Design Reviews at a Distance:

A Qualitative Analysis of Mediated Interaction in 3D Real-Time Virtual Environments

A Thesis Submitted to Newcastle University for the Degree of

Doctor of Philosophy

By

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To Mohamed, Yosef and Sarah

Abstract

The use of new media such as massively multi-user 3D virtual environments; 'virtual worlds', in design learning is directed by expectations that they have the potential to simulate human characteristics via Avatars. The three dimensional spatial and communicational properties afforded by this virtual environment provide an opportunity to distantly interact, visualise and keep records of the students' design reviews, while reducing the levels of tension, defence and shyness experienced by some students in traditional face-to-face design reviews.

This thesis proposes that despite these potentials for a successful interactional medium, properties of *mediation*, *virtuality* and *remoteness* of mediated design reviews affect how learning interactions are communicated and delivered; changing the overall learning experience, and thus its effectiveness. In order to determine the effectiveness of the mediated learning interaction process in 3D virtual worlds, this research performs a protocol analysis study where it proposes an assessment framework that examines indicators of effectiveness of three constituting processes; *communication efficiency*, *learning effectiveness* and *learner-technology interaction*.

The study hypothesises that the availability and limitation of certain communication modes afforded by the virtual environment may affect the flow and sequences of synchronous communication, but not necessarily the quality and content of mutually communicated information. It proposes that certain properties of the technology, specifically those which aim to support different forms of interaction, such as embodiment, presence and remoteness will play a positive role in the effectiveness of the learning interaction process. This thesis hypothesises as well that students and tutors will continue to interact effectively and create a shared language of communication despite some communicational challenges.

To test these hypotheses and examine the effectiveness of the learning interaction process, this thesis adopts an exploratory methodology. Varying in the degree of mediation, three categories of small size design review groups of students and tutors were conducted and closely observed. A coding scheme specific to the design review protocol was designed and developed in this thesis based on observations of the first category; face-to-face design reviews. Two other virtual reviews performed at two degrees of mediation/remoteness, allowed us to explore mediated interactions 'within' the 3D virtual world and 'with' the physical computer. Qualitatively-based interaction and content analyses of the recorded activities, in addition to questionnaires and focus groups with the participants, provided evidence that there are noticeable differences in both; verbal content and nonverbal interactions between the three design review categories, hence variations in learning effectiveness. It was found that not only the availability or restriction of certain communication modes that had caused these differences, but the way the users used, adopted and perceived the virtual properties of the medium, had played a significant role as well.

It is hoped that the method developed in this thesis can shed more light upon the neglected communicational aspects of final design reviews and come closer to enhance the delivery of learning in the design studio. It is hoped as well that this research can inform the literature on virtual worlds as online-learning environments in design-based disciplines, by probing deeper than simply accepting or rejecting the use of the technology, but rather to analyse the properties they afford or deny within context. Furthermore, it is hoped that the recommendations of this research be employable to aid virtual world and Avatar designers to develop interactional aspects of virtual worlds to be considered for a wider range of more complicated interaction processes such as the architectural design review.

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Table of Contents

Chapter One **1**
1 Design Reviews at a Distance: An Introduction **3**
1.1 Statement of the Research, Scope and Motivation **3**
1.1.1 The Final Design Review: Moving to the Online Realm 4
1.1.2 Analysing Learning Interactions of Mediated Design Reviews 7
1.2 Research Question, Aims and Objectives **9**
1.3 Research Strategy **12**
1.3.1 The Research Settings 12
1.3.2 The Methodological Approach and Stages of the Research 13
1.3.3 The Structure of the Thesis 15
Chapter Two **23**
2 Learning Interactions of Design Reviews: Theories and Concepts **27**
2.1 Introduction **27**
2.2 The Design Review: A Design Learning Interaction Process **27**
2.2.1 Components of Learning Events 29
2.2.1.1 Objectives of Critiques 30
2.2.1.2 Types and Protocols of Design Critiques 31
2.2.1.3 Actors and their Communicational Roles 32
2.2.1.4 Content and Structure of the Design Review 34
2.2.1.5 Socio-pedagogical Factors in the Design Review 35
2.2.2 Communication Properties and Dynamics 35
2.2.2.1 Communication Modes and Media 36
2.2.2.2 The Nature and Context of Communication 39
2.2.2.3 Communication Transmission and Management 40
2.2.3 Illustration of the Design Review Communication Spiral 40
2.3 Online Learning in Design **43**
2.3.1 New Media: Richness and Suitability 44
2.3.2 3D Real-time Virtual Worlds: A Platform for Design Learning? 49
2.4 The Mediated Design Review: A Proposed Learning Technique **54**
2.5 Summary **57**
Chapter Three **59**
3 Assessing Mediated Design Review Learning Interactions **63**
3.1 Introduction **63**

3.2 Interaction and Interactivity in Mediated Design Reviews 63
3.3 Assessment of Learning Delivery 66
3.3.1 Cognitive Learning 68
3.3.2 Affective learning 69
3.4 Assessment of Information Delivery 70
3.4.1 Transmission of Information: Mediation 71
3.4.2 Perception of Information: Perception of Meanings 73
3.5 Assessment of Learner-Technology Interaction 75
3.5.1 Interactions within the Computer Space 78
3.5.2 Interactions within the Remote Context: Remoteness 79
3.5.3 Virtual Perceptions within the Virtual World 81
3.6 From Theories to Conceptualisation: The Research Proposals and Frameworks 88
3.6.1 A Conceptual Framework of Mediated Learning Interactions 88
3.6.2 Assessment of the Mediated Design Review Learning Interactions: A Proposed Analytical Framework 93
3.7 Summary 97
Chapter Four 101
4 Analysing Mediated Design Review Activity: Methodology 104
4.1 Introduction 104
4.2 Research Design 104
4.2.1 Aspects and Levels of Investigation: A Qualitative Approach 104
4.2.2 The Research Methodology: Protocol Analysis 109
4.3 Development of the Research Coding Scheme 111
4.3.1 Exploring Existing Coding Schemes: Externally Derived Structuring 112
4.3.2 Initial Structuring of the Coding Scheme 114
4.3.3 Pilot Observations: Data Derived Structuring 115
4.4 The Review Interaction Protocol 116
4.4.1 The Design Review Structure 119
4.4.2 Cognitive and Critique Levels of the Discourse 119
4.4.3 Communication Facilitation and Management 121
4.4.4 The Nonverbal Dimension of the Review Interaction Protocol 122
4.5 Application of the Protocols: Transcription, Coding and Visualising Data 125
4.5.1 Coding Nonverbal Data 126
4.5.2 Visualising Data 126
4.6 Summary 128

Chapter Five **129**
5 Design of the Research Instruments **132**
5.1 Introduction **132**
5.2 Observing Learning Interactions of Design Reviews **132**
5.2.1 Settings, Participants and Projects 134
5.2.2 Procedures of the Design Reviews 140
5.3 Data Capturing Methods **147**
5.3.1 Capturing Design Review Interactions 147
5.3.2 Capturing Participants' Experiences and Opinions 151
5.4 Summary **154**
Chapter Six **159**
6 Communication Efficiency **162**
6.1 Introduction **162**
6.2 Structure and Sequence of the Design Review Phases **162**
6.3 Orientation of Narratives **170**
6.3.1 Pointing 172
6.3.2 Illustrator Gestures 175
6.3.3 Moving the Body (Navigation) 180
6.3.4 Orientation Discourse 184
6.4 Communication Control **188**
6.4.1 Interruptions 188
6.4.2 Acknowledgements 192
6.4.3 Hand Over and Floor Holding 196
6.5 Perception of Meanings **199**
6.5.1 Missing Information 199
6.5.2 Misconception of Scale and Space 202
6.5.3 Compensating Nonverbal Cues to Convey Meanings 203
6.6 Findings on Communication Efficiency **206**
Chapter Seven **208**
7 Learning Effectiveness **211**
7.1 Introduction **211**
7.2 Cognitive Learning **211**
7.2.1 Student Initiative-Taking Behaviour and Speaking Time 212
7.2.2 The Cognitive Levels and Characteristics of the Verbal Discourse 220
7.2.3 The Critique Level of the Discourse 231

7.2.4 Students' Own Perception of Learning....243
7.3 Affective Learning....246
7.3.1 Showing Solidarity, Immediacy and Emotions....246
7.3.2 Social Communication....249
7.3.3 Stress-Free Crits?....251
7.3.4 Satisfaction....255
7.4 Findings on Learning Effectiveness....258
Chapter Eight....260
8 Effectiveness of Learner-Technology Interactions....263
8.1 Introduction....263
8.2 Status and Properties of the Technology....264
8.2.1 Connectivity and Capacity....265
8.2.2 Properties of the Avatar....266
8.2.3 Visual Properties....269
8.3 Users and Usability....270
8.3.1 Usability and Preference of Modes of Communication....271
8.3.2 Technology Communication....274
8.3.3 Readiness, Adoption and Enthusiasm- to the Technology....276
8.4 Interaction with the Computer....282
8.5 Virtuality: Experiences and Perceptions in the Virtual World....285
8.5.1 Embodied Presence....285
8.5.2 Visual Displays and Camera Viewpoints....290
8.5.3 Virtual Proximity....293
8.6 Remoteness....294
8.6.1 Being 'in' a Virtual Crit....294
8.6.2 Separation and Disassociation: Transactional Distance....295
8.6.3 Identity Issues....297
8.7 Findings on Learner-Technology Interaction....299
Chapter Nine....301
9 Concluding Discussion....304
9.1 Introduction....304
9.2 Back to the Research Question....304
9.3 Key Issues and Related Findings....306
9.3.1 The 'Unemployed' Avatar....307
9.3.2 The Separation of the Two Worlds....309

9.3.3 Embodied Presence,... or Focus of Attention? 311
9.3.4 Remote Learning, Where is the Group? 313
9.3.5 Situation-Provoked Actions 314
9.4 Validation of the Research Hypotheses 316
9.5 The Road to Development and Improvement of Learning Interactions of Design Reviews 317
9.5.1 Developing Technologically-Mediated Design Reviews 318
9.5.2 Improving Traditional Face-to-Face Design Reviews 320
9.6 Lessons Learned: Difficulties and Constraints of the Research 322
9.6.1 Experimental Risk Assessment 322
9.6.2 Technical/ Media-Related Difficulties 324
9.7 Contribution and Qualities of the Research 326
9.7.1 Developing a Specialised Analytical Tool; "The Review Interaction Protocol" 326
9.7.2 Developing a Framework for Assessing the Effectiveness of Mediated Learning Interactions 327
9.7.3 Employing Design Reviews in the Virtual World of SecondLife 328
9.8 Future Research 329
10 References 333
11 Appendices 353
Appendix (A): Subject Consent Forms 354
Appendix (B): Instruction Sheet emailed to Participants of Virtual Crit (1) 355
Appendix (C): Pre-Test Questionnaire 357
Appendix (D): Participants Completion Status and Raw Data Sources in Virtual Crits (1) and (2) 360
Appendix (E): Post-Test Questionnaire 362
Appendix (F): A Sample Transcript from a Face-to-Face Crit Session 369
Appendix (G): A Sample Transcript from a Virtual Crit (1) Session 371
Appendix (H): A Sample Transcript from a Virtual Crit (2) Session 373
Appendix (I): Timeline Grids with Selective Analysis for one of the Face-to-Face Design Reviews 376
Appendix (J): An Abstract of a Published Paper 381

Table of Figures

FIGURE 1-1 THE RESEARCH OUTLINE AND DESIGN 15
FIGURE 1-2 SECTION ONE: THEORY, CONTEXT AND ANALYTICAL CONCEPTUALISATION; CHAPTERS TWO & THREE 21
FIGURE 2-1 THE LEARNING INTERACTION PROCESS IN DESIGN REVIEWS 29
FIGURE 2-2 INITIAL ILLUSTRATION OF THE DESIGN REVIEW COMMUNICATION STRUCTURE/SPIRAL 42
FIGURE 2-3 INITIAL CONCEPTUALISATION OF THE MEDIATED DESIGN REVIEW IN A 3D VIRTUAL WORLD 56
FIGURE 3-1 WAGNER'S INTERACTIVE INFORMATION TRANSPORT MODEL 64
FIGURE 3-2 COMPONENTS OF INTERACTION AND INTERACTIVITY IN MEDIATED DESIGN REVIEWS 66
FIGURE 3-3 RELATIONSHIPS BETWEEN LEARNING GOALS AND LEARNING EFFECTIVENESS 67
FIGURE 3-4 ONLINE LEARNING INTERACTIONS 76
FIGURE 3-5 CONCEPTUALISATION OF THE INTERACTION WITH THE TECHNOLOGICAL INTERFACE 77
FIGURE 3-6 LEARNER- TECHNOLOGY INTERACTION: EACH CIRCLE REPRESENTS A LAYER OF INTERACTION 78
FIGURE 3-7 THREE LAYERS OF PRESENCE, FROM (WARBURTON, 2009) 83
FIGURE 3-8 A CONCEPTUAL FRAMEWORK OF THE LEARNING PROCESS IN MEDIATED DESIGN REVIEWS 91
FIGURE 3-9 CONCEPTUALISATION OF INTERACTION AND INTERACTIVITY IN THE MEDIATED DESIGN REVIEWS 92
FIGURE 3-10 THE PROPOSED RESEARCH ASSESSMENT FRAMEWORK: INDICATORS OF EFFECTIVENESS OF LEARNING INTERACTION IN THE MEDIATED DESIGN REVIEW 96
FIGURE 3-11 SECTION TWO: METHODOLOGICAL AND EXPERIMENTAL FRAMEWORKS; CHAPTERS FOUR & FIVE 99
FIGURE 4-1 A DESCRIPTIVE-INTERPRETIVE-EXPLANATORY APPROACH BASED ON OBSERVATIONS AND INDUCTIVE REASONING 105
FIGURE 4-2 RELATING DATA SOURCES AND METHODS OF INVESTIGATION TO THE RESEARCH ASSESSMENT FRAMEWORK 108
FIGURE 4-3 THE RESEARCH DESIGN 110
FIGURE 4-4 DEVELOPMENT STAGES OF THE RESEARCH CODING SCHEME: THE REVIEW INTERACTION PROTOCOL 112
FIGURE 4-5 DIMENSIONS OF THE INITIAL CODING SCHEME 115
FIGURE 4-6 THE REVIEW INTERACTION PROTOCOL CODING SCHEME 118
FIGURE 4-7 DIFFERENT FILLING OF THE TUTORS' (T) AND STUDENTS' (S) OBSERVATIONAL UNITS IN EXCEL GRIDS TO DISTINGUISH THEIR INTERACTIONS 127
FIGURE 5-1 PINNED-UP PROJECTS IN ONE OF THE FACE-TO-FACE CRITS 134
FIGURE 5-2 PLAN OF FACE-TO-FACE STAGE ONE CRIT SETTINGS 135
FIGURE 5-3 FACE-TO-FACE CRIT STAGE ONE CRIT SETTINGS 135
FIGURE 5-4 PLAN OF FACE-TO-FACE STAGE TWO CRIT SETTINGS 135
FIGURE 5-5 FACE-TO-FACE CRIT STAGE TWO CRIT SETTINGS 135
FIGURE 5-6 PLAN OF FACE-TO-FACE CRIT STAGE THREE CRIT SETTINGS 136
FIGURE 5-7 FACE-TO-FACE CRIT STAGE THREE CRIT SETTINGS 136
FIGURE 5-8 A LECTURE AREA IN HARVARD LAW SCHOOL 137
FIGURE 5-9 OHIO UNIVERSITY EXHIBITION AREA 137
FIGURE 5-10 VIRTUAL SETTINGS OF VIRTUAL CRIT (1) IN SECONDLIFE 138
FIGURE 5-11 PHYSICAL SETTINGS OF VIRTUAL CRIT (2) IN THE BREA CLUSTER, NEWCASTLE UNIVERSITY 139
FIGURE 5-12 VIRTUAL CRIT (2) VIRTUAL SETTINGS IN SECONDLIFE 140
FIGURE 5-13 PAYING MONEY TO STUDENTS TO UPLOAD THEIR IMAGES 143
FIGURE 5-14 THE RESEARCHER WITH A STUDENT PRACTICING TO UPLOAD IMAGES 143
FIGURE 5-15 THE CHAT BOX AS A PRIMARY MODE OF VERBAL COMMUNICATION IN VIRTUAL CRIT (1) 144
FIGURE 5-16 A WHITE DOTTED BEAM TRACKS THE DESTINATION OF AVATAR POINTING IN VIRTUAL CRIT (1) 144
FIGURE 5-17 ORIENTATION ISLAND, PROVIDES PRACTICAL TRAINING TO THE TOOLS OF SECONDLIFE 145
FIGURE 5-18 AVATAR POINTING IN VIRTUAL CRIT (2), NO TRACKING OR CORRELATION WITH THE CURSOR 146
FIGURE 5-19 NAVIGATION CONTROLS; WALK, RUN, FLY 146
FIGURE 5-20 THE CAMERA SETTINGS IN THREE SESSIONS OF FACE-TO-FACE CRITS 148
FIGURE 5-21 VERBAL COMMUNICATION IS SAVED FROM THE CHAT HISTORY BOX IN VIRTUAL CRIT (1) 149
FIGURE 5-22 VIDEO CAMERA PLACEMENTS IN THE PHYSICAL SPACE OF VIRTUAL CRIT (2) 150
FIGURE 5-23 DEBUT VIDEO CAPTURE SOFTWARE USED TO RECORD VIRTUAL INTERACTIONS IN VIRTUAL CRIT (2) 150
FIGURE 5-24 FOCUS GROUP SETTINGS FOR VIRTUAL CRIT (2) STUDENTS 154
FIGURE 5-25 SECTION THREE: ASSESSMENT OF LEARNING INTERACTIONS OF MEDIATED DESIGN REVIEWS; CHAPTERS SIX, SEVEN & EIGHT 157
FIGURE 5-26 READING OF CHAPTERS SIX, SEVEN AND EIGHT 158

FIGURE 6-1 DISTRIBUTION AND DURATIONS OF VERBAL COMMUNICATION IN THE REVIEW STRUCTURE DIMENSION FOR FACE-TO-FACE CRIT, ACADEMIC STAGE ONE: (F-Y1S8) 164
FIGURE 6-2 DISTRIBUTION AND DURATIONS OF VERBAL COMMUNICATION IN THE REVIEW STRUCTURE DIMENSION FOR FACE-TO-FACE CRIT, ACADEMIC STAGE THREE: (F-Y3S6) 165
FIGURE 6-3 DISTRIBUTION AND DURATIONS OF VERBAL COMMUNICATION IN THE REVIEW STRUCTURE DIMENSION FOR VIRTUAL CRIT (1): (V1-Y5S3) 167
FIGURE 6-4 DISTRIBUTION AND DURATIONS OF VERBAL COMMUNICATION IN THE REVIEW STRUCTURE DIMENSION FOR VIRTUAL CRIT (2): (V2-Y2S5) 169
FIGURE 6-5 ASKING FOR ORIENTATION IN THREE SESSIONS OF THE THREE DESIGN REVIEW CATEGORIES 171
FIGURE 6-6 POINTING IN THE FACE-TO FACE CRITS, VIRTUAL CRIT (1) AND VIRTUAL CRIT (2) 172
FIGURE 6-7 POINTING GESTURES ACCOMPANYING THE PASSAGE: 173
FIGURE 6-8 STUDENT'S AVATAR POINTING AT IMAGES VIRTUAL CRIT (1) 174
FIGURE 6-9 AVATAR POINTING WAS SUCCESSFUL IN SOME OCCASIONS IN VIRTUAL CRIT (2) 175
FIGURE 6-10 ILLUSTRATOR GESTURES IN THE FACE-TO FACE CRITS, VIRTUAL CRIT (1) AND VIRTUAL CRIT (2) 176
FIGURE 6-11 SPATIAL ILLUSTRATOR GESTURES ACCOMPANYING THE PASSAGE: 177
FIGURE 6-12 KINETIC- METAPHORICAL GESTURES ACCOMPANYING THE PASSAGE: 177
FIGURE 6-13 ENACTING A PATH AND A DIRECTION, USING HAND GESTURES (SEQUENCE FROM 1 TO 3) 178
FIGURE 6-14 STUDENT V2-Y2S5: USING ILLUSTRATOR GESTURES WHILE SPEAKING 179
FIGURE 6-15 STUDENT V2-Y2S3: USING ILLUSTRATOR GESTURES WHILE SPEAKING 179
FIGURE 6-16 MOVING BODY/ NAVIGATION IN THE FACE-TO FACE CRITS, VIRTUAL CRIT (1) AND VIRTUAL CRIT (2) 180
FIGURE 6-17 MOVING WHOLE BODY TO PICK UP THE MODEL 180
FIGURE 6-18 MOVING CLOSER TO THE PINNED-UP DRAWINGS 181
FIGURE 6-19 CORRELATION BETWEEN 'ASKING FOR/ GIVING ORIENTATION' AND 'AVATAR NAVIGATION' IN VIRTUAL CRIT (1) .. 181
FIGURE 6-20 THE TUTOR'S AVATAR FIRST STANDS AT THE DRAWING BOARD NUMBER (2) 182
FIGURE 6-21 THE TUTOR'S AVATAR MOVES TO STAND AT THE DRAWING BOARD NUMBER (4) TO PERFORM SPATIAL REFERENCE . 182
FIGURE 6-22 CORRELATION BETWEEN 'ASKING FOR GIVING & ORIENTATION' & 'AVATAR NAVIGATION' IN VIRTUAL CRIT (2) ... 182
FIGURE 6-23 AVATAR FLYING TO POINT TO THE DRAWING: A VIRTUAL NONVERBAL INTERACTION 183
FIGURE 6-24 THE STUDENT MOVES FROM ONE SPOT TO THE OTHER TO GIVE ORIENTATION 184
FIGURE 6-25 ORIENTATION DISCOURSE (TEXT COMPENSATION) IN VIRTUAL CRIT (1) AND VIRTUAL CRIT (2) 184
FIGURE 6-26 NUMBERS USED AS ORIENTATION DISCOURSE TO AID THE PRESENTATION OF THE PROJECT 185
FIGURE 6-27 INTERRUPTION IN THREE SESSIONS OF THE THREE DESIGN REVIEW CATEGORIES 189
FIGURE 6-28 ACKNOWLEDGEMENT IN THREE SESSIONS OF THE THREE DESIGN REVIEW CATEGORIES 193
FIGURE 6-29 CO-OCCURRENCE BETWEEN ACKNOWLEDGEMENTS AND HEAD NODDING IN THE FACE-TO-FACE CRITS 194
FIGURE 6-30 HANDOVER AND FLOOR HOLDING IN THREE DIFFERENT DESIGN REVIEWS 196
FIGURE 6-31 RELATION BETWEEN ASKING FOR ORIENTATION, REPEATING, DISAPPROVING, AND NEGATIVE EVALUATION IN VIRTUAL CRIT (2): SESSION V2-Y2S5 202
FIGURE 6-32 DISTRIBUTION OF USING TEXTUAL PUNCTUATION IN THE MEDIATED REVIEWS 203
FIGURE 7-1 DISTRIBUTION OF TUTOR/STUDENT SPEAKING TIME IN THE PRESENTATION PHASE OF FOUR DIFFERENT DESIGN REVIEWS 213
FIGURE 7-2 DISTRIBUTION OF TUTOR/STUDENT SPEAKING TIME IN THE DISCUSSION PHASE OF FOUR DIFFERENT DESIGN REVIEWS 215
FIGURE 7-3 DISTRIBUTION OF TUTOR/STUDENT SPEAKING TIME IN THE EVALUATION PHASE OF FOUR DIFFERENT DESIGN REVIEWS 218
FIGURE 7-4 THE COGNITIVE LEVEL OF DISCOURSE OF THE THREE DESIGN REVIEWS 221
FIGURE 7-5 CHARACTERISTICS AND COGNITIVE LEVEL OF DISCOURSE IN THE PRESENTATION PHASE OF FACE-TO-FACE CRIT 222
FIGURE 7-6 THE CHARACTERISTICS AND COGNITIVE LEVEL OF DISCOURSE IN THE PRESENTATION PHASE OF VIRTUAL CRIT (1) 223
FIGURE 7-7 THE CHARACTERISTICS AND COGNITIVE LEVEL OF DISCOURSE IN THE PRESENTATION PHASE OF VIRTUAL CRIT (2) 225
FIGURE 7-8 THE CHARACTERISTICS AND COGNITIVE LEVEL OF DISCOURSE IN THE DISCUSSION PHASE OF FACE-TO-FACE CRIT 227
FIGURE 7-9 THE CHARACTERISTICS AND COGNITIVE LEVEL OF DISCOURSE IN THE DISCUSSION PHASE OF VIRTUAL CRIT (1) 228
FIGURE 7-10 THE CHARACTERISTICS AND COGNITIVE LEVEL OF DISCOURSE IN THE DISCUSSION PHASE OF VIRTUAL CRIT (2) 229
FIGURE 7-11 THE CRITIQUE LEVEL OF DISCOURSE IN THE THREE DESIGN REVIEWS 232
FIGURE 7-12 CHARACTERISTICS AND COGNITIVE LEVEL OF DISCOURSE IN THE EVALUATION PHASE OF FACE-TO-FACE CRIT 233
FIGURE 7-13 WHAT IS CRITICISED IN THE FACE-TO-FACE CRIT SESSION 235
FIGURE 7-14 CHARACTERISTICS AND COGNITIVE LEVEL OF DISCOURSE IN THE EVALUATION PHASE OF VIRTUAL CRIT (1) 237
FIGURE 7-15 WHAT IS CRITICISED IN THE VIRTUAL CRIT (1) SESSION 238
FIGURE 7-16 CHARACTERISTICS AND COGNITIVE LEVEL OF DISCOURSE IN THE EVALUATION PHASE OF VIRTUAL CRIT (2) 240

