteristics and task-technology fit. The details of the questionnaire items for the structured questionnaire for evaluating technology adoption are presented in Appendix C. It consists of questionnaire items that are developed to address the factors affecting students' intention to adopt the collaborative technology represented by the Google Applications platform. The

questionnaire also includes students' demographic information, such as age, gender and previous experiences in using the Google Applications platform.

Table 8-1 The constructs, conceptual definitions, and source of literature

Construct	**Conceptual Definitions**	**Source of Literature**
Perceived usefulness	The extent of an individual's trust that a task will be better performed with the aid of technology	Davis (1989)
Perceived ease of use	The degree to which a person believes using a specific kind of system to be 'free of effort'	
Attitude	An individual's favourable or unfavourable feeling toward a behaviour to be performed	
Behavioural intention	The degree to which a person has formulated conscious plans to perform or not perform some specified future behaviour	Bhattacher-jee (2001)
Subjective norm	An individual's perception of social pressures to perform or not to perform a behaviour	Taylor and Todd (1995b)
System usage	The frequency with which the respondent currently uses the technology	Fishbein and Ajzen (1975)
Technology characteristics	The characteristics of the tools used by individuals in carrying out their tasks	Goodhue & Thompson (1995)
Task-technology fit	The degree to which a technology assists an individual in performing his/her portfolio of tasks	

According to Hossain and de Silva (2009), the adoption of a technology in a social networking environment needs to consider weak and strong social ties in the system. Therefore the subjective norm construct is decomposed (Taylor & Todd, 1995b) into three components: peer, lecturer, and external media, resulting in a total of ten constructs for the research model. All questionnaire items for the constructs were identified as a reflective measure instead of using formative measures (Chin, 1998b). Table 8-2 shows all the questionnaire items relating to the constructs used in the study. The use of reflective measures associated with the constructs identified from the technology acceptance model is also supported by Mathieson and Peacock (2001).

Table 8-2 The questionnaire items for the constructs

Constructs		Questionnaire Items
Perceived Usefulness	PU1 PU2 PU3	• Google Applications are of benefit to me. • The advantages of Google Applications outweigh its disadvantages. • Overall, Google Applications are advantageous.
Perceived Ease of Use	PEOU1 PEOU2 PEOU3	• Learning to operate Google Applications is easy for me. • It is easy for me to become skilful at using Google Applications. • Overall, Google Applications are easy to use.
Subjective Norms	SN1 SN2 SN3 SN4 SN5 SN6 SN7 SN8	• I read/saw news report that using Google Applications was a good way of learning. • The popular press depicted a positive sentiment for using Google Applications. • Mass media reports influenced me to try out Google Applications. • My team members expect me to use Google Applications for my project. • My team members want me to use Google Applications for project collaboration frequently. • My lecturer's participation in our Google Applications project Web site is high. • My lecturer's online participation influences me to use the Google Applications platform for the project. • My lecturer is very supportive in our project Web site for the use of Google Applications for my project.
Behavioural Intention	INT1 INT2 INT3	• All things considered, I expect to continue using Google Applications platform for the project. • All things considered, it is likely that I will continue to use Google Applications platform for the project. • If I could, I would like to continue my use of Google Applications platform for the project.
Technology characteris-tics	TECH1 TECH2 TECH3	• Google Applications provide the functionalities for collaboration. • Google Applications provide the functionalities for sharing. • Google Applications facilitates online communications.
Task-Technology Fit	TTF1 TTF2 TTF3	• The Google platform that I use or would like to use is accurate enough for my collaborative project tasks. • Through the Google Applications platform I can share resources for the project tasks. • The Google Applications platform fit into my tasks for collaborative projects.
Attitude	ATT1 ATT2 ATT3	• Using Google Applications is a good idea. • I like using Google Applications. • It is desirable to use the Google Applications platform for learning that involves collaborative projects.
System Usage	USE1 USE2 USE3	• I frequently use Google Applications for my collaborative project. • I frequently browse Web pages and information in Google Sites. • I frequently post and read messages in Google forum in the AMR subject Web site.

8.5.2. Data Collection

This study aims at investigating user perceptions of collaborative learning technologies for project-based learning. In order to avoid over generalizations, it focuses on the factors affecting student acceptance in a specific course delivery context. The attitudes of students toward the use of the CSCL platform in an 'Advanced Marketing Research' course were investigated at the Hong Kong Polytechnic University. During the course, students were required to work collaboratively in groups (with 5-6 students within a project group) to complete a marketing research project for a selected company in Hong Kong. The CSCL platform incorporating Web 2.0 tools from Google Applications technology was used to facilitate collaborations among students. A structured questionnaire was distributed to a sample of 262 students enrolled in this subject, and a total of 240 completed questionnaires were collected and used for data analysis. The overall response rate was about 92%. The data collected from the survey was used to investigate the critical factors affecting the students' decisions to adopt the collaborative platform.

8.6. Data Analysis

The partial least squares (PLS) technique was used for data analysis. This is a type of structural equation modelling technique used to statistically analyse and measure latent, unobserved concepts with multiple observed indicators (Chin, 1998a; Jöreskog & Wold, 1982). It can also be used to confirm the validity of the constructs of a particular instrument and assess the structural relationships among constructs (Chin, 1998a; Jöreskog & Wold, 1982). Partial least square technique is most effective when used for theory development, whereas linear Structural Relationships (LISREL) is recommended for confirmatory analysis, as it requires a more stringent adherence to distributional assumptions (Jöreskog, 1989). For example, the application of covariance-based structural equation modelling (SEM) techniques requires that all the variables under consideration should follow a normal distribution.

In this study, the PLS technique was used for statistical analysis because its premises are less limiting than those techniques represented by LISREL and covariance-based structural equation modelling (SEM) techniques. As shown in Figure 8-6, most of variables used in this study did not show a normal distribution. Therefore, statistical analysis using partial least square techniques was employed in this study.

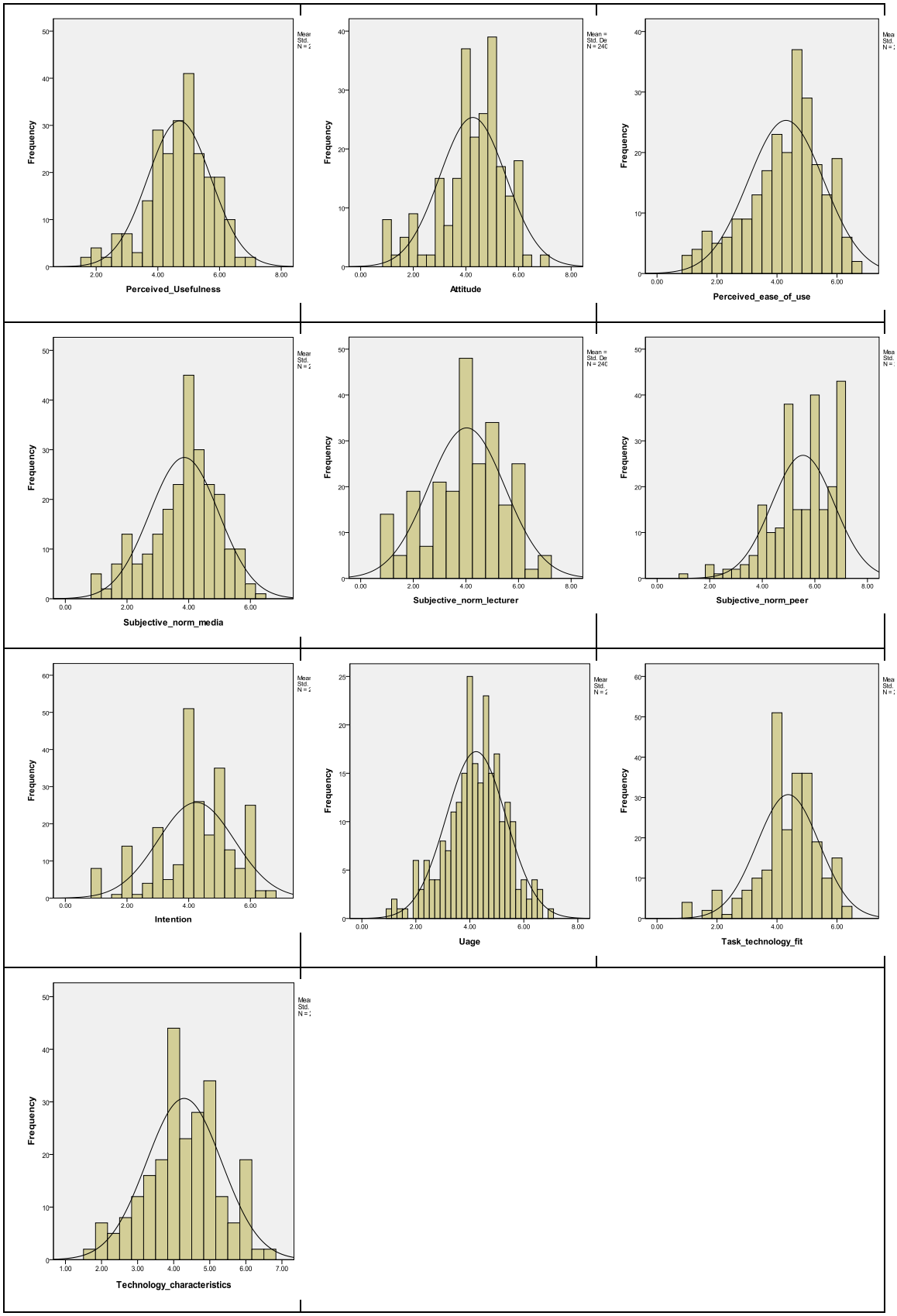


Figure 8-6 The histograms for the manifest variables

The SmartPLS 2.0 software was used to assess the measurement and structural models in the study because the PLS techniques do not require the assumption of a normal distribution for the variables associated variables. Furthermore, as the study of adoption behaviours of collaborative technologies is a relatively new research area, the use of partial least square techniques is more appropriate because PLS is prediction-oriented compared with purely confirmatory co-variance based methods.

Demographics

The students involved in the implementations were enrolled in the advanced marketing research course, which was based on a marketing research project as the focus of the entire course. The course was being offered to both full-time and part-time students and the majority of the participants in this research are full-time students. The age range of student was between 19 to 33 years old. There were 262 students enrolled in the subject and most of them were Chinese in terms of nationality. Six-nine percent of the students were female and thirty-one percent of the students in the class were male. As the collaborative platform for supporting the marketing research project was developed using Google Applications technology, statistics were also collected from a survey on whether students had previous experience in using Google Applications before the course. About 27% of the students had previous experience in using Google Applications for their projects before attending the course, and about 73% of the student did not have previous experience in using the Google Applications technology. Therefore, this study involved the investigation of the adoption of a newly introduced technology to support learning.

Nonnormality of the Variables

In order to investigate the normality of the variables, the manifest variables were calculated as the mean of the corresponding measurement items. The SPSS package was used to generate the reports for the descriptive statistics such as mean, median, skewness, kurtosis etc. In addition, the standardized Z scores for skewness and kurtosis were also calculated by the assumption of the standard normal distribution, both having a mean of 0 and a standard deviation of one standard error. For a distribution that is assumed to be normally distributed, the value of kurtosis and skewness should be within 1.96 standard errors when the data are normally distributed.

Table 8-3 Descriptive statistics for the manifest variables

	Mean	Skewness			Kurtosis			Shapiro-Wilk	
	Stat.	Stat	Std. Error	$Z_{Skewness}$	Stat.	Std. Error	$Z_{Kurtosis}$	Shapiro-Wilk	Sig. (p)
Perceived_ease_of_use	4.30	-.604	.157	-3.85	-.095	.313	-0.30	0.958	0.000
Subjective_norm_media	3.86	-.517	.157	-3.29	-.070	.313	-0.22	0.963	0.000
Subjective_norm_lecturer	4.03	-.330	.157	-2.10	-.461	.313	-1.47	0.924	0.000
Subjective_norm_peer	5.55	-.830	.157	-5.29	.662	.313	2.12	0.962	0.000
Attitude	4.26	-.758	.157	-4.83	.371	.313	1.19	0.942	0.000
Intention	4.25	-.616	.157	-3.92	.207	.313	0.66	0.949	0.000
Task-technology fit	4.27	-.696	.157	-4.43	.666	.313	2.12	0.959	0.000
Usage	4.23	-.324	.157	-2.06	.173	.313	0.55	0.987	0.026
Perceived_usefulness	4.70	-.524	.157	-3.34	.326	.313	1.04	0.969	0.000
Technology_characteristics	4.29	-.194	.157	-1.24	-.207	.313	-0.66	0.978	0.001

As shown in Table 8-3, most the variables have a $Z_{Skewness}$ score larger than 1.96 for skewness (except 'Technology_characteristics'), while the $Z_{Kurtosis}$ score for 'Subjective_norm_peer' and 'Task-technology fit' were larger than 1.96. The large Z score values indicated that most of the variables have a distribution which was significantly different from a normal distribution. Furthermore, all the values from the Shapiro-Wilk normality test were significant ($p < 0.05$), which also confirmed that the distribution of all the variables were different from a normal distribution. Therefore, partial least square techniques are suitable for the statistical analysis associated with this study rather than using covariance-based methods.

Multicollinearity

In order to analyse the relationships between the dependent and independent variables, it is necessary to test for the existence of multicollinearity among the independent variables. The measures for assessing multicollinearity are represented by the variance inflation factor (VIF) and the tolerance value. These measures relate to the degree to which each independent variable is explained by other independent variables. When a significant value of multicollinearity is reported, the results of prediction from the independent variables become unstable. As a rule of thumb, in

order to ensure that the value of multicollinearity is not significantly high among the independent variables, the VIF value should not exceed 10 (Neter, Wasserman, & Kutner, 1989). Furthermore, the tolerance value represents the proportion of a variable's variance that is not shared with other independent variables. According Field (2005), the value of the tolerance value for an independent variable should be larger than 0.20 to avoid multicollinearity problems.

To investigate multicollinearity, the independent variables used in this study were derived from the average of all the items in the corresponding constructs. By considering all the independent variables that were associated with the dependent variable under consideration, the VIF values were computed by feeding blocks of independent variables to the SPSS statistical package. The VIF values for all the independent variables were well below 10, which ranged from 1.10 to 2.51, showing that the collected data for the research model did not suffer from multicollinearity problems. Furthermore, the tolerance values for all the independent variables were in the range 0.40 to 0.91, showing that all the tolerance values were well above the recommended value of 0.20 (Field, 2005).

8.6.1. Exploratory Factor Analysis

In order to reduce the 29 measurement items in the survey into a number of distinct factors, an exploratory factor analysis was conducted. Regarding the pre-analysis testing for the suitability of the entire sample for factor analysis, the Kaiser-Meyer-Olkin (KMO) measure of overall sampling adequacy from the collected data set was 0.915. The high KMO measure supports factor analysis. The appropriateness of applying factor analysis was also indicated by the Bartlett's test of sphericity ($\chi 2=5394.6$, $p=0.000<0.001$), which was significant at 0.001 significance level, suggesting that factor analysis could be assumed to provide distinct and reliable factors.

Exploratory factor analysis was used to remove the redundant variables from the survey data and to reduce the number of variables into a definite number of dimensions. The factor analysis was performed using the principle component extraction method with varimax rotation (Hair, Black, Babin, & Anderson, 2010). The sorted rotated values of the factor loading with a minimum value of 0.5 were

considered. Generally, factor loading represents how much a factor analysis explains a variable. High loading indicated that the factor strongly influences the variable. Table 8-4 presents the results of the exploratory factor analysis, which were conducted to determine those items with sufficiently high loadings for the constructs. The results show that all factor loadings for the questionnaire items were well above 0.8 (above the recommended value of 0.5), which were regarded as having high factor loadings in all the constructs in the analysis.

Table 8-4 The factor loadings

	Component									
	1	2	3	4	5	6	7	8	9	10
INT2	.819									
INT3	.804									
INT1	.778									
PEOU1		.846								
PEOU2		.813								
PEOU3		.745								
SN7			.923							
SN6			.894							
SN8			.831							
TTF2				.830						
TTF1				.691						
TTF3				.688						
SN3					.808					
SN2					.805					
SN1					.730					
TECH1						.763				
TECH2						.745				
TECH3						.650				
PU2							.845			
PU3							.703			
PU1							.581			
USE3								.789		
USE2								.780		
USE1								.615		
SN4									.884	
SN5									.867	
ATT2										.642
ATT3										.595
ATT1										.522

8.6.2. The Measurement Model

The PLS measurement model for the reflective constructs was evaluated by examining the convergent and discriminant validity of individual indicators and the composite reliability of a block of indicators. Convergent validity was assessed by examining the correlation (loading) between the indicators, and construct scores were computed using PLS techniques. This study evaluated the measurement scales using the following three criteria suggested by Fornell and Larcker (1981) and Chin (1998b):

(1) All indicator factor loadings should be significant and exceed 0.5.
(2) Composite reliability should exceed 0.7.
(3) Average variance extracted (AVE) from each construct should exceed 0.5.

Table 8-5 The measurement model

Constructs	Indicators	Factor Loadings	t-value	Average Variance Extracted (AVE)	Composite Reliability (CR)	Cronbach's Alpha (α)
Attitude (ATT)	ATT1	0.93	76.24	0.84	0.94	0.91
	ATT2	0.91	54.94			
	ATT3	0.91	54.37			
ATT*SN-PEER	Att1*SN4	0.89	6.71	0.81	0.96	0.95
	Att1*SN5	0.90	7.07			
	Att2*SN4	0.88	7.57			
	Att2*SN5	0.90	8.10			
	Att3*SN4	0.91	7.36			
	Att3*SN5	0.91	7.55			
Behavioural Intention (INT)	INT1	0.94	95.36	0.89	0.96	0.94
	INT2	0.95	103.80			
	INT3	0.94	65.20			
Perceived Ease of Use (PEOU)	PES1	0.92	78.43	0.84	0.94	0.91
	PES2	0.94	109.65			
	PES3	0.89	66.02			
Perceived Usefulness (PU)	PU1	0.88	54.40	0.78	0.92	0.86
	PU2	0.85	24.43			
	PU3	0.92	79.29			
Subjective Norm—Lecturer (SN-LEC)	SN6	0.90	12.88	0.80	0.92	0.88
	SN7	0.93	16.38			
	SN8	0.86	13.73			
Subjective Norm—Media (SN-MEDIA)	SN1	0.89	61.21	0.76	0.91	0.84
	SN2	0.88	30.89			
	SN3	0.84	31.43			
Subjective Norm—Peer (SN-PEER)	SN4	0.96	128.07	0.93	0.96	0.93
	SN5	0.97	179.33			
Technology Characteristics (TECH)	TECH1	0.84	32.04	0.76	0.90	0.84
	TECH2	0.90	52.28			
	TECH3	0.87	37.66			
Task-Technology Fit (TTF)	TTF1	0.84	27.55	0.76	0.91	0.84
	TTF2	0.89	41.60			
	TTF3	0.89	48.86			
System Usage (USAGE)	USE1	0.87	46.51	0.71	0.88	0.80
	USE2	0.83	21.54			
	USE3	0.83	24.01			

Convergent validity also shows the degree to which the items of a certain instrument are related. Table 8-5 shows the values for the loadings of in the measurement model. All the reflective measures met the recommended levels for composite reliability and AVE. The Cronbach's alpha scores ranged from 0.80 to 0.95, indicating that all constructs have Cronbach's alpha scores greater than the recommended minimum level of 0.7, and that they exhibit strong internal reliability. In addition, confirmatory factor analysis of the measurement model showed that all the standard factor loading values exceeded 0.5 and were significant at the 0.001 level. Furthermore, each indicator loading was also found to be higher than all its cross-loadings.

The composite reliabilities of constructs ranged from 0.88 to 0.96, again with all values above the recommended level of 0.7. The AVE values, ranging from 0.71 to 0.93, were greater than the variance due to measurement error. Therefore, all three conditions for convergent validity were met. In addition, a rule for assessing the discriminant validity requires that the square root of the AVE to be larger than the correlations between the construct and any other construct in the model (Chin, 1998b). In Table 8-6, the diagonal entries represent the square root of the AVE for each construct. All other entries represent the corresponding correlation coefficients among the constructs. As shown in Table 8-6, all constructs met the minimum requirements. Therefore, all constructs in the model displayed adequate discriminant validity.

Table 8-6 Correlation matrix and discriminant validity

Construct	ATT	INT	PEOU	PU	SN-LECT	SN-MEDIA	SN-PEER	TECH	TTF	USAGE
ATT	**0.92**									
INT	0.72	**0.94**								
PEOU	0.68	0.57	**0.92**							
PU	0.68	0.57	0.62	**0.88**						
SN-LEC	0.17	0.19	0.17	0.25	**0.89**					
SN-MEDIA	0.54	0.45	0.46	0.48	0.10	**0.87**				
SN-PEER	0.39	0.48	0.33	0.25	0.09	0.49	**0.96**			
TECH	0.64	0.59	0.62	0.61	0.11	0.50	0.44	**0.87**		
TTF	0.65	0.60	0.51	0.52	0.25	0.52	0.45	0.56	**0.87**	
USAGE	0.54	0.54	0.43	0.55	0.29	0.49	0.44	0.46	0.55	**0.84**

8.6.3. The Structural Model

The structural model (see Figure 8-7) was evaluated by examining the structural paths, t-statistics, and variance explained (the R-squared value). Path significances

were determined by running the model through a bootstrap re-sampling routine with 240 cases and 9,000 bootstrap samples. The results of this analysis are presented with the path coefficients listed in Table 8-7.

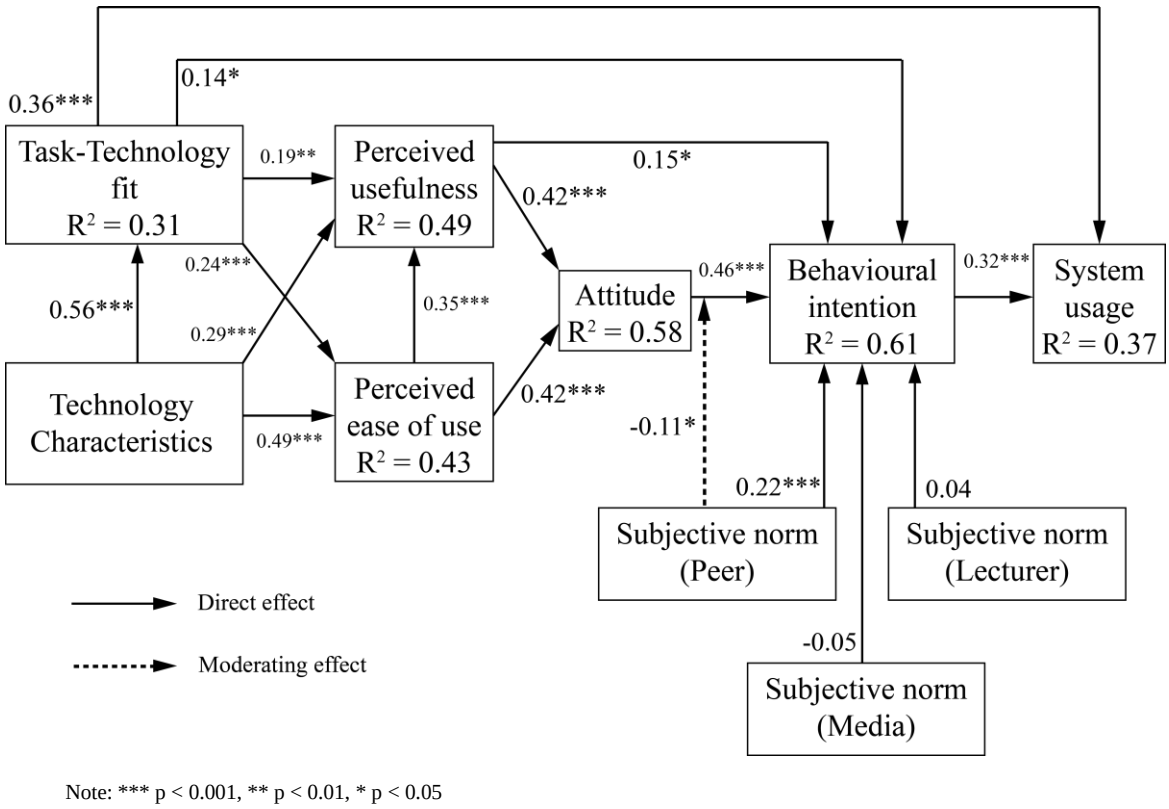


Figure 8-7 The structural model and the path coefficients

The seventeen hypotheses presented above were tested using the PLS approach. The path significance of each hypothesized association included in the research model and the variance explained (R^2) by each path were examined. In this study, a two-tailed t-test was used because the test of significance of subjective norm-peer may either show a positive moderating effect or a negative moderating effect (Helm, Eggert, & Garnefeld, 2010). According to the two-tailed t-test (d.f. = 239), the 0.05 significance level, or $p < 0.05$, requires a t-value > 1.97, and the 0.01 significance level, or $p < 0.01$, requires a t-value > 2.60. The 0.001 significance level, or $p < 0.001$, requires the corresponding t-value > 3.32.

Table 8-7 The path coefficients

Path	***β***	***T***	**Sig.**	**R^2**	**Hyp/Sig**
Perceived ease of use → Perceived usefulness	0.35	4.48	***	0.49	H_3/Yes
Technology characteristics → Perceived usefulness	0.29	4.12	***		H_9/Yes
Task-Technology fit → Perceived usefulness	0.19	3.20	**		H_{11}/Yes
Technology characteristics → Perceived ease of use	0.49	8.37	***	0.43	H_{10}/Yes
Task-Technology fit → Perceived ease of use	0.24	3.50	***		H_{12}/Yes
Perceived usefulness → Attitude	0.42	6.97	***	0.58	H_1/Yes
Perceived ease of use → Attitude	0.42	6.84	***		H_2/Yes
Attitude → Behavioural intention	0.46	5.21	***	0.61	H_4/Yes
Perceived usefulness → Behavioural intention	0.15	2.11	*		H_6/Yes
Subjective norm (Peer) → Behavioural intention	0.22	3.81	***		H_{7a}/Yes
Subjective norm (Media) → Behavioural intention	-0.05	0.77			H_{7b}/**No**
Subjective norm (Lecturer) → Behavioural intention	0.04	0.84			H_{7c}/**No**
Task-Technology fit → Behavioural intention	0.14	2.00	*		H_{13}/Yes
ATT*SN-PEER → Behavioural intention	-0.11	2.31	*		H_{15}/Yes
Behavioural intention → System usage	0.32	3.99	***	0.37	H_5/Yes
Task-Technology fit → System usage	0.36	4.33	***		H_{14}/Yes
Technology characteristics → Task-Technology fit	0.56	12.70	***	0.31	H_8/Yes

Table 8-7 shows the path coefficients and their significance. Fifteen of the proposed hypotheses were supported at the 0.05 level; thus, all of the hypotheses derived from TAM—H_1, H_2, H_3, H_4, H_5 and H_6—were supported. Technology characteristics were found to have a positive influence on perceived ease of use, perceived usefulness, and task-technology fit, supporting both H_8, H_9 and $H_{10.}$ In addition, task-technology fit was found to have a positive influence on perceived usefulness, ease of use, behavioural intention, and system usage, supporting H_{11}, H_{12}, H_{13}, and $H_{14.}$

However, the experimental results did not show that the instructor and mass media had a significant effect on intentions to use a technology, and thus H_{7b} and H_{7c} were

rejected. As a component of subjective norms, peer influence was found to have a positive influence on behavioural intention, and H_{7a} was supported. Finally, peer influence was also found to have a significant negative moderating effect on the relationship between attitude and behavioural intentions, thus supporting H_{15}.

The behavioural intention construct was predicted by subjective norm-peer, attitude, and perceived usefulness, and these variables together explained 61% ($R^2 = 0.61$) of the variance in behavioural intention, indicating a high overall R-squared value. Attitude was predicted by perceived ease of use and perceived usefulness; together, these variables explained 58% ($R^2 = 0.58$) of the variance in attitude. Perceived ease of use was predicted by technology characteristics and task-technology fit, and these variables explained 43% ($R^2 = 0.43$) of the variance in perceived ease of use. Perceived usefulness was predicted by perceived ease of use, technology characteristics and task-technology fit, and these variables explained 49% ($R^2 = 0.49$) of the variance in perceived usefulness. System usage, in turn, was predicted by behavioural intention and task-technology fit, and these variables explained 37% ($R^2 = 0.37$) of the variance in system usage. Finally task-technology fit was predicted by technology characteristics, which explained 31 % ($R^2 = 0.31$) of the variance in task-technology fit.

8.6.4. The Explanatory Power of the Research Model

The major factors affecting student perceptions of collaborative learning technology are related to behavioural intention (INT), attitude (ATT), and behaviour (USAGE). The R-squared values for these constructs were used to compare the explanatory power of different research models. In this study, the predictive power of the research model was compared to other attitude-behaviour models used in the literature. The current research model (abbreviated as TTF-TAM-TRA model) was developed with reference to a specific educational context in which collaborative learning technologies are used. Table 8-8 shows the comparison between the explanatory power of the TTF-TAM-TRA model with the Technology Acceptance Model (TAM), and Theory of Planned Behaviour (TPB) models. Comparing with the experiments conducted by Taylor and Todd (1995b), the TTF-TAM-TRA model provides better predictive power than the TAM and TPB models. According to the R-squared values, the explanatory power for the TTF-TAM-TRA model was highest among the three

models for behavioural intention (INT) and behaviour (USAGE). In the TTF-TAM-TRA model, the R-squared value for intention was 0.61 (R^2_{INT} =0.61) and the R-squared value for USAGE was 0.37 (R^2_{USAGE} =0.37), which was the highest among the three models. However, in the TTF-TAM-TRA model, the R-squared value for attitude (R^2_{ATT} =0.58) was smaller than the TAM model (R^2_{ATT} =0.73). The TTF-TAM-TRA model incorporated all the elements in the TAM model, but showed a lower R-squared values for attitude than the TAM model. The reason for this was that the Google Applications framework was implemented in a Web 2.0 environment. Ultimately, attitudes toward technology may involve many social factors that are too complicated to be considered by the current TTF-TAM-TRA research model (Cheung & Vogel, 2011). It is also important to note that the TTF-TAM-TRA model was used in a collaborative context, which is more complicated to perform predictions. On the other hand, the TAM and TPB models were evaluated for prediction of individual computer usage (Taylor & Todd, 1995b).

Table 8-8 Comparisons between the explanatory powers of the three models

	R^2_{USAGE} (Behaviour)	**R^2_{INT} (Behavioural Intention)**	**R^2_{ATT}(Attitude)**
TAM	0.34	0.52	0.73
TPB	0.34	0.57	0.58
TTF-TAM-TRA Model	**0.37**	**0.61**	**0.58**

8.6.5. The Moderating Effect of Peer Influence

In this study, the moderation analysis approach was applied through the use of the PLS product indicator approach (Chin, Marcolin, & Newsted, 2003) to detect the moderating effect of subjective-norm-peer on the relationship between attitude and intention. To test the possibility of such effect, attitude (predictor) was multiplied to subjective-norm-peer (moderator) to create an interaction construct (attitude x subjective-norm-peer) to predict behavioural intentions (Chin, et al., 2003; Henseler & Fassott, 2010). The AVE and composite reliability (CR) values of these interaction variables were 0.81 and 0.96, which exceeded the required cutoff values. In the path analysis, the interaction construct (represented by attitude x subjective-norm) had a negative moderating effect on the link between attitude and behavioural intention,

with a path coefficient of -0.11, and a t-value of 2.31. The significance of the moderating effect was confirmed at 0.05 significance level. A two-tailed test was used to test the significance because of the theoretical support that the moderating construct represented by subjective norm can either enhances or reduces the association between attitude and intention (Helm, et al., 2010). The negative path coefficient of -0.11 for the moderating link implied that the effect of attitude on behavioural intention would decrease with any increase in peer influence.

To study interaction effects using PLS techniques, Chin, Marcolin and Newsted (2003) recommend a hierarchical process for comparing R-squared values for the interaction and the main effect model. Therefore, in testing the interaction effects of peer influence on the relationship between attitude and intention, a comparison was made between the R-squared value of the interaction effect model (as shown in Table 8-9) with the main effect model (which was computed by deleting the interaction construct corresponding to the model's moderating link). The difference in R-squared values was used to assess the size of the overall effect (f^2) in order to determine the moderating effect of peer influence. The interaction effect model (with the moderating effect included) resulted in an R-squared value of 0.610. With the interaction effect excluded, the main effect model resulted in an R-squared value of 0.599. As shown in Table 8-9, the proposed link for moderating the relationship possessed significantly higher explanatory power than the main effect model.

Table 8-9 Hierarchical test

	$\mathbf{R^2}$
Main Effect Model	0.599
Interaction Effect Model	0.610
f^2	0.03

According to Chin (2010), the effect values of 0.02, 0.15, and 0.35 can be used to gauge whether a latent predictor variable has a small, medium, or large effect at the structural level. The effect size is calculated using the formula $f^2 = [R^2_{\text{interaction-effect}} - R^2_{\text{main-effect}}] / [1 - R^2_{\text{main-effect}}]$. Application of this hierarchical test showed that the

value of the size effect (f^2) for the moderating link was 0.03, which represented a small effect. Given the significant negative path coefficient for the moderating link, it should be noted that a small size effect does not imply an unimportant effect (Limayem & Cheung, 2011; Limayem, Hirt, & Cheung, 2007). Actually, the inclusion of the moderating effect indicated a moderate beta value of -0.11, increasing the R-squared value for intention to 0.61.

8.6.6. Evaluating the Final Research Model

By considering all the significant paths from the structural model, a final research model is constructed for predicting user adoption of collaborative technologies. Figure 8-8 shows the final research model. It extends the TAM with three constructs that are associated with the use of collaborative technologies for learning, namely, technology characteristics, task-technology fit and subjective norm – peer.

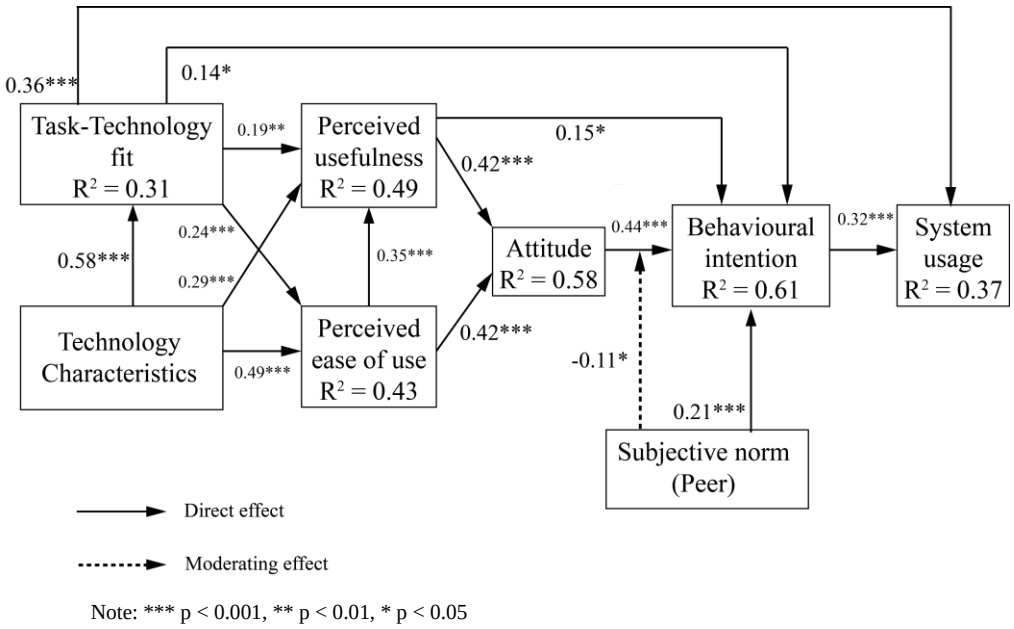


Figure 8-8 The final research model and the path coefficients

According to Chin (1998b), the effect size f^2 can be used to assess the strength of the effect of a particular independent construct on the dependent construct in the research model. Effect size for each path from the independent variable to the dependent variable is calculated by considering the $R^2_{included}$ value of the dependent variable and the $R^2_{excluded}$ value with the path of independent variable deleted from the model. This

is calculated using the formula $f^2 = [R^2_{included} - R^2_{excluded}] / [1 - R^2_{included}]$. In the formula for f^2, $R^2_{included}$ is the R^2 value of the dependent construct where the particular independent construct is included in the model, and $R^2_{excluded}$ is the calculated R^2 value when the same independent construct is removed from the model.

The magnitude of the effect size values are considered as having a small, medium, or large effect according to suggested values of 0.02, 0.15, and 0.35 from previous researchers (Chin, et al., 2003). As these are guidelines suggested for classifying effect sizes for comparison purpose rather than as a statistical test, the classifications are applied by selecting the category with the nearest suggested value rather than as a cutoff point. As this research focuses on the factors affecting the adoption of a technology, the corresponding dependent variables affecting behavioural intention and usage can be assessed in terms of the effect sizes in the operational model. Table 8-10 shows the corresponding effect sizes of the independent variables associated with behaviour intention. The effect size of the independent variables associated with behavioural intention ranges from small to medium. Out of the five effect size values, both the effect sizes of attitude and subjective norm show a medium effect on the dependent variable behavioural intention. Table 8-11 shows the corresponding effect sizes of the independent variables that are associated with system usage. Both behavioural intention and task-technology fit show a marginally medium effect size on the influence on system usage.

Table 8-10 Effect sizes for independent variables associated with behavioural intention

Independent Construct	***B***	**$R^2_{excluded}$**	**$R^2_{included}$**	**Effect Size (f^2)**	**Degree of Effect**
Attitude	0.46	0.509	0.605	0.24	Medium
Perceived usefulness	0.15	0.593		0.03	Small
Subjective norm (Peer)	0.22	0.559		0.12	Medium marginally
Task-Technology fit	0.14	0.595		0.03	Small
ATT*SN-PEER (Moderating Effect)	-0.11	0.592		0.03	Small

Table 8-11 Effect sizes for independent variables associated with system usage

Independent Construct	***B***	$\mathbf{R^2_{excluded}}$	$\mathbf{R^2_{included}}$	$\mathbf{f^2}$	**Degree of Effect**
Behavioural intention	0.32	0.288	0.369	0.10	Medium marginally
Task-Technology fit	0.36	0.304		0.13	Medium marginally

Predictive Relevance

Partial least square techniques are predictive in nature and they offer measures of predictive relevance for each dependent variable, which are calculated based on predictive sample reuse techniques. The predictive relevance values are based cross-validated redundancy values (CV-Redundancy), which are calculated by applying a blindfolding procedure in PLS that omits a part of the data for a particular block of indicators during parameter estimation using an omission distance of seven in this study.

The predictive relevance values assess the relative impact of the structural model on the observed measures for the latent dependent variables. The blindfolding results computed from the SmartPLS package are shown in Table 8-12. According to Chin (2010), the predictive relevance is calculated by computing cross-validated redundancy values. In order to show predictive relevance, the cross-validated redundancy should be greater than zero (Marcoulides & Saunders, 2006). The cross-validated redundancy values for the dependent variables listed in Table 8-12 represent the predictive relevance values for each of the dependent variables, which are all well above zero. Therefore, all dependent variables in this study exhibit predictive relevance.

Chin (2010) states that the cross-validated redundancy values above 0.5 are a good indicator of predictive relevance for the dependent variable. As the focus of the research model is on the prediction of adoption of the technology platform, the predictive relevance of the variable behavioural intention is most important for the analysis. The cross-validated redundancy (CR-Redundancy) value for behavioural intention is 0.54 (Table 8-12), showing that the research model provides a good predictive relevance for students' intentions to use a technology.

Table 8-12 Communality and Redundancy

Construct	R^2	Communality	Redundancy	CV-Redundancy (Predictive Relevance)
SN-PEER		0.93		
PEOU	0.427	0.84	0.31	0.36
PU	0.487	0.78	0.24	0.38
ATT	0.577	0.84	0.34	0.48
INT	0.605	0.89	0.39	**0.54**
TECH		0.76		
TTF	0.310	0.76	0.24	0.24
USAGE	0.369	0.71	0.17	0.26
Average	***0.463***	***0.813***		
GoF	***0.61***			

Model Fit (Goodness-of-Fit Measure GoF)

The PLS framework has not provided a *single goodness-of-fit measure* to evaluate the overall fitness of a set of research data for the research model that is based on R^2 values of the endogenous constructs to indicate whether a particular PLS model meets the requirements to maximize the variance explained (Hulland, 1999). According to Cohen (1988), the values 0.02, 0.13, and 0.35 can be used to gauge whether a latent predictor variable has a small, medium, or large effect at the structural level. Tenenhaus et al. (2005) develop a single global fit measure for PLS by considering the R^2 values and the communality values. The Goodness of Fit measure (GoF) is defined as the geometric mean of the average community and average R^2 (for endogenous constructs):

$$\text{GoF} = \sqrt{\text{average communality} * \text{average } R^2}$$

Since communality equals AVE in the PLS path modelling approach, a cutoff value of 0.5 for communality is suggested by Fornell and Larcker (1981). In line with the effect sizes for R^2 (small: 0.02; medium: 0.13; large: 0.26) that are proposed by Cohen (1988), the criteria for defining small, medium, and large GoF measures can be derived. The criteria for evaluating GoF values can be derived by substituting the minimum average values of AVE of 0.50 and the effect sizes for R^2 (Cohen, 1988) in the equation defining GoF, following the guidelines of Wetzels et al. (2009).

$$\text{GoF} = \sqrt{\overline{\text{AVE}} * \text{average } R^2}$$

Therefore $\text{GoF}_{\text{small}} = \sqrt{0.5 * 0.02} = 0.1$

$\text{GoF}_{\text{medium}} = \sqrt{0.5 * 0.13} = 0.25$

$\text{GoF}_{\text{large}} = \sqrt{0.5 * 0.26} = 0.36$

These values serve as the cutoff points for small, medium, and large values for categorizing the Goodness-of-Fit (GoF) measures globally (Tenenhaus, et al., 2005). For the research model used in this study, the average R^2 value was 0.463 and the average communality value was 0.813 (see Table 8-12). The overall GoF value for this study was equal to $\sqrt{0.463 * 0.813} = 0.61$. This value exceeded the cutoff value of $\text{GoF}_{\text{large}}$, showing a large goodness-of-fit measure for the current model. Therefore, the above analysis indicates a good fit of the final research model to the data.