FIGURE 7-17 WHAT IS CRITICISED IN THE VIRTUAL CRIT (2) SESSION 241
FIGURE 7-18 SHOWING SOLIDARITY IN THREE DIFFERENT REVIEW SESSIONS 247
FIGURE 7-19 CORRELATION BETWEEN FACIAL DISPLAYS, APPROVING/ DISAPPROVING, SHOWING SOLIDARITY AND POSITIVE/ NEGATIVE CONSTRUCTIVE FEEDBACK IN A FACE-TO-FACE CRIT SESSION 247
FIGURE 7-20 SOCIAL AND INTERPERSONAL INTERACTIONS IN THREE DIFFERENT DESIGN REVIEWS 249
FIGURE 8-1 RELATIONS WITHIN THE LEARNER-TECHNOLOGY INTERACTION IN THE MEDIATED DESIGN REVIEWS 264
FIGURE 8-2 SLOW LOADING OF AN AVATAR 266
FIGURE 8-3 AN IMAGE IN VIRTUAL CRIT (2) APPEARS BLURRED FOR A LONG WHILE. 266
FIGURE 8-4 GESTURES LIST IN SECONDLIFE 267
FIGURE 8-5 TECHNOLOGY COMMUNICATION IN VIRTUAL CRIT (1) AND VIRTUAL CRIT (2) 274
FIGURE 8-6 LOOKING AT THE KEYBOARD WHILE TYPING 283
FIGURE 8-7 LOOKING AT THE 'CHAT BOX' ON THE SCREEN 283
FIGURE 8-8 ZOOMING-IN, 'PHYSICALLY' 283
FIGURE 8-9 PHYSICAL POINTING AT THE COMPUTER SCREEN ACCOMPANIED THE USE OF VOICE 284
FIGURE 8-10 CO-OCCURRENCE BETWEEN POINTING, GESTURING AND MOUSE/KEYBOARD NAVIGATION WHILE USING VOICE IN VIRTUAL CRIT (2): SESSION V2-Y2S5 285
FIGURE 8-11 BOTH THE TUTOR AND THE STUDENT HAVE THE CONVERSATION AT BOARD NUMBER ONE. 289
FIGURE 8-12 THE TUTOR AND THE STUDENT MOVE THEIR AVATARS TO BOARD NUMBER THREE 289
FIGURE 8-13 THE TUTOR AND THE STUDENT RESUME THE CONVERSATION AT BOARD NUMBER THREE. 289
FIGURE 8-14 TYPING MODE 291
FIGURE 8-15 LOOKING MODE 291
FIGURE 8-16 LISTENING MODE 291
FIGURE 8-17 THREE USERS VIEWING THREE DIFFERENT VIEWPOINTS FOR THE SAME PROJECT 292
FIGURE 8-18 USING CAPITALISATION TO EMPHASIS TEXT IS PERCEIVED AS SHOUTING: 296
FIGURE 8-19 SOME AVATAR APPEARANCES IN VIRTUAL CRIT (1) 298

Table of Tables

TABLE 1-1 AIMS AND OBJECTIVES OF THE RESEARCH 11
TABLE 4-1 SUMMARY OF THE ASPECTS OF THE RESEARCH 107
TABLE 4-2 PHASES AND INTERACTIONS OF THE DESIGN REVIEW STRUCTURE 119
TABLE 4-3 COGNITIVE DIMENSION 120
TABLE 4-4 CRITICISM DIMENSION 121
TABLE 4-5 COMMUNICATION CONTROL DIMENSION 122
TABLE 4-6 TECHNOLOGY COMMUNICATION DIMENSION 122
TABLE 4-7 SOCIAL COMMUNICATION DIMENSION 122
TABLE 4-8 NONVERBAL COMMUNICATION CODING SCHEME 124
TABLE 5-1 CONDITIONS OF THE THREE OBSERVATIONAL CASES 133
TABLE 5-2 NUMBERS OF OBSERVED FACE-TO-FACE DESIGN REVIEW SESSIONS 141
TABLE 5-3 INITIAL AND FINAL NUMBERS OF PARTICIPANTS IN VIRTUAL CRIT (1) 143
TABLE 5-4 INITIAL AND FINAL NUMBERS OF PARTICIPANTS IN VIRTUAL CRIT (2) 145
TABLE 7-1 STUDENTS PERCEPTION OF OWN LEARNING AND COMMUNICATION 244
TABLE 7-2 STUDENTS OPINIONS ABOUT FEELING STRESSFUL IN THE VIRTUAL CRITS (1) AND (2) 253
TABLE 7-3 RATING OF ENJOYMENT AND LEARNING SATISFACTION 256
TABLE 8-1 STUDENTS' USABILITY OF THE CHAT MODE TO DESCRIBE THEIR PROJECTS 271
TABLE 8-2 RELATION BETWEEN READINESS &ENTHUSIASM ABOUT THE TECHNOLOGY AND USABILITY AND FUTURE USE 281
TABLE 9-1 SIGNIFICANCE OF SOME MISSING OR UNDERDEVELOPED NONVERBAL INTERACTIONS IN 3D VIRTUAL WORLDS AND DEVELOPMENTAL RECOMMENDATIONS 319
TABLE 9-2 THE SIGNIFICANCE OF SOME EDUCATIONAL STRENGTHS FOUND IN DISTANT/MEDIATED REVIEWS AND THE RECOMMENDATIONS NEEDED FOR IMPROVING TRADITIONAL FACE-TO-FACE REVIEWS 320

Chapter One

Design Reviews at a Distance: an Introduction

"The goal of design is —at its simplest and yet its most elegant— to conceptualize and then bring about changes to a positive end. Similarly, the goal of design teaching is to understand both the design process and the student, and then to design and arrange the circumstances in which student learning will flourish".

Sarah Dinham, 1991

Chapter One Contents

Chapter One **1**

1 Design Reviews at a Distance: An Introduction **3**

1.1 Statement of the Research, Scope and Motivation **3**

1.1.1 The Final Design Review: Moving to the Online Realm 4

1.1.2 Analysing Learning Interactions of Mediated Design Reviews 7

1.2 Research Question, Aims and Objectives **9**

1.3 Research Strategy **12**

1.3.1 The Research Settings 12

1.3.2 The Methodological Approach and Stages of the Research 13

1.3.3 The Structure of the Thesis 15

1 Design Reviews at a Distance: An Introduction

1.1 Statement of the Research, Scope and Motivation

The aim of this thesis is to analyse the final design review learning activity from a communicational perspective in order to come closer to enhance the delivery of learning and interaction in the design studio. While focusing to explore the possibility of using 3D real-time virtual worlds as environments for communication and interaction in distant design reviews; this research attempts to assess the mediated interaction and analyse the design review activity. A number of researchers have studied design learning from a pedagogical perspective, yet, the assessment of learning interactions in final design reviews in particular have not been fully developed in the current body of literature, let alone when mediated.

This thesis therefore attempts to build and develop both analytical and assessment frameworks based on physical and virtual observational studies of face-to-face and mediated design reviews; the study is guided by current methods of protocol analysis, computer-mediated interaction studies and the author's conceptualisation of human-computer interaction in mediated design reviews in 3D virtual environments. The aim of this thesis therefore is not to re-create design reviews for virtual environments, but rather, it aims to develop a methodology to assess the learning interactions when mediated in such environment.

This introductory chapter begins with a narration on learning interactions of final design reviews as the scope of the research; highlighting the research motivation. The chapter then presents the research questions, main aims and objectives and briefly describes the methodological strategy followed throughout the research stages. Finally, the structure of the thesis chapters are illustrated and explained briefly in an outlining diagram.

1.1.1 The Final Design Review: Moving to the Online Realm

Teaching models based on the direct one-to-one forms of interaction between the students and the tutors are held up as a critical paradigm of design learning (Schön, 1985; 1987). Following the methodologies of the Ecole des Beaux-Arts, in which the design studio interactions are considered more of an active learning experience, the student tutor interaction is conducted through verbal, visual and nonverbal forms of communication. At the heart of this interaction in architectural education, is the design review that aims to evaluate the students' design projects, their design skills and thinking and directs future learning. The design review pedagogy is based on the valid teaching and learning methods of criticism and evaluation recognised and used in schools of architecture worldwide (Dinham, 1986). The definition of the term *final* relates here to the stage of the design project as well as the state of the design product; hence the project *final* mark. Perceptions of 'finalising' the design project are different between schools of architecture worldwide, some schools perceive the final review as the one and only accepted form of evaluation and grading of the design project, while other schools consider it another, yet, last form of formal feedback followed by the submission of a final portfolio. According to intensive research carried out by (Anthony, 1987; Anthony, 1991; Doidge *et al.*, 2000; Parnell and Sara, 2004) the notion of entering the final design review knowing it will end with the final mark of the project, influences the student's behaviour before and during the final design review making it an emotionally difficult experience.

There is an on-going debate in the current body of literature about the right format of the design critique, many researchers have stated the problems of the traditional tutor-led design review, yet student-led reviews also encounter many pedagogical problems as well Doidge *et al.* (2000) and Campbell (2007). Therefore the tutor-led review was chosen to be studied to give us a base line for comparison in the mediated environment for evaluation and assessment. Moreover, many communicational and organisational problems have been reported to come with this traditional teaching method; and these created the motive to closely examine such activity in order to contribute to its improvement, so for example:

- Face-to-face interaction can become a tense experience for some design students who often do not do well in spontaneous spoken interaction (e.g. shy, reflective, more comfortable with emotional distance and proximity), for them the final design review becomes a very critical situation (Anthony, 1991; White, 2000).

- Due to the changing trends in studio-based education; the increasing numbers of students in the schools of architecture with no consistent increase in physical space and numbers of staff, create an organisational problem that leave students waiting long hours for their review (Duggan, 2004; Bender and Vredevoogd, 2006), the traditional front-row advantage inhibits many students from viewing the reviewed material, and thus miss out on chances of learning (Sclater *et al.*, 2001).

The increasing importance of distant and online communication and technology in all aspects of education is well recognised. Recently, there is a growing awareness that the impact of the computer is less about how it empowers individual learning, but more about how it changes the way students support their learning and collaborate in synchronous interaction. One of the solutions suggested by Fiona Duggan (2004) for overcoming the above mentioned communicational and organisational problems in design education is using technology to supplement traditional studio-based learning. According to Sclater *et al.* (2001) the most important advantage of online learning in design is the diminishing of location constraints for active communication and interaction. Therefore the validity of a digital/ paperless/ online/ virtual design studio lies in the notion that digital media can change the process of design, the forms of design, and how design ideas are communicated/learned by building and maintaining connectivity (Stover, 2004; Reffat, 2006).

Yet according to Reffat (2007) the majority of internet-based courses in design education carried out in recent years, have only revolved around online course materials using 2D virtual learning environments and asynchronous discussion forums, missing out on immediate and interaction and feedback, which are the essence of design review

learning. Given the recent development of technological possibilities afforded by new media, the need to exploit the ability to carry out synchronous interaction and collaborate and exchange ideas, share design representations and learning experiences with tutors and students in other countries is becoming highly significant.

A number of researchers have promoted the use of online media to deliver design reviews specifically, (Clayton, 2000; Jabi *et al.*, 2003; Weidong, 2005) using different types of media such as shared whiteboards and networked groupware. Yet being one of the disciplines that have high level learning objectives which involve motor skills and are traditionally taught by direct coaching rather than through lectures, (Stover, 2004), it is still argued that the mediation of communication can disturb the process of design learning and miss out on the richness that the verbal and nonverbal aspects of direct face-to-face communication bring to the conversation.

On the other hand, there is a range of options available to extend the architectural studio into the online/virtual realm and provide mediated forms of communication. For example, virtual design studios which utilise immersive real time virtual reality have become a viable supplementary and extension to the traditional design studio in some schools of architecture and design (Maher *et al.*, 2000). However, these systems are expensive to set up and require high-end communication technology, agents, apparatus and maintenance. Less immersive systems that involve video conferencing and shared surfaces (e.g. whiteboards) are available as well, although these also can have technical complexities and require facilitation and preparations (Jabi *et al.*, 2003; Bender and Vredevoogd, 2006).

Despite the technical complexity of such systems, some recent developments, particularly in the context of 3D massively multi-user virtual environments, or as academically accepted to be called ‘virtual worlds’, pose a range of unique visual, spatial and communicational affordances which give them significant potential to support verbal, visual and nonverbal interaction (Dickey, 2005; DeFreitas, 2006; Mennecke *et al.*, 2011). 3D virtual worlds attempt to simulate our perception of space, sense of presence, as well as our perception of self and others, bringing new experiences to the learning environment.

The apparent effectiveness of this simulation has the potential, it has been suggested, to provide rich interactions in the context of a range of learning experiences which are not well supported by other media, for example, according to a number of scholars, virtual environments may raise the level of cognitive learning i.e. knowledge perception, while encouraging affective learning i.e. learning satisfaction, and thus, enrich the overall learning experience (Wong, 2006; Ondrejka, 2008; Warburton, 2009; Peachey *et al.*, 2010). Besides giving the opportunity to communicate together apart, a distant design review can promote openness to discussion and release tension and defensiveness, which according to Parnell and Sara (2004) and mentioned above, are highly experienced in traditional design reviews. One significant attribute of virtual worlds that sets them apart from other technologies is their capacity for real-time *embodied interactivity*; this utilises the impersonation of the Avatar as a simulation of the human body which is capable of conveying embodied nonverbal means of communication and expressions (Mennecke *et al.*, 2011), and this may be what is needed to communicate a successful mediated design review.

However with the reported capacity limitations of these technologies and modality constraints, it can be anticipated that the learning interaction of design reviews may be affected negatively at some points. However, the acceptance or rejection of such technologies should only take place after an objective assessment and criticism of the learning interactions. Therefore, an assessment criterion is needed to examine the effectiveness and appropriateness of such learning interventions after an empirical exploration of a number of experimental design reviews.

1.1.2 Analysing Learning Interactions of Mediated Design Reviews

Many studies in design learning have focused on assessing the learning policies, creating teaching models, developing curriculum content or evaluating the final design project (Abdellatif, 2003), but not as much have focused on the interactional aspects of design learning from a communicational perspective. As Iordanova *et al.* (2006:2) implies, "*most of them are oriented towards design content, design outcome and design actions, not considering in depth the communication itself*". In order to successfully integrate

mediation and computation in ways which support interaction in design learning, specifically, in design reviews, a full understanding of the learning interaction process in traditional design reviews is a necessary first step. Any form of mediation must be then evaluated and assessed in the context of these learning interactions.

A richer comprehension of learning interactions will enable us to ask questions beyond whether online design reviews and virtual studios can replace the design studio, but rather, whether the present studio method is the only way for carrying out design reviews, and whether it is the best method for every student.

Many studies in other disciplines that assess and compare online learning to traditional learning find no significant differences in student learning perception and other outcome measures (Swan, 2003). According to Meyer (2002), the perception is that most studies on online education or the use of technology are prone to incomplete analyses. That is true of the simple comparison study, where learning effectiveness of online courses are compared to those of traditional courses by using objective measures such as exam scores that assess cognitive performances, or by survey results of learning satisfaction and students' own perception of learning, etc. This is the source of the "*no significant differences*" phenomenon, where possible intervening forces are ignored. In architectural design education, Bender and Vredevoogd's (2006) conclusions also imply that supplementing traditional learning interactions with online support of technologies in the design studio tend to produce the same or better success rates, while drop-out rates become lower as learning satisfaction increases, yet their study focused on instruction in 2D virtual learning environments rather than interaction and two-way communication. However, very few studies; such as (Weidong, 2005; Iordanova *et al.*, 2006; Tang *et al.*, 2011), were found in the existing literature on design learning and interaction that attempt to assess the effectiveness of communication of online learning in the design studio using interaction-based assessment methods. Therefore this thesis is motivated to continue research in that area of knowledge and propose assessment methods for synchronous learning interactions in the design reviews specifically using 3D virtual worlds as highly potential media of communication.

A number of researchers have concluded that the medium of communication plays an important role in the construction of learning itself and that the properties of the technological interface play a role in the way learning interactions are carried out (Su *et al.*, 2005). But in an interaction-based learning method such as the design review, where the core of learning is through direct communication and feedback, it is proposed by this research that the media of communication is central to the effectiveness of learning performances and perceptions, yet the dynamics of this process are still unknown.

According to Wagner (1994), the process of online learning interaction consists of both (1) learning interactions, which include the communicating actors, the pedagogical settings and the content material and (2) interactivity dynamics, which are the properties of the media of communication, and the users' perceptions of its affordances. In the online-learning literature, the notion of interactivity has been studied with regards to student interaction with four components; the content, the tutor, other students and the interface (Rourke *et al.*, 2001). However interacting with the technological 'interface' of 3D virtual worlds is found in this research to be a complex notion; involving how the users interact with (1) the graphical interface which supports interaction, (2) the 3D environment of the virtual world and (3) the computer itself.

Moreover, attempting to mediate the design review puts it under influences of 'mediation', 'virtuality' and 'remoteness' which are shown in this research to have potential effects on (1) the content of the exchanged verbal and visual information of the design review, and (2) the resulting nonverbal interactions, affecting in turn (3) the perception of communicated information. These influences combined in the format of 3D virtual worlds may support or constrain the overall effectiveness of the learning interactions of the mediated design review, therefore, this research aims to identify, describe and assess these influences based on empirical study.

1.2 Research Question, Aims and Objectives

This research proposes that 3D virtual worlds, as a medium for learning interaction in design reviews, may be an important component of future online learning interactivity. As students and tutors interact with the virtual world as an interactional interface, they also

interact within the virtual world as a surrounding context, and this has the potential to affect the way learning interactions are carried out and perceived.

However some questions may be raised here;

- To what extent does mediation in 3D virtual worlds affect design review learning interactions; visual, verbal and nonverbal interactions?
- Are there any advantages of such media and mediation? i.e. would virtual environments and mediated design reviews give students who do not fit the profile of the successful face-to-face learner a better chance for communication?
- Moreover, can 3D virtual worlds in terms of the current state of the art contribute to creating effective learning experiences in design reviews? i.e. Can they be used in conjunction with the traditional design studio to the studio to solve organisational and communicational problems?
- How can their influences be measured? Consequently, how can the effectiveness of the learning interactions be measured in a virtually mediated design review?

This study therefore focuses to explore how visual and verbal content, nonverbal interactions and participants' perceptions of the design review learning interactions are created in the mediated context of 3D virtual worlds; attempting to answer this question:

What is the role of mediated interactivity in the creation of effective mediated design reviews?

A number of hypothesise may be proposed hereby as well;

- The availability and limitation of certain communication modes afforded by the virtual environment may affect the flow and sequences of synchronous communication, but not necessarily the quality and content of mutually communicated design review information.
- Certain properties of the virtual format, specifically those which aim to support different forms of interaction, such as embodiment, presence and remoteness will play a positive role in the effectiveness of the learning interaction process of the mediated design review.
- The students and tutors will continue to interact effectively and create a shared language of communication despite some communicational challenges.

To answer the research questions, and address the above hypotheses, this study attempts to explore three main aims:

1) To describe and understand the learning process of the design review; components, influences and interactions.
2) To assess the effectiveness of design reviews in three sets of media varying in the degree of mediation.
3) To identify the role of mediated interactivity in the creation and perception of learning interactions of mediated design reviews.

Fulfilling such aims requires carrying out a set of objectives; these are expressed in Table 1-1 where links are made to the relevant chapters of this thesis.

Table 1-1 Aims and Objectives of the Research

Aims	Objectives	Chapter
Aim (1): to describe and understand the learning interaction process of the mediated design reviews.	Objective (1-a): to describe the components of learning interactions in traditional (face-to-face) and online settings; verbal content and nonverbal interactions, actors and media.	Two
	Objective (1-b): to propose a conceptualisation for understanding and assessing the effectiveness of learning interactions of mediated design reviews.	Three
	Objective (1-c): to develop a qualitative protocol analysis framework to code, manage, visualise and analyse the learning activity in mediated design reviews.	Four
Aim (2): to assess the effectiveness of design reviews in three sets of media.	Objective (2-a): to carry out observations of three sets of design reviews under varied levels of mediation, and collect relevant data sets.	Five
	Objective (2-b): to examine the efficiency of the communication in the observed reviews; by studying the orientation of narratives, communication control and perception of meanings.	Six
	Objective (2-c): to examine the quality of learning delivery in the observed reviews; by studying cognitive and critique levels of discourse and affective learning.	Seven
Aim (3): to identify the role of mediated interactivity on the creation and perception of learning interactions in mediated design reviews.	Objective (3-a): to examine the effectiveness of learner-technology interactions in the observed reviews; by studying media properties, learner usability, virtual and remote perceptions and experiences in the mediated context.	Eight
	Objective (3-b): to collectively view and conclude the effects of mediated interactivity, and identify how the findings of the research may lead to the development of 3D virtual worlds to support learning in design reviews specifically.	Nine

1.3 Research Strategy

This research focuses on mediating final design reviews using 3D virtual worlds, not to substitute the traditional learning process, but rather to complement it. Therefore, it combines the study of design learning theories and analysis protocols of traditional learning formats with technologically mediated communication and interaction offered by the virtual world platform. The investigation is based on the conceptualisation of the mediated design review as a socio-pedagogical form of interaction and interactivity which occurs within the two virtual and physical contexts. Exploring the effects of these two contexts on how the design review content and interactions are created and delivered, and thus the level of effectiveness of the learning process is assessed in a three-step; descriptive-interpretational-explanatory qualitative approach. The research settings, the methodological approach and the structure of the document are discussed in the following subsections.

1.3.1 The Research Settings

This research examines the mediated interaction in a specific learning technique common in design education; the final design review. Accordingly, the use of the terms 'design review' or 'crit' will be used throughout this thesis to refer to this process. Examining the proposed framework of this study required carrying out a number of observational studies in both physical settings and experimental virtual settings.

The researcher has selected 'SecondLife' 3D virtual world to host the empirical study. Because this research attempts to examine in detail the array of human interactions in design reviews and compares how these interactions are affected by the components of technological interactivity dynamics when mediated in 3D virtual worlds, it can be made clear, hereby, that this thesis is not attempting to study the successfulness of a specific piece of commercial software, but rather to explore the potentials of the remote embodied communication technology represented in it. The selection of such software hence is merely based on two reasons:

(1) Newcastle University's Information System Services 'ISS' has bought the ownership of a number of 'islands' in the virtual world of SecondLife in 2005. This made it practically convenient to make use of this land and add to the existing educational research revenue supported by the university.

(2) Tempted and motivated by many recent publications that support the educational and communicational potentiality of SecondLife as a rich context of interaction, it was only necessary to explore this before confirming or dismissing its suitability for supporting design review learning interactions.

Three different communication modalities were examined in physical and virtual contexts by manipulating the afforded communication channels and thus degrees of mediation, to explore a rich variety of interactional data:

- Face-to-Face Crits: Full access to face-to-face human interaction.
- Virtual Crit (1): Text-only mode with enabled Avatar pointing.
- Virtual Crit (2): Text and Voice modes with limited Avatar pointing.

The users who have voluntarily participated in these observational studies are tutors and students in different architectural academic levels in the University of Newcastle. The Face-to-Face Crits have been set on the premises of the University, while the virtual settings of Virtual Crits (1) and (2) have been created by the researcher on an 'island' in SecondLife 3D virtual world. The empirical observational studies; physical and virtual design reviews were carried out in individual settings between 2007 and 2010.

1.3.2 The Methodological Approach and Stages of the Research

After presenting the research concepts, proposals and conceptualisations, this thesis attempts to build and analytical framework for analysing and assessing the mediated design review process. This includes carrying out several tasks within the stages of this study:

(1) To overcome the unsuitability seen in the application of existing protocol analysis coding schemes that fail to address the kind of interaction enacted in the design review and put forward a new description of interaction based on the multi-layered nature of design reviews.

(2) To design and apply both, real-time physical and virtual observational studies of on-going design projects involving volunteering students and tutors in Newcastle University to examine phases, themes and patterns of interaction in design reviews.

(3) To propose a set of coding schemes for analysing interaction of mediated design reviews; which is proposed in this thesis under the name the 'Review Interaction Protocol' model.

(3) To analyse the participants' opinions, learning perceptions and virtual experiences collected through questionnaires and focus groups; and to analyse their embodied interactions and learning performances in the mediated design reviews using qualitative analysis methods such as content/ discourse analysis and interaction analysis.

(4) To assess the effectiveness of such mediated learning interaction, by carrying out a qualitative-based collective analysis process that assesses three learning interaction processes; communication efficiency, learning effectiveness and the learner-technology interaction.

1.3.3 The Structure of the Thesis

This thesis is structured around nine chapters as shown in Figure 1-1, and described below.

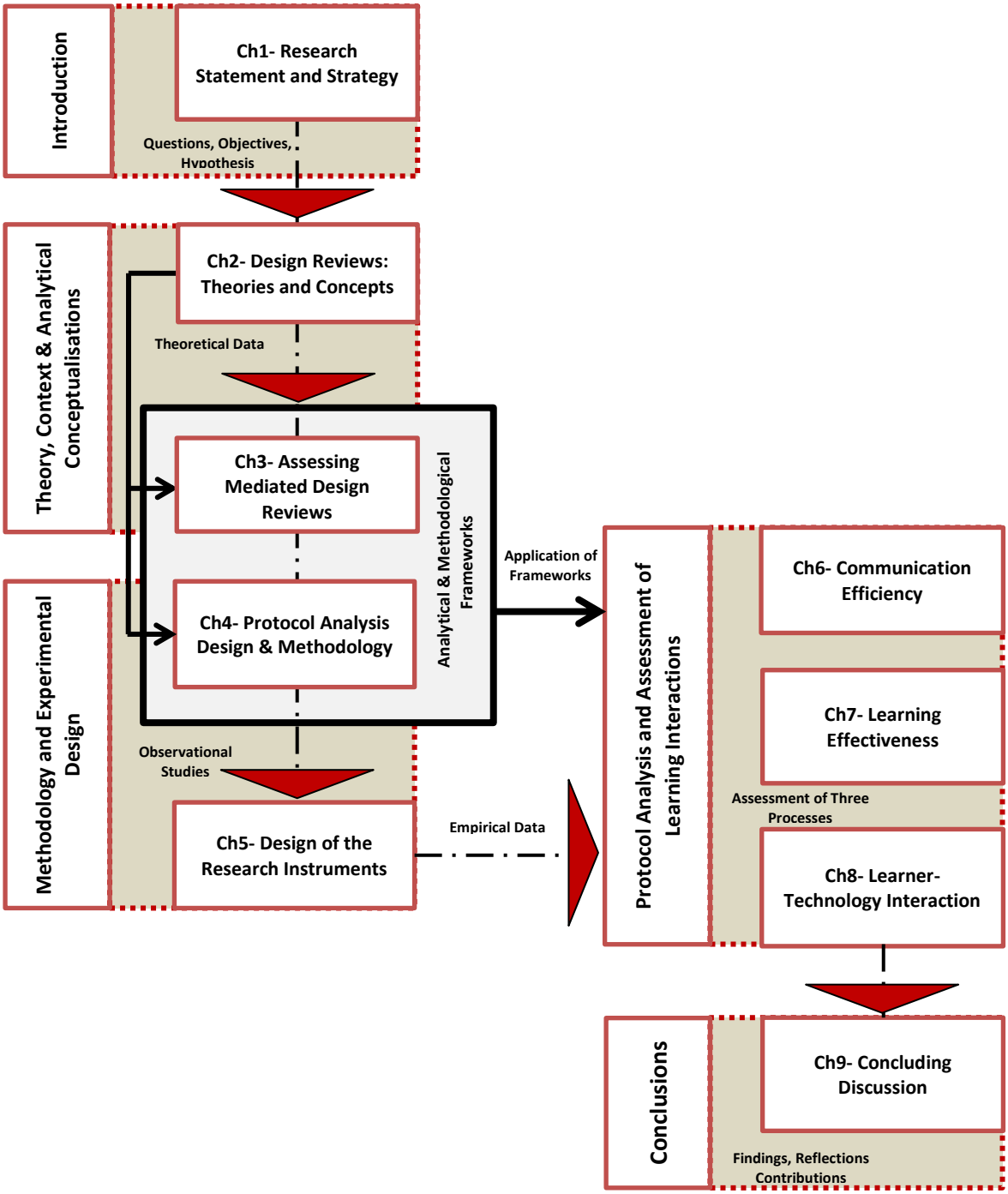


Figure 1-1 The Research Outline and Design

As shown in Figure 1-1, in addition to the Introductory and the Concluding Chapters, this thesis consists of three main sections as described below.

Section One: Theory, Context & Analytical Conceptualisations; Chapters Two and Three.

Section Two: Methodological and Experimental Frameworks; Chapters Four and Five.

Section Three: Discussion and Analysis of the Results; Chapters Six, Seven and Eight.

This first introductory chapter; **Chapter One; Design Reviews at a Distance: an Introduction**, presents the research problem, motives, scope, questions, aims and objectives, it also introduces some definitions while a brief preview on the research settings and methodological strategies are clarified. This chapter sums the outline of the thesis in a diagram that illustrates the flow and connections of the constituting chapters.

- **Section One: Theory, Context & Analytical Conceptualisations**

Section One consists of two chapters; Chapters Two and Three, which aim to set theoretical foundation and conceptual proposals necessary for developing the research analytical framework. These two chapters relate the current body of literature to the development of the proposed assessment framework employed in the later chapters of this thesis.

Chapter Two; Learning Interactions in Design Reviews: Theories and Concepts, reviews the existing literature that describes communication components of the 'final design review' as an interactive learning and evaluation technique in design education, reaching an illustration of the design review communication spiral. The chapter then presents the potentials of online technologies to complement the interaction experience of design review communication when applied at a distance; rationalising why 3D virtual worlds are a suggested host for distant design reviews.

Following that, **Chapter Three; Assessing Mediated Design Review Learning Interactions,** examines the two components of online learning interactions; interaction and interactivity. It then develops a framework to identify indicators that measure the success of mediated learning interactions; this includes learning effectiveness, communication

efficiency, and learner-technology interactions effectiveness. Finally, the chapter draws from this discussion along with the theories presented in Chapter Two, and builds a conceptualisation of the learning-interaction process of the mediated design review and proposes an approach to examine this multi-faceted dynamic process and assess its effectiveness by breaking the process down into three constituting processes and assessing each of them in parallel.

- **Section Two: Methodological and Experimental Frameworks; Chapters Four and Five.**

The methodological tools and approaches used to examine the learning interactions of face-to-face and mediated design reviews are explained in **Chapter Four; Analysing Mediated Design Review Activity: Methodology.** Chapter four describes the research design and rational, then reviews how a purposely designed interaction analysis protocol and coding scheme; the '*Review Interaction Protocol*' was structured to analyse observed interactional data. The chapter finally presents the strategy of data analysis and demonstrates how the collected sets of data are applied to complement achieving the study's aims and objectives by following a descriptive-interpretive-explanatory analytical approach.

While **Chapter Five; Design of the Research Instruments** describes how the research methodology is executed. Chapter Five describes the design, preparations, participants, communication modes and the recording procedures of each of the three observed cases of design reviews in the physical and the virtual contexts. The design of additional data collection instruments which include questionnaires and focus groups are described in this chapter as well.

- **Section Three**: **Discussion and Analysis of the Results; Chapters Six, Seven and Eight.**

After collecting the necessary data, this thesis then attempts to assess the effectiveness of the mediated design reviews by following the framework of assessment developed earlier in Chapter Three. Here, examining the indicators of effectiveness in three resulting

processes; namely, (1) the communication efficiency, (2) the learning effectiveness, and (3) the effectiveness of learner-technology interaction is carried out on the course of the three following chapters; Six, Seven and Eight where each of those chapters targets one of those processes.

Chapter Six; Communication Efficiency, The chapter aims to determine the factors that play a role in creating efficient learning communication of the observed design reviews. The chapter examines four indicators, these are namely; (1) the consistency of the structure and sequences of the review phases, (2) efficiency of orienting the narrative which studies mediating nonverbal communication, (3) the level of communication control, (4) the extent of maintaining a shared perception of meanings.

Chapter Seven; Learning Effectiveness, studies the second process of learning interaction, it determines the levels of student learning gains in the observed mediated design reviews. Specifically by examining (a) cognitive learning, i.e. the level of perceived knowledge, student performance and the cognitive and critique level of the discourses (b) affective learning, i.e. students' learning satisfaction, levels of stressfulness and the overall learning climate.

The next chapter; **Chapter Eight; Learner-Technology Interactions**, addresses the relation between the learner and the technology, here the technology is conceptualised in a wider view that includes the *virtual*, *remote* and *mediated* context as well as the *physical* context. This chapter proposes that the effectiveness of the learning interaction depends on both the user and the technology; it therefore examines (a) the status and properties of the technology, (b) the users' readiness and their usability, (c) interaction with the computer, (d) virtual experiences and perceptions, and finally (e) experiences and perceptions in the remote context.

Finally, **Chapter Nine; Concluding Discussion**, attempts to achieve the research aims and objectives by initiating discussions around research findings on several issues such as mediating nonverbal communication, development of the Avatars as tools for interaction and orientation, users virtual perceptions of presence and the appropriateness of such tools and senses in the context of design reviews, and the suitability of remote and virtual

platforms to support interactions in the design reviews. This concluding chapter also draws on the lessons learned from carrying out the mediated procedures of the virtual design reviews, by introducing how to avoid difficulties and work around potential problems; it suggests possibilities for future enhancements as well. The road to development and improvement of learning interactions in final design reviews are recommended in this chapter as well by highlighting the advantages found in the observed design reviews in both physical and virtual contexts. Chapter Nine presents the significance of the research and its contribution to the current body of knowledge in the area of computer-mediated design learning communication and interaction by highlighting the design of the methodological frameworks specifically. Finally, the chapter points out some areas of future research in the same field of study and beyond.

Section One

Theory, Context & Analytical Conceptualisations

Section One

Theory, Context & Analytical Conceptualisations

Section One consists of two chapters; Chapters Two and Three, which aim to set theoretical foundation and conceptual proposal necessary for developing the research analytical framework. These two chapters relate the current body of literature to the development of the proposed assessment framework employed in the later chapters of this thesis.

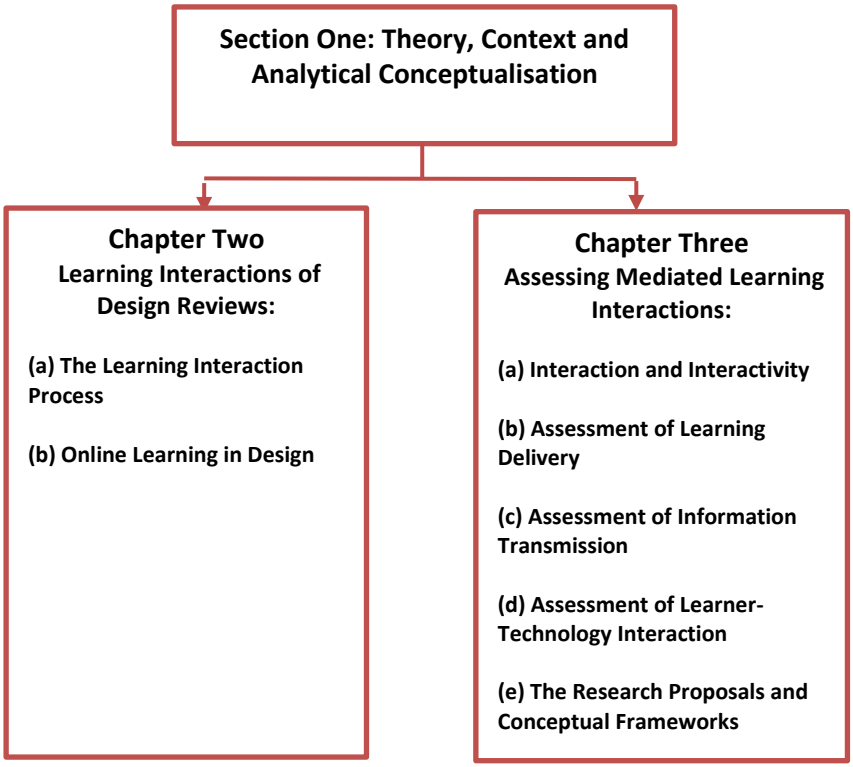


Figure 1-2 Section One: Theory, Context and Analytical Conceptualisation; Chapters Two & Three

Chapter Two discusses two subjects;

(1) The interactional aspects of the final face-to-face design review based on the current literature; resulting in an illustration of the design review communicational spiral.

(2) The online potentials of 3D Virtual Worlds to host design reviews, proposing to explore this type of new media in experimental settings.

While Chapter Three looks at:

(1) Interaction and Interactivity components in online education.

(2) Assessment methods used to analyse mediated learning interactions, proposing that in order to fully assess learning interactions, three processes should be analysed, these constitute the analytical framework of the research: (a) Assessment of Learning Delivery, b) Assessment of Information Transmission and (c) Assessment of Learner-Technology Interaction.

(3) The research conceptual and assessment frameworks are described and proposed.

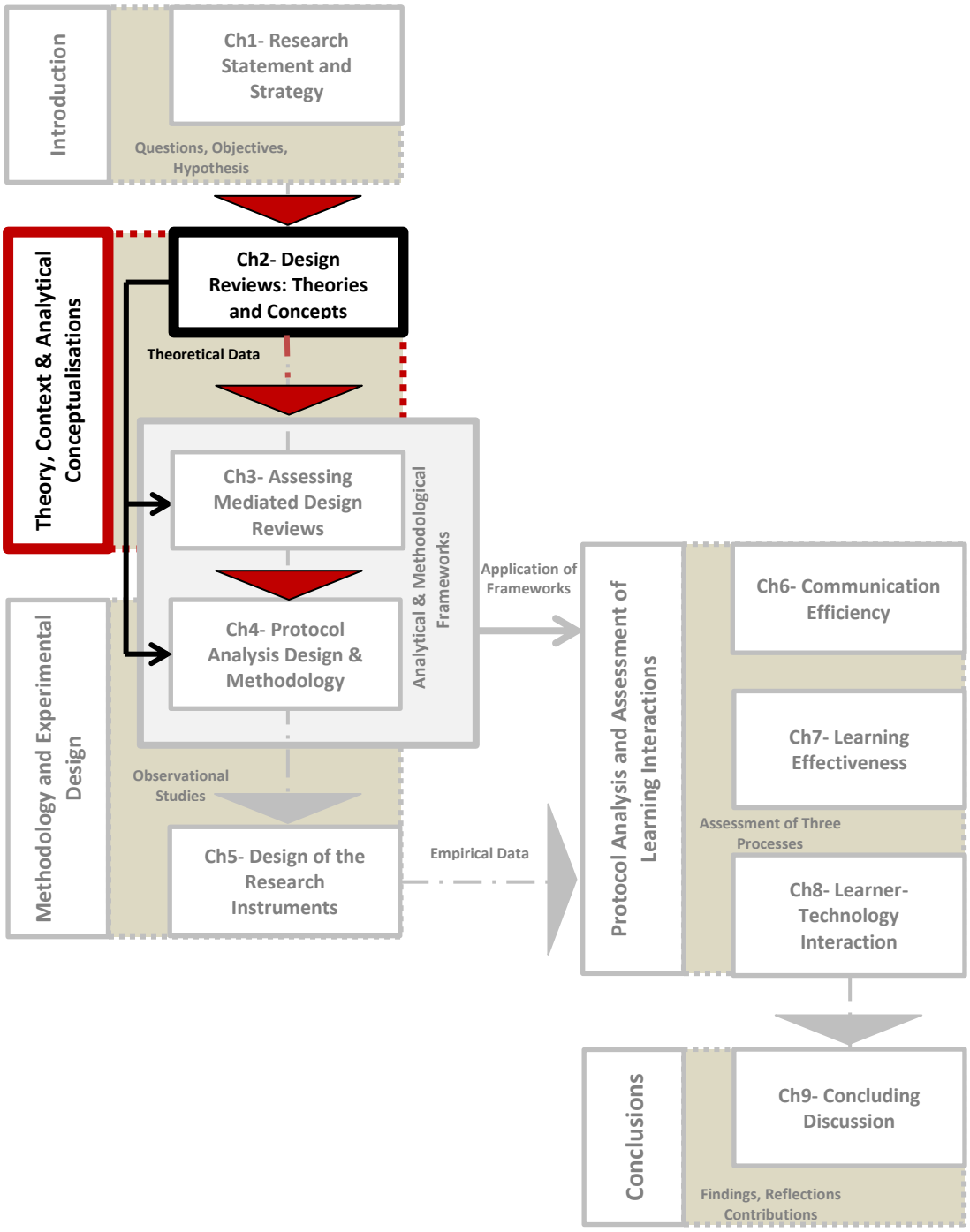
Chapter Two

Learning Interactions in Design

Reviews: Theories and Concepts

Chapter Two Contents

Chapter Two **23**
2 Learning Interactions of Design Reviews: Theories and Concepts **27**
2.1 Introduction **27**
2.2 The Design Review: A Design Learning Interaction Process **27**
2.2.1 Components of Learning Events 29
2.2.1.1 Objectives of Critiques 30
2.2.1.2 Types and Protocols of Design Critiques 31
2.2.1.3 Actors and their Communicational Roles 32
2.2.1.4 Content and Structure of the Design Review 34
2.2.1.5 Socio-pedagogical Factors in the Design Review 35
2.2.2 Communication Properties and Dynamics 35
2.2.2.1 Communication Modes and Media 36
2.2.2.2 The Nature and Context of Communication 39
2.2.2.3 Communication Transmission and Management 40
2.2.3 Illustration of the Design Review Communication Spiral 40
2.3 Online Learning in Design **43**
2.3.1 New Media: Richness and Suitability 44
2.3.2 3D Real-time Virtual Worlds: A Platform for Design Learning? 49
2.4 The Mediated Design Review: A Proposed Learning Technique **54**
2.5 Summary **57**


Introduction
Ch1- Research Statement and Strategy
Questions, Objectives, Hypothesis
Theory, Context & Analytical Conceptualisations
Ch2- Design Reviews: Theories and Concepts
Theoretical Data
Ch3- Assessing Mediated Design Reviews
Ch4- Protocol Analysis Design & Methodology
Analytical & Methodological Frameworks
Application of Frameworks
Methodology and Experimental Design
Observational Studies
Ch5- Design of the Research Instruments
Empirical Data
Protocol Analysis and Assessment of Learning Interactions
Ch6- Communication Efficiency
Ch7- Learning Effectiveness
Assessment of Three Processes
Ch8- Learner-Technology Interaction
Conclusions
Ch9- Concluding Discussion
Findings, Reflections Contributions

2 Learning Interactions of Design Reviews: Theories and Concepts

2.1 Introduction

Chapter Two discusses the context of this thesis which is the 'final design review' presenting theories and concepts of learning interactions in both face-to-face and online settings from a communicational point of view for the purpose of analysing learning interactions. Based on Herring's (1987) classification and definition of 'learning interactions', which includes (1) learning interactions and (2) delivery dynamics, the review of the literature is mapped and organised accordingly.