Table 8-13 Reflective measurement model evaluation

Rules for Model Evaluation (Hair et al., 2011)	**Model Evaluation for this Study**
Indicator reliability: Indicator loadings should be higher than **0.70**.	**Indicator reliability**: all factor loadings for the indicators are larger than **0.82**.
Internal consistency reliability: Composite reliability (CR) measure should be higher than **0.70**.	The result shows **internal consistency reliability**: all composite reliability (CR) measures are larger than **0.87**.
Convergent validity: Average variance extracted (AVE**)** > **0.5**.	**Convergent validity**: all the average variance extracted (AVE) values are larger than **0.7**.
Discriminant validity: AVE for each construct should be higher than the constructs' highest squared correlations with any other construct.	**Discriminant validity**: as shown in Table 8-6, the AVE for each construct is higher than the constructs' highest squared correlations with any other construct.
An indicator's loadings should be higher than all its cross-loadings.	Each indicator's loading was found to be **higher than** all its cross-loadings.

Table 8-14 Structural model evaluation

Rules for Model Evaluation (Hair et al., 2011)	**Model Evaluation for this Study**
The sample size should be larger than ten times the largest number of structural paths directed at a particular latent construct in the inner path model, and the minimum number of bootstrap samples is **5,000**.	Sample size for this study = **240**, and is larger than ten times the largest structural paths directed at a particular construct in the inner path model. Number of bootstrap samples = **9,000**.
Predictive relevance (CR-redundancy) for all dependent variables > **0**.	Predictive relevance for all dependent variables in this study > **0**. Predictive relevance value for intention = **0.54**, which is larger than 0.5, representing a good indication of predictive relevance (Chin, 2010).
Goodness-of-fit (**GoF**) value should be larger than **0.36** for large fit of the model data.	GoF value = **0.61**, which is larger than 0.36 for large fit of the model data.

Overall Model Evaluation

In order to estimate the causal model for predicting adoption of collaborative technology from the theoretical model and the empirical data for this study, the overall model evaluation was conducted according to the rules suggested by Hair, Ringle and Sarstedt (2011). The summary of evaluations (see Table 8-13 and Table 8-14) shows that all the evaluation criteria are satisfied in this study.

8.7. Research Findings

In this study, the TAM was enhanced to predict the acceptance of collaborative learning technologies. All hypotheses related to the original TAM are supported. In addition, our results are supported by previous studies on the application of the TAM model for e-learning (Ngai, et al., 2007; Roca, Chiu, & José, 2006; Van Raaij & Schepers, 2008). According to the results, determinants consistent with the technology acceptance model are the major factors influencing the acceptance of collaborative technologies. Perceived ease of use and perceived usefulness are found to influence the attitude of students toward the technology and perceived usefulness is

predicted by perceived ease of use. The research model depicts that students' intention to use the technology is predicted by both attitude and perceived usefulness. Behavioural intention is also found to be the determinant of system usage. This is consistent with the research by Davis (1989) on the technology acceptance model.

In addition to the original TAM constructs, a number of constructs were included in the enhanced research model, including task-technology fit, technology characteristics and subjective norms, which are found to be important determinants affecting the adoption of collaborative technologies. Task-technology fit is also found to be an important factor in a collaborative environment affecting perceived usefulness, perceived ease of use, and system usage. The results are consistent with previous researches (Shang, et al., 2007; Yen, et al., 2010; Zigurs & Buckland, 1988). Task-technology fit is also influenced by technology characteristics in a collaborative environment, the result is consistent with previous researches on the task-technology fit model (Dishaw & Strong, 1999; Goodhue, 1998; Goodhue & Thompson, 1995; Klopping & McKinney, 2004; Yen, et al., 2010; Zigurs & Buckland, 1988). Task-technology fit also shows a significant influence on behavioural intention. This is consistent with the findings from Yen Wu & Huang (2010), which show that task-technology fit has a direct influence on behavioural intention. Thus the use of the technology characteristic construct is consistent with the results of previous research from Yen Wu & Huang (2010).

In this study, the subjective norm component that is represented by student peer group members shows a significant effect on behavioural intention. This is consistent with previous studies on the direct effect of subjective norms on behavioural intention to use a collaborative technology (Schepers & Wetzels, 2007). Although the value of β for peer influence is only moderate ($\beta = 0.22$), it significantly influences behavioural intention ($t=3.08$, $p < 0.001$). As part of a group, potential users may feel obligated to use the technology because they feel that they belong to the group. They may realize that their participation is important for other group members to make use of Google Applications for project-based collaborations. However, the experimental results do not support the hypotheses on the direct influence of the instructor and mass media on the intention to use Google Applications. Even with positive communications about the collaborative platform, their influence on behavioural intention is not significant.

The result is consistent with previous studies involving weak social ties in a social networking environment (Hossain & de Silva, 2009). As a critical mass effect (Lou, et al., 2000), peer influence was also found to have a negative moderating effect on the relationship between attitude and behavioural intention ($\beta = -0.11$, $t=2.31$, $p < 0.01$). At the introductory stage of the Google Applications platform, attitude is found to be a good predictor of behavioural intention. As the influence of peers on behavioural intention increases and becomes dominant, the predictive power of attitude on intention decreases.

8.8. Chapter Summary

This chapter describes a quantitative approach for the investigation of technology adoption in a collaborative learning environment. It provides details of the statistical analysis that was used to test and verify a combined TAM/TTF/TRA research model for technology adoption. The research results derived from the quantitative analysis showed that the determinants of the technology acceptance model, together with subjective norms, technology characteristics and task-technology fit were the major factors that influenced students' decisions to adopt a collaborative technology. The relationship between attitude and intention was also found to be moderated by peer influence. The research results also confirm the importance of peer influence in a collaborative context. The next chapter provides a detailed discussion of the findings from this study to provide insights for future research.

Chapter 9

Discussion

9.1. Introduction to the Chapter

This chapter summarizes the research problem and the research process for CSCL development together with a discussion of the findings. The chapter begins with a recapitulation of the research problem, objectives and research process. Following a discussion on the research approach that guided the research and development processes, the major findings are summarized. The implications for development of CSCL solutions for project-based learning in a Web 2.0 environment are discussed and future directions of research are presented to provide insights on future researches into the implementations of CSCL platforms using social networking tools that encourage creativity, innovation, critical thinking and collaboration.

9.2. Recapitulation of the Research Problem, Research Objectives and Research Process

This research is motivated by the need to develop Web 2.0 based collaborative technologies to improve teaching and learning in higher education through a project-based learning environment. The use of an effective learning environment fosters collaboration among students, allows creating and sharing new knowledge through a collaborative learning environment. Such kind of learning environment can be easily be facilitated through a computer-supported collaborative learning platform employing the use of social software tools. Through the development, adoption and use of such kind of learning environment, this study aims at achieving the following research objectives:

1. To assess the applicability of collaborative technologies for supporting collaborative learning in a Web 2.0 environment.
2. To develop design principles for the adoption and use of a CSCL platform using social networking tools.
3. To test the theoretical models that explain the adoption of a CSCL platform.

Although the social software tools were not originally designed for use in teaching and learning, they offer huge potentials for education because of their intensive use by students in their daily communications. This research also aims at exploiting the capabilities of employing social software tools to support active and social learning, and to support a collaborative environment for project-based learning. Because of the need to address the practical aspects of providing a design solution as well as investigating the role of theories to inform practice, design research is considered as a suitable approach for this study. Design research facilitates theory-driven development, accommodating complex interventions in the teaching and learning environment that can be implemented iteratively, and offers multiple research methods for conducting research. The development of collaborative technologies for collaborative learning in a Web 2.0 environment is an emerging field of research. The use of design research accommodates the emerging issues that could arise during the various design stages. Therefore, it is possible to ensure the feasibility of implementing a completely new learning environment for computer-supported collaborative learning.

This research was developed through two phases of research: the development phase conducted during phase I of the research, and the subsequent evaluation during phase II of the research. Design research was used throughout the development phase for designing the CSCL platform because it offered a unique combination of practical and theoretical orientation to CSCL development. It facilitated the creation of prototype solutions based on existing guiding principles and technological innovations, and provided gradual refinement of both the prototyped solution and the design principles to arrive at satisfactory solutions. Therefore the output from the research included a design solution as well as a set of design principles to be shared among practitioners for future implementations. During the subsequent evaluation of the CSCL platform in phase II of the research, a research model was developed to evaluate the factors which influence students' decisions to adopt a collaborative technology. The details of the research process are summarized in Figure 9-1. It was adapted by incorporating the major stages of design research from Reeves (2006).

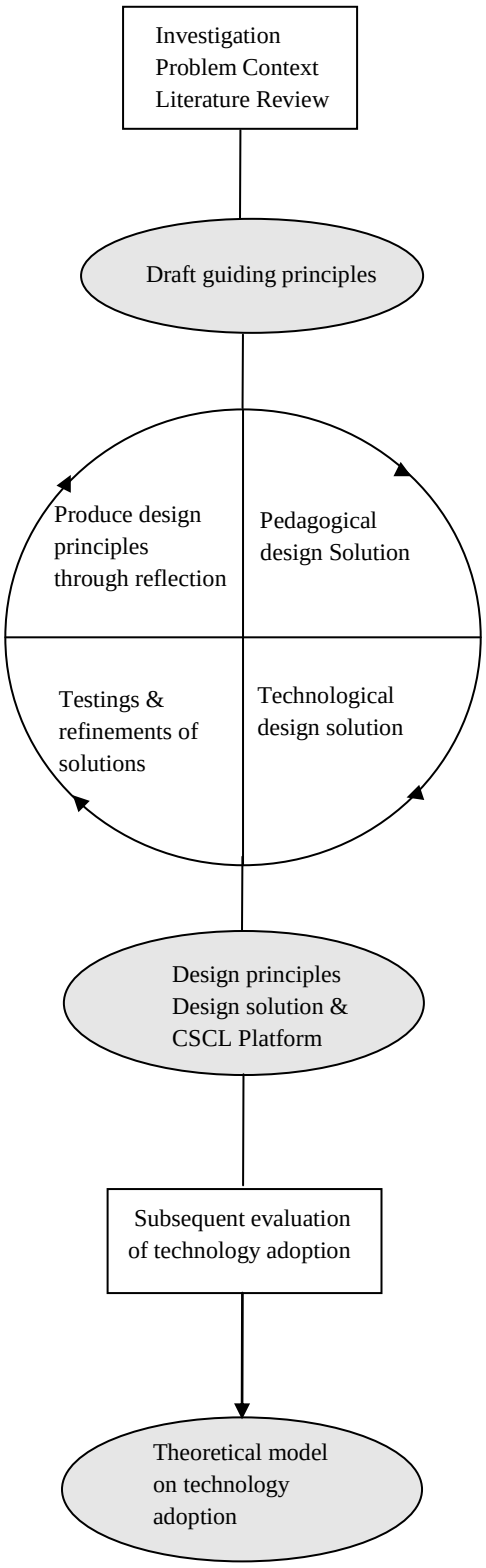


Figure 9-1 Summary of the research process

To accommodate the complexity of designing social software platforms to support learning, this study includes the development of design principles, design solutions and theoretical models. The research was based on the requirements to develop problem-solving skills of the students through marketing research projects. It started with the investigation of the context of the problem, which involved the need to address the issues relating to the teaching of marketing research projects at the Hong Kong Polytechnic University. Through the investigation of the various approaches adopted by other researchers in the literature, an authentic learning environment was introduced and a set of draft guiding principles was developed initially to guide the development of the design solution.

The research was conducted through two iterative cycles of design research, including pedagogical solution design, technological solution design, implementation, testing, reflection, evaluation, refinement of solutions and principles. As the outputs of the first phase of the research, a design solution was developed, which also included a set of design principles and an IT design artefact to support learning. Through the evaluations that were conducted with students, this study has achieved its objective to assess the applicability of collaborative technologies to support learning. The applicability of these technologies for formal learning in a Web 2.0 environment was also assessed based the on evaluations of the adoption aspects relating to project-based collaborations.

To develop design principles for the adoption and use of a CSCL platform using social software tools, this study also employed an iterative approach. In order to develop an initial design solution, a set of draft guiding principles was developed from literature. The evaluations and reflections from the implementations provided further opportunities to refine these guiding principles, and subsequently they were documented as the design principles for this study. Therefore, this study has achieved the second research objective for the development of design principles.

In order to achieve the third research objective, this study follows the approach adopted by Dix (2007) and Williams (2004) to employ structured evaluations of the IT design artefact during the final stages of design and development. A subsequent evaluation was conducted during the second phase of the research to empirically evaluate the computer-based collaborative platform, in order to investigate students'

adoption of the final CSCL platform. A quantitative approach was used to evaluate the factors which influence students' decisions to adopt the collaborative platform. During the second phase of the research, a theoretical model for explaining the adoption of the CSCL platform was developed and tested to explain the adoption of the CSCL platform. The development of research models for collaboration technologies was more complicated than expected. A theoretical model for adoption of a Web 2.0 based collaborative platform covers many aspects. It includes aspects relating to technology acceptance, task and work compatibility, task and technology fit, self-efficacy, facilitating resources and peer influences. Findings from a previous study (Cheung & Vogel, 2013) show that all these factors contributed significantly to technology adoption, and there are also interaction components from these factors that might well affect the acceptance of the technology. In order to test the theoretical models that explain technology adoption, this thesis focuses on the major constructs that contribute to adoption in a collaborative context. By focusing on collaboration technology aspects, the final research model was developed based on the technology acceptance model (Davis, 1989), the theory of reasoned action (Fishbein & Ajzen, 1975) and the task-technology fit model (Goodhue, 1995). It was tested and validated through an empirical research using a survey study. The research model was used to explain the critical factors that affect students' decisions to adopt a collaborative technology in a Web 2.0 learning environment. Therefore, the third research objective for testing of the theoretical models was also achieved in this study.

9.3. Discussion of Findings

This section discusses the findings and lessons learnt from the two phases of the research, including the design and implementations of the CSCL platform during phase I of the study, and the evaluation of technology adoption during phase II of the study.

9.3.1. Findings from Phase I - CSCL Design and Development

Evaluations from the design, implementations and testing of the CSCL environment provided the feedback for the CSCL design. The findings were summarized from the results of evaluations from students' participation records, activity logs, Web site

content analysis, survey and focus group studies. Evaluations for CSCL design and implementation revealed the following findings:

- Students considered a collaborative platform to be necessary for project-based learning - for sharing and communicating with project relating tasks. The project-based sharing platform should be organized within individual project groups.

- The Google Applications platform provided a way of organizing project-related artefacts in the project Web site, facilitating an overall picture of the project portfolio rather than embedding the project communications through email communications among the peer project members.

- Student participation with the collaborative platform was reasonable, but as a new environment, the user interface aspects of the CSCL environment could be improved.

- The usage of the CSCL platform revealed that students employed the CSCL platform for group-based activities and students considered the participation with peer members, perceived ease of use, and perceived usefulness of the collaborative platform as important factors affecting the usage of the technology.

- Students collaborated by sharing project documents and discussing project matters, communications and sharing increases during the critical stages of the project: presentations of research framework, proposal presentation, data analysis and project presentation, which demonstrated the importance of sharing for articulation.

- Supporting and scaffolding through the CSCL platform needed to be strengthened, and students expected more instant responses from the tutor, which required participations from the tutor through the individual project area facilitated by the CSCL platform.

- The collaborative platform supported the long-term development of artefacts and documents for project-based learning and students frequently updated and

revised their project documents through the CSCL platform to facilitate knowledge creation and sharing.

Findings from phase I of the research showed that project-based learning requires careful structuring, guiding and mediating of collaborative learning activities to increase individual and group level participation. This could be achieved through a design process, incorporating a pedagogy that exploited the capabilities of Web 2.0-based collaborative technologies. As Web 2.0 based social software technologies have not been developed for formal education environments, adoption of the technologies was a major target of this study. The two iterations of implementation for the project-based course showed a reasonable amount of participation in the CSCL platform, with an average of 226 activities per group that contributed to an average of 70 digital represented objects per group in the form of 'conceptual artefacts', and each object had an average of two revisions during the processes of developing and sharing project documents. The discussion and sharing with the student project groups were centred on the project stages in terms of problem definition, literature review, research design, analysis and reporting, showing that the advancement and construction of knowledge with a collective effort were visible within the computer-mediated collaborative learning environment.

With a social software learning environment, learning was developed as a social process through conversation, interaction and sharing. Through the survey with students, evaluations showed that the sharing of digital represented artefacts and the influence of their peer members were the most important factors that affected the adoption of collaborative technologies for project-based learning. An implication is that future development of collaborative learning should exploit the capabilities of the social media technologies as a 'communication channel' to develop the potentials to make new form of interactions possible. The computer-mediated platform should be employed for supporting interactions (Stahl, et al., 2006) rather purely use learning management systems to replicate exiting practices in delivering lecture contents .

The findings do not imply that we should change all the existing learning management systems. However, learners do not spend a lifetime using the traditional learning management systems environments, and it is import to investigate the opportunities offered by social software to use technologies to customize the use of

technologies in a constructive way (White & Davis, 2011), thus, effectively enabling a 'digital cognitive apprenticeship'. It is also important to note that the type of learning developed in the research was socio-cultural in nature. The use of digital resources and project documents as mediating artefacts to support learning was demonstrated in the project Web sites. These mediating artefacts helped the articulation process, as well as guiding students' project work during the various project stages for conducting marketing research. The use of activity theory provided a theoretical lens to aid understanding as well as informing the design of learning activities for project-based learning. The introduction of theories to develop a solution for learning was also facilitated by design research. This study has also demonstrated that a study of theories relating to learning and pedagogical aspects of collaborative learning can inform the design decisions for computer-mediated platform to support project-based learning. Teaching practices that promote students' participation was often considered as important, but the decisions to implement such practices were usually embedded within the personal philosophy of the teacher on learning. This research promotes practices in making explicit and informed decisions for the design of learning. Such practices can best be promoted through the design of educational technologies to support learning. This study has demonstrated the use of design research as a suitable approach to develop collaborative technologies using social software to support project-based learning. The development of design principles in this study also offered guidelines for future implementations.

9.3.2. Findings from Phase II – Evaluation of Technology Adoption

To investigate social software practices and rethinking learning in line with the new technologies for education, it might be necessary to employ instructional technology for students to participate in learning differently (Ravenscroft, 2009). In order to develop social software for learning in different ways, it is necessary to investigate technology adoption because the acceptance of a completely new environment is a prerequisite for participation. During the first phase of the project, investigations on technology adoption were evaluated through the feedback collected from students. Focus group studies that were conducted during the phase I of the research revealed that the adoption and use of a collaborative platform was influenced by several important factors: usefulness of the technological platform for project work, ease of the collaborative platform, peer influence and sharing. An investigation of the factors

influencing students' intention to adopt a collaborative technology was conducted during phase II of the study using a quantitative approach. A total of 262 students enrolling in the advanced marketing research course during the 2011-12-S2 session were selected for evaluation of technology adoption through a survey using a structured questionnaire. Statistical analysis using the feedback collected from a sample of 240 students revealed the following results:

- TAM and TRA - the adoption of the collaborative platform can be predicted by the major determinants of the technology acceptance model. In addition, by incorporating the theory of reasoned action, the intention to use a collaborative technology was predicted by perceived usefulness, peer influence and attitude toward the collaborative platform. Attitude has the largest effect size on behavioural intention (f^2=0.24), showing a medium effect, which is consistent with behavioural prediction theories. Peer influence on intention showed a medium effect size (f^2=0.12) for this study, but prior studies on adoption of mobile banking technologies showed a small size effect on the influence of peers on intention (Püschel, Mazzon, & Hernandez, 2010). This can be explained by the fact that the support provided by collaborative technologies was designed for collaboration among peer members. Therefore, the effect size for peer influence on intention (for collaborative use of a technology) was larger than previous studies (with the individual use of a technology). Perceived ease of use and perceived usefulness of the collaborative platform also showed significant influence on the attitude toward the technology, while perceived usefulness was predicted by perceived ease of use.

- TAM and TTF - additional variables from the task technology fit (TTF) model also significantly influence technology adoption for collaborative learning. The TTF variables task-technology fit and technology characteristics both influenced the external variables in TAM – perceived ease of use and perceived usefulness. In addition, the task technology fit variable also influences both intention and usage of the collaborative technology represented by the Google Applications platform.

The research results were consistent with the previous TAM studies involving

perceived ease of use, perceived usefulness, attitude and intention. The results of statistical analysis were also confirmed by the focus group study from the implementations, which showed that perceived ease of use and perceived usefulness were the important factors that influence the attitude toward the collaborative platform. Like previous studies, the research results also showed that both attitude and perceived usefulness have significant effects on intention to a technology. The reason was that students would use the collaborative technology only if they thought that the collaborative technology would help them to perform their tasks. The relationship between perceived ease of use and perceived usefulness was consistent with previous TAM studies (Davis, 1989). Perceived ease of use may encourage students to explore the various features of a collaborative platform, which was critical in making the features and utilities in the Web 2.0 based technological platform more useful for participation (Chau, 1996).