Two main sections constitute this chapter; first Chapter Two explains the multi-dimensionality of the design review interaction process by examining the involved modes, roles, protocols and the structure and context of communication in face-to-face design reviews. This detailed examination leads to the illustration of the Design Review Communication Spiral (in section 2.2.3, page 40), which sets ground for building the communicative structure of the design review learning activity; this is an important part of developing an analytical protocol for the mediated design review learning process, which will be described later in Chapter Four; '*The Review Interaction Protocol*'.

Moving from that, the second section of this chapter describes the potentials of online media, which may be a way to overcome some communicational and organisational problems experienced in traditional design reviews by entering the online realm. The chapter reviews communication channels, modalities and platforms that have been used in online design communication; then puts forward the learning potentials and anticipated problem/limitations of 3D virtual worlds for hosting mediating design reviews.

2.2 The Design Review: A Design Learning Interaction Process

Simpson and Galabo (1986) suggest that human interaction can be viewed as all types of behaviour in which individuals and groups act upon each other.

> *"Reciprocity in actions and responses in an infinite variety of relationships: verbal and nonverbal, conscious and non-conscious, enduring and casual, interaction is a continually emerging process; as communication in its most inclusive sense".*

Ellen Wagner's (1994:8) details in her definition of learning interactions and refers to reciprocal events involving at least two actors and/or objects and at least two actions in which the actors, objects and events mutually influence each other. Kahveci (2003:12) adds that outcomes of learning interactions are affected by human psychology and cognition. This means that no matter what learning theories we employ, reciprocal events and mutual response in some form must be integral to our notions of how we learn (Moore, 1997).

Based on Herring's (1987) argument, it was found that when attempting to study learning interactions in general, many researchers often fail to separate between the two main categories of interaction; which are:

(1) **Learning Interactions, which are the property of learning events**; these include actors, protocols, content and pedagogical factors.

(2) **Communication Dynamics, which are the property of information delivery processes**; these include interaction procedures and dynamics, modes, contexts/media and the management of the communication.

It is necessary, therefore, to distinguish in this research between these two categories with regards to the design review, and explore each component within context. Figure 2-1 presents this categorisation and illustrates the two components of the learning interaction process specific to the architectural design review.

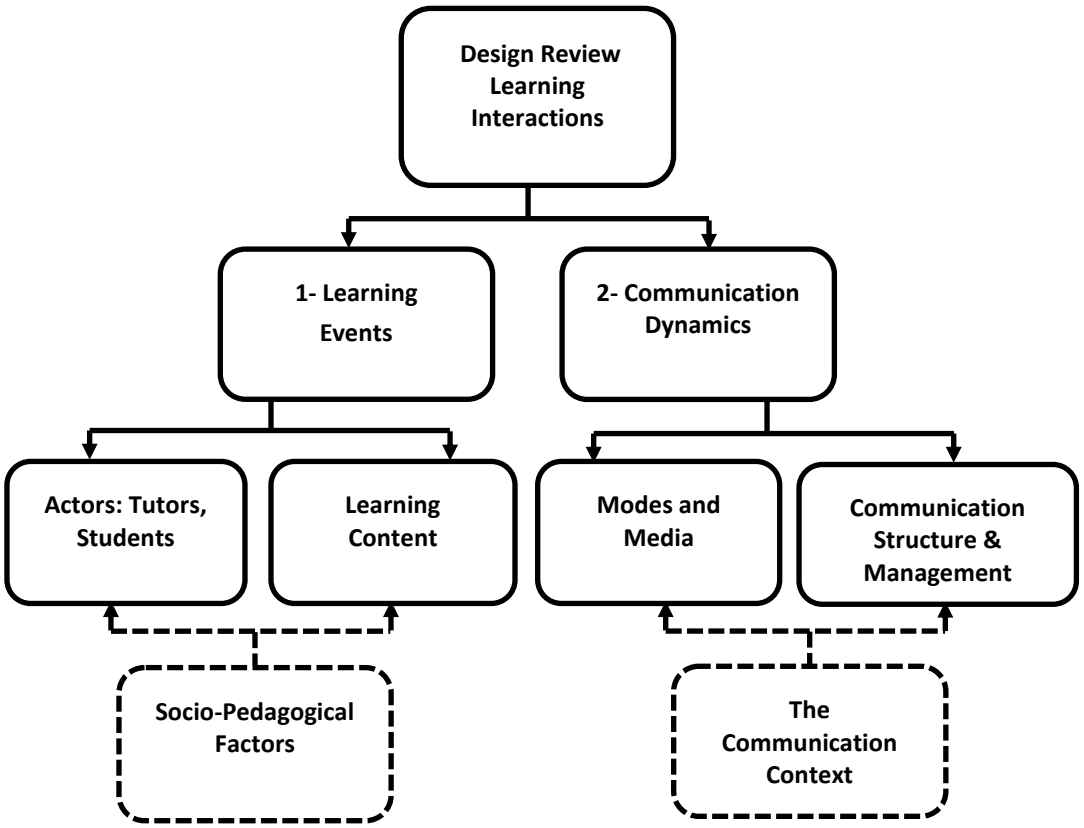


Figure 2-1 The Learning Interaction Process in Design Reviews

(Conceptualised by the Author)

The literature has widely discussed the design process, and the outcomes of design learning, but the interaction dynamics in the design review have not been properly framed. The following sections aim to reveal aspects of the two categories the design review interaction process in terms of their roles in the design learning dialogue.

2.2.1 Components of Learning Events

Learning events as the first category of the proposed model of the design review learning interaction process shown above in Figure 2-1, consist of a number of components; these are namely, (1) communicating actors and their roles (2) learning content, protocols and outcomes and (3) socio-pedagogical factors that influence the process. The following subsections discuss these components as reported in the current literature in order to guide us in building a conceptualisation of the design review interaction process.

2.2.1.1 **Objectives of Critiques**

The design studio is the central focus of architectural design education in schools worldwide, the term describes not only a place, but a totally immersive learning process and a social system which is aimed at supporting the design learning process (Schön, 1985; Anthony, 1987). One of the most common learning methods used in the design studio, is 'critiquing' which has been a vehicle for judging the quality of students' design work (Anthony, 1987). Critiquing as defined by (Fischer *et al.*, 1998) is;

> *"a dialog in which the interjection of a reasoned opinion about a product or action triggers further reflection on or changes to the artefact being designed".*

As such, critiquing –either during the earlier stages of the design project or at the final stage- helps students reflect on their own work and reframe design problems for further learning. Different terms are associated with critiquing in design learning; so for example, we may find: design critiques, desk tutorials, crits, criticism, design reviews and design juries. Each type of critical encounter takes place at a different stage of a design project. Critiquing may be applied differently in various design cultures but they exhibit the same fundamental set of protocols.

Focusing on final design reviews, Dinham (1986) names three objectives:

(1) to criticise individual student's work

(2) to provide general instructions to an entire group of students

(3) to initiate scholarly seminar- like exchanges of knowledge

Doidge *et al.* (2000) and Campbell (2007) add to those;

(4) to practice presentation and communication skills

(5) to develop transferable skills, of which critical thinking skills are amongst them, all of which are intended to contribute to future effective learning

Furthermore, critiques help develop students thinking skills as they provide an environment where students can enhance their presentation techniques and gain verbal confidence in discussing their work before others, these skills are important in the practice of architecture (Milton, 2003). Anthony (1991) has proven in her studies about students' reactions to design learning through criticisms, that students after participating in design critiques learn how to improve their design concepts. Students, therefore, learn how to evaluate critically design work of their peers.

2.2.1.2 **Types and Protocols of Design Critiques**

All forms of critiques follow similar protocols and procedures, they differ according to the stage of the project, the participants involved, how they participate, and what is evaluated. Therefore different structures and protocol of communication and interaction construct this process depending on the types, timing and objectives in which they are carried out in design studios. These different contexts can be described as follows:

1- **Informal Tutorials or Desk Reviews**: Desk review or desk crits are held in the initial stages of the project, they are often one-on-one discussions about the student's progressing work usually held at the student's desk; they involve the tutor and his student, sometimes nearby students. The tutor reflects upon the student's work but usually no assessment is undertaken. However, we may find variations in the formality and the way desk tutorials are held from one school of architecture to the other, so for example, desk tutorials may take as well the form of round-table discussion such as workshops that involve small or larger groups of students and tutors, and can be a perfect opportunity to learn from others and bounce around initial ideas (Doidge *et al.*, 2000).

Design theorist Donald Schön (1987) has explored the interaction process specifically in design education in his book 'Educating the Reflective Practitioner' focusing on the 'desk tutorial' as a clear and visible reflective conversation between the studio master Quist, and Petra; one of the students. He describes the protocol of the tutorial that goes on for twenty minutes as Petra gives a presentation of her preliminary sketches, she describes the problems she has encountered. Quist reframes the problems in his own terms and

proceeds to demonstrate the working out of a design solution. There is a coda of '*reflection-in-action'* on the whole conversation, see (Schön, 1987:44-56).

2- **Formal Presentations** include:

(a) **Interim Reviews**, are usually conducted in an open environment involving the tutors of the studio and their students, where each student pins his/her work up on boards and presents his project. Interim reviews are milestones done in the intermediate stages of the project to demonstrate work in progress. They are held one or more times during the project to evaluate students' progress, discuss main issues and give interim marks.

(b) **Final Reviews/Crits/ Juries**, are carried out in the final stages of the project. They are more formal presentations and can take the form of an exhibition of work. As described by Webster (2005; Webster, 2007), the final design review is 'a *liberal celebration of the student creativity', the* students present their individual designs both visually and verbally to a group of fellow students, staff and visiting critics (Doidge *et al.*, 2000). The group then discusses the work and argues with the author. The tutor(s) elicits reasons or justifications for the student's decisions, and delivers a critical assessment of the project (Vasques DeVelasco and Zhang, 2004). They might also point out weaknesses in a design or important factors that the student may have overlooked, provide encouragement and further development of a promising scheme, point out historical precedents by other architects, or suggest alternative approaches to a problem; giving notes for future learning (Stover, 2004).

2.2.1.3 **Actors and their Communicational Roles**

Most design conversations according to Cross (1996), are forms of collaboration between role players, particularly in the design studio, the participants must understand and respect the roles the others are playing at the time. These roles serve to construct and organize creative conversations according to cues (words or gestures) or to emphasis certain aspects of the conversation.

In a typical student-tutor review, the student describes his/her project and the tutors will initiate a discussion to ask about unclear issues, or to test the student's knowledge and assess his/her skills. This discussion will lead to a justified evaluation and further instruction and/or concluding remarks for future knowledge. Experienced critics balance perceptions and instinct with rational, analytic assessment, communicated clearly and constructively (Dinham, 1986).

Typically, the student's role would be:

- Pin-up his/her project
- Start describing the concepts, ideas, designs and structures.
- Answer the tutors' questions and clarify his/her design.
- Engage in discussion and give explanations or orientations.

In a best-case scenario of a review, (Doidge *et al.*, 2000) have concluded that the role of the tutor should cover the following tasks:

- To define the purpose of the review. When the goals are clearly defined from the outset, e.g. assessment, learning, presentation practice, etc., this saves time and reduces confronting situations and students feel more confident.
- To provide expert knowledge. As the tutor is someone with more experience who can provide students with insights and valuable knowledge.
- To enable the learning process. Initiating discussion, and encouraging students towards self-learning.
- To ensure that important and relevant issues are covered. The project brief will specify relevant issues and learning goals, the tutor must make sure these issues are included in the review discussion.
- To ensure a compromise between equality and flexibility. It is the tutor's responsibility to make sure that each student is given similar attention.
- To ensure that the same references are used by all tutors if they are marking work.

Most studies on reviews and design juries have revealed that the tutor's role is essential to the success of the review, as it may lead to the success or the failure of the learning method. As Dinham (1991) expresses "*the tutor's role is to convert the unknown talents and skills of their students into mature professionalism*".

2.2.1.4 **Content and Structure of the Design Review**

The concepts of dialogue and interaction are sometimes used synonymously; however, an important distinction can be made. The term *'dialogue'* is used to describe a series of interactions having positive qualities that other interactions might not have. A dialogue is considered purposeful, constructive and valuable by each party. The direction of the dialogue in an educational relationship is towards the improved mutual understanding of the tutor and the student. As stated before, reflection is an essential characteristic of the dialogue in studio-based learning.

The structure of the design critique changes depending on the project and is adjusted to the changing level of knowledge of the students by bringing in different technical information or tailoring references of particular architects or precedents (Milton, 2003). The structure also depends on the student; some tutors tailor their methods to suit specific students; this comes partly from experience and knowing when students are struggling and how to support them (Robinson, 2007). Schön (1987) talks about a protocol for the tutorial situation, from which, the structure of the dialogue may be extracted:

- Students will present sketches and discuss problems they have had.
- Tutor 're-frames' this problem and demonstrates how to work on a solution.
- Brief internal reflection on the tutorial so far.
- Tutor sets out next steps to be taken.
- End of section of reflection on all of the above.

In a final design review, the protocol and thus the structure of the communication differs from what Schön (1987) has described of the desk tutorial, after the student introduces his/her concepts, ideas, design and other representations, the stage of re-framing the design idea here is not relevant, but rather, a discussion stage is most necessary so the student can revisit any misinterpreted information by the tutor. The tutor then creates a full understanding of the student's project, and aims to evaluate it and give feedback for future learning.

2.2.1.5 **Socio-pedagogical Factors in the Design Review**

There are many factors that directly influence the learning communication in a design review including, according to Moore (1997) the education philosophy of the course author, the personalities of the participants i.e. tutors and students, the subject content, and the academic level of the students. Margaret Wilkin (2000) has found from her study on learning opportunities of design reviews that despite the encouragement of tutors, student participation in reviews is limited. Some of the reasons for this are personal (for example some students are made extremely anxious by the review situation), some are organisational (large numbers of students, less time slots, and extended reviews) and other reasons are cultural (e.g. some students coming from rural and small size communities may feel more stress when exposed to situations than students living in urban and large size cities.

According to Doidge's *et al.* (2000) studies, the amount of stress produced by public criticism in design reviews is a key to understand their learning effectiveness. Stress can be caused by a number of socio-pedagogical and personal or cultural factors. These studies revealed that stress can be a positive pedagogical tool, provided it is used in moderation. In the case of the criticism/review system, the optimal level of stress is high enough to motivate and discipline students to put their best work forward, but should not be so high as to interfere with the students' ability to participate and function normally.

Along with the students' personalities, and encouragement of the tutors, the academic level of the students also play a role in their performance; higher academic stage students experience a larger number of formal design reviews, the develop better preparation and presentation skills as they level up in their educational stages (Parnell and Sara, 2004).

2.2.2 Communication Properties and Dynamics

This section presents the second category of the learning interaction process, which describes how learning conversations develop and how information is communicated in the design review. According to Kalay (2004a:87) communication in design is a process

whose purpose is to transfer design information from a sender to a receiver through some intermediary medium of transmission. This section studies the properties of the medium of communication which includes (1) communication modes and media, (2) communication transmission and management and (3) the nature and context of communication.

2.2.2.1 **Communication Modes and Media**

Natural human interaction known as face-to-face interaction is based, according to Fabri *et al.* (1999), on speech, facial expressions, body posture and gestures all together. Nigel Cross (1996) points out the importance of the conjunction between forms of communication in the design process; drawing and talking in design groups, both, verbal and nonverbal communication have their advantage, but combined they offer a very powerful language of design (Schön, 1984). Morris's *et al.* (1979) idea of the 'talking body' is particularly relevant in the context of design education as a form of social interaction, which critically depends on verbal and nonverbal communication between the tutors and the students, and act together to deliver the design message (Eastman, 1970).

Looking at the design review as a system for exchanging information; i.e. ideas and designs, there are different tools/carriers/media which may be used to communicate this information. Schön (1983: 81) explains how design representations in the form of visual, verbal and nonverbal dimensions are closely connected. He maintains that communication between the two subjects in his experiments -Quist and Petra- is not complete and remains unclear if the verbal discourse is not closely linked with nonverbal cues:

> *"The verbal and nonverbal dimensions are closely connected. Quist's lines are unclear in their reference except insofar as he says what they mean. His words are obscure insofar as Petra can connect them with the lines of the drawing …Whether Quist and Petra speak in words or drawings, their utterances refer to spatial images which they try to make congruent to one another. As they become more confident that they have achieved congruence of meaning, their dialogue tends to become elliptical and inscrutable to outsiders"*

Whilst a significant proportion of information in design reviews is likely to be communicated through verbal modes of communication, i.e. speech and text, other media

objects according to (Bellamy *et al.*, 2005) include artefacts, drawings and gestures. The design review context is a dynamic environment which requires participants to have access to the full range of verbal, nonverbal, (gestural) and visual mediums for a successful design learning communication.

Nonverbal communication refers to intentional and unintentional messages which are encoded and decoded along with verbal words to convey meaning. As DeVito (1997) stated; almost every behaviour can be interpreted as meaning, the range of nonverbal communication is very wide, and is often a better indicator of thoughts, feelings and emotions than spoken or written language.

According to Druckman (1982:11), the results of numerous studies support the assumption that gestures, expressions and other nonverbal behaviour participate greatly in conveying the meaning. McNeill (1992:1) expresses that '*the hand and its movements are symbolic; they present thought in action*' he also proposes that '*gesture provides a new perspective on the processes of language*'. A great amount of information is expressed through nonverbal modes of communication, and therefore the study of nonverbal media objects in the design review cannot be ignored.

Researchers have studied the role of gesturing in design communication, mainly in design profession such as (Tang, 1991; Ishii *et al.*, 1992; Bekker *et al.*, 1995; Bellamy *et al.*, 2005; Iordanova *et al.*, 2006), there is very little research, however, on the specifics of nonverbal communication in the design review. Bekker *et al.* (1995) categorises gestures that are commonly used in design activity in general, into the following categories:

- Kinetic: The movement executes all or part of an action performance.
- Spatial: The movement indicates distance or location or size.
- Pointing: Fingers (usually) point to some person, to some object or place. The referent can be concrete or abstract, denoting an attitude, attribute, affect, direction, or location. Pointing gestures are used to select objects or to reduce the scope of a spoken statement as of "this" and "that'. Therefore pointing is considered a special gesture, since its meaning is always context dependant (Kendon, 1980).

Bekker *et al.* (1995:163) analyses the kinds of gestures and how they were used for various purposes in designing communication by stating the frequency of use for each purpose. He has identified several functions of gestures in design, these include:

- Showing distances, sizes and shapes,
- Enacting the interaction between user and product,
- Referring to objects, persons or places,
- Listing items related to the design,
- Managing of information and actions,
- Regulating the conversation, and
- Giving emphasis or focus attention to the conversation

Proxemics or 'interpersonal spacing' is perhaps one of the more important elements in direct face-to-face interactions (Druckman *et al.*, 1982), according to McNeil (1986), proxemics are "*the communicative aspect of the use of space*". This includes the personal space around a body to which one attaches ownership, as well as meanings generated through the arrangement and orientation of bodies in space.

Despite their importance in the delivery of the communicational message in learning interventions, there are other nonverbal means of communication that have not been studied with regards to design learning; these nonverbal means of communication are, according to (Argyle *et al.*, 1973; Chovil, 1991; Kendon, 2004):

- Facial expressions, which are primarily used to convey emotion and are the most thoroughly researched category (Chovil, 1991), because they are the best way of nonverbal communication that is able to convey emotion vividly where words can only do it abstractly.
- Oculesics refers to Gaze, which is a powerful channel of nonverbal communication and is different to facial expression although it involves facial operators (Earle, 2001). Michael Argyle and colleagues (1973) studied the different functions of gaze that affect social interaction, they concluded in their research that looking while talking is used to obtain immediate feedback on the reactions of listeners; looking while listening on the other hand may be used to supplement auditory, this function of gaze is linked to information seeking (Argyle *et al.*, 1973); this is also relevant to design learning.

- Paralanguage is behaviour that indicates the true meaning of a spoken message. Typical operators are voice tone, tempo, rhythm, articulation and pitch range. They may show emphasis to certain words, and may express emotions.

In order to have an effective learning interaction, students and tutors must have access to the use of these different communication modes and media objects.

2.2.2.2 **The Nature and Context of Communication**

Conditions of the learning space, or as Moore (1989) refers to them as; '*environmental factors*' affect and influence the learning communication directly and indirectly, these factors are as following:

(1) The physical conditions of the environment or 'space' in which the students learn and teachers teach; as this may cause reduction in engagement in the dialogue or conversation, due to the characteristics of the physical environment, i.e. space dimensions, area, volume, orientation, lighting, temperature, noise, etc. (Abdellatif, 2003).

(2) The organisational conditions of the environment which refers to the number of students involved in the learning space, and their frequency to communicate. For as nearly half of the respondents of Wilkin's (2000) survey agreed that students were constrained from participating by their '*distance from the action*'. Students could not see the drawings that are being criticised due to the large number of students, therefore could not understand what was being said, and feel they are wasting their time. If the coherent and systematic presentation of learning issues aid understanding, a further condition for learning to take place is that the learning material should be readily accessible.

This may seem an obvious assumption, but the large students groups that schools of architecture host today, present a problem in this respect (Wilkin, 1999). In addition to that, learning is promoted by a positive state of mind (Anderson and Krathwohl, 2001). The situation of increasing student numbers is de-motivating for students for another reason, large numbers mean extended review times, and waiting for their turns can lead to students feeling that they have insufficient tutorial time or tutor interest. All-day reviews are unproductive, as the respondents to Wilkin's (1999; 2000) two studies; 'Reassessing the

Design Project Review' and 'Reviewing the Review' implied; concentration is difficult to sustain and tutors become less effective as fatigue sets in.