Although the theories of technology adoption explain the factors that influence students to accept the collaborative platform, it is important to focus on those factors that characterize the collaborative aspects of technology adoption. In this study, peer influence was found to be a significant factor influencing the intention to use a collaborative technology. This can be explained by students' need to collaborate and share artefacts with peer members in project-based learning. Sharing was considered as a reciprocal behaviour in online environments (Wasko & Faraj, 2005). If peer members contributed to contents online, an individual might feel obliged to contribute in return. Furthermore, as part of a small project group, users might feel obligated to use the technology because they felt that they belong to a group.

The effect of peer influence was also found to have a significant moderating effect on the relationship between attitude and behavioural intention. In the beginning, the attitude toward a collaborative platform was found to be a good predictor of behavioural intention. As peers contributed to the contents, the influences of peer members increased and became a dominating effect that diminished the influence of attitude on intention. The research result is consistent with the investigation of the critical mass effect on technology adoption on group-based technology by Lou et al. (2000), The findings indicated that a users' decision to use a group-based technology was influenced by whether or not the same technology was used by their peer

members. The findings were also consistent with the studies relating to diffusion of innovation research (Rogers, 1995), which posits that personal interaction is regarded as an important source of external influence for technology adoption. Therefore, it is important for instructors to encourage group participations in the online platform in the beginning. Allocating a component of assessment to participation in online group might facilitate a critical mass effect for peer participation within a project group.

The technology characteristic construct derived from the TTF model was found to be important for analysing the adoption behaviours in a collaborative context. The research results revealed that technology characteristics influence perceived ease of use, perceived usefulness as well as the task-technology fit. The collaborative tools provided by the social software provided personal online experiences for the user. As the user tried out the technology characteristics the tools, they discovered the usability of these tools and those features that were useful. Therefore perceptions on the functionality of collaborative tools have a direct influence on perceived ease of use and perceived usefulness. The results were consistent with the research conducted by Yen, Wu and Huang (2010), which showed that the characteristics of the technology offered by a technology have a direct influence on both perceived ease of use and perceived usefulness.

Task-technology fit was also found to be another important factor influencing technology adoption in a collaborative environment, which influenced perceived usefulness, perceived ease of use, behavioural intention and system usage. The results are consistent with prior studies (Shang, et al., 2007; Yen, et al., 2010; Zigurs & Buckland, 1988). Task-technology fit was also influenced by technology characteristics in a collaborative environment, and the results are consistent with previous researches on the task-technology fit model (Dishaw & Strong, 1999; Goodhue, 1998; Goodhue & Thompson, 1995; Klopping & McKinney, 2004; Yen, et al., 2010; Zigurs & Buckland, 1988). An important finding from this study is that while behavioural intention was considered to be a major determinant of system usage with a marginal medium effect size (f^2=0.10), the task-technology construct also showed a significant influence on system usage with a marginal medium effect size (f^2=0.12). The results showed that the influence of task-technology fit on system usage was consistent with prior research (Goodhue, 1995), and the research results

has shown that the effect size of task-technology fit construct on system usage showed a higher value than behavioural intention. This can be explained by prior research from Dishaw and Strong (Dishaw & Strong, 1999), which shows that the TTF research model is more effective than the TAM for predictive use in work-related tasks. The results showed that while the technology acceptance model was originally developed for investigating individual usage, the task-technologies fit aspects are more important for the use of a collaborative technology (Zigurs & Buckland, 1988). Purely considering individual use of a technology might ignore the more important characteristics of social technologies for collaborative learning. If the technologies were not put into use in a meaningful way for collaborative project environments, their use would become questionable. Therefore, practitioners need to consider the affordance offered by the social software tools to make best use of the technology to support learning. The results also provide explanations for the relatively low utilization of social software tools experienced by other researchers in formal educational environments, even with the popularity of social software tools for social networking among students. Instead of focusing on informal learning aspects of social software tools, practitioners should put more emphasis on the design of learning activities to cope with the demands of project-based learning in a digital age, and to provide support that addresses the task-technology fit aspects.

9.3.3. Salient Issues in Using the Design Research Approach

A design research approach was employed to provide a solution for computer-supported collaborative learning because it afforded a unique combination of practical as well as theoretical orientations. The use of design research approach, which included the studying of pedagogical aspects as well as the design and development of a CSCL environment, proved to be an important method for understanding how social software can be employed for collaborative learning through marketing research projects. Through the CSCL platform, the communications, collaborations and portfolios of artefacts of collaborative project development are more visible in the CSCL technological platform. Although the method provided opportunities to explore the new social software technologies for supporting project-based learning, tension rose between the opportunities and challenges of a design approach. The issues that needed to be addressed include the multiple roles played by the researcher and the flexibility of the design research approach.

Multiple Roles

Educational research through design research was characterized by the close collaboration between the researchers and the practitioners, resulting in solutions that address the practical needs of CSCL development. In this project, this researcher played the multiple roles of a teacher, a CSCL designer and a researcher. As a CSCL designer, it was possible to experiment with Google Applications and introduced them in the CSCL platform for learning by pursuing personal ideas on what should be included in the student project Web site. The personalization features of Google Applications also made it easier to manage the Web design features easily. Although the researcher has a good knowledge of the context and requirement for learning, such kind of 'subjective and imaginative involvement' might have a negative effect that might be offered through a mixed team of researchers, Web designers and instructional designers that might offer 'objective and distant critique' (van den Akker, 2002) to avoid the risk factor of subjectivity.

By acting as the role of a researcher as well as the other multiple roles enhanced decision-making in the design process. The researcher, acting both as the role of a teacher, was able to include the context-based information in the design process. For example, the feedback from the first iteration of implementation showed that the CSCL platform was difficult to use, because there were too many items on the Web site. Through the second implementation, the pages in the project Web site were simplified, by deleting items which were not used by students (e.g. time tracker). By acting as a platform developer-designer, the researcher was able to implement the ideas from feedbacks through a rapid iteration between consecutive semesters to refine the theory-driven design of the learning environment. This type of changes was also supported by the observation on students' use of the platform, playing the role of an instructor before conducting the evaluations.

Flexibility of Design Research

The design research process was highly flexible and there was no restriction on coupling the type of research evaluation to the design process. In fact, research techniques such as triangulation were recommended using multiple research methods. In the evaluation of the CSCL design solution, multiple methods were used for data collection, such as focus group interviews, surveys, content analysis of Web site data and activity logs. The use triangulation helped to increase the reliability of the findings to avoid the subjectivity that might be induced by the researcher acting through multiple roles.

Social software, technology adoption, Web 2.0 technologies might be considered as technological innovations that serve as important players in the evolving paradigm for learning, but do not provide clear solutions to well-understood problems (Ravenscroft, 2009). Design research was considered as a suitable approach for introducing such kinds of collaborative technology for project-based learning. It was also considered as a viable approach for conducting 'socially responsible' research (Reeves, 2005) to solve practical problems in education. However, the highly flexible and iterative nature of design research, which takes a long time to complete, might exclude its usage in educational environments. For example, there were several notable initiatives at Hong Kong Polytechnic University for implementing educational technology to support learning, such as the introduction of the Blackboard learning management system and the introduction of mobile learning platforms. However, the introduction of these e-learning platforms has not been evaluated extensively using a design-based research approach. This research also puts forward a model for conducting a small scale design research involving the practitioners for the design of computer-supported collaborative learning environments.

9.4. Implications of the Findings

There are several implications that can be derived from this study. In order to adopt and use a collaborative platform to support learning employing the new generation of social software, practitioners should consider the design aspects and instructor support aspects, as well as other factors that influence the adoption of the technology among students.

Designing Platforms to Support Learning

In recent years, numerous researchers have focused on how to employ Web 2.0 technologies to create new learning experiences in blended environments. Instructional and e-learning designers should make full use of Web 2.0 and collaborative learning technologies for project-based collaborations. This research addresses the need for a shift away from the use of traditional e-learning systems (such as WebCT) to collaborative technologies for project-based learning. The research has shown that social software tools can be successfully implemented to support project-based learning in authentic environments. Furthermore, it puts forward a model for developing a computer-supported learning environment using design research for project-based learning. Therefore, the research has practical significance in that it addresses key factors relevant to practitioners and Web 2.0 e-learning designers.

To develop a learning platform using social software, designers should work closely with practitioners to address practical problems in education. The interactive nature of Web 2.0 technologies and social software tools allows learners to explore a variety of resources to establish connections with their peers. However, the adoption and use of these technological platforms for learning may not fit the specific learning context without the provision of a sound instructional model that fosters them. In order to meet the specific requirements for problem-based learning, designers of computer-mediated learning environments should move away from conventional content-based e-learning Web sites, and develop learning strategies which directly relate to the intended learning outcomes based on project-based activities that reflect 'real-life' settings. Because of the need to design learning associated with meaningful contexts, the information that was used to support learning became artefacts of the learning process. Therefore, collaborative technologies can be used to support authentic project-based learning by developing group-based communities through scaffolding, collaborative content generation, sharing of knowledge and ideas for problem-solving.

Instructor Support for CSCL Platforms

The Google Applications framework was implemented in a Web 2.0 environment. The communications and activities of project groups in Google Applications can be interpreted as collaborative tasks within a social networking environment. The project

groups within a project-based environment facilitate the development of strong social ties within a group, and these strong social ties are associated with strong investment of time, reciprocity and sharing (Wellman, 1997). According to the 'strength of weak ties theory' of Granovetter (1973), weak ties are characterized by absent or infrequent contact, lack of emotional closeness and reciprocal services. Examinations on the amount of online interaction of the instructor in the project Web site, together with the survey results revealed that online participation of the tutor in project Web sites is low. According to the approach used by Hossain and de Silva (2009), the instructor can be classified as a 'weak social tie' in the e-learning system. Therefore, being considered as a 'weak social tie' component of subjective norms, the instructor's influence on intention to use a collaborative platform is insignificant. Instructors involved in Web 2.0 collaborative learning systems should make sure that they show a significant amount of reciprocity and sharing to cope with the shift toward peer-learning environments. With a large number of project groups implemented in a CSCL platform, scaffolding within a large number of project groups might not be feasible (e.g. with over 20 project groups). Additional tutors might be employed to support scaffolding within a group-based CSCL environment. A significant implication resulting from this study is that while an emphasis on what the lecturer does to improve teaching is important, it is of greater importance to consider 'what the students do' (Biggs, 2003) to cope with the changes toward student-centred learning environments.

Implications for Technology Adoption

In terms of technology adoption, this study attempts to integrate the various models associated with the behavioural aspects of e-learning: the TAM, TRA and TTF models. Previous researchers have extended TAM with additional constructs for e-learning. However, in-depth analyses of collaborative technologies and empirical research that investigates students' intentions to use collaborative platforms from an information systems perspective are still rare. The significance of the current study is the identification of underlying factors that influence students' intentions to use new learning technologies involving collaborative features. For example, peer influence was found to be one of the most important factors for technology adoption in a collaborative environment, and task-technology fit turns out to be a more important factor than behavioural intention when the direct influence on system usage is

considered. This research has shown that while the TAM is applicable to technology adoption for collaborative environments, researches in technology adoption in a collaborative context require significant extensions to the TAM. The key constructs from the TRA and TTF models play a more significant role than the conventional TAM constructs in explaining students' behaviours in adopting a collaborative technology.

Designers of CSCL platforms should also focus on the functionalities that foster community building, collaboration and sharing among peers. This study also fills the gaps in extant research by incorporating students' perceptions regarding Web 2.0 collaborative technologies into the empirical research model. The current study shows that ease of use and usefulness directly influence the intention to use a collaborative technology for project-based learning. This is supported by the conventional TAM model, which suggests that the social software tools should be designed to provide simple user-friendly interfaces and features that promote their usefulness. In addition, this research has shown that there are other important factors that influence the perceived ease of use and perceived usefulness of the collaborative platform. The implementations of CSCL platform should also focus on the technology characteristics that fit well with the collaborative task for project-based learning. The well-design tools with functionalities to support collaborative tasks will directly improve the user-friendliness and usefulness of the collaborative platform, hence, will contribute significantly to active student participation.

9.5. Future Research Opportunities

In order to introduce social software for computer-supported collaborative learning, a technological platform was developed to support the pedagogical implementation for project-based learning. As an initial development in this area, this research mainly focuses on the platform design associated with a pedagogical implementation and technology adoption aspects. To improve teaching and learning in a project-based environment, future research could investigate the use of social software tools to enhance student engagement in a CSCL environment. Another direction of research might include affective factors, such as intrinsic motivations that can influence behaviours in collaborative platform for knowledge sharing. Furthermore, the findings of this research can only be applied to the use of the Google Applications platform for

collaborative learning. As Google Applications technology is only one of the widely used tools for collaborations, more research is needed before we can generalize our findings to other technologies for Web-based collaboration.

9.6. Chapter Summary

The chapter begins with a recapitulation of the research problem, objectives and research process. Following a discussion on the research approach that guided the research and development processes, this chapter provides a discussion of the findings from the research. The implications for development of CSCL solutions for project-based learning in a Web 2.0 environment are discussed and future directions of research are presented to provide insights on future researches into the implementations of CSCL platforms using social networking tools. The following chapter discusses the extent to which the research questions of this study are being addressed, in order to provide a final conclusion for this study.

Chapter 10

Conclusions

10.1. Introduction to the Chapter

This research focuses on the practical as well as the theoretical aspect of computer-supported collaborative learning in project-based environments. It addresses the design issues associate with the use of a collaborative platform to support project-based learning, and investigates the behaviours associated technology adoption for computer-supported collaborative learning. This concluding chapter discusses the extent to which the research questions have been addressed by this study. A discussion is also provided to highlight the research limitations, opportunities for future work, and the conclusions for this study.

10.2. Revisiting the Research Questions

In order to assess the applicability the new technologies for collaborative learning, this research aims at investigating the use of a CSCL platform for project-based learning, taking into considerations the perceptions of students toward the technology. The research was conducted through the use of multiple approaches to deal with the complexity of computer-supported collaborative learning. Three research questions were proposed with reference to the research phases in Table 10-1, and were addressed through different phases of the research. The research was conducted through two iterative cycles of CSCL implementations through design research during the first phase of the research, and a subsequent evaluation of technology adoption was conducted during the second phase of the study. The development through separate phases of research is supported by previous researchers (Dix, 2007; Williams, 2004), who argue that the design of technologies for learning involves the development of an IT artefact for supporting learning and a final subsequent evaluation is required when the features of the IT designed artefact are stabilized.

Table 10-1 Project phases and research questions

Research Phase	**Research Approach**	**Research Questions**
Phase I – Design Semesters 2010-11-S2 & 2011-12-S1	Design Research	RQ1: How to design an effective CSCL environment using social networking, user-generated technologies for project-based learning?
		RQ 2: What are the design principles for developing a CSCL platform using collaborative technologies for project-based learning?
Phase II – Subsequent evaluation Semester 2011-12-S2	Quantitative Approach	RQ3: What are the factors that influence students' decisions to adopt a collaborative technology?

The first two research questions (RQ1 and RQ2) addresses the practical and pedagogical aspects of designing CSCL environments to improve teaching and learning practices through design research. The IT artefacts developed during the research embody the assumptions about the design principles that are hypothesized to respond to a set of user requirements. The third research question (RQ3) addresses the behavioural aspects of adoption for a collaborative platform, and was addressed through a quantitative approach. The following paragraphs summarize the research work to explain how each research question is being addressed in the study.

> RQ1: How to design an effective CSCL environment using social networking, collaborative, and user-generated technologies for group-based collaborative learning?

The research question RQ1 is addressed by the incorporation of design research approach to draw on a number of theories to deal with the pedagogical aspects of learning, including the theory of authentic and situated learning (Lave & Wenger, 1991), activity theory (Engeström, 1999a) and models of knowledge building (Bereiter, 2002).

Through a marketing research project that was developed based on an authentic learning environment, collaborative activities were constructed to developed students' problem solving capabilities. By employing social software tools, a computer-

supported collaborative learning environment was constructed based on the design principles for developing Web 2.0 pedagogies and participatory learning (McLoughlin & Lee, 2007, 2008), authentic e-learning (Herrington, et al., 2010), collaborative learning and knowledge building (Bereiter, 2002; Paavola & Hakkarainen, 2005).

Two iterations of learning interventions were designed to support project-based learning for an undergraduate course in marketing research. Data were captured via focus group interviews, surveys, online discussions, activity logs, and collaborative documents available from the learning platform. The multiple sources of data facilitated a mixture of quantitative and qualitative evaluations to promote understandings on the adoption aspects of the collaborative technologies among students. This also helped to evaluate the efficacy of the interventions and provide data for further analysis. Through the collaborative platform developed for this study, learning was supported through cultural practices that promoted participation, collaboration and self-reflections among students. The evaluations showed that the collaborative platform helped the participants to share knowledge artefacts and knowledge creation processes taking place between individual and collective activities, indicating that these collaborative tools helped individuals and their communities to work jointly for advancement of knowledge for project-based learning.

RQ2: What are the design principles for developing a CSCL platform using collaborative technologies for project-based learning?

In order to provide a bridge between theory and practices in the design of CSCL solutions for project-based learning, various activities were conducted. These include the analysis of the problem context and requirements, literature review, solution design, iterative cycles of implementations, evaluations, documentation and reflections. The findings from these activities resulted in seven design principles. These principles (Table 10-2) inform the design of CSCL environments employing social software tools for project-based learning, in order share design knowledge among practitioners for future implementations.

Table 10-2 The design principles and the associated implementations

	Design principles	Issues addressed/highlighted in the implementations
1.	Embed learning within relevant and authentic contexts	An authentic project-based learning environment was implemented
2.	Focus on sharing of meaningful knowledge	Sharing was facilitated through the wiki pages, project forums, digital depositories, file sharing facilities, and collaborative tools for online survey development
3.	Develop opportunities for group-based collaborations	The CSCL platform implemented within each project group facilitates collaboration, articulation, and reflection within the group-based projects for marketing research
4.	Support for coaching and scaffolding in a timely manner	The Web 2.0 facilities provided scaffolding and coaching facilities, but students were disappointed that the instructor was not actively responding to queries within the group-based forums regularly
5.	Keep project-based communications separate from students' social networking sites	Access to the Google Applications platform was separated from Facebook or the Google Plus social networking sites
6.	Promote participation, personalization and productivity	Elements of participation, personalization and productivity were evaluated based on e-portfolios. Appropriate pedagogies and technologies were used to cultivate independent learning and self-regulated learning
7.	Support the long-term development of knowledge artefacts	Evaluations through the second cycle of implementation showed active contributions among group members for development of knowledge artefacts through the Web-based collaboration facilities

Design *principle 1* focuses on the pedagogical design for authentic activities (Oliver, et al., 2007) and is important for facilitating learning in project-based environments. Design *principle 2 and 3* focus on sharing and collaboration (Hedberg, 2006), articulation (Pea, 1991), reflection and community building (Wenger, 1998) that should be facilitated by an authentic e-learning environment employing social software facilities. Design *principle 4* for scaffolding and coaching emphasizes on the social constructivist view (Vygotsky, 1978) to support scaffolding and coaching for ill-structured problems through interactions with more capable peers and experts.

Design *principle 5* is constructed based on previous studies involving project-based communications in social networking environments. Studies from the literature also support the arguments for keeping the project platform separate from private social networking sites (Cheung & Vogel, 2011). Design *principle 6* for participation, personalization, and productivity is developed based on the principles of pedagogy 2.0 (McLoughlin & Lee, 2008) for promoting participatory learning. Design *principle*

7 emphasizes on the long-term development of knowledge artefacts (Bereiter, 2002; Paavola, et al., 2011) for project-based learning, and is best facilitated by a Web 2.0 based CSCL platform.

The outputs of the design research are represented by a set of design principles, as well as a mature IT design artefact, which was developed as a technological platform to support project-based learning. A subsequent evaluation was conducted to evaluate the psychological and behavioural factors that influence students' adoption of the collaborative technologies, in order to address the research question RQ3.

RQ3: What are the factors that influence students' decisions to adopt a collaborative technology?

During subsequent evaluation conducted during the second phase of the research, a survey was conducted using a sample of 240 students from the marketing research course, which was supported by the collaborative platform. A quantitative approach was employed and a theoretical model was developed to investigate technology adoption in a collaborative learning environment. The results of the statistical analysis showed that the determinants of the technology acceptance model (Davis, 1989) together with subjective norms, technology characteristics and task-technology fit (Dishaw & Strong, 1999; Goodhue, 1995) were the major factors that influenced students' decisions to adopt a collaborative technology.

10.3. Research Contributions

This research provides practical as well as theoretical contributions through the integration of multiple theories and multiple research methodologies in a design-based study. Qualitative techniques were used to evaluate the feedback from students on the CSCL platform. Quantitative techniques were employed to develop a research model to predict the adoption behaviour of collaborative technologies for project-based learning. The results of the study are useful for researchers and practitioners to address the important issues for the development of Web-based platforms to support collaborative learning.

Theoretical Contributions

By employing a design research approach that incorporates learning theories and pedagogical principles, this research contributes to the integration of Web 2.0 facilities in collaborative learning environments to support project-based learning. A set of design principles was developed to facilitate knowledge sharing among practitioners. These design principles contain substantive information on the learning context, and evidence-based heuristics that can inform future developments and implementation decisions.

This research addresses the research gap in applying design theories (Gregor & Jones, 2004, 2007) for testing pedagogical designs (Herrington & Oliver, 2000; Mcloughlin & Luca, 2006) in a Web 2.0 collaborative learning environment using social software tools. By comparing with existing e-learning design theories for collaborative learning (Cocciolo, Mineo, & Meier, 2010; Hakkarainen, et al., 2006; Paavola, et al., 2011), this research also addresses the need for design principles (Paavola, et al., 2011) for developing collaborative environments for project-based learning.

The design-science contributions of this research are the CSCL platform and the design principles. The CSCL platform demonstrates the feasibility of using the design principles to develop an artefact using Web 2.0 technologies to support collaborative learning in project-based environments. Because the CSCL platform is the first artefact that has been developed and tested to address this task, its construction is itself a contribution to design science. Furthermore, this research provides an articulation of the design principles upon which its construction was based, they also serve as hypotheses to be tested by future research work. Their applicability to the development of other types of collaborative technologies can also be tested by applying the similar research techniques developed in this study. Furthermore, the current study has theoretical foundations in design theory for education, learning theories and the application of design science theory in information systems. It demonstrates the integration of multiple theories in a design-based study.

By developing extensions to the technology acceptance model for computer-supported collaborative learning in the subsequent evaluation, this study also contributes to theories that explain the adoption behaviour of collaborative technologies among students for project-based learning. A research model was

constructed by the integration of multiple theories through a quantitative study. The research contributes to the integration of technology acceptance and collaboration technology research using theories from the technology acceptance model (Davis, 1989), the theory of reasoned action (Fishbein & Ajzen, 1975) and the technology fit model (Dishaw & Strong, 1999; Goodhue & Thompson, 1995; Yen, et al., 2010).

This study has shown that TAM applies to the study of collaborative technologies. However, the extension to TAM incorporates an additional construct that is specific to the use of collaborative technologies for project tasks. The additional construct, task-technology fit was found to have the largest effect on the usage of a collaborative platform. This stands in contrast to TAM's argument that the intention to use a technology is the major determinant of technology usage. The results suggest that, in making decisions on the usage of collaborative technologies, individuals are not only influenced by their own perceptions about the technology, but also by the technological aspects that fit in with the collaborative tasks driven by the peer members. The proposed research model helps users better understand the factors affecting user acceptance decisions on the usage of collaborative technologies.

From a theoretical point of view, the research results empirically confirmed the influence of peers on the intention to use a collaborative technology. This is consistent with the research from Luo, Luo and Strong (2000) on groupware technology. In addition, peer influence has a negative moderating effect on the relationship between attitude and intention. The research results suggest that although the intention to use a collaborative technology is influenced by the users' own perceptions, such perceptions may be changed through the interactions with peer members. The negative moderating effect suggests that subjective norms from peers reduce the power of attitude to predict behavioural intention. At the introductory stage of a collaborative learning platform, the attitude toward a technology is an important factor that influences the intention to use it. As more peer members participated in the collaborative platform, intention becomes unconsciously directed by peers. Through the integration of multiple theories, the research model developed in this study contributes to understandings on the interaction effect of these factors. Therefore, this study provides an extension of the technology acceptance model to cope with the adoption of collaboration technologies.

Excerpts from theoretical and practical contributions of this thesis have been published in peer-reviewed publications in research areas relating to social software evaluations (Cheung & Vogel, 2011; Cheung & Wan, 2010), theoretical models on the adoption of collaborative technologies (Cheung, in press; Cheung & Vogel, 2013), design of collaborative environments employing social software tools (Cheung & Vogel, in press), and the socio-cultural aspects surrounding the blended learning environments (Cheng, et al., 2010).

Practical Contributions

Despite the growing interest in Web 2.0 applications and Internet-based collaborative technologies, research investigating the relationship of these aspects to design frameworks for collaborative learning has been scarce. Researchers have called for the need to apply social software and Web 2.0 concepts to create new learning experiences in blended learning environments (Greenhow & Belbas, 2007; Greenhow, et al., 2009). Instructional and e-learning designers should make full use of social software employing Web collaborative technologies for project-based learning. This research addresses the need for the shift from top-down, knowledge-push models of traditional e-learning (such as WebCT) to collaborative learning technologies with a bottom-up approach that is driven by the learner, facilitating collaboration and sharing through Internet-based technologies. In practical terms, this study shows that collaborative technologies can be applied to support collaborative learning in a Web 2.0 environment. It contributes to the design of collaborative learning environments employing collaborative tools for project-based learning.

The research also contributes to the development of effective teaching practices and understanding on ways to improve students' learning. It shows that face-to-face teaching can be effectively designed through project-based learning and careful planning of learning activities throughout the entire duration of a course. This is achieved through the design of a group-based marketing research project that engages students in practical problem-solving to maximize their intellectual growth. The research has shown that these learning activities can best be supported by a computer-mediated platform implemented using social media technologies. Through the implementations, this study contributes to research in computer-supported collaborative learning.

The project-based approach fosters students' involvement in learning through participation in group-based assignments for their projects. By developing a culture of 'learning-by-doing', students develop their skills in problem-solving. The role of the instructor serves as an expert to provide guidance on students' acquisition of key concepts as well as acting as a facilitator for learning. Such kind of learning may transcend the boundaries of the traditional classroom and is best supported by a computer-mediated learning platform. Through the Web-based environment developed in this study, it was possible to form learning communities, where students' learning is exposed to other members and instructors, who also assume the role of 'experts', 'coaches' and 'professionals' in marketing research. Furthermore, these Web-based communications also mirror the sharing practices that often occur in authentic environments.

This study has provided an active learning environment by involving students in collaborative discovery of consumer behaviours. Through the collaborative platform developed for this study, students were engaged in authentic problems by defining approaches, debating ideas, making predictions, designing plans and solutions, gathering information, collecting and analysing data, drawing conclusions, and communicating their ideas and findings to others. The feedback collected from students showed that the collaborative platform helped the participants to share knowledge artefacts and knowledge creation processes taking place between individual and collective activities, showing that these collaborative tools helped individuals and their communities to work jointly for the advancement of knowledge for project-based learning. This study also operationalizes activity theory for analysis of complex problems and applies these techniques to a collaborative problem-solving environment. This research provides unique contributions by providing a complete implementation of the activities for collaborative learning. The analysis records in Table 6-8 showed that the learning activities were mediated through concrete shared objects across long time scales, which were in line with the socio-cultural and cultural-historical theories of human cognition.

10.4. Research limitations and extensions for future work

There are several limitations that create opportunities for future research to improve the research results. First, any generalization of these research results to other Web

2.0 based collaborative systems should be done cautiously, as the various technologies facilitate collaborative learning differently. The current study was limited to the use of social software tools employing Web 2.0 based collaborative technologies using the Google Applications environment. Second, educational research is highly context dependent. Therefore, researchers need to interpret the findings that are appropriate to their learning contexts, in order to apply the results of this study to other learning environments. Third, the evaluations of the adoption and use of the collaborative technology in this study were limited to a single project-based course environment at the Hong Kong Polytechnic University. In order to test the applicability of the research results to other learning environments, implementations and testing with other courses are required.

There are several opportunities for future works which became apparent during the research project. A future project might consider the possibility of reusing the design principles developed in this research to inform the design of CSCL environments for other subjects. An initial question to be addressed as future work might be how the changes in subject matter and level would influence the design of CSCL environments to support project-based learning.

Another extension of the project is to enhance the design principles develop in this project to include other aspects of project-based learning, such as knowledge articulation (Boland, Tenkasi, & Te'eni, 1994), affective and cognitive domain of learning (Lebow, 1993), and distributed knowledge building processes (Hewitt & Scardamalia, 1998). In addition, it is likely that new design principles will become necessary if the design is used by other researchers for the learning context relevant to the domains of interest.

Finally, future research might consider other aspects that influence adoption of CSCL platform, such as user profiling, media sharing, learner characteristics, and technology choices (Davis, 2009). These factors were not considered in the current study. Future research could also focus on other elements that could further improve the CSCL design to develop students' motivation engagement, social presence (Kreijns, Kirschner, Jochems, & Van Buuren, 2011), and mobile aspects of project-based learning (Cheung, in press).

10.5. In Conclusion

A significant part of this study covers the research into the understanding on the design issues associated with the development, adoption and use of collaborative technologies for project-based learning in a computer-supported collaborative learning environment. This study has confirmed that employing technologies to support collaborative learning does not mean replicated conventional teaching practices in online environments, but needs extensive practices with design for learning. The final CSCL environment that was supported by social software tools has been shaped over time through analysis and reflections on teaching and learning practices in the delivery of project-based courses. This research has demonstrated how specially design social software tools can be used to support collaborative learning and collective inquiries in project-based environment. This study provides new insights into collaborative learning because collaborative technologies from social software were not being developed fully to support formal learning, and this study puts forward a means of incorporating design principles for introducing these tools in a collaborative learning environment. Furthermore, it provides a theoretical model for understanding technology adoption in a collaborative context. The results of this study add to the body of literature on collaborative technology, technology adoption and the design of learning environments.

References

Agarwal, R., & Prasad, J. (1997). The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies. *Decision Sciences, 28*(3), 557-582.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Cliffs, NJ: Prentice-Hall.

Ajzen, I., & Madden, T. J. (1986). The prediction of goal-directed behavior, attitudes, intentions, and perceived behavioral control. *Journal of Experimental Social Psychology, 22*, 453-474.

Al-Gahtani, S. S., & King, M. (1999). Attitudes, satisfaction and usage: Factors contributing to each in the acceptance of Information Technology. *Behaviour & Information Technology, 18*(4), 277-297.

Al-Zoube, M. (2009). E-Learning on the cloud. *International Arab Journal of E-technology, 1*(2), 58-64.

Ala-Mutka, K., Broster, D., Cachia, R., Centeno, C., Haché, A., Kluzer, S., Lindmark, S., Lusoli, W., Misuraca, G., Pascu, C., Punie, Y., & Valverde, J. A. (2009). *The impact of social computing on the EU information society and economy*. Luxembourg: Office for Official Publication of the European Communities.

Alavi, M., & Leidner, D. E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly*, 107-136.

Alier, M., Casañ, M. J., & Piguillem, J. (2010). Moodle 2.0: Shifting from a learning toolkit to a open learning platform. *Communications in Computer and Information Science, 73*, 1-10.

Arteaga Sánchez, R., & Duarte Hueros, A. (2010). Motivational factors that influence the acceptance of Moodle using TAM. *Computers in Human Behavior, 26*, 1632-1640.

Atkins, D. E., Brown, J. S., & Hammond, A. L., 2007, 'A review of the open educational resources (OER) movement: Achievements, challenges, and new opportunities', accessed on 22 Feb 2013, <http://www.hewlett.org/uploads/files/ReviewoftheOERMovement.pdf>.

Ayas, K., & Zeniuk, N. (2001). Project-based learning: Building communities of reflective practitioners. *Management Learning, 32*(1), 61-76.

Babbie, E. R. (2004). *The practice of social research* Belmont, NJ Wadsworth.

Bagozzi, R. P. (1981). Attitudes, intentions and behavior: A test of some key hypotheses. *Journal of Personality and Social Psychology, 41,* 607-627.

Baker, D. A., & Rees, M. J. (2008). WILE: A very low cost web-based integrated learning environment. In *Proceedings of the14th Australasian World Wide Web Conference*.

Barab, S., & Squire, K. (2004). Design-based research: Putting a stake in the ground. *The Journal of the learning sciences, 13*(1), 1-14.

Barab, S., Squire, K., & Dueber, W. (2000). A co-evolutionary model for supporting the emergence of authenticity. *Educational Technology Research and Development, 48*(2), 37-62.

Baran, B. (2010). Facebook as a formal instructional environmemt. *British Journal of Educational Technology, 41*(6), E146-E149.

Barron, B. (2004). Learning ecologies for technological fluency: Gender and experience differences. *Journal of Educational Computing Research, 3*(1), 1-36.

Beck, L., & Ajzen, I. (1991). Predicting dishonest actions using the theory of planned behavior. *Journal of Research in Personality, 25*(3), 285-301.

Beetham, H. (2007). An approach to learning activity design. In H. Beetham & R. Sharpe (Eds.), *Rethinking pedagogy for a digital age: designing and delivering e-learning* (pp. 26-40). New York, NY: Routledge.

Bell, P., Hoadley, C. M., & Linn, M. C. (2004). Design-based research in education. In M. C. Linn, E. A. Davis & P. Bell (Eds.), *Internet environments for science education* (pp. 73-85). Mahwah, NJ: Erlbaum.

Bereiter, C. (2002). *Education and mind in the knowledge age*. Mahwah, NJ: Lawrence Erlbaum.

Bhattacherjee, A. (2001). Understanding information systems continuance: An expectation-confirmation model. *MIS Quarterly, 25*(3), 351-370.

Biggs, J. (1993). What do inventories of students' learning processes really measure? A theoretical review and clarification. *British Journal of Psychology, 83,* 3-19.

Biggs, J. (2003). *Teaching for quality learning at university*. Maidenhead, Berkshire: Open University Press.

Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational psychologist, 26*(3-4), 369-398.

Boland, R., Tenkasi, R., & Te'eni, D. (1994). Designing information technology to support distributed cognition. *Organization Science, 5*, 456-475.

Boud, D., Keogh, R., & Walker, D. (1985). Promoting reflection in learning: A model In D. Boud, R. R. Keogh & D. D. Walker (Eds.), *Reflection: Turning experience into learning* (pp. 18-40). London: Kogan Page.

Boyd, D. M., & Ellison, N. B. (2007). Social network sites: Definition, scholarship and history. *Journal of Computer - Mediated Communication, 13*(1), 210-230.

Brinberg, D. (1979). An examination of the determinants of intention and behavior: A comparison of two models. *Journal of Applied Social Psychology, 9*, 560-575.

Brown, A. L. (1992). Design Experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *Journal of the Learning Sciences. Journal of the Learning Sciences, 2*(2), 141-178.

Brown, J. S., & Adler, R. P. (2008). Open education, the long tail, and learning 2.0. *Educause review, 43*(1), 16-20.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational researcher, 18*(1), 32-42.

Brown, J. S., & Duguid, P. (1991). Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation. *Organization Science*, 40-57.

Brown, S. A., Dennis, A. R., & Venkatesh, V. (2010). Predicting collaboration technology use: Integrating technology adoption and collaboration research. *Journal of Management Information Systems, 27*(2), 9-54.

Bryman, A. (2004). *Social research methods*. Oxford: Oxford University Press.

Buckingham, D. (2007). *Beyond technology: Children's learning in the age of digital culture*. Malden: Blackwell Publishing.

Burton, J. K., Moore, D. M., & Magliaro, S. G. (2003). *Behaviorism and instructional technology*. Mahwah, NJ: Lawrence Erlbaum Assoc Inc.

Casquero, O., Portillo, J., Ovelar, R., Romo, J., & Benito, M. (2008). iGoogle and gadgets as a platform for integrating institutional and external services. In *Proceedings of the first workshop on mash-up personal learning environments* (pp. 37-41).

Castells. (2009). *Communication power*. Oxford, New York: Oxford University Press.

Caswell, T., Henson, S., Jensen, M., & Wiley, D. (2008). Open content and open educational resources: Enabling universal education. *The International Review of Research in Open and Distance Learning, 9*(1).

Chatti, M. A., Dahl, D., Jarke, M., & Vossen, G. (2008). Towards web 2.0 driven learning environments. In *Proceedings of the Fourth International Conference on Web Information Systems and Technologies* (pp. 370-375).

Chau, P. Y. (1996). An empirical assessment of a modified technology acceptance model. *Journal of Management Information Systems, 13*(2), 185-204.

Chau, P. Y. K., & Hu, P. J. H. (2002). Investigating healthcare professionals' decisions to accept telemedicine technology: An empirical test of competing theories. *Information & Management, 39*(4), 297-311.

Cheng, C., Cheung, R., & Wan, C. (2010). E-learning in higher education – A case study in Hong Kong. In *Proceedings of the IEEE International Conference on Advanced Management Science* (pp. 79-85).

Cheung, R. (in press). Predicting user intentions for mobile learning in a project-based environment. *International Journal of Electronic Commerce Studies, 5*(1).

Cheung, R., & Vogel, D. (2011). Can Facebook enhance the communications between teachers and students? *The International Journal of Learning, 17*(11), 35-397.

Cheung, R., & Vogel, D. (2013). Predicting user acceptance of collaborative technologies – An extension of the technology acceptance model for e-learning. *Computers & Education*(63), 160-175.

Cheung, R., & Vogel, D. (in press). Activity theory as a design framework for collaborative learning using Google Applications technology. In *Lecture Notes in Computer Science* (Vol. 7697): Springer.

Cheung, R., & Vogel, D. (submitted). Designing Web 2.0 collaboration tools to support project-based learning: An activity-oriented approach. *International Journal of Systems and Service-Oriented Engineering*.

Cheung, R., & Wan, C. (2010). An evaluation and implementation of collaborative and social networking technologies for computer education. *International Journal of Cyber Society and Education, 4*(1), 17-30.

Chin, W. W. (1998a). Issues and opinion on structural equation modeling. *MIS Quarterly, 22*(1), 7-16.

Chin, W. W. (1998b). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern Methods for Business Research* (pp. 295-336). London: Lawrence Erlbaum Associates.

Chin, W. W. (2010). How to write up and report PLS anlayses. In V. Esposito Vinzi, W. W. Chin, J. Henseler & H. Wang (Eds.), *Handbook of Partial Least Squares* (pp. 655-690). Heidelberg: Springer.

Chin, W. W., Marcolin, B. L., & Newsted, P. R. (2003). A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. *Information Systems Research, 14*(2), 189-217.

Chiu, C. M., Hsu, M. H., & Wang, E. T. G. (2006). Understanding knowledge sharing in virtual communities: An integration of social capital and social cognitive theories. *Decision Support Systems, 42*(3), 1872-1888.

Christensen, C. M. (1997). *The innovator's dilemma: when new technologies cause great firms to fail*. Cambridge, MA: Harvard Business Press.

Christensen, C. M., Anthony, S., & Roth, E. (2004). *Seeing what's next: Using the theories of innovation to predict industry change*. Boston, MA: Harvard Business School Press.

Christensen, C. M., Horn, M. B., & Johnson, C. W. (2008). *Disrupting class: How disruptive innovation will change the way the world learns*: McGraw-Hill New York.

Churchill, G. A. J. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research, 16*(1), 64-73.

Cocciolo, A., Mineo, C., & Meier, E. (2010). Using online social networks to build healthy communities: A design-based research investigation. In *Proceedings of the World Conference on Educational Multimedia, Hypermedia & Telecommunications* (pp. 3107-3116). Toronto, Canada.

Coenen, T. (2005). How social software and rich computer mediated communication may influence creativity. In *Proceedings of the IADIS International Conference on Web Based Communities* (pp. 255-261). Algarve.

Coenen, T., Kenis, D., Van Damme, C., & Matthys, E. (2006). Knowledge sharing over social networking systems: Architecture, usage patterns and their application. In (pp. 189-198): Springer.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2 ed.). Hillsdale: NJ: Lawrence Erlbaum Associates.

Coiro, J., Knobel, M., Lankshear, C., & Leu, D. J. (2008). *Central issues in new literacies and new literacies research*. New York: Lawrence Erlbaum Associates.

Collins, A., & Brown, J. S. (1988). The computer as a tool for learning through reflection. In H. Mandl & A. Lesgold (Eds.), *Learning issues for intelligent tutoring systems* (pp. 1-18). New York: Springer-Verlag.

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. B. Resnick (Ed.), *Knowing, Learning and instruction: Essays in honour of Robert Glaser* (pp. 453-494). Hillsdale, NJ: LEA.

Collins, A., Joseph, D., & Bielaczyc, K. (2004). Design research: Theoretical and methodological issues. *The Journal of the learning sciences, 13*(1), 15-42.

Collis, B., & Moonen, J. (2001). *Flexible learning in a digital world: Experiences and expectations.*: Oxford: Routledge Falmer.

Conole, & Oliver. (2007). *Contemporary perspectives in e-learning research*. New York, NY: Routledge.

Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches*. Thousand Oaks, CA: Sage.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. In A. Tashakkorn & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research* (pp. 209-240). Thousand Oaks: CA, Sage.

Cronje, J. (2006). Paradigms regained: Toward integrating objectivism and constructivism. *Educational Technology Research and Development, 54*(4), 387-416.

Crotty, M. (1998). *The foundations of social research: Meaning and perspectives in the research process*. St Leonards, Australia: Allen & Unwin.

Curverider, 2012, 'Elgg-The open source social networking engine', accessed on 22 Feb 2013, <http://www.elgg.org/about.php>.

Dalsgaard, C. (2006). Social software: E-learning beyond learning management systems. *European Journal of Open, Distance and E-Learning, 2006*(2).