2.2.2.3 **Communication Transmission and Management**

As frequently expressed in the literature, the richness of dialogue in the context of design education is a vital component, as it affects the educational outcome and can have a direct impact on the creation of the future architect (Schön, 1987). According to Chiu (2002:189) communication in design is;

> *"the dynamic process in which one person consciously or unconsciously affects the cognition of another through materials or agencies in symbolic ways"*

Within the context of a small group of students and tutors involved in an activity, a key criterion for a successful outcome is their ability to communicate effectively (Kvan, 2000), this is true for the design review as well. This in turn enhances the design review learning outcomes, providing students with knowledge and an improved set of skills. On the one hand, communication transmission and management are two components that affect the way the conversation is shaped and delivered. Schramm (1954) had described the way communication is transmitted in his model of communication, where he added a component which he describes as the '*field of experience'* to represent the influence that experience and context have on the interpretation of information transmitted in a communications enterprise. The sender may have good communication skills, but the receiver may misinterpret the meanings due to problems with interpersonal skills, language, physical conditions, and/ or external noise effects.

2.2.3 Illustration of the Design Review Communication Spiral

From the previous review of the literature on design reviews, it can be concluded that the design review is central to design learning as it affords directions for further learning, promotes a set of thinking skills, and active discussion and negotiation. Furthermore, it provides justification of evaluation and marking for the final design project. Yet, the

dynamics of the design review interaction have not been fully studied in the literature, aspects of the communication content and structure, quality of both criticism and cognitive dialogue, as well as the effects of pedagogical factors on the learning communication need to be further explored. In essence, there is still missing information on the nature and dynamics of interaction in the design review. Putting in mind Herring's (1987) theory of learning interactions and Simpson's and Galabo's (1986) definition of interaction; "*reciprocity in actions and responses*…", it was possible to initially illustrate the design review communication spiral in Figure 2-2, as a first step to analyse the design review learning activity.

Here, the design review is structured based on the activities or tasks involved, this of course relates to the learning objectives of the final design review where the student presents his/her project, and the tutor seeks clarifications within a phase of discussion, and finally creates an assessment of the student's project, and gives a final mark. The numbered tasks in the figure show the order of the reciprocal actions of communication. The activities and tasks involved within the design review communication structure may be divided into three phases:

(1) Presenting and sharing information about the project.

(2) Discussing ideas and clarifying the design.

(3) Evaluation, feedback and final assessment of the project.

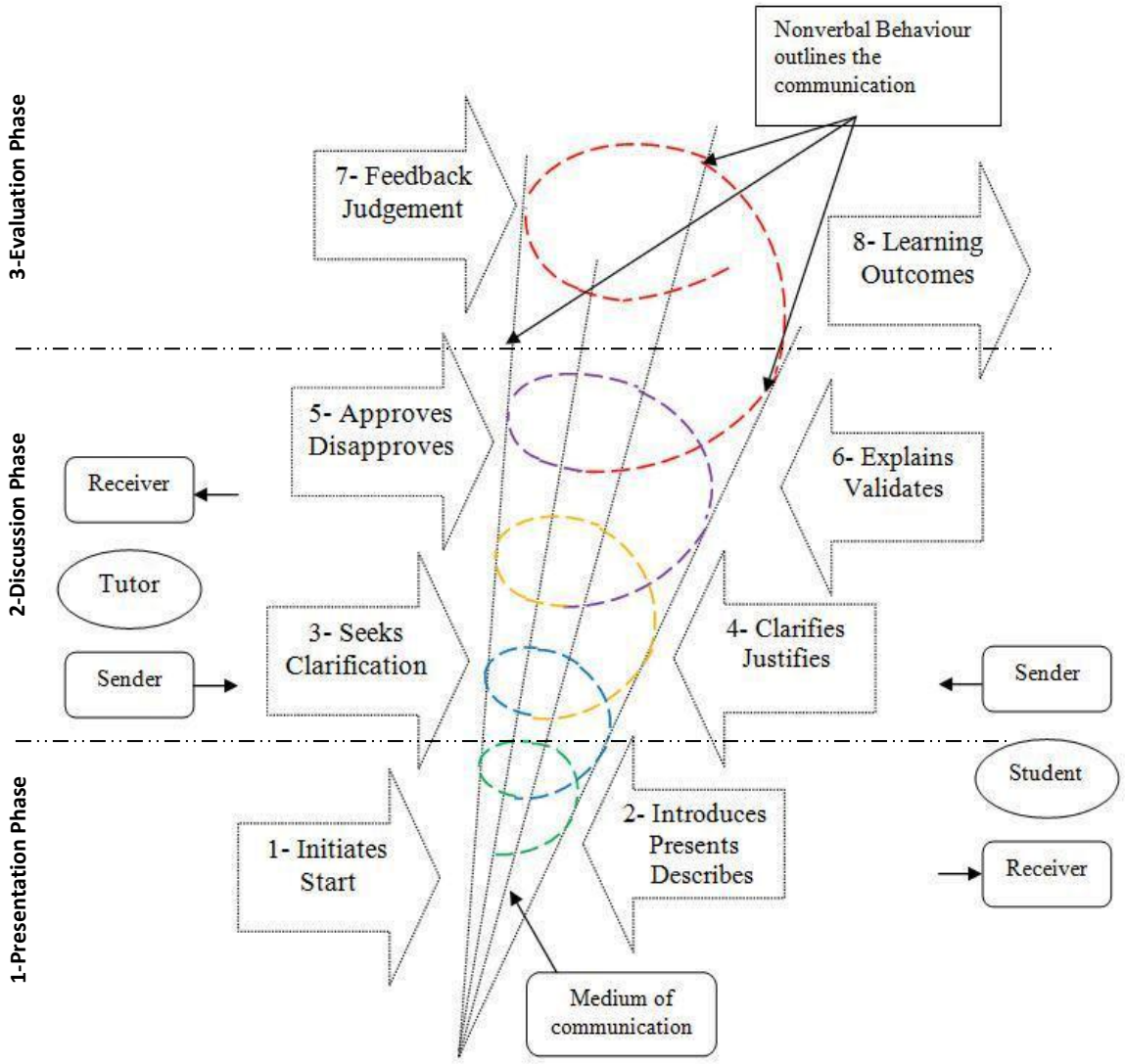


Figure 2-2 Initial Illustration of the Design Review Communication Structure/Spiral

The following section aims to introduce aspects of online learning and how mediated communication is practiced in design learning. In addition it attempts to shed the light on the different communication platforms and why they may be suitable for design review interaction.

2.3 Online Learning in Design

This section explores existing online learning concepts by presenting the different communication platforms and channels of new forms of media needed to communicate verbal and visual messages as well as nonverbal interactions, and how this related to design learning and communication. The learning affordances and shortcomings of new media –represented in this thesis by 3D virtual worlds- are as well reviewed in order to create a picture of how interaction may be carried out in these rich formats, and whether their richness may provide us with an effective design review learning interaction outcome or not.

As the world becomes connected by information and communication technologies the ability and means to transfer, communicate, and collaborate design ideas in more efficient ways in timely manner is increasing. As (Duggan, 2004) put it, '*the real value of education lies in the discourse generated via interaction, and computers support this'*. Although the importance of face-to-face interaction has always been recognised and valued in studio-based education, it is believed that greater acknowledgement needs to be given to the value of computing technology in facilitating online learning.

The late 80's and early 90's ushered in a different view of computers in architecture; first, the computer was no longer seen as a replacement for other things such as draftsmen, hard copy documents and organizations. Second, it came to be considered as a medium, and thirdly as a component and collaborator in the design process in which the computer and the human complement each other's strengths (Reffat, 2005). Recently, the continuous development of computer and telecommunication technologies in hardware, software, and information systems and networks, have resulted in an increased number of remote/ distance interactive design tools aiming at liberating learners from distance and time constraints (Maher and Saad, 1995; Gabriel, 2000; Reffat, 2002; Shiratuddin and Thabet, 2011). This in turn prompted several schools of architecture to employ distance learning in some of their courses.

Interaction in design education can be carried out in two different communication models: asynchronous and synchronous (Maher *et al.*, 2000). On the one hand, asynchronous communication is a non-real time interaction of the participants in which information is exchanged with the use of e-communication tools such as e-mail, mailing lists and newsgroups. In this system, there is no time constraint since the participants do not have to be online at the same time. Thus asynchronous tools enable permanent and continuously accessible communication (Cicognani, 1996). On the other hand, synchronous communication is a real-time interaction of geographically distributed participants. Chat rooms, audio-video conference, white boards can be used for real-time interaction.

Design reviews in almost every architecture school are carried out in direct face-to-face mode; this means tutors and students have to be in the same space (co-located) at the same time. Communication is spontaneous; ideas and feedback are represented, verbally and nonverbally, by talking and using traditional drawing tools. If tutors and students are geographically displaced, as in the case of distance education, the interaction will then be space affected not to mention the probability of being time affected, too. In this case remote communication is conducted either synchronously through the use of video conferencing or sending verbal and graphical representations of designs via messenger programmes, or asynchronously through the use of e-mail, virtual learning spaces, or File Transfer Protocol, etc., hence, losing the interactional aspect of face-to-face communication.

2.3.1 New Media: Richness and Suitability

According to Earle (2001), the term message in online communication refers to a single continuous piece of information that is sent as one unit to the domain or software addressed by the sender, and is subsequently received by the recipient/s. It is important to note that the structure of the message is not based upon linguistic units such as sentences, but a message can contain several sentences and a single sentence may be split over two or more messages. This unit can also be a symbol expressing an emotion like a smile '☺'. When a message is read it is usually seen by a recipient as referring to a previous message

(unless it is the start of a new subject), in this case there is a directional link from the later message to the early one. The term conversation in that sense is used to describe a sequence of messages that have meanings linked to each other in this way. The two main forms of communicated messages in online communication are verbal and nonverbal. Graphical media such as drawings and models are forms of nonverbal communication used and recognised in the context of design learning.

Before the information technology revolution three discrete medium systems existed: the text, the sound and the image. Each was supported by and expressed a whole different technological platform. Information technology has resulted in the unity of all those systems into one, through 'bits'. Fibre Optics has become the primary medium for the transmission of bits (Papadopoulos, 2006). An understanding of Media Richness theory is useful when examining the potential impact of different media types on the communication of different messages. Media richness theory suggests that the medium of communication can be characterized in terms of richness, and that richness influences media choice and the communication process (Daft and Lengel, 1984). Researchers have noted that most users prefer communication media that are rich over those that are lean or poor (Clayton, 2000). A medium may be characterised as rich or lean based upon: (1) the availability of instant feedback or immediacy (Russo and Benson, 2005:55), (2) the utilization of multiple cues such as body language to convey interpretations and feelings (Mennecke *et al.*, 2011); (3) the use of natural language rather than numbers to convey subtleties (Clayton, 2000:42), and (4) the ability to present individual tailored messages that reflect personal focus (Ishii *et al.*, 1992).

Multi-modal communication media produce richer messages that are encoded simultaneously and perceived by the receiver resulting in better understanding and thus meaningful responses (Earle, 2001). Theoretically, the richer the media, the more information it conveys, in other words, a multi modal medium seems to deliver the complete message. A popular view held by many researchers is that adding graphics, audio and video is somehow expected to make the medium more ''real'' (McKay, 2008).

Researches on communication channels in design have introduced experiments using different stages of media richness. Early research studied sharing files through File Transfer Protocol (FTP) and conversing through e-mail in the context of a digital design studio (Wojtowicz *et al.*, 1995). More elaborate experiments have expanded the scope to multiple time zones and complex design teams, and explored additional technologies such as audio conferencing and shared whiteboards to conduct electronic pin-ups or crits since the early nineties throughout recent years; (Ishii *et al.*, 1992; Kolarevic *et al.*, 1999; Anderson *et al.*, 2000; Jabi *et al.*, 2003; Vasques DeVelasco and Zhang, 2004). 3D virtual worlds have been introduced to collaborative design teams and learning (Bellamy *et al.*, 2005; Maher *et al.*, 2006; Ryan, 2008; El Antably, 2010). Communication channels used in various schools of architecture are mainly, audio, video and shared drawing space channel or whiteboards.

Online communication when achieved through the exchange of either text or voice messages may occur so rapidly that communication is considered to be real time. Text messages are typically authored by typing into a text field within the client software, and sent to the server by pressing the enter key or as set, this subsequently sends the message to the recipient instantly. Audio is streamed to participants and heard through speakers or headphones.

Due to the importance of nonverbal communication, researchers have debated whether live stream video is essential for communication and collaboration in design-related disciplines, see (O'Conail and Whittaker, 1997; Olson *et al.*, 1997; Gabriel, 2000; Kalay, 2004b; Maher *et al.*, 2006). Most of those researchers have concluded that there are no significant results that confirm or deny the importance of video streaming in learning interactions. As a matter of fact, the importance of video related to seeing other things rather than the face of the communicator, for example, Gabriel (2000) and Kalay (2004b) both reached a conclusion that there was no real need to see the face of the communication partner via video. Ishii's *et al.* (1992) results, confirmed that seeing the workspace and design graphics is essential to relate the actions of drawing to the design representations and not the face of the communication partner as well. However, Tang (1991) in a number of studies had concluded that seeing the communicators' gestures in

context of the design representation should be a design priority for distributed systems as long as we consider gestures a part of the conversation.

Avatars, which serve as visual representation of the users (Boteva, 2006), may create a representation of the human nonverbal communication channel, as they are controlled by real people in real time, they contribute a human dimension to the creation of a sense of a 'real' learning environment (Davis *et al.*, 2009; Ward, 2010). According to (Johnson, 2006), the fact that the Avatars exist in the virtual world changes the feeling of a discussion by providing the nonverbal dimension to interaction. As Mennecke *et al.* (2011) add, being able to see the person you are talking to -even if through a representation- enables one to sense the presence of others, and makes his/her presence apparent to them.

Other researchers saw that seeing the actual face of the communication partner is important in design disciplines. Thus, for example, to compensate for the lack of facial expressions afforded by Avatars, Rosenman *et al.* (2006) developed DesignWorld which uses a video-embedded agent system that works with a virtual world such as Second Life to show the face of the user in a hybrid interface.

Online communication in design education requires information that is strongly dominated by visual media in the form of images, maps and 3D models with text as an important subset of such data. Although networked computing existed for many years prior to the development of the World Wide Web, it was the development of graphical user interfaces in the form of browsers that enabled mass populations to go online. Without such graphic interfaces, the idea of online participation would be impossible (Maher *et al.*, 2000). Hardware is critical in such communication, computers need to be powerful enough to process pictorial information while networks need to have enough capacity to enable users to communicate quickly (Hudson-Smith *et al.*, 2002). Researchers such as O'Hara-Devereaux and Johansen (1994:411) stress on the importance of looking at the real potentials of computer-mediated communication as face-to-face interaction may not be the ultimate form of communication in all contexts:

> *"Electronic media have already suggested that the face-to-face encounter may not be the ultimate form of human communication for every*

> *situation, though most people are not willing to listen to this lesson. Cyberspace will introduce us to a new range of options, at least some of which will be superior to face-to-face, at least for certain tasks".*

Understanding the characteristics of human interaction and communication is essential to create effective and appropriate online communication spaces; these spaces are the medium that transports codes and symbols between communicators. However these characteristics are just a few aspects of the communication process, (Heiskanen *et al.*, 2001). Communication is considered as symbolic behaviour, as relationships agreed between certain symbols result in shared meanings. Shared code is the basis of this relationship, the more similar the code that the participants are sharing, the more probable is the similarity of the meaning, designing the right tools to convey such code results in delivering the intended meaning or close.

Different media offer different levels of immediacy and interactivity, selection of media for design communication should be based on this criterion. Multimodal interaction provides many benefits over traditional uni-modal interfaces, and as LaViola (1999) explains, providing more than one mode of input; such as speech and gestures. Human computer interaction is, therefore, augmented, because users can interact more naturally and intuitively with multiple modes of input, since this is the way human to human interaction occurs.

Recently, people have gained experience of virtual reality from computer games and multi-user virtual worlds (Wong, 2006; El Antably, 2010). Mennecke *et al.* (2011:414) define 3D virtual worlds as computer-generated 3D spaces with unique affordances for communication activities, the spatial characteristics of such environments realistically simulate physical proximity, which enhances propinquity and fosters rich interaction by allowing users to perform activities collectively via the mediation of their virtual bodies.

These applications of virtual reality are known as Massively Multi-user Online Games (MMOG) which describes a genre of online virtual environments also known as Massively Multiuser Online Role-Playing Games (MMORPGs), Multi-User Virtual Environments (MUVEs), persistent worlds, or persistent universes (El Antably, 2010). Some scholars and

researchers refer to it as Virtual Environments (Minocha and Reeves); (Reffat *et al.*, 2008), where according to DeFreitas and Veletsianos (2010), the term Virtual Worlds is particularly popular within the academic community as well.

The next subsection proposes that virtual worlds may be a new method of communicating at a distance in design reviews, based on the various educational and communicative potentials explored by recent researchers.

2.3.2 3D Real-time Virtual Worlds: A Platform for Design Learning?

Research into the educational use of 3D virtual worlds argues that these environments can be used effectively to support educational instruction and discussion that serves as an extension of traditional classroom environments and as a medium for distance learning (Minocha and Reeves, 2010; Thackray *et al.*, 2010). What motivated this argument was the need to find a single platform that affords to convey an array of interactions that cannot be conveyed in basic 2D learning environments used in many higher education institutes, the most important in nonverbal modes of communication.

So for example, Kalay (2004b) argues that most distance learning programmes in design education are a little more than an organized way of distributing materials in an efficient, electronic way, because the participants in 2D learning environments miss out the rich culture and social phenomenon of the learning experience itself. Unlike text-based environments, 3D virtual worlds provide visual representations of actual environment and users in the form of Avatars and include socio-cultural and perceptual qualities- adds this richness to the learning activity through the social actions it affords and the cultural settings it provides, thus can be used as a constructive element of the learning process.

In a recent report by Kirriemuir (2009) on UK higher education institutions, almost every higher education institute is applying some teaching and learning course in 3D virtual worlds. However according to Thackaray (2010), this only represents active use of virtual world environments for teaching or research by a very small number of staff in each institution. The University of Newcastle among many UK higher education institutions has

started in 2005 to investigate educational potentialities of SecondLife; and have owned a number of islands in the virtual world for academic and research purposes, the university community have promoted to explore in a variety of disciplines, see for example, (Abdellatif and Calderon, 2007; Papagiannidis *et al.*, 2007; Bourlakis and Papagiannidis, 2008; Zhu and Morgan, 2008; Morgan, 2009; Ward, 2010). Therefore, it has become a further interest of the researcher to examine how mediated design reviews can be effectively carried out in this platform and continue research in this venue.

Studies have provided important insights into the pedagogical implications of 3D virtual environments (Minocha and Reeves, 2010). It is revealed that, with some limitations, this technology supports constructivist learning by allowing for the emergence of knowledge building (Book, 2006; Girvan and Savage, 2010; Thackray *et al.*, 2010). There are growing numbers of potential students and just as importantly, an increasing desire to use these tools by a wider range of staff to support new teaching techniques (Choi and Baek, 2011; Wasko *et al.*, 2011).

There are many definitions of virtual worlds, as Wasko *et al.* (2011) describe them; they are computer-synthesised, three-dimensional environments in which a plurality of human participants, engage and manipulate simulated physical elements in the environment, and interact with representations of other humans. MMOGs are Internet-based computer generated environments that allow a large number of users to interact with each other and with the environment. Some are used for social interactions such as 'Second Life' and 'Active Worlds'; others are game-based environments where users interact to achieve structured goals such as 'World of Warcraft' and 'Lord of the Rings. These environments do not pause and users cannot undo their actions which may have consequences that they must deal with. Almost all virtual environments ground their social interactions in a realistic or quasi-realistic representation of space where users are represented as anthropomorphic self-representations called 'Avatars'.

The importance of Avatars comes from their ability to represent human nonverbal communication and add a sense of presence to the conversation. A study on the visual components of nonverbal communication for Avatars in Virtual Worlds was presented by

Nicholas Earle (2001) in a doctoral thesis. He observed the sets of nonverbal communication codes or 'body language' used by Avatars in selected virtual world systems. According to Antonijevic (2008), the repertoire of nonverbal communication provided within the current technological framework of most virtual worlds can be divided into four categories of nonverbal cues:

> (a) User-defined cues are nonverbal acts that the user deliberately performs and individually encodes. These include Avatars' gestures and are carried out by selecting the desired gesture from a pull down menu or by entering a shortcut key in the text box.
>
> (b) Predefined cues are nonverbal acts that the user neither deliberately performs nor individually encodes. According to Earle (2001) these are called 'Lifelike animations' which are techniques used by the virtual world creators to break away from the early static models and give Avatars a greater sense of 'real' life.
>
> (c) Blended cues refer to nonverbal acts that are user selected and system encoded. For example, the user can select to take a seat, but once he or she has done it the system will model the user's sitting posture.
>
> (d) Finally, missing cues refer to nonverbal acts that cannot be executed in the virtual world. However, this category changes with the development of the system (Antonijevic, 2008).

3D virtual worlds such as 'Active Worlds' and 'SecondLife' afford online learning, as Girvan and Savage (2010) claim, of the kind enjoyed by students gathered in a virtual classroom, where they know they are in a communal space, they are aware of the social process of learning, and are affected by the presence and behaviour of their fellow students and tutor. They are systems that support communication and interaction between users, typically these systems run on desktop computers and no other advanced input and output devices are used, hence, the user's expectations rely heavily on the visualisation on the computer screen. These systems however, are easy to learn and use, and according to many researchers have great potentialities for being tools for online group learning and communication.

One of the most popular virtual worlds used for educational purposes is SecondLife, this multi-purpose online virtual world has proven its use beyond being just an entertainment medium (Ranathunga *et al.*, 2011). Using SecondLife in distance education has been the interest of a growing number of educators around the world; for more information of

learning uses of SecondLife, see the works of (Avisthi, 2006; Conklin, 2006; Wankel and Kingsley, 2009; Warburton, 2009; De Freitas and Veletsianos, 2010; Girvan and Savage, 2010; Masters and Gregory, 2010; Shi *et al.*, 2010; Storey and Wolf, 2010; Thackray *et al.*, 2010; Erickson *et al.*, 2011; Wasko *et al.*, 2011). The potentials studied by these works motivated the researcher to carry out the design review in the platform of SecondLife in order to assess the effectiveness of mediated interactions.

Communication in SecondLife is mainly through real-time text and voice chat, the transaction of this communication occurs immediately. SecondLife offers a virtual 3D environment where the presence of each user is visible through Avatars that provide a of what can be seen, they can walk, fly, look around, build, interact and communicate with others in real (Peachey *et al.*, 2010). SecondLife provides educational resources such as (SecondLifeEducation, 2009) and (SimTeach, 2010) which provide links, a wiki and a bibliographic resource for educators using multi-user virtual environments. The company that owns and runs Second Life; Linden Research, are supporting this activity with a campus registration (Linden, 2004) that provides an environment for teaching classes in areas of urban planning, game design, social and business studies.

Focusing on what participants want is very important to designing any type of learning environment, so researchers are now beginning to study the personality characteristics of users who find virtual worlds of value. One type of person who would be interested in communicating through virtual worlds are those who often do not do well in spontaneous spoken interaction (e.g. shy, reflective, more comfortable with emotional distance), but who have valuable contributions to share with others. For these type of people, informal written communication is often more authentic than face-to-face verbal exchange.

As established, interaction is fundamental to knowledge acquisition and with a virtual world we can provide more than a linear 'point and click' progress through pre-prepared learning materials (Granger and McGarry, 2002:13). The virtual environment and the learning activities together provide the realistic environment where academic skills can be grounded in meaningful practice. Therefore, it is necessary to investigate the features that this technology affords to support learning in mediated design reviews. Here we find the

'Affordance Theory' by James J. Gibson's most useful; affordances, as Gibson (1977) conceived them are a direct result of the relationship between the objective physical properties of the environment and the subjective experience of the perceiving actor within that environment and because they focus on relevant properties of the environment, analyses of affordances can directly suggest implications for development design.

According to Gaver (1992:17), affordances are properties of the environment that offer actions to appropriate organisms. Kalay (2004a) has defined affordances of a medium as the medium's capacity to transmit different sorts of information, verbal and nonverbal. In one of the many interpretations of the theory of affordances, Gaver (1992) studied the technological affordances of audio-video technologies as communication media. He looked at the affordances of this media as an environment that has properties similar to real physical environments, and studied the relation between its affordances and the possibilities for supporting communicational interactions. In the same manner, virtual worlds are mediated environments that provide unique affordances and have a potential to support online learning interactions; this is a finding of a number of recent researches such as; (Dickey, 2003; Book, 2006; Warburton, 2009; El Antably, 2010; Masters and Gregory, 2010; Shi *et al.*, 2010; Choi and Baek, 2011; Mennecke *et al.*, 2011). These studies point out vital key features of many 3D virtual worlds that are relevant to interaction in mediated-design reviews, among those are:

- Shared Space: The virtual world allows many users to participate at once.
- Graphical User Interface: The world depicts space visually.
- The Illusion of Space, provided by visual representations of surrounding 3D objects.
- Immediacy: Interaction takes place in real time through an interactive chat environment or sometimes through audio channels.
- Parallel Group Communication: Simultaneously written responses, in the context of text transcripts that prevent speech overlap (Dede, 1995).
- Group Memory: which records all information generated from the group members (Weidong, 2005).
- Interactivity: The virtual world allows users to alter, develop, build, or submit customized content.

- Persistence: The virtual world's existence continues regardless of whether individual users are logged in; this is perceived as ‘asynchronous space,' which allows critics to observe students work before or after the reviews (Warburton, 2009; El Antably, 2010).
- Embodied Interaction: The use of Avatars conveys body language, and nonverbal expressions (Mennecke *et al.*, 2011).
- Presence: provided by subjective immersion that a user is participating in a ‘world’ comprehensive and realistic enough to induce the willing suspension of disbelief (Book, 2006; Masters and Gregory, 2010).

However, According to Chiu (2002); Warburton (2009), a number of typical communication problems in design communication and collaboration using computer-mediated technologies have been observed and recorded. In the context of 3D virtual worlds, the following problems may be most relevant:

- The Media problem: this relates to the capacity of the media to transfer a range of communication modalities. 3D virtual worlds do transfer text, voice, nonverbal symbols and gestures including facial expressions in addition to the virtual environment itself, however according to Antonijevic (2008), many nonverbal cues disappear in the virtual world, but the human user adopts methods to convey his/her message nontheless.
- The Semantic problem: the purpose of communication is the accurate conveying of information. The problem is how to transmit symbols effectively to carry their original meaning without interference from noise factors such interruptions.
- The Performance problem: this problem is related to the users’ readiness and usability of the technology; interface and tools and their willingness to communicate remotely.
- The Perception problem: which relates to how meaning is received through transmitted messages and how it effectively influences behaviour as the sender wished.
- The Technology problem: which relates to the current state of the art of the technology; machine-related client-side issues of bandwidth, hardware and firewalls, to server-side issues of down time and lag, machine crashes, logging on difficulties, and slow uploading of files.

2.4 The Mediated Design Review: A Proposed Learning Technique

In order to benefit from the educational potentials of the currently developing technologies and solve communicational and organisational problems of the traditional design review, this research proposes to explore design review learning interactions at a

distance in 3D virtual worlds. Carrying out the educational recommendations suggested by (Dinham, 1986; Anthony, 1987; Frederickson, 1990; Doidge *et al.*, 2000; Parnell and Sara, 2004) to enhance the design review process, and bearing in mind the potentials and limitations of 3D virtual words discussed earlier, a new distance communication and learning technique is proposed hereby; the 'Mediated Design Review'.

In order to enhance the effectiveness of the traditional design review, Anthony (1987) recommended considering the use of private methods of delivering criticism and using writing techniques to submit comments, this helps the tutor to use the written feedback in determining the students grade, as it helps the student to remember the comments on his work. In virtual worlds, the textual 'chat' communication can be easily saved, so this adds to the potentialities afforded by virtual worlds to support design reviews.

Another recommendation by Anthony (1987; 1991) was that the review jury see the students' projects in a large exhibit and comment on them on general trends and themes. The name of students should not be mentioned, this removes both public defences and the emphasis on knowledge and comprehension at the individual level, thus sparking discussion and participation aiming at higher levels of cognition and learning (Bloom *et al.*, 2001). It also removes the advantages and disadvantages from being the first or last to present a project (Doidge *et al.*, 2000). Again, virtual worlds offer these properties, and may as well be an answer to promoting focused conversations.

It is proposed hereby, that carrying out these recommendations in a 3D virtual world; removing tension of face-to-face reviews, promoting successful exchange of design information through multiple input modalities and getting a written transcript of the review dialogue via saving the chat transcripts may reduce some of the organisational and communicational problems that face some students in the traditional design review. In addition, the reviewed interactive potentials of virtual worlds such as, having a shared space to communication synchronously, using embodied interactions that simulate the human figure and nonverbal interactions, as well as feeling the sense of presence, may add richness to the shared learning interaction between tutors and students in the mediated

design review. The following illustration in Figure 2-3, shows an initial conceptualisation of the mediated design review in a 3D virtual environment.

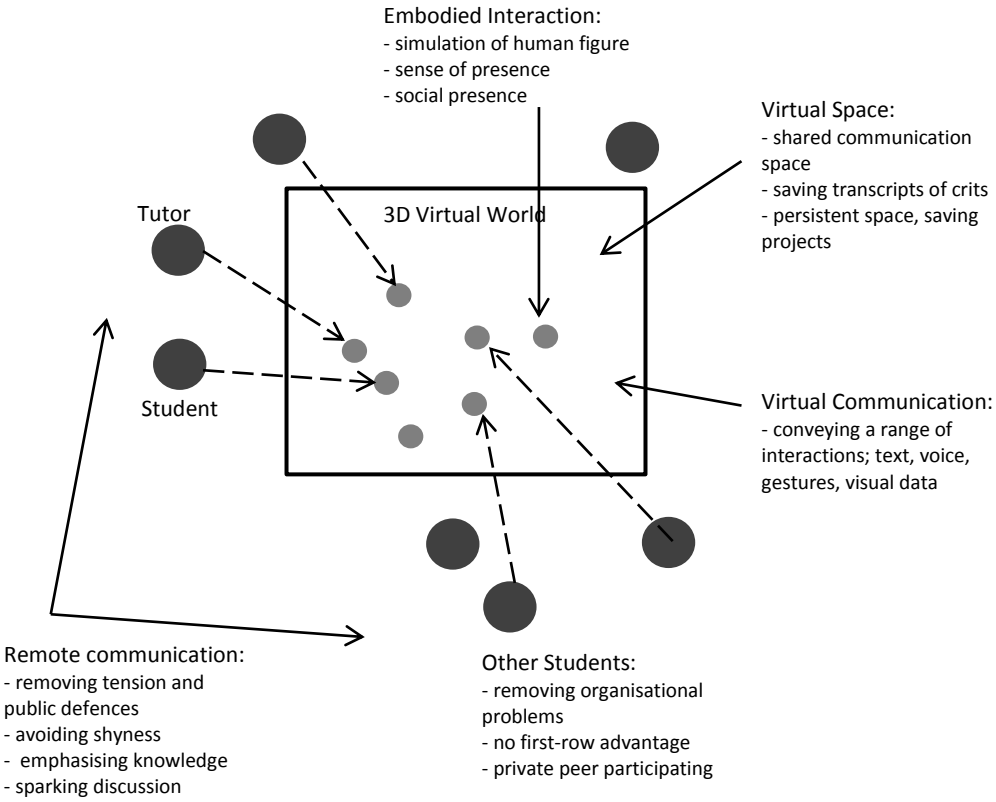


Figure 2-3 Initial Conceptualisation of the Mediated Design Review in a 3D Virtual World (Conceptualised by the Author)

However it can be anticipated that some constraints and shortcomings that come with every technology may affect the learning interaction of design reviews negatively. Whether these limitations are related to the capacity of connectivity and speed of the technology, or medium and modality related constraints, or due to the usability of theses technologies; some of these limitations are managed with practice while and others go down to the state of the art of the used media. However to this end, it is not known how the mediated interaction will be delivered exactly, and how the participants may feel about it, or whether this may affect the learning outcome of the design review or not. Therefore, an assessment

criterion is needed to examine the effectiveness and appropriateness of such learning interaction after an empirical exploration of a number of experimental mediated design reviews. The next chapter therefore looks into different ways to assess the effectiveness of information transmission through this technology, online learning communication, and human-computer interaction, and results in the development of an assessment framework that will aid the data analysis in the later chapters of this thesis.

2.5 Summary

Chapter two has presented the concepts that describe the 'final design review' as an interactive learning and evaluation technique in design education. This chapter reviewed the components that construct the complex process of the design review learning experience. Categorising learning interactions of the design review into (1) learning events, and (2) communication properties, the chapter describes how these elements affect the learning interactions and influence the learning outcome.

The chapter presents a conceptualisation of the Design Review Communication Structure, from theoretical data retrieved from reviewed the current literature. The communication structure of the design review is emphasised upon further in Chapter Four, as part of building the research analytical coding scheme.

Chapter Two then presents the potentials of online technologies to enhance the interaction experience. From the review, it became clear that 3D virtual worlds possess significant educational potential in design-based contexts, due to their unique features; they exhibit a sense of real place in terms of environmental quality and socio-cultural experience through sophisticated graphics which combine different activities and contexts. This gives a good opportunity for exchanging design ideas and drawings at a distance in both text-based and graphic-based communication. This approach to communication and learning has been demonstrated by a number of design educators to be effective, powerful and add to the positive results of many learning scenarios. However, these technologies bear some limitations that may disrupt communication and interaction in the design

review. Unless 3D virtual worlds are tested for effective hosting of different kinds of interaction, immediate dismissal of their potentials is not accepted.

Building on the discussed concepts, the next chapter highlights the properties of the interaction process of the mediated design review as a potential learning technique. It presents a conceptualisation of mediated learning interactions in the remote context, and proposes an assessment framework for examining the effectiveness of mediated design reviews.

Chapter Three

Assessing Mediated Design Review Learning Interactions

Chapter Three Contents

Chapter Three **59**

3 Assessing Mediated Design Review Learning Interactions **63**

3.1 Introduction **63**

3.2 Interaction and Interactivity in Mediated Design Reviews **63**

3.3 Assessment of Learning Delivery **66**

3.3.1 Cognitive Learning 68

3.3.2 Affective learning 69

3.4 Assessment of Information Delivery **70**

3.4.1 Transmission of Information: Mediation 71

3.4.2 Perception of Information: Perception of Meanings 73

3.5 Assessment of Learner-Technology Interaction **75**

3.5.1 Interactions within the Computer Space 78

3.5.2 Interactions within the Remote Context: Remoteness 79

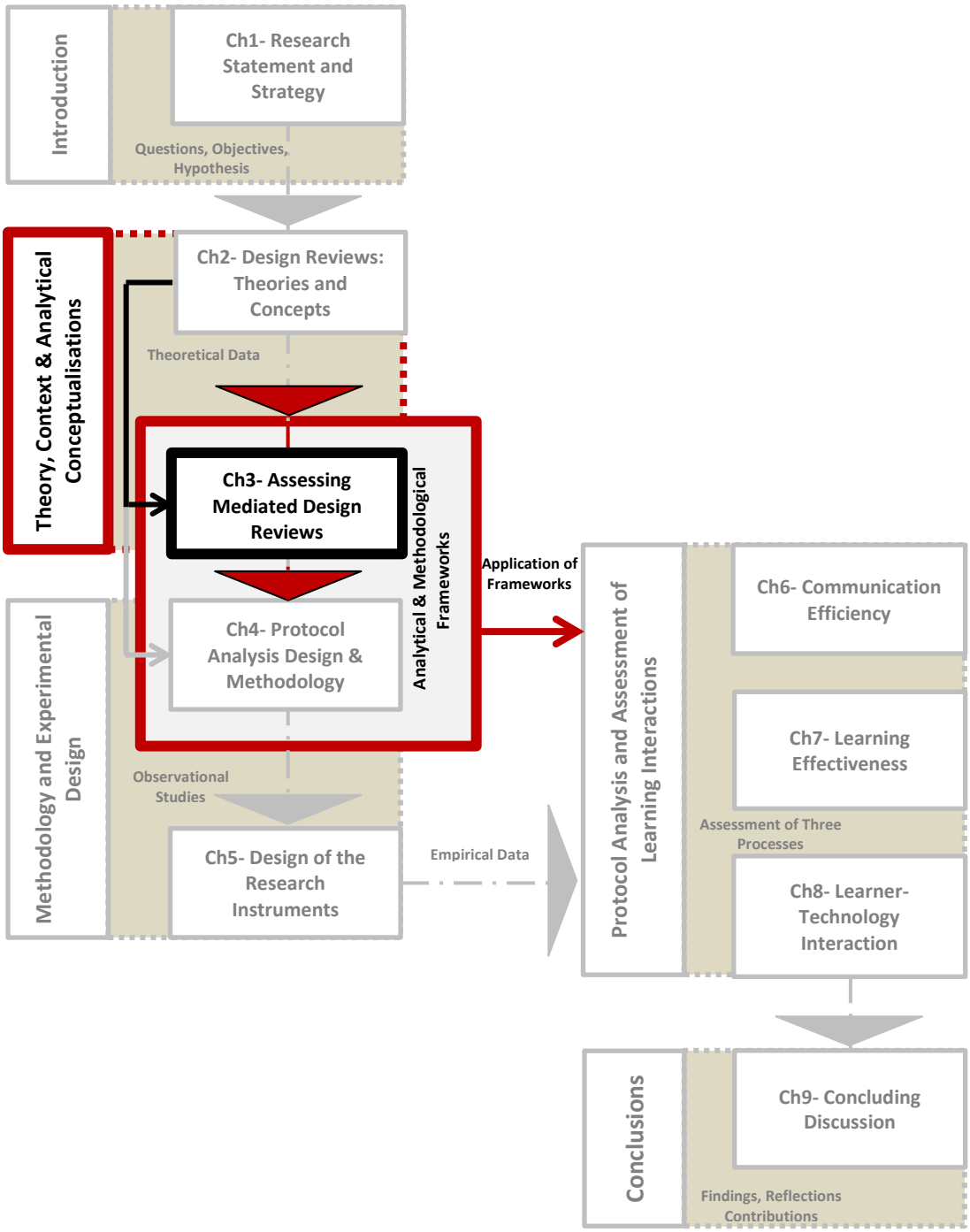
3.5.3 Virtual Perceptions within the Virtual World 81

3.6 From Theories to Conceptualisation: The Research Proposals and Frameworks 88

3.6.1 A Conceptual Framework of Mediated Learning Interactions 88

3.6.2 Assessment of the Mediated Design Review Learning Interactions: A Proposed Analytical Framework 93

3.7 Summary **97**


Introduction
Ch1- Research Statement and Strategy
Questions, Objectives, Hypothesis
Theory, Context & Analytical Conceptualisations
Ch2- Design Reviews: Theories and Concepts
Theoretical Data
Ch3- Assessing Mediated Design Reviews
Analytical & Methodological Frameworks
Application of Frameworks
Methodology and Experimental Design
Ch4- Protocol Analysis Design & Methodology
Observational Studies
Ch5- Design of the Research Instruments
Empirical Data
Protocol Analysis and Assessment of Learning Interactions
Ch6- Communication Efficiency
Ch7- Learning Effectiveness
Assessment of Three Processes
Ch8- Learner-Technology Interaction
Conclusions
Ch9- Concluding Discussion
Findings, Reflections Contributions

3 Assessing Mediated Design Review Learning Interactions

3.1 Introduction

The previous chapter examined the procedures, key components and properties of communication and learning interactions in face-to-face design reviews, in addition to that, it described the properties and potentials of online media, specifically 3D virtual worlds to host mediated design reviews.

Chapter Three builds upon concepts presented in the previous chapter and aims to conceptualise the 'Mediated Design Review' in 3D virtual worlds as a proposed online learning technique. It also aims to create an assessment framework that examines the effectiveness of virtual/mediated design reviews.

By the end of this chapter, the final conceptualisation and assessment model of the mediated design review will be presented (see section 3.6, page 88).

3.2 Interaction and Interactivity in Mediated Design Reviews

Examining the different forms of online interactions has been the concern of several researchers in many disciplines, (Rourke *et al.*, 2001; Picciano, 2002; Swan, 2003; Russo and Benson, 2005). Yet, studies on interaction in design-based online learning situations, specifically the design review, have not been fully developed. Activity theory Engeström *et al.* (1999) suggests that we can only develop our understanding of others through subjective lenses that are influenced by both objective stimuli and subjective interpretation. The important stimuli when communicating in online environments are the activities taken by actors along with contextual factors i.e. media, objects and symbols (Mennecke *et al.*, 2011). Activities consist of verbal and nonverbal actions that involve tools such as the language used to communicate and the body that enacts emotions, expressions and meaningful signals; these all can be considered symbols in context.

Wagner (1994:7) argues that when most online distant educators discuss interaction, their focus is merely on the attributes and outcomes of real-time two way exchange of information in the communication process;

> *"Fascination with what the technologies do, often supersedes the broader issue of learning interactions and dynamics."*

Wagner has also questioned whether to consider online interaction an attribute of learning instruction, or a characteristic of the technology and therefore, she has suggested in (Wagner, 1989) that the term **interaction** functions as an attribute of teaching and instruction and falls under the influence of interpersonal relations, while the term **interactivity** functions as an attribute of the delivery system and the communication context; modes, channels, and transmission. This view approaches interaction as both an outcome and an attribute of the learning interaction at the same time. Figure 3-1 illustrates Wagner's interactive information transport model for online learning.

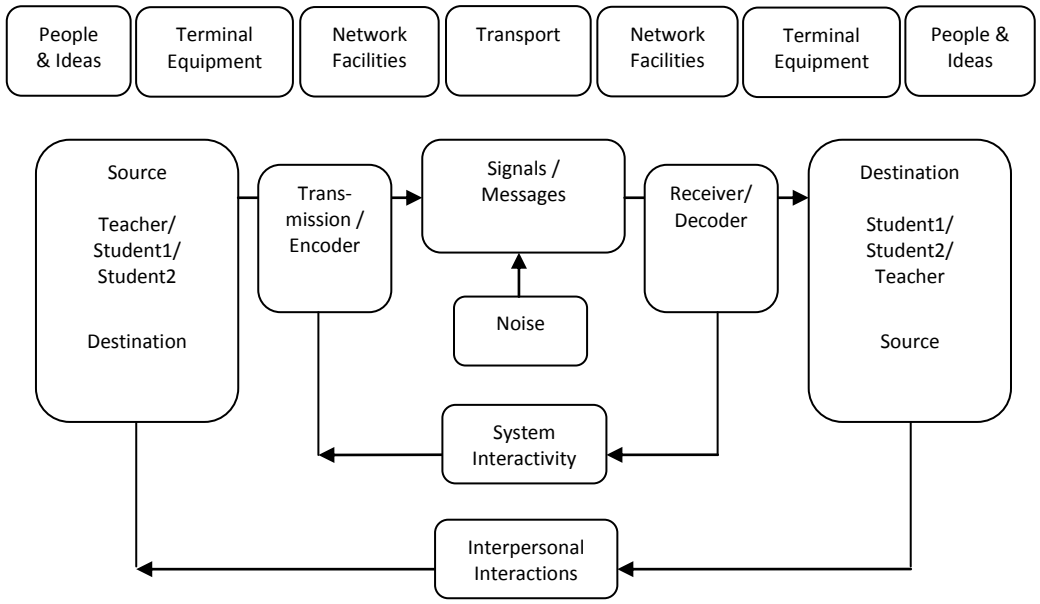


Figure 3-1 Wagner's Interactive Information Transport Model

Source: (Wagner, 1994)

The term *interactivity*, is widely cited in a number of studies defining the characteristics of computing media and online education, e.g. (Salomon, 1981b; Rouet and Passerault, 1999; Swan, 2003; Hine, 2005; O'Neill, 2008), (Rouet and Passerault, 1999). Interactivity

highlights what is unique in online learning and hence the potential for any paradigm change (Swan, 2003). Therefore, analysing online learning interactivity when design reviews are mediated is the focus of this research. Interactivity as such, is a characteristic of media, according to (Shiratuddin and Thabet, 2011), it refers to the interaction between a computer and a user which takes place through the changes of location views, typed commands, voice commands, mouse movements and clicks, or other means of interfacing.

Viewing learning interactions as both an outcome as well as an attribute of the learning situation, we propose that learning interactions and interactivity dynamics consist of the active users (tutors and students) as well as three on-going processes:

(1) Learning Perception

(2) Information Transmission Dynamics

(3) Learner-Technology Interaction

The components of the physical environment as well as the properties of the virtual/remote context play a role in shaping these three processes. Figure 3-2 illustrates this initial concept of interactions and interactivity in mediated design reviews.