Davis, A. (2009). *A study of interventions and technology choice in virtual teams.* PhD thesis, University of Nebraska at Omaha, Omaha.

Davis, F. D. (1986). *A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results.* PhD thesis, Sloan School of Management, Massachusetts Institute of Technology.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*, 319-340.

Davis, F. D., Bagozzi, R., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982-1003.

De Rezende, J. L., Da Silva, R. L. S., De Souza, J. M., & Ramirez, M. (2005). Building personal knowledge through exchanging knowledge chains. In *Proceedings of the IDIS International Conference* (pp. 87-94). Algarve, Portugal.

De Vaus, D. A. (1995). *Surveys in social research. Contemporary social research series*: George Allen and Unwin Pub.

De Wever, B., Schellens, T., Valcke, M., & Van Keer, H. (2006). Content analysis schemes to analyze transcripts of online asynchronous discussion groups: A review. *Computers & Education, 46*(1), 6-28.

Dillenbourg, P. (1999). *What do you mean by collaborative learning? Collaborative learning: Cognitive and computational approaches*. Amsterdam, NL: Pergamon Elsevier Science.

Dillenbourg, P. (2005). Designing biases that augment socio-cognitive interactions. In R. R. Bromme, F. F. Hesse & H. H. Spada (Eds.), *Barriers and Biases in Computer-Mediated Knowlege Communications - How They May be Overcome* (pp. 243-264). Dordrecht, Netherlands: Kluwer Academic Publisher.

Dillenbourg, P., Järvelä, S., & Fischer, F. (2009). The evolution of research on computer-supported collaborative learning. In N. Balacheff, S. Ludvigsen, T. Jong, A. Lazonder & S. Barnes (Eds.), *Technology-enhanced learning* (pp. 3-19). Netherlands: Springer.

diSessa, A. A., & Cobb, P. (2004). Ontological innovation and the role of theory in design experiments. *The Journal of the learning sciences, 13*(1), 77-103.

Dishaw, M. T., & Strong, D. M. (1999). Extending the technology acceptance model with task–technology fit constructs. *Information & Management, 36*(1), 9-21.

Dishaw, M. T., Strong, D. M., & Bandy, D. B. (2002). Extending the task-technology fit model with self-efficacy constructs. In (pp. 1021-1027).

Dix, K. L. (2007). DBRIEF: A research paradigm for ICT adoption. *International Education Journal, 8*(2), 113-124.

Drexler, W., Baralt, A., & Dawson, K. (2008). The teach Web 2.0 Consortium: a tool to promote educational social networking and Web 2.0 use among educators. *Educational Media International, 45*(4), 271-283.

Dron, J., & Anderson, T. (2009). Lost in social space: Information retrieval issues in Web 1.5. *Journal of Digital information, 10*(2).

Dwyer, N., & Suthers, D. D. (2005). A study of the foundations of artifact-mediated collaboration. In (pp. 135-144): International Society of the Learning Sciences.

Edelson, D. C., Pea, R. D., & Gomez, L. (1996). Constructivism in the collaboratory. In B. G. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design* (pp. 151-164). Englewood Cliffs, NJ: Educational Technology Publications.

Elliott, J. (1991). *Action research for educational change*. Philadelphia: Open University Press.

Ellison, N. B., Steinfield, C., & Lampe, C. (2007). The benefits of Facebook friends: Social capital and college students' use of online social network sites. *Journal of Computer-Mediated Communication, 12*(4), 1143-1168.

Engeström, Y. (1987). *Learning by expanding. An activity-theoretical approach to developmental research*. Helsinki, Finland: Orienta-Konsultit Oy.

Engeström, Y. (1999a). *Activity theory and individual and social transformation*. Cambridge: Cambridge University Press.

Engeström, Y. (1999b). Innovative learning in work teams: Analyzing cycles of knowledge creation in practice. In Y. Engeström, R. Miettinen & R.-L. Punamäki (Eds.), *Perspectives on Activity Theory* (pp. 377-406). Cambridge Cambridge Univ. Press.

Ferdig, R. E. (2006). Assessing technologies for teaching and learning: understanding the importance of technological pedagogical content knowledge. *British Journal of Educational Technology, 37*(5), 749-760.

Field, A. P. (2005). *Discovering statistics using SPSS*. London: Sage.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intentions and behavior: An introduction to theory and research*: Reading, MA: Addison-Wesley.

Forman, E. A., & Cazden, C. B. (1985). Exploring Vygotskyan perspectives in education: The cognitive values of peer interaction. In J. V. Wertsch (Ed.), *Culture, communication and cognition: Vygotskian perspectives* (pp. 323-347). Cambridge: Cambridge University Press.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39-47.

Fuchs, C. (2008). *Internet and Society. Social theory in the information age*. London: Routledge.

Furst, S., Blackburn, R., & Rosen, B. (1999). Virtual team effectiveness: A proposed research agenda. *Information Systems Journal, 9*(4), 249-269.

Garrett, N., Herrera, J. C., Thoms, B., & Ryan, T. (2008). Understanding the roles of knowledge sharing and trust in online learning communities. In *Proceedings*

of the 41st Hawaii International Conference on System Sciences (pp. 1-10). Hawaii.

Gibson, J. J. (1977). The theory of affordances. In R. Shaw & J. Bransford (Eds.), *Perceiving, acting, and knowing: Toward an ecological psychology* (pp. 67-82). Hillsdale, NJ. Erlbaum: Houghton-Mifflin.

Godin, G., Valois, P., Lepage, L., & Desharnais, R. (1992). Predictors of smoking behaviour: An application of Ajzen's theory of planned behaviour. *British Journal of Addiction, 87*(9), 1335-1343.

Goldman, R., Crosby, M., Swan, K., & Shea, P. (2005). Qualitative and quisitive research methods for describing online learning. In S. R. Hiltz & R. Goldman (Eds.), *Learning together online* (pp. 103-120). Mahwah, NJ: Lawrence Erlbaum Associates.

Gong, M., Xu, Y., & Yu, Y. (2004). An enhanced technology acceptance model for web-based learning. *Journal of Information Systems Education, 15*(4), 365-374.

Goodhue, D. L. (1998). Development and measurement validity of a task-technology fit instrument for user evaluations of information system. *Decision Sciences, 29*(1), 105-138.

Goodhue, D. L., & Thompson, R. L. (1995). Task-technology fit and individual performance. *MIS Quarterly, 34*(2), 213-236.

Goodhue, L. (1995). Understanding user evaluations of information systems. *Management Science, 41*(12), 1827-1844.

Grabinger, S., Aplin, C., & Ponnappa-Brenner, G. (2007). Instructional design for sociocultural learning environments. *E-Journal of Instructional Science and Technology, 10*(1), 16.

Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology, 78*(6), 1360-1380.

Gravemeijer, K. (1998). Developmental research as a research method. In J. Kilpatrick & A. Sierpinska (Eds.), *Mathematics education as a research domain: A search for identity, An ICMI Study* (Vol. 2, pp. 277-295). Dordrecht: Kluwer Academic Publishers.

Greenhow, C. (2009). Social networking and education: emerging research within CSCL. In *Proceedings of the International Conference on Computer Supported Collaborative Learning* (pp. 454-458). Rhodes, Greece: International Society of the Learning Sciences.

Greenhow, C., & Belbas, B. (2007). Using activity-oriented design methods to study collaborative knowledge-building in e-learning courses within higher education. *International Journal of Computer-Supported Collaborative Learning, 2*(4), 363-391.

Greenhow, C., & Robelia, B. (2009). Old communication, new literacies: Social network sites as social learning resources. *Journal of Computer-Mediated Communication, 14*(4), 1130-1161.

Greenhow, C., Robelia, B., & Hughes, J. E. (2009). Learning, teaching, and scholarship in a digital age: Web 2.0 and classroom research: What path should we take now? *Educational researcher, 38*(4), 246-259.

Gregor, S., & Jones, D. (2004). An information system design theory for e-Learning. In *Proceedings of the Association for Information Systems Conference*. Hobart.

Gregor, S., & Jones, D. (2007). The anatomy of a design theory. *Journal of the Association for Information Systems, 8*(5), 312-335.

Grippa, F., Secundo, G., & Passiante, G. (2009). An integrated model to monitor and evaluate web 2.0 project-based learning. In M. D. Lytras (Ed.), *Visioning and Engineering the Knowledge Society. A Web Science Perspective* (pp. 50-59). Berlin Heidelberg: Springer.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *The Journal of Marketing Theory and Practice, 19*(2), 139-152.

Hair, J. J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis, 7th edition*: Prentice Hall.

Hakkarainen, K., Ilomäki, L., Paavola, S., Muukkonen, H., Toiviainen, H., Markkanen, H., & Richter, C. (2006). Design principles and practices for the knowledge-practices laboratory (KP-Lab) project. In W. Nejdl & K. Tochtermann (Eds.), *Innovative Approaches for Learning and Knowledge Sharing* (pp. 603-608). New York: Springer.

Hardless, C., Lindgren, R., & Schultze, U. (2007). Technology-mediated learning systems for project work. *Scandinavian Journal of Information Systems, 19*(2), 3.

Hartshorne, R., & Ajjan, H. (2009). Examining student decisions to adopt Web 2.0 technologies: theory and empirical tests. *Journal of Computing in Higher Education, 21*(3), 183-198.

Hawkins, D., & Tull, D. (2002). *Marketing research: Meaning, measurement, and method*. London: Macmillan Publishing Co.

Hedberg, J. G. (2006). E-learning futures? Speculations for a time yet to come. *Studies in Continuing Education, 28*(2), 171-183.

Helic, D., Krottmaier, H., Maurer, H., & Scerbakov, N. (2005). Enabling project-based learning. *International Journal on E-Learning, 4*(4), 445-461.

Helm, S., Eggert, A., & Garnefeld, I. (2010). Modeling the impact of corporate reputation on customer satisfaction and loyalty using partial least squares. In V. Esposito Vinzi, W. W. Chin, H. , j. & H. Wang (Eds.), *Handbook of Partial Least Squares*. Heidelberg: Springer.

Henseler, J., & Fassott, G. (2010). Testing moderating effects in PLS path models: An illustration of available procedures. In V. Esposito Vinzi, W. W. Chin, J. Henseler & H. Wang (Eds.), *Handbook of Partial Least Squares*. Heidelberg: Springer.

Herrington, A., & Oliver, R. (2000). An instructional design framework for authentic learning environments. *Educational Technology Research and Development, 48*(3), 23-48.

Herrington, J. (2006). Authentic e-learning in higher education: Design principles for authentic learning environments and tasks. In *Proceedings of the World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education*. Chesapeake, Va.

Herrington, J., & Oliver, R. (1997). Multimedia, magic and the way students respond to a situated learning environment. *Australian Journal of Educational Technology, 13*(2), 127-143.

Herrington, J., Oliver, R., & Reeves, T. (2003). Cognitive realism in online authentic learning environments. In D. Lassner & C. McNaught (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications* (pp. 2115-2121). Chesapeake, VA: AACE.

Herrington, J., Reeves, T. C., & Oliver, R. (2010). *A guide to authentic e-Learning*. New York: Routledge.

Herrington, J., Reeves, T. C., Oliver, R., & Woo, Y. (2004). Designing authentic activities in web-based courses. *Journal of Computing in Higher Education, 16*(1), 3-29.

Hevner, A., & Chatterjee, S. (2010). *Design science research in information systems: Theory and practice*. New York: Springer.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly, 28*(1), 75-105.

Hewitt, A., & Forte, A. (2006). Crossing boundaries: Indentity management and student/faculty relationships on the Facebook. In *Proceedings of The ACM Conference on Computer Supported Cooperative Work*. Banff, Alberta.

Hewitt, J., & Scardamalia, M. (1998). Design principles for distributed knoweldge buiding process. *Educational Psychology, 10*(1), 75-96.

Hine, C. (2000). *Virtual ethnography*. Thousand Oaks: SAGE.

Honebein, P. (1996). Seven goals for the design of constructivist learning environments. In B. Wilson (Ed.), *Constructivist learning environments. Case studies in instructional design* (pp. 11-24). Englewood Cliffs, NJ Educational Technology Publications.

Honebein, P. C., Duffy, T. M., & Fishman, B. J. (1993). Constructivism and the design of learning environments: Context and authentic activities for learning. In T. M. Duffy, J. Lowyck & D. H. Jonassen (Eds.), *Designing Environments for Constructive Learning* (pp. 87-108). Heidelberg: Springer-Verlag.

Hong, H. Y., & Sullivan, F. R. (2009). Towards an idea-centered, principle-based design approach to support learning as knowledge creation. *Educational Technology Research and Development, 57*(5), 613-627.

Hossain, L., & de Silva, S. (2009). Exploring user acceptance of technology using social networks. *Journal of High Technology Management Research, 20*(1), 1-19.

Hsu, M. H., & Chiu, C. M. (2004). Predicting electronic service continuance with a decomposed theory of planned behaviour. *Behaviour & Information Technology, 23*(5), 359-373.

Hulland, J. (1999). Use of partial lease squares (PLS) in strategic management research: a review of four recent studies. *Strategic management journal, 20*(2), 195-204.

Hung, D. W. L., Manu, K., & Wong, A. F. L. (1999). Activity theory as an instructional model: A case study of a computer-mediated support system in interdisciplinary project work. In *The Second Regional Symposium on New Media and Learning Technologies in Asia*. Singapore.

Hutchins, E. (1995). *Cognition in the wild*: MIT Press Cambridge, MA.

Jöreskog, K. G. (1989). *LISREL 7: A guide to the program and applications*. Chicago: SPSS.

Jöreskog, K. G., & Wold, H. O. A. (1982). *Systems under indirect observation: Causality, structure, prediction*. Amsterdam: North Holland.

Jenkins, H., Clinton, K., Purushotmas, R., Robinson, A., & Wiegel, M. (2006). *Confronting the challenges of participatory culture: Media education for the 21st century*. Chicago: MacArthur Foundation.

Jick, T. D. (1979). Mixing Qualitative and Quantitative Methods: Triangulation in Action. *Administrative Science Quarterly, 24*, 602-611.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed method research: A research paragidm whose time has come. *Educational researcher, 33*(7), 16-24.

Jonassen, D. H. (1990). Thinking technology: Toward a constructivist view of instructional design. *Educational Technology, 30*(9), 32-34.

Jonassen, D. H. (1994). Thinking technology: Toward a constructivist design model. *Educational Technology, 34*(4), 34-37.

Jonassen, D. H., & Hernandez-Serrano, J. (2002). Case-based reasoning and instructional design: Using stories to support problem solving. *Educational Technology, Research and Development, 50*(2), 65-77.

Jones, C., Asensio, M., & Goodyear, P. (2000). Networked learning in higher education: Practitioners' perspectives. *Journal of the Association for Learning Technology, 8*(2), 18-28.

Jones, C., & Sclater, N. (2010). Learning in an age of digital networks. *International Preservation News, 55*, 6-10.

Jones, D., & Gregor, S. (2006). The formulation of an information systems design theory for e-learning. In *Proceedings of the First International Conference on Design Science Research in Information Systems and Technology* (pp. 356-373). Claremont, CA.

Kali, Y., Levin-Peled, R., & Dori, Y. J. (2009). The role of design-principles in designing courses that promote collaborative learning in higher-education. *Computers in Human Behavior, 25*(5), 1067-1078.

Kamel Boulos, M. N., & Wheeler, S. (2007). The emerging Web 2.0 social software: an enabling suite of sociable technologies in health and health care education. *Health Information & Libraries Journal, 24*(1), 2-23.

Karahanna, E., Agarwal, R., & Angst, C. M. (2006). Reconceptualizing compatibility beliefs in technology acceptance research. *MIS Quarterly, 30*(4), 781-804.

Kaufer, D., Gunawardena, A., Tan, A., & Cheek, A. (2011). Bringing social media to the writing classroom: Classroom salon. *Journal of Business and Technical Communication, 25*, 299-321.

Keeves, J. P. (1997). Models and model building. In J. P. Keeves (Ed.), *Educational Research, Methodology and Measurement: An International Handbook (2nd ed.)* (pp. 386-394). Oxford: Pergamon.

Kerlinger, F. N., & Lee, H. B. (2000). *Foundations of Behavioural Research (4th ed.)*. Wadsworth Thomson-Learning.

Klopping, I. M., & McKinney, E. (2004). Extending the technology acceptance and the task-technology fit model. *Information technology, learning, and performance journal, 22*(1), 35-48.

Kock, N., Verville, J., & Garza, V. (2007). Media Naturalness and Online Learning: Findings Supporting Both the Significant-and No-Significant-Difference Perspectives. *Decision Sciences Journal of Innovative Education, 5*(2), 333-355.

Kolmos, A. (2002). Facilitating change to a problem-based model. *International Journal for Academic Development, 7*(1), 63-74.

Koschmann, T. (2002). Dewey's contribution to the foundations of CSCL research. In *Computer support for collaborative learning: Foundations for a CSCL community* (pp. 17-22). Mahwah, NJ: Lawrence Erlbaum Associates.

Kreijns, K., & Kirschner, P. A. (2001). The social affordances of computer-supported collaborative learning environments. In *Proceedings of the 31st ASEE/IEEE Frontiers in Education Conference* (Vol. 1, pp. 12-17). Reno, NV, USA: IEEE.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2002). The sociability of computer-supported collaborative learning environments. *Educational Technology & Society, 5*(1), 8-22.

Kreijns, K., Kirschner, P. A., Jochems, W., & Van Buuren, H. (2011). Measuring perceived social presence in distributed learning groups. *Education and Information Technologies, 16*(4), 365-381.

Kvanvig, J. L. (1998). Why should inquiring minds want to know?: Meno problems and epistemological axiology. *Monist, 81*, 426-451.

Lampe, C., Ellison, N., & Steinfield, C. (2006). A Face(book) in the crowd: Social searching vs. social browsing. In *Proceedings of the 20th Anniversary Conference on Computer Supported Cooperative Work*. Banff, Alberta, Canada: ACM.

Lampe, C., Wohn, D. Y., Vitak, J., Ellison, N. B., & Wash, R. (2011). Student use of Facebook for organizing collaborative classroom activities. *International Journal of Computer-Supported Collaborative Learning*, 1-19.

Laurillard, D. (2009). The pedagogical challenges to collaborative technologies. *International Journal of Computer-Supported Collaborative Learning, 4*(1), 5-20.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.

Lebow, D. (1993). Constructivist values for instructional systems design: Five principles toward a new mindset. *Educational Technology: Research and development, 41*(3), 4-16.

Lebow, D., & Wager, W. W. (1994). Authentic activity as a model for appropriate learning activity: Implications for emerging instructional design technologies. *Canadian Journal of Educational Communications, 23*(3), 231-244.

Lee, A. S. (2004). Thinking about social theory and philosophy for information systems. In L. Willcocks & J. Mingers (Eds.), *Social theory and philosophy for Information Systems* (pp. 1-26). Chichester, West Sussex ; Hoboken, N.J: Wiley.

Lee, M. C. (2010). Explaining and predicting users' continuance intention towards e-learning: An extension of the expectation-confirmation model. *Computers & Education, 54*(2), 506-516

Lee, Y., Kozar, K. A., & Larsen, K. R. T. (2003). The technology acceptance model: Past, present, and future. *Communications of the Association for Information Systems, 12*, 780.

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical reivew of the technology acceptance model. *Information & Management, 40*(3), 191-204.

Leidner, D. E., & Jarvenpaa, S. L. (1995). The use of information technology to enhance management school education: A theoretical view. *MIS Quarterly, 19*(3), 265-291.

Leung, E. W. C., & Li, Q. (2006). Distance learning in Hong Kong. *International Journal of Distance Education Technologies, 4*(3), 1-5.

Liaw, S.-S., Chen, G.-D., & Huang, H.-M. (2008). Users' attitudes toward Web-based collaborative learning systems for knowledge management. *Computers & Education, 50*(3), 950-961.

Light, D. (2011). Building a classroom learning community: three instructional design principles for a Web 2.0 world. In S. B. e. al (Ed.), *Proceedings of the Global Learn Asia Pacific Conference* (Vol. 2011, pp. 333-340). Singapore: AACE.

Limayem, M., & Cheung, C. M. K. (2011). Predicting the continued use of Internet-based learning technologies: The role of habit. *Behavior and Information Technology, 31*(1), 91-99.

Limayem, M., Hirt, S. G., & Cheung, C. M. K. (2007). How habit limits the predictive power of intention: The case of information system continuance. *MIS Quarterly, 31*(4), 705-737.

Liska, A. E. (1984). A critical examination of the causal structure of the Fishbein/Ajzen attitude-behavior model. *Social Psychology Quarterly, 47*(1), 61-74.

Lou, H., Luo, W., & Strong, D. (2000). Perceived critical mass effect on groupware acceptance. *European Journal of Information Systems, 9*, 91-102.

Love, D., Mckean, G., & Gathercoal, P. (2004). Portfolios to webfolios and beyond: Levels of maturation. *EDUCASE quarterly*, *25*(2), 29-37.

Lowenthal, P. R., & Leech, N. L. (2009). Mixed research and online learning: Strategies for improvement. *Online education and adult learning: New frontiers for teaching practices*, 202-211.

Ma, Y., & Harmon, S. (2009). A case study of design-based research for creating a vision prototype of a technology-based innovative learning environment. *Journal of Interactive Learning Research, 20*(1), 75-93.