Assessing the learning interaction process of design reviews requires carrying out assessment of these three processes collectively, and in context of both the activity and the situation it falls within.

However, reviewing the literature showed that most published studies have proposed assessment models that only examine each of these three processes individually, and separate to each other. The following sections examine components and properties that shape these three processes, as well as the models that attempt to assess their effectiveness. This in turn will lead by the end of this chapter, to a final proposition of a collective assessment framework.

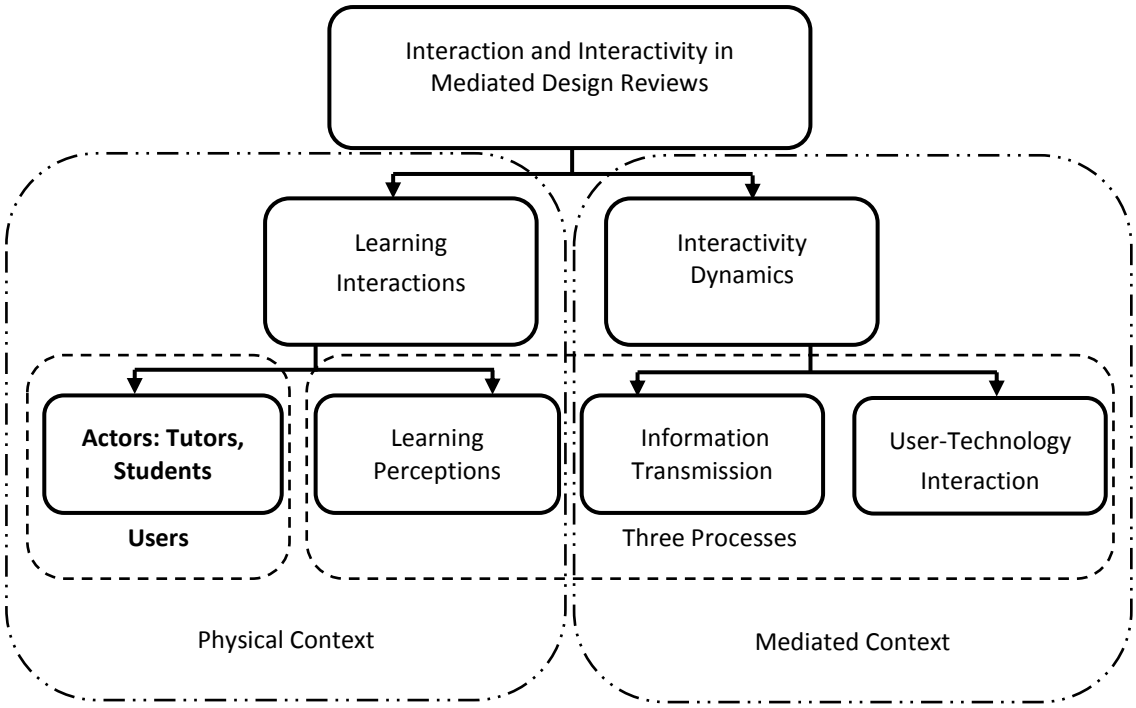


Figure 3-2 Components of Interaction and Interactivity in Mediated Design Reviews (Conceptualised by the Author)

3.3 Assessment of Learning Delivery

The effectiveness of any educational programme can only be sensibly assessed in the context of its learning goals. Bloom *et al.* (1956) define learning goals as "particular knowledge, skills or attitudes that participants should have at the end of the learning episode/s". Therefore, learning goals can be classified into three domains:

- Knowledge: The facts and concepts participants should understand at the end of the learning process.
- Skills: The abilities participants should gain at the end of the learning process.
- Attitudes: The contentment and beliefs participants should possess at the end of the learning process.

Moody and Sindre (2003:14) have proposed as a result of their exploratory analysis, that there is a relationship between knowledge acquisition and skills with short-term learning, and skills and attitudes and long-term learning, this is shown from their model in Figure 3-3. The arrows represent learning interactions.

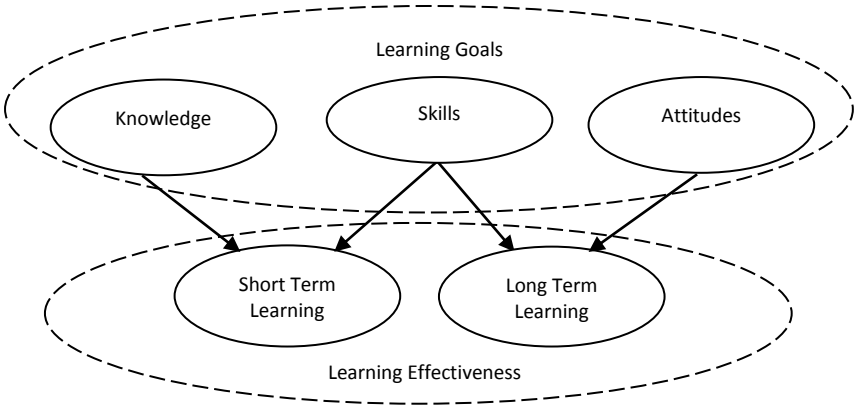


Figure 3-3 Relationships between Learning Goals and Learning Effectiveness

Developed from (Moody and Sindre, 2003:14)

The pedagogical learning system of a design review, as a final milestone in a design project, sets both short-term and long-term learning goals. Long-term learning goals, as reviewed earlier in this chapter, include: (1) focusing on providing critical feedback to the student and making sure that the student has understood the feedback comments for future learning and (2) developing students' presentation skills, as well as other transferable skills such as communication and critical thinking skills, etc. during the presentation and the discussion of the project. A short-term goal is evaluating the project, which requires a very clear reading and understanding of the project to give a justified final mark.

Cognitive learning and Affective learning are used to indicate effective learning interactions (Gunawardena and Duphorne, 2000). Cognitive learning considers short-term goals while, affective learning is used to measure long-term goals. The effective delivery of the design review learning goals is an indicator of the effectiveness of the interaction process, if the interaction system fails to address some or all of the learning goals, then some or all of the components of this system need further developments or amendment. As established before, the aim of this research is not to evaluate whether the students have learnt from the mediated design review or not, but it is concerned with examining to what extent the mediated interactivity process has affected the delivery of these learning goals. The following sections address how the delivery of cognitive and affective learning is perceived to be a result of the learning interaction process, and how they may be measured to indicate the effectiveness of the interaction.

3.3.1 Cognitive Learning

Cognitive learning is the comprehension and retention of knowledge (Christophel, 1990) and is an important outcome in most learning contexts. In the context of design reviews, gained knowledge refers to understanding of tutors critical instructions and feedback, and the re-examination of knowledge as a result of reflection and discussion (Kvan, 2000). This provokes the question, how can cognitive learning be observed or measured in design reviews?

Cognitive learning is most frequently operationalised in research on online courses as both (1) student performance and (2) student perceptions (Russo and Benson, 2005). Student performance according to Picciano (2002:22) is open to many definitions. Depending upon the content of the course and the nature of the students, successful completion of a course, course withdrawals, grades, added knowledge and skill building are some of the ways that performance is measured. Researchers such as Moody and Sindre (2003:5) have concluded that performance-based assessments for evaluating learning effectiveness are preferable on theoretical grounds, i.e. they demonstrate the real improvement in learning as opposed to a perceived improvement.

On this basis, Henri's framework for assessing online learning may be relevant to this research, as it targets interaction performances, but not through traditional achievement tests or grades. Henri (1991b) has developed a qualitative assessment framework to evaluate online education using content analysis of text-based communication transcripts. She has based her assessment method on searching for indicators in the texted-based transcripts that express five dimensions of online learning interaction, (1) participative, (2) social, (3) interactive, (4) cognitive and (5) meta cognitive.

In Henri's framework, the level of knowledge as a form of learning performance is measured by the indicators of cognitive and meta-cognitive statements found in the dialogue. Active student interaction and participation; which is examined by the students' speaking time and their initiative-taking behaviour and leading of the discussion (Weidong, 2005). This method of assessment is relevant to assessing cognitive learning in the

mediated design review, as it makes use of actual statements delivered by the students and observed behaviour which are considered evidence of knowledge among other dimensions of interaction.

Inversely, Moody and Sindre (2003) have concluded, that the perception-based approach to evaluate learning effectiveness is the workable approach to an interaction-based university context, which is also relevant to the mediated design review. Many studies of student performance in face-to-face and online courses, according to (Picciano, 2002), rely on student perceptions of their own learning experiences including 'how well' or 'how much' they have learned. Picciano (2002) has determined that ultimately, student perceptions of their own learning may be as good as other measures because these perceptions may be the catalysts for continuing to pursue coursework and other learning opportunities, hence long-term learning.

Skills as learning goals in design learning are perceived by the student not only in a single design review episode, but are acquired during a long-term period of training and knowledge. Therefore, it is difficult to attempt to measure skills in mediated design reviews. Instead, this research is interested to find out if interaction in the online environment allows the tutor to evaluate the students' skills, and if interactivity in 3D virtual worlds has encouraged the student to learn new skills and/ or discouraged others, hence, the level of criticism must be assessed (Weidong,2005). In addition to students' own perceptions of learning as a valid method of assessing cognitive learning, this research will make use of Henri's framework to examine the cognitive level of learning, which is considered evidence of learning delivery.

3.3.2 Affective learning

Affective learning is the acquisition of behaviours involved in expressing feelings in attitudes; satisfaction, appreciation, and values. In online learning, as it is for traditional learning. Russo and Benson (Russo and Benson, 2005:55) have considered that affective learning represents the development of students' attitudes about: (1) the course, (2) the

topic, (3) the instructor and (4) the delivery system. Hence, these attitudes are indicators of online learning success. Satisfaction is one variable of affective learning.

Satisfaction as an attitude developed within the learning environment has been a widely used indicator to evaluate online interaction effectiveness in both academia and industry (Alavi, 1994; 1995). As for online learning, the effectiveness of learning interactions may depend heavily on learners' acceptance of this new type of learning and communication methods (Chou and Liu, 2005). Moreover, many perceptions the students develop in the learning situation may affect their appreciation, satisfaction and attitudes as well. A number of researches have emphasised on the relationship between feeling a sense of presence in the online classroom and learning satisfaction (Gunawardena and Zittle, 1997; Newberry, 2001; Russo and Benson, 2005; Wheeler, 2005). The emotional learning climate is also an important indicator of learning effectiveness, as according to Alavi (1994) and Chou and Liu (Chou and Liu, 2005). In the mediated learning environments, there is a tendency towards a creation of a positive learning climate and attitudes, hence satisfaction.

Attitudes surveys that target affective learning ask for assessment of a number of items. Based on Chou and Liu's (2005) and Russo and Benson's (2005) researches, attitudes surveys target students' satisfaction with the online delivery system through asking about three indicators. These indicators measure the degree to which the delivery system contributed to their learning experience, the degree to which the online course was more enjoyable than others they have taken, and the degree to which the class was a positive learning environment.

3.4 **Assessment of Information Delivery**

Chute (1987) has integrated media issues with communications issues in mediated learning, where interactivity and direct feedback are seen as keys to communication success (Wagner, 1994). Chute (1987) suggested that various media could potentially serve as the source in a communications enterprise. Chute's work emphasizes the point that the media themselves are simply a means to the end of effectively transmitting information

messages for communications tasks (Wagner, 1994). Here, the effectiveness to transmit visual, verbal and nonverbal forms of information in the mediated design review is addressed, conveying the right meaning is also important. In this section, two communication issues are reviewed (1) how information is transmitted, and (2) how information is perceived.

3.4.1 Transmission of Information: Mediation

The mathematical communication models developed by Schramm (1954) and Chute (1987) have been used to help distance educators conceptualize the dynamics of interactive communication. Based on this, Wagner (1994:24) proposes in her functional definition of interaction, that information needs to be transmitted effectively between the source and the destination. A great chunk of information in the design review is considered visual e.g. drawings and models) and nonverbal (e.g. gestures, facial and vocal expressions, body language, etc., besides the verbal mode of communication. Following Wagner's recommendation and the fact that the tutor-student interaction is more than a sender-receiver mathematical relation, there is a need to ensure that verbal, nonverbal and visual forms of information and meanings are delivered both interactively and effectively to transmit a complete and meaningful design review message.

One of the major objectives of this research is to determine whether interactions can be translated effectively and efficiently into the online setting. For example, when communication is facilitated using a teleconference, research has shown that this method can result in a reduction of social interactions between team members (Gabriel and Maher, 1999) and difficulties in sharing visual information, as May and Carter (2001); Poltrock and Engelbeck (1999) were cited in (Bellamy *et al.*, 2005). The most prominent area of concern is the use of nonverbal cues in virtual worlds. Even when interacting using visual capabilities (i.e. video conference or web cameras), the ability to communicate using nonverbal interactions (body language) can be inhibited (Hoyt 2000). However, the use of technology can hold some advantages when communicating over distance. These

technologies often allow more focused and concise information exchange between team members and assist their adherence to their task (Cleland and Ireland 2002).

Garrison and Shale (1990) have established that the effectiveness of the educational transaction is dependent on the tutor's facilitation of communication and the active involvement of the learner equally. In addition to that, researchers such as (Gero and McNeill, 1998; Gabriel, 2000; Jabi *et al.*, 2003; Sandoe, 2005; Weidong, 2005), state that interaction management and communication facilitation play an important role in ensuring the effectiveness in conveying the meaning of the conversation. Researchers such as (Gero and McNeill, 1998; Gabriel, 2000; Weidong, 2005), have studied the effectiveness of communication in the designing process. They have stated that good management and facilitation of the conversation while ensuring fewer interruptions and good handovers is essential for an effective communication. According to Robinson (2007), the following conversation management procedures should be insured by the tutors for a successful interaction in the design review:

- Inviting students to the conversation.
- Making sure that the students discuss/ show everything they have been working on (they may be holding things back for fear of lack of quality or relevance etc.).
- Handing over the conversation.
- Focusing the information and goals for the coming session.

Gay and Lentini (1995) have examined the communication channels and resources that students utilise during collaborative design activities and then developed a description of what is best for supporting online activities among students. By addressing the communication needs of designers in a collaborative medium, Gay and Lentini (1995) concluded that students need multiple representations of design information to effectively move the design process forward in any computer supported collaborative environment. Heiskanen *et al.* (2001) as well, have concluded that what is necessary for a successful interaction is a system that combines several media and conveys essential information to create the sense of presence and the experience of *being there*. Newberry (2001) also concludes the factors that educators should look for when choosing the right media:

> *"Each media type has its own advantages and disadvantages and each is probably more appropriate than the others in different situations. In fact that is the point of much of the media richness research; one should choose the media type that offers the greatest efficiency and the greatest opportunity for the intended message to be conveyed accurately. In educational activities the choice of media can be influenced by many factors, some of which include, technology availability, time constraints, familiarity with the technology, task appropriateness of the technology and desired outcomes of the learning activity."*

Thus, it is evident that media that makes use of multiple forms of communication delivery, and possesses greater numbers of media objects tend to bridge the distance more effectively; the 3D virtual worlds have all these properties and more. The previous paragraphs examined the technical side of communication transmission, but we must not neglect the human element in that process; this leads us to the notion of perception of information.

3.4.2 Perception of Information: Perception of Meanings

"*Words are only a poor substitute for complex feelings and thoughts*" (DeVito, 1997). According to Kalay (2004a), abstraction that occurs while representing information in a form fit to the media of communication leaves out some of the original information which subsequently must be made up by the receiving party on its own from resources that are not included in the communicated message. Thus proper decoding depends on the ability of the receiver to add the missing information in a matter consistent with the intentions of the sender.

So meanings are the core of human interaction, but sometimes it is difficult to translate these meanings into spoken language or written words, as so many factors are involved in the communication process; such as the communicators' skills, level of knowledge, social background, attitudes, experiences, values, beliefs, feelings as well as the message itself, the media of communication, mutual understanding of codes, and instant feedback, which all contribute in conveying the right meaning (Ehninger *et al.*, 1986). As Heiskanen *et al.* (2001) declare, coding meanings into verbal form is difficult because they can have different denotative and connotative meanings and they can also be represented in

different levels of abstraction. Facial and vocal expressions along with body language and gestures play an important role in the process of encoding and decoding meanings. Therefore, effective integration of both language and nonverbal signals is vitally important in all means of communication (DeVito, 1997).

Communication as Simpson and Galbo (1986:38) establish, can only take place within a common meaning system. The content of a communication must 'make sense' to parties of a communication, if it does not, then there is no communication. Mabry (1993, as cited in Sudweek and Rafaeli, 1996:116) confirms that no matter how rich the information is, the perception of the message is what really matters:

> *"... regardless of the medium--or media mixture--elected for transmitting messages, communicating Information Systems vocabulary-language-and some form of "structure" of symbolic impressions derived from the active use of symbolic expressiveness. A "picture is worth a thousand words" only to those with a thousand words to appropriate for construing the pictorial image. It might only be worth ten words to some people or ten thousand words to some others. A message can only be text +sound +visualization because a message encoder can rationalize (a decidedly linguistic task) the assembly of its components into an explanation of planned message effects. ... Granted, McLuhan (1964) was at least half right in asserting that the medium is the message in that without a medium there isn't going to be a message. But, a more compelling stance argues that meaning resides in people. In other words, the "reality" of a message is a matter of receiver perception and attribution and not sender encoding complexity. The ultimate reality of any phenomenon is its existence".*

Face-to-face interaction is highly advantageous when it comes to immediate feedback, fluency, speed and correct interpretation. New technology can simulate face-to-face communication in terms of spontaneity, immediate feedback, and speed, and could result in an outcome close to spoken language but in a written form, as it will produce spontaneous text that is not polished or revised. Interpretation of the meanings though, may vary according to the communicators' communication skills and shared social backgrounds (Veltman, 2006). In terms of speed and immediate feedback, some people prefer communicating via chat instead of telephone due to their fast typing skills and the opportunity to use abbreviations, which makes it more convenient to them. They create a

shared abstract language, a combination of words and symbols and are widely understood amongst communicators, and therefore meanings are easily interpreted. As Kalay (2004a) explains further, the capacity of the transmitting medium to carry more or less information is its affordance; this affects the abstraction needed to encode the message. The richer the medium is, the more effort needed by the sender to encode and the less effort needed from the receiver to decode the meaning. So, as the reliance on the receiver to fill in missing information grows, so does the potential for the message to be misinterpreted. The design review aims at judging the student's design work. The student delivers his/her work as clearly as possible using the richest media available. Misinterpretation of the design information from the tutor definitely results in an unjustified mark and dissatisfaction with the results.

From the previous review, according to several examinations in the literature, the success and effectiveness of delivering communication depends on a number of factors. Due to such factors, the message may reach the receiver in a way not entirely as intended by the sender. These factors act as a series of meaning-changing filters, an incomplete message is the result.

3.5 Assessment of Learner-Technology Interaction

According to Moore (1997), there are three kinds of learning interactions involved in online learning communication, these include student interactions with (1) the online interface, (2) the tutor, (3) class mates. These types of interactions do not function independently in practice. In a number of their publications Garrison, Anderson, Archer and Rourke, (1995; 2000; 2001) have developed a useful way to think about these three forms of interaction in a learning context. In their Community of Inquiry Model of Online Learning they equate cognitive presence with interaction with content, social presence with interaction with peers, and teaching presence with interaction with instructors; Figure 3-4.

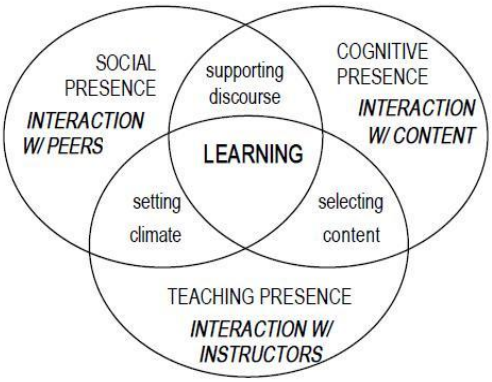


Figure 3-4 Online Learning Interactions

Adapted from Rourke's *et al.* (2001) Community of Inquiry model

In specific studies on developing online learning paradigms, Hillman *et al.* (1994) and Ganawardeena *et al.* (1997) note that new and emergent technologies had created a fourth type of interaction, learner-interface interaction, which they defined as the interaction that takes place between a student and the interface used to implement a particular distance education process. Other studies use the term vicarious interactions, referring to new interactions experienced by the users within online learning environments (Swan, 2003).

Interface as explained by Hillman *et al.* (1994), refers to specific technologies, platforms, and applications students must use to interact with course content, instructors and classmates online and in other distance learning situations, as illustrated in Figure 3-5. Interactions with an interface thus afford or constrain the quality and quantity of the other three forms of interactions (Gunawardena *et al.*, 1997).

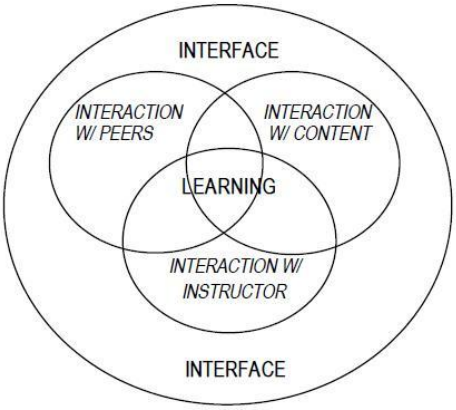


Figure 3-5 Conceptualisation of the Interaction with the Technological Interface Obtained from (Swan, 2003)

Researchers such as McIsaac and Gunawardena (1996) along with Hillman *et al.* (1994) maintain that learner-interface interactions are critical because failure to interact successfully could dramatically inhibit learning. There are many factors that directly influence learning interaction and hence, the delivery and quality of the dialogue between the students and tutors. This means that in a 3D virtual world, students and tutors' perceptions 'within' the learning environment are created in context, and affects the outcomes of the learning interaction directly and indirectly. The same observation is true for students and tutors' perceptions of their shared experiences and representations of themselves as Avatars and of their digital projects, as well as their use of technological tools.

Rourke *et al.* (2001) have considered the learner-interface interaction significance when studying online learning and communication. In the case of communicating within a 3D virtual world as a learning interface, the interface includes more than tools and menus of the software interface. It goes beyond that to include the 3D virtual space where communication happens remotely and involves virtual perceptions and usability. The physical computer and the surrounding physical space must not be neglected, as these components may play a role in the resulting interactions as well. The interface has a broader conceptualisation in this research, it includes: (1) the 3D virtual environment that the users interact inside (2) the 2D interface and tools of the virtual world, and (3) the physical computer parts and the surrounding physical space. This exceeds what Hillman

(1994) and McIsaac and Ganawardeena (1996) have proposed and shown above, 'the learner-technology interaction' is illustrated in Figure 3-6.