Machado, M., & Tao, E. (2007). Blackboard vs. Moodle: Comparing user experience of learning management systems. In *Proceedings of the 37th ASEE/IEEE Frontiers in Education Conference* (pp. S4J-7-S4J-12). Milwaukee: IEEE.

Marcoulides, G. A., & Saunders, C. (2006). Editor's comments: PLS: a silver bullet? *MIS Quarterly, 30*(2), iii-ix.

Markus, M. L., Majchrzak, A., & Gasser, L. (2002). A design theory for systems that support emergent knowledge processes. *MIS Quarterly, 26*(3), 179-212.

Martínez, A., Dimitriadis, Y., Gomez-Sanchez, E., Rubia-Avi, B., Jorrín-Abellán, I., & Marcos, J. A. (2006). Studying participation networks in collaboration using mixed methods. *International Journal of Computer-Supported Collaborative Learning*, *1*(3), 383-408.

Mathieson, K. (1991). Predicting user intentions: Comparing the technology acceptance model with the theory of planned behavior. *Information System Research*, *2*(3), 173-191.

Mathieson, K., Peacock, E., & Chin, W. W. (2001). Extending the technology acceptance model: The influence of perceived user resources *The Database for Advances in Information Systems, 32*(3), 86-112.

Mayes, T., & De Freitas, S. (2006). Review of e-learning theories, frameworks and models.

Mayring, P. (2000). Qualitative content analysis. *Qualitative Social Research Forum, 1*(12).

Mazer, J. P., Murphy, R. E., & Simonds, C. J. (2007). I'll see you on Facebook: The effects of computer - mediated teacher self - disclosure on student motivation, affective learning, and classroom climate. *Communication Education, 56*(1), 1-17.

Mazman, S. G., & Usluel, Y. K. (2010). Modeling educational usage of Facebook. *Computers & Education, 55*(2), 444-453.

McAfee, A. P. (2006). Enterprise 2.0: The dawn of emergent collaboration. *MIT Sloagn Management Review, 47*(4), 21-28.

McKay, J., & Marshall, P. (2001). The dual imperatives of action research. *Information Technology People, 14*(1), 46-59.

McKenney, S., Nieveen, N., & van den Akker, J. (2006). Design research from a curriculum perspective. In J. v. d. Akker, K. Gravemeijer, S. McKenney & N. Nieveen (Eds.), *Educational design research* (pp. 110-143). New York: Routledge.

McKenney, S., & Reeves, T. (2012). *Conducting educational design research*. London: Routledge.

McLellan, H. (1994). Siutated learning: Continuing the conversation. *Educational Technology, 34*(10), 7-8.

McLoughlin, C., & Lee, M. J. W. (2007). Social software and participatory learning: Pedagogical choices with technology affordances in the Web 2.0 era. In *Proceedings of the Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education* (pp. 664-675). Singapore.

McLoughlin, C., & Lee, M. J. W. (2008). The three p's of pedagogy for the networked society: Personalization, participation, and productivity. *International Journal of Teaching and Learning in Higher Education, 20*(1), 10-27.

Mcloughlin, C., & Luca, J. (2006). Applying situated learning theory to the creation of learning environments to enhance socialisation and self-regulation. In A. Herrington & J. Herrington (Eds.), *Authentic Learning Environments in Higher Education* (pp. 194-213). Hershey, PA: ISP.

McQuarrie, E. F., & McIntyre, S. H. (1988). Conceptual underpinnings for the use of group interviews in consumer research. *Advances in Consumer Research, 15*(1), 580-586.

Merriam, S. (1988). *Case study research in education*. San Francisco: Jossey-Bass.

Miles, M., & Huberman, M. (1994). Opportunities for research on the organizational impact of school computers. *Educational researcher, 19*(3), 8-13.

Mingers, J., & Brocklesby, J. (1997). Multimethodology: Towards a framework for mixing methodologies. *Omega, 25*(5), 489-509.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research, 2*(3), 192-222.

Mwanza-Simwami, D. (2011). AODM as a framework and model for characterising learner experiences with technology. *Journal of e-Learning and Knowledge Society, 7*(3), 75-85.

Mwanza, D. (2002). Conceptualising work activity for CAL systems design. *Journal of Computer Assisted Learning, 18*(1), 84-92.

Nardi, B. A. (1996). *Context and consciousness: Activity theory and human-computer interaction*: The MIT Press.

Neter, J., Wasserman, W., & Kutner, M. H. (1989). *Applied linear regression models* (2nd Edition ed.). Homewood, Illinois: Richard D. Irwin

Neuman, W. L., & Kreuger, L. (2003). *Social work research methods: Qualitative and quantitative approaches*: Allyn and Bacon.

Ng, P., & Cheung, R. (2011). Predicting online purchase intentions for Taobao.com. In P. Kommers, J. Zhang, T. Issa & P. Isaias (Eds.), *Proceedings of the IADIS International Conference on Internet Technologies & Society, China* (pp. 246 - 250). Shanghai: IADIS Press.

Ngai, E., Poon, J., & Chan, Y. (2007). Empirical examination of the adoption of WebCT using TAM. *Computers & Education, 48*(2), 250-267.

Nunamaker Jr, J., Chen, M., & Purdin, T. D. M. (1991). Systems development in information systems research. *Journal of Management Information Systems, 7*(3), 89-106.

Nunamaker Jr, J. F., Briggs, R. O., Mittleman, D. D., Vogel, D. R., & Balthazard, P. A. (1996). Lessons from a dozen years of group support systems research: A discussion of lab and field findings. *Journal of Management Information Systems, 13*(3), 163-207.

O' Reilly, T., 2005, 'What is Web 2.0. Design patterns and business models for the next generation of software', accessed on 22 Feb 2013, <http://oreilly.com/web2/archive/what-is-web-20.html>.

Oliver, R. (2000). When teaching meets learning: Design principles and strategies for web-based learning environments that support knowledge construction. In *Proceedings of the Australasian Society for Computers in Learning in Tertiary Education Conference* (pp. 17-28).

Oliver, R., Herrington, J., Herrington, A., & Reeves, T. C. (2007). Representing authentic learning designs supporting the development of online communities of learners. *Journal of Learning Design, 2*(2), 1-21.

Olson, G. M., & Olson, J. S. (2000). Distance matters. *Human-Computer Interaction, 15*(2), 139-178.

Ong, C. S., Lay, J. Y., & Wang, Y. S. (2004). Factors affecting engineers' acceptance of asynchronous e-learning systems in high-tech companies. *Information & Management, 41*(6), 795-804.

Onwuegbuzie, A. J., & Leech, N. L. (2004). Significant findings: The role of mixed methods research. *Qualitative Report, 9*(4), 770–792.

Overdijk, M., & van Diggelen, W. (2008). Appropriation of a shared workspace: Organizing principles and their application. *International Journal of Computer-Supported Collaborative Learning, 3*(2), 165-192.

Püschel, J., Mazzon, J. A., & Hernandez, J. M. C. (2010). Mobile banking: proposition of an integrated adoption intention framework. *International Journal of Bank Marketing, 28*(5), 389-409.

Paavola, S., & Hakkarainen, K. (2005). The knowledge creation metaphor - An emergent epistemological approach to learning. *Science & Education, 14*, 537-557.

Paavola, S., Lakkala, M., Muukkonen, H., Kosonen, K., & Klas, K. (2011). The roles and uses of design principles for developing the trialogical appraoch on learning. *Research in Learning Technology, 19*(2), 233-246.

Padilla-Meléndez, A., Garrido-Moreno, A., & Aguila-Obra, A., R., D. (2008). Factors affecting e-collaboration technology use among management students. *Computers & Education, 5*(1), 609-623.

Parker, D., Manstead, A. S. R., Stradling, S. G., Reason, J. T., & Baxter, J. S. (1992). Intention to commit driving violations: An application of the theory of planned behavior. *Journal of Applied Psychology, 77*(1), 94-101.

Pata, K., & Väljataga, T. (2007). Collaborating across national and institutional boundaries in higher education - the decentralized iCamp approach. In *Proceedings of the World Conference on Educational Multimedia, Hypermedia & Telecommunications* (pp. 353-362). Canada: AACE.

Patton, M. (2002). *Qualitative evaluation and research methods*. Newbury Park, CA: Sage.

Pavlou, P. A. (2003). Consumer acceptance of electronic commerce: Integrating trust and risk with the technology acceptance model. *International Journal of Electronic Commerce, 7*(3), 101-134.

Pavlou, P. A., & Fygenson, M. (2006). Understanding and predicting electronic commerce adoption: An extension of the theory of planned behavior. *MIS Quarterly, 30*(1), 115-143.

Pea, R. D. (1991). Learning through multimedia. *IEEE Computer Graphics and Applications, 11*(4), 58-66.

Piaget, J. (1970). *The science of education and the psychology of the child*. NY: Grossman.

Premkumar, G., & Ramamurthy, K. (1995). The role of interorganizational and organizational factors on the decision mode for adoption of interorganizational systems. *Decision Sciences, 26*(3), 303-336.

Prencipe, A., & Tell, F. (2001). Inter-project learning: processes and outcomes of knowledge codification in project-based firms. *Research policy, 30*(9), 1373-1394.

Price, K. (2006). Web 2.0 and education: What it means for us all. In *Proceedings of the Australian Computers in Education Conference*. Cairns, Australia.

Prilla, M., Knipfer, K., Degeling, M., Cress, U., & Herrmann, T. (2011). Computer support for collaborative reflection on captured teamwork data. In W. Reinhardt, T. D. Ullmann, P. Scott, V. Pammer, O. Conlan & A. J. Berlanga (Eds.), *First European Workshop on Awareness and Reflection in Learning Networks* (pp. 56-61).

Prilla, M., & Ritterskamp, C. (2010). The Interplay of Web 2.0 and collaboration support systems: Leveraging synergies. In D. Randall & P. Salembier (Eds.), *From CSCW to Web 2.0: European Developments in Collaborative Design* (pp. 193-218). Manchester, UK: Springer.

Proserpio, L., & Gioia, D. A. (2007). Teaching the virtual generation. *The Academy of Management Learning and Education, 6*(1), 69-80.

Qureshi, S., & Vogel, D. (2001). Adaptiveness in virtual teams: Organisational challenges and research directions. *Group Decision and Negotiation, 10*(1), 27-46.

Qureshi, S., & Zigurs, I. (2001). Paradoxes and prerogatives in global virtual collaboration. *Communications of the ACM, 44*(12), 85-88.

Ravenscroft, A. (2009). Social software, Web 2.0 and learning: status and implications of an evolving paradigm. *Journal of Computer Assisted Learning, 25*(1), 1-5.

Reeves, T. C. (1993). Evaluating interactive multimedia. In D. M. Gayeski (Ed.), *Multimedia for learning: Development, application, evaluation* (pp. 97-112). Englewood Cliffs, NJ: Educational Technology Publication.

Reeves, T. C. (2000). Enhancing the worth of instructional technology research through design experiments and other development research strategies. In *International perspectives on instructional technology research for the 21st century, New Orleans, LA, USA*.

Reeves, T. C. (2005). A Socially Responsible Approach to Instructional Technology Research in Higher Education. *Journal of Computing in Higher Education, 16*(2), 96-115.

Reeves, T. C. (2006). Design research from a technology perspective. In J. v. d. Akker, K. Gravemeijer, S. McKenney & N. Nieveen (Eds.), *Educational design research* (pp. 86-109). New York: Routledge.

Reeves, T. C., & Okey, J. R. (1996). Alternative assessment for constructivist learning environments. In B. G. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design* (pp. 191-202). Englewood Cliffs, NJ: Educational Technology Publications.

Reeves, T. C., & Reeves, P. M. (1997). Effective dimensions of interactive learning on the World Wide Web. In B. H. Khan (Ed.), *Web-based instruction* (pp. 59-66). Englewood Cliffs, New Jersey: Educational Technology Publications.

Resnick, L. (1987). Learning in School and out. *Educational researcher, 16*(9), 13-20.

Richardson, W. (2006). *Blogs, Wikis, Podcasts, and other powerful tools for classrooms*. Thousand Oaks, CA: Sage.

Richey, R., & Nelson, W. (1996). Developmental research. *Handbook of research for educational communications and technology*, 1213-1245.

Richey, R. C., Klein, J. D., & Nelson, W. A. (2004). Developmental research: Studies of instructional design and development. *Handbook of research on educational communications and technology, 2*, 1099-1130.

Rienzo, T., & Han, B. (2009). Microsoft or Google web 2.0 tools for course management. *Journal of Information Systems, 20*(2), 123-127.

Roberts, D. F., & Foehr, U. J., 2005, 'Generation M: Media in the lives of 8 - 18 year - olds', accessed on 22 Feb 2013, <http://www.kff.org/entmedia/7251.cfm>.

Roca, J. C., Chiu, C. M., & José, F. (2006). Understanding e-learning continuance intention: An extension of the technology acceptance model. *International Journal of Human-Computer Studies, 64*(8), 683-696.

Rogers, E. M. (1995). *Diffusion of Innovations* (4th ed.). New York: Free Press.

Rollett, H., Lux, M., Strohmaier, M., Dösinger, G., & Tochtermann, K. (2007). The web 2.0 way of learning with technologies. *International Journal of Learning Technology, 3*(1).

Ronkko, K., Lindeberg, O., & Dittrich, Y. (2002). Bad practice or bad methods are software engineering and ethnographic discourses incompatible? In *Empirical Software Engineering International Symposium* (pp. 204-210).

Saade, R., & Bahli, B. (2005). The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: An extension of the technology acceptance model. *Information & Management, 42*(2), 317-327.

Salomon, G. (1993). *Distributed cognitions: Psychological and educational considerations*: Cambridge University Press.

Salomon, G., & Perkins, D. N. (1998). Individual and social aspects of learning. *Review of Research in Education, 23*(1), 1-24.

Sanchez-Franco, M. J. (2010). WebCT–The quasimoderating effect of perceived affective quality on an extending Technology Acceptance Model. *Computers & Education, 54*(1), 37-46.

Sandoval, W. A. (2004). Developing learning theory by refining conjectures embodied in educational designs. *Educational psychologist, 39*(4), 213-223.

Sarantakos, S. (2005). *Social research*. New York: Palgrave, Macmillan.

Savery, J. R., & Duffy, T. M. (1995). Problem Based Learning: An instructional model and its constructivist framework. *Educational Technology, 35*(5), 31-38.

Scardamalia, M., & Bereiter, C. (1991). Higher levels of agency for children in knowledge building: A challenge for the design of new knowledge media. *The Journal of the learning sciences, 1*(1), 37-68.

Scardamalia, M., & Bereiter, C. (1994). Computer support for knowledge-building communities. *The Journal of the learning sciences, 3*(3), 265-283.

Scardamalia, M., & Bereiter, C. (1996). Student communities for the advancement of knowledge. *Communications of the ACM, 39*(4), 36-37.

Schepers, J., & Wetzels, M. (2007). A meta-analysis of the technology acceptance model: Investigating subjective norm and moderation effects. *Information & Management, 44*(1), 90-103.

Schmitz-Justen, F. J., & Wilhelm, A. F. X. (2007). An empirical study of factors impacting on knowledge processes in online forums: Structural equation modelling analysis and results. *International Journal of Web Based Communities, 3*(3), 252-270

Selim, H. M. (2003). An empirical investigation of student acceptance of course websites. *Computers and Education, 40*(4), 343-360.

Selim, H. M. (2007). Critical success factors for e-learning acceptance: Confirmatory factor models. *Computers & Education, 42*(9), 396-413.

Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational researcher, 27*, 4-13.

Shang, R. A., Chen, Y.-C., & Chen, C.-M. (2007). Why people blog? An empirical investigations of the task technology fit model. In *Proceedings of the Eleventh Pacific-Asia conference on information systems.*

Shen, Q., Chung, J. K. H., Challis, D., & Cheung, R. C. T. (2007). A comparative study of student performance in traditional mode and online mode of learning. *Computer Applications in Engineering Education, 15*(1), 30-40.

Shirky, C. (2003). A group is its own worst enemy: Social structure in social software. In *Proceedings of the O'Reilly Emerging Technology Conference*. Santa Clara.

Sirca, N. T., & Shapiro, A. (2007). Action research and constructivism: Two sides of the same coin? Or, one side? *International Journal of Management in Education, 1*(1), 100-107.

Slavich, G. M., & Zimbardo, P. G. (2012). Transformational teaching: Theoretical underpinnings, basic principles, and core methods. *Educational Psychology Review, 24*(4), 569-608.

Spiggle, S. (1994). Analysis and interpretation of qualitative data in consumer research. *Journal of Consumer Research, 21*(Dec), 491-501.

Stahl, G. (2006). *Group cognition: Computer support for building collaborative knowledge*. Cambridge, MA: MIT Press.

Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. In R. K. Sawyer (Ed.), *Cambridge*

handbook of the learning sciences (pp. 409-426). Cambridge: Cambridge University Press.

Steinfield, C., Ellison, N. B., & Lampe, C. (2008). Social capital, self-esteem, and use of online social network sites: A longitudinal analysis. *Journal of Applied Developmental Psychology, 29*(6), 434-445.

Straub, D. W. (1989). Validating instruments in MIS research. *MIS Quarterly, 13*(2), 147-166.

Straub, E. T. (2009). Understanding technology adoption: Theory and future directions for informal learning. *Review of Educational Research, 79*(2), 625-649.

Swanson, E. B. (1974). Management information system: Appreciation and involvement. *Management Science, 21*, 178-188.

Sykes, T. A., Venkatesh, V., & Gosain, S. (2009). Model of acceptance with peer support: A social network perspective to understand employees' system use. *MIS Quarterly, 33*(2), 371.

Taylor, S., & Todd, P. (1995a). Assessing IT usage: The role of prior experience. *MIS Quarterly*, 561-570.

Taylor, S., & Todd, P. A. (1995b). Understanding IT usage: A test of competing models. *Information Systems Research, 6*(2), 144-176.

Teddlie, C., & Tashakkori, A. (2003). Majro issues and controversies in the use of mixed methods in the social and behavioral sciences. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research* (pp. 3-50). London: Sage.

Tenenhaus, M., Vinzi, V. E., Chatelin, Y.-M., & Lauro, C. (2005). PLS path modeling. *Computational statistics and data analysis, 48*(1), 159-205.

Triandis, H. C. (1977). *Interpersonal behavior*. Monterey, CA: Brooks/Cole Pub. Co.

Tripp, S. D. (1993). Theories, traditions and situated learning. *Educational Technology, 33*(3), 71-77.

van den Akker, J. (1999). Principles and methods of development research. In J. van den Akker, N. Nieveen, R. M. Branch, K. L. Gustafson & T. Plomp (Eds.), *Design methodology and developmental research in education and training* (pp. 1-14). Netherlands: Kluwer Academic Publishers.

van den Akker, J. (2002). The potential of development research for improving the relation between curriculum research and curriculum development. In M. Rosenmund, A. Fries & W. Heller (Eds.), *Comparing Curriculum-Making Processes* (pp. 37-53). Bern: Peter Lang.

van den Akker, J., Gravemeijer, K., McKenney, S., & Nieveen, N. (2006). Introducing educational design research. In J. van den Akker, K. Gravemeijer, S. McKenney & n. Nieveen (Eds.), *Educational design research* (pp. 1-9). New York: Routledge.

van der Veen, J. (2001). *Telematic support for group - based learning*. Enschede, The Netherlands: Twente University Press.

Van Raaij, E. M., & Schepers, J. J. L. (2008). The acceptance and use of a virtual learning environment in China. *Computers & Education, 50*(3), 838-852.

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decisions, 39*(2), 273-315.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186-204.

Venkatesh, V., Dennis, A. R., & Brown, S. A. (2010). Predicting Collaboration Technology Use: Integrating Technology Adoption and Collaboration Research. *Journal of Management Information Systems, 27*(2), 9-54.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly 27*(3), 425-478.

Vie, S. (2008). Digital divide 2.0: Generation M and online social networking sites in the composition classroom. *Computers and Composition, 25*(1), 9-23.

Visscher-Voerman, I., & Gustafson, K. L. (2004). Paradigms in the theory and practice of education and training design. *Educational Technology Research and Development, 52*(2), 69-89.

Vogel, D., Davison, R., Shroff, R., & Qureshi, S. (2001). Socialcultural learning in globally distributed teams: An exploratory study. In *Proceedings of the Information Science Conference* (pp. 527-536). Krakow, Poland.

Vogel, D. R., & Wetherbe, J. C. (1984). MIS research: A profile of leading journals and universities. *Database, 16*(1), 3-14

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*: Harvard University Press.

Wallis, J. G., Widemeyer, G. R., & El Sawy, O. A. (1992). Building an information system design theory for vigilant EIS. *Information Systems Research, 3*(1), 36-59.

Wan, C., Cheung, R., & Shen, G. Q. (2012). Recycling attitude and behaviour in university campus: a case study in Hong Kong. *Facilities, 30*(13/14), 630-646.

Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development, 53*(4), 5-23.

Wasko, M. M., & Faraj, S. (2005). Why should I share? Examining social capital and knowledge contribution in electronic networks of practice. *MIS Quarterly, 29*(1), 35–57.

Weber, R. (2004). Editor's comments: the rhetoric of positivism versus interpretivism: a personal view. *MIS Quarterly, 28*(1), iii-xii.

Weiser, M., & Morrison, J. (1998). Project memory: information management for project teams. *Journal of Management Information Systems, 14*(4), 149-166.

Wellman, B. (1997). An Electronic Group is Virtually a Social Network. In S. Kiesler (Ed.), *Culture of the Internet* (pp. 179-205.). Hillsdale, New Jersey: Lawrence Erlbaum.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. New York, USA: Cambridge University Press.

Wenger, E., 2005, 'Learning for a small planet - A research agenda 2.0', accessed on 22 Feb 2013, <http://www.ewenger.com/research/index.htm>.

Wetzels, M., Schroder, G. O., & Oppen, V. C. (2009). Using PLS path modeling for assessing hierarchical construct models: Guidelines and empiracle illustrations. *MIS Quarterly, 33*(1), 177-195.

White, S., & Davis, H. C. (2011). Making it rich and personal: Crafting an institutional personal learning environment. *International Journal of Virtual and Personal Learning Environments, 2*(4), 23-39.

Williams, M. A. (2004). *Exploring the effect of a multimedia case-based learning environment in pre-service science teacher education in Jamaica.* PhD thesis, Univeristy of Twente.

Yen, D. C., Wu, C.-S., & Huang, Y.-W. (2010). Determinants of users' intention to adopt wireless technology: An empiracle study by integrating TTF with TAM. *Computers in Human Behavior, 26*, 906-915.

Yu, A. Y., Tian, S. W., Vogel, D., & Kwok, C. W. R. (2010). Can learning be virtually boosted? An investigation of online social networking impacts. *Computers & Education, 55*(4), 1494-1503.

Zhang, J., Hong, H. Y., Scardamalia, M., Teo, C. L., & Morley, E. A. (2011). Sustaining knowledge building as a principle-based innovation at an elementary school. *The Journal of the learning sciences, 20*(2), 262-307.

Zigurs, I., & Buckland, B. K. (1988). A theory of task/technology fit and group support systems effectiveness. *MIS Quarterly, 22*(3), 313-316.

Zigurs, I., & Munkvold, B. E. (2006). Collaboration technologies, tasks, and contexts: Evolution and opportunity. In D. Galletta & P. Zhang (Eds.), *Human-Computer Interaction and Management Information Systems: Applications* (pp. 143-169). Armonk, NY: M. E. Sharpe. Inc.

APPENDIX A

Consent Forms and Information Sheets

CONSENT TO BE A RESEARCH SUBJECT (As a Survey Participant)

Project Title: Adoption and Use of Collaborative Technologies for Project-based Learning

Researcher's Name: CHEUNG CHU TING, Ronnie

Supervisor's Name: Prof. Doug Vogel

- I have read the Participant Information Sheet and the nature and purpose of the research project has been explained to me. I understand and agree to take part.
- I understand the purpose of the research project and my involvement in it.
- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.
- I understand that while information gained during the study may be published, I will not be identified and my personal results will remain confidential.

Name of participant _____

Signed _____ **Date** _____

I have provided information about the research to the research participant and believe that he/she understands what is involved.

Researcher's signature and date _____

University of South Australia

Research Participant Information Sheet for Structured Questionnaire

Research Title: Adoption and Use of Collaborative Technologies for Project-based Learning

Division: Division of Business, International Graduate School of Business, University of South Australia

We invite your participation

This is a Ph.D. study being undertaken at the University of South Australia.

We invite you to participate in this research project with reference to your experience in using Google Applications in the Marketing Research course during your study for the BA in MPR degree.

The information sheet gives an explanation of the research and what happened to you if you agreed to be involved. If you have any questions relating to the research, please make contact with the researcher.

What is the research about?

The research project aims at studying the factors affecting students' acceptance of collaborative learning technologies. We shall investigate the factors that influence students to use Google Applications for their project collaboration and sharing of information in their studies.

Why have I been invited to participate?

You are selected to participate in the research because the study focus on the students in the subject advanced marketing research of the BA in MPR course offered by CPCE. We shall focus the research on a specific subject context: the use of Google Applications for the subject advanced marketing research conducted at the CPCE of the Hong Kong Polytechnic University. During the delivery of the subject, students are using Google Applications was used to support the subject for collaborative learning. That is why you have been selected to participate in the research project.

Do I have to get involved?

Your participation is voluntary. This means that you can choose not to be involved, or if you start, you can choose to withdraw from the research at any time without affecting your studies in the BA in MPR programme in CPCE of PolyU. We'll ask for your consent before participating. If you decide not to participate, just return the

questionnaire to me without filling in any information, it will not affect your current work in CPCE.

What will happen to me if I take part?
You just need to fill in the items in a structured questionnaire. After finishing the questionnaire, which will take around 10 minutes for you to fill in, just submit the completed questionnaire to me.

What are the benefits and risks of getting involved?
By investigating the critical factors that affect students` intention to use a technology, practitioners can make full of web 2.0 and collaborative learning technologies for project-based collaborations. This research addresses the need for collaborative learning technologies that is driven by the learner, facilitating collaboration and sharing through Internet-based technologies.

By considering these factors, the teachers can understand the factors that affect the support for collaboration among students; they can thus enhance or improve the courses supported by using applications on the web, which are based on the student needs identified in the results of the empirical research. Students from the future intakes of the course can be benefited from the improved support.

There are no anticipated physical risks to the participants. All the questions in the questionnaire are only requesting non-identifiable information, if you feel that there are risks involved in releasing sensitive information, you can withdraw at anytime or if physically feel uncomfortable while filling in the questionnaire items, you may contact the clinic at the campus.

Will my details and results be confidential?
Yes, all the information you provide will be kept confidential. Any personal information will be kept securely in the university and anonymous information:

Any information that could identify you will be removed before the research is analysed, written up, or before any presentation of the results is made:

- all records containing personal information will remain confidential and no information which could lead to identification of any individual will be released
- the information collected as part of the study will be retained for five years in a USB disk. All the data will be individually non-identifiable and it will be destroyed after five years.

Can I contact the University of South Australia about this research?
The University of South Australia's Human Research Ethics Committee has reviewed this study. Should you wish to discuss the project with someone not directly involved, in particular in relation to matters concerning policies, information about the conduct of the study, or your rights as a participant, please contact:

Ms Vicki Allen, Executive Officer
Human Research Ethics Committee
University of South Australia
GPO BOX 2471
Adelaide SA 5000
Email: Vicki.Allen@unisa.edu.au
Tel: +61 8 8302 3118

Can I obtain copies of the final research report or summary of the findings?
Yes. You can contact the research – Mr. Ronnie Cheung (the contact information of the researcher is listed at the end of this document) to obtain copies of the final research report or summary of the findings.

Thank you for considering being part of this study.
If you have any other questions about the project, please make contact with the researcher:

Researcher's name and Contact:
Mr. Ronnie Cheung, BSc, MSc
PhD Student, University of South Australia
S1215, PolyU HKCC West Kowloon Campus,
Hoi Ting Road, Yau Ma Tei,
Kowloon, Hong Kong
Email: ronnie.cheung@connect.polyu.hk

Research Supervisor and Contact:
Prof. Doug Vogel
Chair Professor of Information Systems
Department of Information Systems
City University of Hong Kong
Hong Kong
Email: vogel.doug@gmail.com

CONSENT TO BE A RESEARCH SUBJECT (Focus Group Participation)

Project Title: Adoption and Use of Collaborative Technologies for Project-based Learning

Researcher's Name: _____CHEUNG CHU TING, Ronnie_____

Supervisor's Name: _____Prof. Doug Vogel_____

This is a Ph.D. study being undertaken at the University of South Australia. We invite your participation in focus group discussions with reference to your experience in using Google Applications in the "Advanced Marketing Research" course during your study for the BA in MPR degree. The information sheet provided to you gives an explanation of the research and what happened to you if you agreed to be involved. The research project aims at studying the factors affecting students' use and adoption of collaborative learning technologies. We shall investigate the factors that influence students to use Google Applications for their project collaboration and sharing of information in their studies. You are selected to participate in the research because the study focus on the students in the subject advanced marketing research in the BA in MPR programme of CPCE of the Hong Kong Polytechnic University. Your participation is strictly voluntary and you may choose to not answer any of the interview question asked.

By sign this form:

- I agree to maintain the confidentiality of focus group discussions.
- I have read the Participant Information Sheet and the nature and purpose of the research project has been explained to me. I understand and agree to take part.
- I understand the purpose of the research project and my involvement in it.
- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.
- I agree to allow the research team to tape-record the group discussions. This is to make sure that the information reflects what was said by me and other participants.
- I understand that while information gained during the study may be published, I will not be identified and my personal results will remain confidential.

I have read the contents of this consent form and have been encouraged to ask questions. I have received answers to my questions. I agree to participate in this study. I have received (or will receive) a signed copy of this form for my records and future reference.

Name of participant _____

Signed _____ **Date** _____

University of South Australia

Research Participant Information Sheet for Focus Group Study

Research Title: Adoption and Use of Collaborative Technologies for Project-based Learning

Division: Division of Business, International Graduate School of Business, University of South Australia

We invite your participation

This is a Ph.D. study being undertaken at the University of South Australia.

We invite you to participate in this research project with reference to your experience in using Google Applications in the Marketing Research course during your study for the BA in MPR degree.

The information sheet gives an explanation of the research and what happened to you if you agreed to be involved. If you have any questions relating to the research, please make contact with the researcher.

What is the research about?

The research project aims at studying the factors affecting students' acceptance of collaborative learning technologies. We shall investigate the factors that influence students to use Google Applications for their project collaboration and sharing of information in their studies.

Why have I been invited to participate?

You are selected to participate in the research because the study focus on the students in the subject advanced marketing research in the BA in MPR programme of CPCE. We shall focus the research on a specific subject context: the use of Google Applications for the subject advanced marketing research conducted at CPCE of the Hong Kong Polytechnic University. During the delivery of the subject, Google Applications was used to support the subject for collaborative learning. From the class of advanced marketing research students, we would also like to conduct an in-depth focus group study. That is why you have been selected to participate in a focus group discussion in the research project.

Do I have to get involved?

Your participation is voluntary. This means that you can choose not to be involved, or if you start, you can choose to withdraw from the research at any time without affecting your studies in the BA in MPR programme in CPCE of PolyU. We'll ask for

your consent before participating. The focus group discussions last for about 1 ½ hours. During the study, there will be a briefing about the questions and contents of the discussion. If you don't agree to participate, you can choose to withdraw any time and any information collected from you will be deleted. Participants may also choose not to respond to any of the focus group questions from the researcher.

All the findings used in any written reports or publications which result from this evaluation project will be reported in aggregate form with no identifying information. We shall provide transcripts of the focus group discussion to all participants. This will allow participants to confirm what they have said and allow them to remove anything that they do not want to be part of the research. You can request to delete anything from the transcript and any stage, if you decided to withdraw, all information will be deleted.

What we ask from you?

If you participate you will be asked to take part in a focus group discussion with other students led by a member of the research team, or to be interviewed by a researcher to verify the information from a focus group study. At the beginning of the focus group you will be asked to complete a short background questionnaire so we can report on the demographics of the participants.

During the focus group or interview you will be asked questions about the technologies that are suitable for supporting your group project work. In particular we shall ask you about the factors that influence the use of collaborative technologies such as Google Applications. You will be asked questions relating to Google Applications, your attitude, peer influence, tutor influence and your opinions about the ease use and usefulness of Google Applications for supporting your project work.

The focus group discussion is conducted with a group of participants and is expected to run for approximately 1.5 hours. For the focus group or interview:

- Information will be audio-taped and transcribed.
- The tape of a certified transcript of the tape is raw data and will be securely retained for five years
- All your identity can be masked if you request this

There is no obligation to participate. Participation is voluntary and should you agree to participate you may withdraw at any stage without prejudice.

What are the benefits of getting involved?

By investigating the critical factors that affect students` intention to use a technology, practitioners can make full of web 2.0 and collaborative learning technologies for project-based collaborations. This research addresses the need for collaborative learning technologies that is driven by the learner, facilitating collaboration and sharing through Internet-based technologies.

By considering these factors, the teachers can understand the factors that affect the support for collaboration among students; they can thus enhance or improve the

courses supported by using applications on the web, which are based on the student needs identified in the results of the empirical research. Students from the future intakes of the course can be benefited from the improved support.

What are the risks/inconveniences of getting involved?

There are no anticipated physical risks to the participants. Focus group members will be asked to keep the information provided in the groups confidential; we insist that information of the participants' discussions is confidential. All the questions in the questionnaire are only requesting non-identifiable information, if you feel that there are risks involved in releasing sensitive information, you can withdraw at anytime or if physically feel uncomfortable while participation in the focus group study, you may contact the clinic at the campus.

Will my identification details be kept confidential?

Yes, all the information relating to your identity will be kept confidential. Any personal information will be kept securely in the university. Any information that could identify you will be removed before the research is analyzed, written up, or before any presentation of the results is made. Although the researcher cannot guarantee confidentiality of focus group discussions, measures will be taken to ensure that:

- all records containing personal information will remain confidential and no information which could lead to identification of any individual will be released
- the information collected as part of the study will be retained for five years in a USB disk. All the data will be individually non-identifiable and it will be destroyed after five years.

Can I contact the University of South Australia about this research?

The University of South Australia's Human Research Ethics Committee has reviewed this study. Should you wish to discuss the project with someone not directly involved, in particular in relation to matters concerning policies, information about the conduct of the study, or your rights as a participant, please contact:

Ms Vicki Allen, Executive Officer
Human Research Ethics Committee
University of South Australia
GPO BOX 2471
Adelaide SA 5000
Email: Vicki.Allen@unisa.edu.au
Tel: +61 8 8302 3118

Can I obtain copies of the final research report or summary of the findings?

Yes. You can contact the research – Mr. Ronnie Cheung (the contact information of the researcher is listed at the end of this document) to obtain copies of the final research report or summary of the findings.

Thank you for considering being part of this study.
If you have any other questions about the project, please make contact with the researcher:

Researcher's name and Contact:
Mr. Ronnie Cheung, BSc, MSc
PhD Student, University of South Australia
S1215, PolyU HKCC West Kowloon Campus,
Hoi Ting Road, Yau Ma Tei,
Kowloon, Hong Kong
Email: ronnie.cheung@connect.polyu.hk

Research Supervisor and Contact:
Prof. Doug Vogel
Chair Professor of Information Systems
Department of Information Systems
City University of Hong Kong
Hong Kong
Email: vogel.doug@gmail.com

APPENDIX B

Approval to Conduct Research

The Hong Kong Polytechnic University
香港理工大学

SPEED

13 Sept, 2010
Chu-Ting CHEUNG, Ronnie
20/F, Flat F, Block 2, Island Place, Tanner Rd.,
Hong Kong

Dear Chu-Ting CHEUNG, Ronnie,

We understand that you require permission from our organisation to conduct qualitative and quantitative research during your Ph.D. Programme. We understand that you are investigating a research topic on the factors affecting student acceptance of collaborative learning technologies.

We grant permission for the gathering of data through interviews of staff and students of the course BA in Marketing and Public Relations for your research. You are permitted to select students in the BA in Marketing and Public Relations programme for qualitative in-depth interviews and also conduct quantitative surveys using structured questionnaires to classes in the course during Nov 2010 – Mar 2012.

As you know, an exercise such as this must be treated in the strictest confidence. We trust you will treat all information confidentially throughout the exercise. We wish to obtain your commitment on the following (please tick relevant boxes):

	Our corporate identity is to remain anonymous throughout the research, including any published articles.
√	All information provided through the data collection to remain confidential.
√	The names and positions of participants to remain anonymous.
√	A copy of your final report to be extended to us upon completion of the research.

Please do not hesitate to contact me should you have any queries in relation to the above.

Yours sincerely

Mr. K.F. Lau (Programme Leader)
Programme Leader of the Degree Course: BA in Marketing and Public Relations
Senior Lecturer
SPEED (School of Professional and Continuing Education)
The Hong Kong Polytechnic University
Hong Kong

Letter to Programme Leader: Request to Conduct Research

Mr. K.F. Lau (Programme Leader)
Senior Lecturer
SPEED, The Hong Kong Polytechnic University, Hong Kong

Dear Mr. K.F. Lau

I am a doctoral student of the Doctor of Philosophy in Business and Management at University of South Australia. Currently, I am in the process of conducting doctoral research on "Adoption and Use of Collaborative Technologies for Project-Based Learning".

I would like to study closely the use of Technology and students' perceptions toward the technology for students in the Course BA in Marketing and Public Relations, offered by the Hong Kong Polytechnic University, to investigate the factors that affect students' perception of collaborative technologies.

Therefore, I kindly request your permission to conduct anonymous surveys and in-depth interviews with a few students in selected classes of undergraduate students who have enrolled in the Course BA in Marketing and Public Relations. The names of those individuals will not be used or mentioned in any way or means during the research period and in the final document. The research will be conducted according to and adhere fully to the policies of the Human Research Ethics Committee at University of South Australia.

If you have any questions or concerns, please do not hesitate to contact me. I would appreciate a response from you at your earliest convenience. Thank you so much for your time and understanding.

Sincerely,



CHEUNG Chu-Ting, Ronnie

APPENDIX C

Structured Questionnaire for Technology Adoption

Survey - Google Applications Platform

The purpose of this survey is to investigate the factors affecting student adoption of Google Applications platform technology. Your effort is greatly appreciated in sparing about 10 minutes completing the questionnaire. All the information collected is used for academic purposes and all the responses collected from the survey will be kept strictly confidential.

SECTION I – PERSONAL PERCEPTIONS

Please circle according to your level of agreement with each of the following statement relating to the Google Applications platform.

		Strongly Disagree	*Disagree*	*Slightly Disagree*	*Neither Agree nor Disagree*	*Slightly Agree*	*Agree*	*Strongly Agree*
1.	Google Applications are of benefit to me.	1	2	3	4	5	6	7
2.	The advantages of Google Applications platform outweigh its disadvantages.	1	2	3	4	5	6	7
3.	Overall, Google Applications are advantageous.	1	2	3	4	5	6	7
4.	Learning to operate Google Applications is easy for me.	1	2	3	4	5	6	7
5.	It is easy for me to become skilful at using Google Applications.	1	2	3	4	5	6	7
6.	Overall, Google Applications are easy to use.	1	2	3	4	5	6	7
7.	I read/saw news report that using Google Applications was a good way of learning.	1	2	3	4	5	6	7
8.	The popular press depicted a positive sentiment for using Google Applications.	1	2	3	4	5	6	7
9.	Mass media reports influenced me to try out Google Applications.	1	2	3	4	5	6	7
10.	My team members expect me to use Google Applications for my project.	1	2	3	4	5	6	7

		Strongly Disagree	*Disagree*	*Slightly Disagree*	*Neither Agree nor Disagree*	*Slightly Agree*	*Agree*	*Strongly Agree*
11.	My lecturer's participation in our Google Applications project Web site is high.	1	2	3	4	5	6	7
12.	My lecturer's online participation influences me to use the Google Applications platform for the project.	1	2	3	4	5	6	7
13.	My lecturer is very supportive in our project Web site for the use of Google Applications for my project.	1	2	3	4	5	6	7
14.	All things considered, I expect to continue using Google Applications platform for the project.	1	2	3	4	5	6	7
15.	All things considered, it is likely that I will continue to use Google Applications platform for the project.	1	2	3	4	5	6	7
16.	If I could, I would like to continue my use of Google Applications platform for the project.	1	2	3	4	5	6	7
17.	Google Applications provide the functionalities for collaboration.	1	2	3	4	5	6	7
18.	Google Applications provide the functionalities for sharing.	1	2	3	4	5	6	7
19.	Google Applications facilitates online communications.	1	2	3	4	5	6	7
20.	The Google platform that I use or would like to use is accurate enough for my collaborative project tasks.	1	2	3	4	5	6	7

		Strongly Disagree	*Disagree*	*Slightly Disagree*	*Neither Agree nor Disagree*	*Slightly Agree*	*Agree*	*Strongly Agree*
21.	The Google Applications platform fit into my tasks for collaborative projects.	1	2	3	4	5	6	7
22.	Using Google Applications is a good idea.	1	2	3	4	5	6	7
23.	I like using Google Applications.	1	2	3	4	5	6	7
24.	It is desirable to use the Google Applications platform for learning that involves collaborative projects.	1	2	3	4	5	6	7
25.	I frequently use Google Applications for my collaborative project.	1	2	3	4	5	6	7
26.	I frequently browse Web pages and information in Google Sites.	1	2	3	4	5	6	7
27.	I frequently post and read messages in Google discussion forums in the AMR subject Web site.	1	2	3	4	5	6	7

SECTION II – DEMOGRAPHIC PROFILE

Please answer or put tick (✓) in the box that best applies.

28. Gender: ☐ Male ☐ Female

29. Age: _____

30. Do you have any previous experience on using Google Applications technology for collaborative projects in the previous semesters?
    ☐ Yes ☐ No

31. Your enrolment status in the course:
    ☐ I am currently a part-time student.
    ☐ I am currently a full time student.

32. I previously own a private Gmail account before attending this course:

    ☐ Yes ☐ No