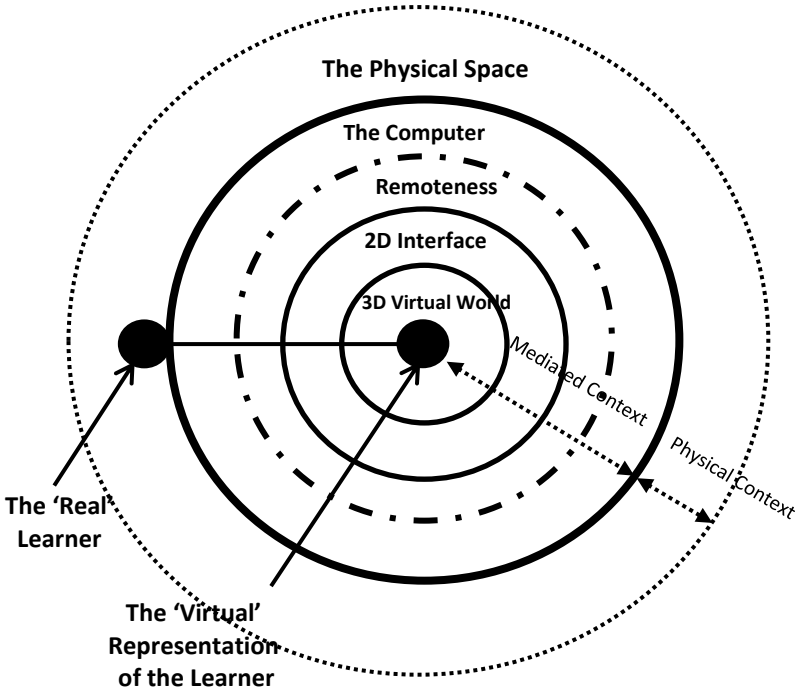


Figure 3-6 Learner- Technology Interaction: Each Circle represents a Layer of Interaction (Conceptualised by the Author)

This study, therefore, examines three interactivity components with the technological environment in mediated design reviews, namely, (1) interactions within the physical computer space, (2) interactions within the remote context 'remoteness' and (3) virtual perceptions and interactivity within the 3D virtual world. The following sections describe current research works that address these three components.

3.5.1 Interactions within the Computer Space

It is important to address that an indicator of learning effectiveness is the learner's attitude towards computers, this is called computer self-efficacy (Chou and Liu, 2005). Based on Bandura's (1986) definition, self-efficacy refers to the learner's judgements of his/her capabilities to attain designated types of performance or to complete a task using computers as (Chou and Liu, 2005) added. As Eastmond (1994) proposes, the term

'Readiness', is the personal and environmental factors that prepare the student for learning and communicating in the online situation. These factors include learning styles, prior learning experiences, computer skills, and interest in the course content. (Harasim, 1990) adds learner attitudes towards interface, motivation, computer self-efficacy and self-discipline. Moore (1997:23) adds that the success of interactivity depends on the will of the people using the medium;

> *"It cannot be said with certainty that any medium, no matter how interactive its potential, will provide a highly dialogic programme, since it is controlled by teachers who might, for good reasons or bad, decide not to take advantage of its interactivity, and it is used by learners who might not be able or willing to enter into dialogue with their teachers".*

On another basis, the relationship one makes with the physical computer is central to the learner-technology interaction. According to (Iordanova *et al.*, 2006), they have seen this in the way users in their experimental research on interpersonal communications in design spaces have started to address the computer as an actor or one of the team. One of Iordanova's *et al.* observations was that verbal expressions can become 'mutated' when working through computers. In terms of dialect; the users' communication transcripts show use of software/ hardware- included terminology (Iordanova *et al.*, 2006:5).

Furthermore, the importance of looking at the interaction within the physical computer space comes from the notion that much of the communication in the design reviews employs nonverbal hand gestures and body language. This mainly is enacted in the 'gesture space' (McNeill, 1992) or 'interpersonal spacing' (Druckman *et al.*, 1982). Therefore, it must be determined, if working on the computer as associated with the mediated online context, how communicators use the surrounding gesture space and whether this may affect the overall learning interactions.

3.5.2 Interactions within the Remote Context: Remoteness

Applying distance learning can affect the way students access and perceive knowledge (Berge and Collins, 1995). Some researchers found that remote connection can be a tool for unlocking discussion and creative thinking as well (Lynch, 2006). For some students;

mediated communication gives the ability to open up when they are not being observed by others; it allows them to participate more without feeling stressed (Lane, 1994). This may be true in the design review context, where many studies have criticised the open jury system where focus from other students and passers-by add to the nervousness of the student (Doidge *et al.*, 2000). However, Michael G. Moore (1989; 1991; 1997) has stressed that remoteness brings a sense of transactional distance to the learning experience. Distant learning also might generate misinterpreting meanings due to miscommunication of words, or nonverbal cues. (Moore, 1997:1) has studied distance education and founded the transactional distance theory:

> *"The transaction that we call distance education occurs between teachers and learners in an environment having the special characteristic of separation of teachers from learners. This separation leads to special patterns of learner and teacher behaviours... It is the separation of learners and teachers that profoundly affects both teaching and learning. With separation there is a psychological and communications space to be crossed, a space of potential misunderstanding between the inputs of instructor and those of the learner. It is this psychological and communications space that is the transactional distance".*

Transactional distance is a construct that addresses all variables of the learning interaction (structure, dialogue, learner autonomy and medium) thus it permeates every educational program as well as addresses each one of these issues (Sandoe, 2005). Hence, distance may not be determined by geography but by the way in which instructors, learners, and the composition of the learning environment interact and affect one another and construct a shared understanding (Moore and Kearsley, 1996).

Another important observation is emphasised by (Erickson *et al.*, 2011) when they received feedback from participants in their experiment in a virtual worlds conference, about real-world interruptions that happen because the participants appear to be present in their homes or workplaces, and at the same time present in the virtual conference, which made confusion to them and the real-world interferences unless highly committed. Thus, remoteness has advantages as well as disadvantages in the learning context.

3.5.3 Virtual Perceptions within the Virtual World

The Activity Theory developed by (Vygotsky and Cole, 1978) suggests that humans and their actions can be best understood when the observer understands the nature of the context where the interaction occurs and when the social actors engage in shared goal-directed activities (Engeström *et al.*, 1999). Students and tutors engaged in communication in an online learning environment such as virtual worlds, experience interactions differently due to the unique characteristics and properties the environment affords or constrains. The sense of being 'virtually represented' in a 'virtual representation of the world' communicating with 'virtual representations of other humans', brings new experiences and perceptions that are different to those in traditional learning interactions. Accordingly, as expressed by various studies, the spatial properties of the 3D virtual worlds, i.e. Second Life, and the use of Avatars specifically, create a sense of presence and immersion, which influences how learning interactions are carried out. An objective of this research is to examine the employment and appropriateness of embodiment and other virtual perceptions in the learning context of mediated design reviews. Therefore, this section focuses on what the current literature presents on the notions of perception of presence and place in the virtual learning environment, what embodiment 'Avatar representation' brings to the interactivity process and which elements of these virtual perceptions may influence creation and delivery of the learning interaction.

- **Presence**

As current research highlights, presence is a concept that is multidimensional and encompasses multiple literatures. Because 3D virtual worlds, which are studied here, are non-immersive environments and do not involve using sensory devices that give real senses of touch, smell, etc. and thus simulation of presence, the focus in this study will be primarily on the psychological perceptions of presence. So, what does it mean to feel as if you are present in a place while communicating with another person? A question that has interested scholars studying information and communication technologies (ICT) for more than three decades such as (Short *et al.*, 1976; Daft and Lengel, 1984; Walther, 1995). They try to determine how best to align communication technologies with organizational and

social needs. Fundamentally, communication is a joint activity that requires two-way interaction and a sense of presence between two or more social actors.

Social Presence Theory (SPT) was developed by the social psychologist John Short (1976). Social presence most frequently has been considered predominantly a characteristic of a communication medium (Russo and Benson, 2005). Measuring presence as a function of the medium however, does not account for context, task, experience, or individual differences (Picciano, 2002). Recognizing the limitations of media-based conceptions of presence, scholars present alternative definitions. For example, Leh (2001) describes social presence as the degree to which a person feels 'socially engaged' in a mediated situation. Wheeler (2005:3) uses the term "*absent presence*" to describe an illusion created by the human mind's ability to manufacture feelings of connection and interaction even when separated by distance.

According to Wheeler (2005), presence, represents the perception or the illusion that one is communicating with people rather than with objects inside a place rather than a technological medium. To achieve this feeling, the actors must possess an acute awareness of self, others, verbal and nonverbal cues, the place, and the context (Krauss and Chiu, 1998). The literature also suggests that perceptions of presence and co-presence are affected by various factors, including the embodied form of the user in the virtual environment (Schroeder, 2002; Biocca *et al.*, 2003). Most forms of communication aim to exchange information through either verbal or nonverbal acts that are mediated by the bodies of the social actors. ICT is commonly designed to support communicative acts that are derivative of and based on stimuli present in proximate, face-to-face or, body-to-body communication (Mennecke *et al.*, 2011). Warburton (2009) identifies three presence layers in virtual worlds, SecondLife particularly; as shown in Figure 3-7, these layers are:

- The physical presence layer is composed of a visual element, where Avatars can see each other through the default camera point of view, the main window on the 3D setting, and a geographic element, where the location of other avatars in-world can be tracked using the in-world 2D maps. Physical proximity also allows Avatars in-world to see physical gestures, poses and any animations.
- The communication layer offers several channels for interaction from synchronous voice and instant messaging (IM) to asynchronous mechanisms,

such as an in-world group notification system and the connection of IM to an email account.

- The status layer provides minimal information about in-world presence indicating when avatars are logged into SecondLife or are away.

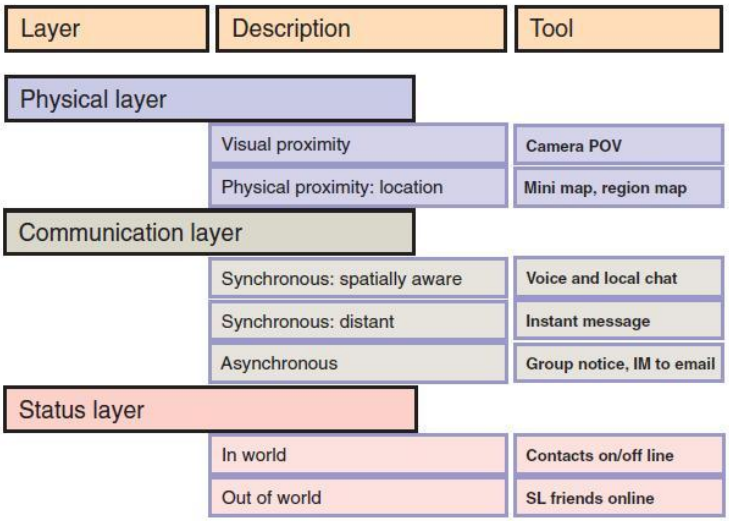


Figure 3-7 Three Layers of Presence, from (Warburton, 2009)

- **Embodiment as a Tool for Interaction and Perception of Presence**

The motivation for embodying users in a communicative system becomes clear when we consider the role of our bodies in everyday interaction. The Avatar, as an embodied representation of the social actor, is the nexus of communication (Mennecke *et al.*, 2011:433). Schroeder (2002) has examined the interactions afforded by Avatars in virtual worlds in a social context, and has established that Avatars are tools of presence as well as tools for interaction. This is also confirmed from the previous diagram of layers of presence by Warburton (2009), as it shows the status of the Avatar indicating the users' presence. Within virtual environments all verbal and nonverbal communication acts and cues are filtered through this embodied representation of the user. One of the Avatar's affordances is the ability to enact nonverbal messages. Most Avatars in popular virtual worlds are capable of animation and can perform a few basic gestures or facial expressions, such as, pointing, waving or nodding their heads. Lip synchronisation and some facial expressions indicate who is speaking in some advanced virtual worlds. Their appearance is open to manipulation and may indicate information about the users.

The theory of Embodied Social Presence (ESP) developed by Mennecke *et al.* (2011) provides a framework that is useful in extending theories of presence by focusing on embodied interactions and engagement with other social actors in a shared activity, as driving forces that shape users' perceptions of presence and co-presence. It was found that theories related to co-presence pay little attention to the role of activity-based interaction and embodiment and thus miss the deeper sense of engagement that is developed through joint interactions that are substantive and goal directed, such as learning interactions. Mennecke's *et al.* (2011) theory of Embodied Social Presence posits that when social actors experience this higher level of embodied interaction and when there is a meaningful shared activity-based interaction process going on, they encode, convey, and decode individual and collective communicative acts more effectively.

The ESP theory suggests that a communicative act in a virtual environment builds on the embodied sense of self and is realized through co-participation in a particular context that is defined, in part, by the symbolic meaning associated with the space that is shared and tools that are used. ESP theory is, therefore, useful when examining the mediated design review as an activity-based form of communication that requires engagement in dialogue between the tutor and the student. 3D virtual worlds posses properties that afford the feeling of embodied presence, and therefore the relevance of using such environments in mediated design reviews depends on the range of presence sensed by the users.

- **Presence and Place**

One of the common themes associated with presence and co-presence is the idea that the user is present with someone else in a place. Therefore, place is relevant to the concept of presence and to understanding how people respond to virtual environments (Bowman & McMahan, 2008). In fact, a close look at the affordances of virtual world environments highlights two unique characteristics compared to other media: (1) the availability of a shared virtual space in which avatars, objects, actions, and higher-level associations e.g., meaning associated with a place can be created and manipulated (Mennecke *et al.*, 2011:416) and (2) selective temporal persistence i.e., places and objects remain when the user departs from a virtual locale (El Antably, 2010).

In this sense, it is clear that the place is important in framing a context for shared activity in a virtual environment. This is because place-based features in virtual environments are similar to those features we associate with real-world places, for example, a simulation of a physical place to convey meaning it represents to the users. As such, the concept of place creates a structure where the milieu of place-based features creates a richer mix of perceptual associations than one would expect if one simply considered a virtual space as a virtual geographical location (Hinds and Kiesler, 2002:380). Furthermore, when the visual properties of the virtual environment create a sense of realism, a sense of presence in that space is developed, and the opportunity to share that space with other users exists, as Mennecke *et al.* (2011:425) suggest, this allows them to experience high order perceptions of embodied co-presence.

- **Presence and Learning Interactions**

There is much urgency to understand how perceptions of presence and co-presence are mediated and impacted by new media and communication tools including 3D virtual environments and their unique affordances i.e. avatars, shared spaces, and activities. Through interactions with other actors in a virtual environment, individuals perceive their own actions as more engaging, dynamic, and satisfying; learning interactions are considered among those as well (Csikszentmihalyi, 1997; Biocca *et al.*, 2003; Davis *et al.*, 2009; Mennecke *et al.*, 2011).

In mediated learning environments, the importance of feelings of social presence and of tutor immediacy to increase learning interaction have been demonstrated often in the literature; (Gunawardena and Zittle, 1997; Newberry, 2001; Rourke *et al.*, 2001; Picciano, 2002; Stein and Wanstreet, 2003; Russo and Benson, 2005; Wheeler, 2005; Warburton, 2009; Peachey *et al.*, 2010). The communication behaviours that students enact in an online learning environment contribute to other's perceptions of them and to the overall learning dynamic (Russo and Benson, 2005). Text-based communication media, with its lack of nonverbal and non-textual cues, is considered by some researchers to have less potential to evoke social presence than visual media such as video conferencing. This is based on the assumption that social presence is best established when verbal and

nonverbal cues are present together in a transaction between two or more separated individuals (Stacey, 2002). This brings us back to the media richness theory. There is evidence that a high proportion of socio-emotional communication can be conveyed in text-based communication media despite its poorer visual affordances (Rice and Love, 1987 as cited in Sudweeks and Rafaeli, 1996) such as email. This depends on the development of shared understanding of meanings between communicators with similar background knowledge and experiences.

Researchers such as (Picciano, 2002) have also investigated the relationship between students' perceptions of their own online presence, and the effectiveness of the learning communication. Gunawardena and Zittle (1997) have concluded that there is a correlation between learner's feel of satisfaction, as an indicator of affective learning, and their feeling of presence in the learning environment. Russo and Benson (2005) have also found that there is a positive relationship between learners' feelings of presence as a component of online interactivity, and the degree of both cognitive and affective learning in instructional-based online courses.

This research looks at the learning interactions and attempts to find out how these interactions may be affected by the users' perceptions of the virtual environment including their sense of presence and embodiment. It is important, however, to make clear that this inquiry does not aim to measure how present the users felt, but rather, it tries to assess whether being in a presence-stimulating environment such as 3D virtual worlds, affects positively on the creation and delivery of the mediated design review communication.

- **Viewpoints**

Another theme to explore is viewpoints as indications of other user's information perception. Body images convey a sense of their on-going activity, for example as Benford *et al.* (1995) imply, position and orientation of the user in the virtual world can indicate which activity that user is doing and which data he/she is accessing. This information is important in co-ordinating a learning activity and encouraging awareness and co-presence. Conveying activity can also be represented by other user's viewpoints. A viewpoint

represents where in space a person is attending and is closely related to the notion of gaze direction, and understanding the viewpoints of others may be critical to supporting interaction (Benford *et al.*, 1995) i.e. in controlling turn taking in conversation or in providing additional context for interpreting talk, especially when spatial-deictic expressions such as there or here are uttered. Furthermore, in face-to-face communication, humans have the ability to register the rapidly changing viewpoints of others at a fine level of detail such as tracking the movement of other's eyes even at moderate distances (Earle, 2001). Previous experimental work in the domain of collaborative designing has shown the importance of conveying users' viewpoints (Shelden, 1997; Salem and Earle, 2000; Earle, 2001; Chiu, 2002; Iordanova *et al.*, 2006).

- **Virtual Proximity**

Spatial proximity is a powerful perceptual organising principle and one of the most useful in design, and because of proximity relationships, we perceive things accordingly (Ware, 2004:189). In a social learning context, proxemics is the study of personal space, a field founded by Edward T. Hall (Cheyne and Efran, 1972). Personal space may be defined as an area with invisible boundaries surrounding an individual's body which functions as a comfort zone during interpersonal communication, violations may result in adverse and emotional reactions (Short *et al.*, 1976; Jeffrey and Mark, 1998; Becker and Mark, 2002). It focuses on the societal use of space to attain comfortable conversational distances and obtain preferred levels of interpersonal involvement. A number of researchers have questioned whether the sense of personal and social space known as virtual proxemics might also exist in virtual environments as it does in face-to-face interaction (Cheyne and Efran, 1972; Jeffrey and Mark, 1998; Jeffrey and Mark, 1999; Schroeder, 2002).

To this end, the previous discussions have presented an initial understanding of the effectiveness of mediating learning interactions in general, focusing on the components of learning interactions, and attributes of potential media. The aim of the final section of this chapter is to draw a conceptualisation of the mediated design review, specifically using 3D virtual worlds in order to achieve effective learning, and how this learning may be assessed.

3.6 From Theories to Conceptualisation: The Research Proposals and Frameworks

Virtual design reviews using 3D real-time virtual worlds afford a virtual platform that acts as a three dimensional communicative interface and at the same time provides virtual representations of the self, others and the environment. Based on the conclusions of (McIsaac and Gunawardena, 1996; Kahveci, 2003; Mennecke *et al.*, 2011), the medium of communication creates a distinct and unique interactional experience for students. Kahveci (2003:12) states that;

> *"There is no surprise that human cognition has many dimensions that influence the way the learner interacts with content and communication medium".*

Furthermore, mediated representations of communicated information, along with the virtual experiences afforded and presented by the medium of communication, affect the way communicated information is constructed, delivered and understood. As a result, it can be proposed here, that the computer-mediated learning process is a form of human interaction combined with media interactivity. These two processes emerge from the nonlinear, multidimensional and complex dynamics of the involved humans' psychology and cognition falling under a number of pedagogical influences, along with their interaction within the media of communication, all together.

3.6.1 A Conceptual Framework of Mediated Learning Interactions

After reviewing the literature from a range of disciplinary backgrounds which include the design review as a method of design learning, 3D real-time virtual environments as computer-mediated communication platforms in design, interactivity in online learning, and learning interaction effectiveness, it is possible to claim that learning, as an interactional activity, in face-to-face design reviews has not been fully analysed in the current literature. It was, therefore, not possible to locate assessment models that study effectiveness of learning interactions, let alone mediated interactions where virtual perceptions affect the way information is transmitted and more importantly, perceived.

However, it was possible to build a picture of the multi-dimensionality of mediated interactivities and how they may affect the mediated design review learning interactions. The challenge here is to draw on these initial understandings to produce a conceptual framework that attempts to link aspects of interaction and interactivity in 3D virtual worlds together to explain how properties of mediation, virtuality and remoteness affect the learning interactions, and reveal which aspects of this type of media may cause transactional distance and which aspects can be advantageous to the learning process and enhance its effectiveness.

Drawing upon Wagner's (1994) Interactive Information Transport (shown previously in Figure 3-1), and our perception of learner-technology interactions, the learning process of mediated design reviews in 3D virtual worlds, is conceptualised in the framework illustrated in Figure 3-8. This conceptual framework shows that the learning content and interactions of the design review is a result of interactions inside and outside the virtual world, and affected by a number of factors.

This research proposes that learning interaction happens within two contexts, looking at Figure 3-8, the inner circle represents the mediated context, in which the mediated design reviews takes place; this contexts can be described as: mediated, virtual and remote. Hence, each of these three properties describes the nature of the resulting interaction and affects the way users perceive information and view the learning situation.

The surrounding physical environment, on the other hand, includes a greater number of components. As reviewed earlier, these are (1) personalities of the communicators, (2) pedagogical factors, and (3) environmental conditions. Though relevant to the inquiry of this research, not all factors are in the scope of this investigation due to limitation of time and resources to address this wide variety of variables. Therefore, the focus of this research is to study the impacts of the virtual/remote context of the learning interaction. However, some pedagogical factors such as the academic levels of the students, the type of projects, and some interpersonal communicative attitudes will be examined, too.

Figure 3-8 also shows that the computer as a physical component, yet a tool for mediated communication, and falls on the border between both contexts. This research aims to explore the components of this framework and determine how this paradigm shapes the learning interaction outcomes.

In more detail, the conceptual framework identifies the two major dimensions of mediated interaction in the design reviews; learning interactions and interactivity dynamics. Sub-components and factors of these two main processes have been initially conceptualised and categorised in the diagram shown in Figure 3-9.

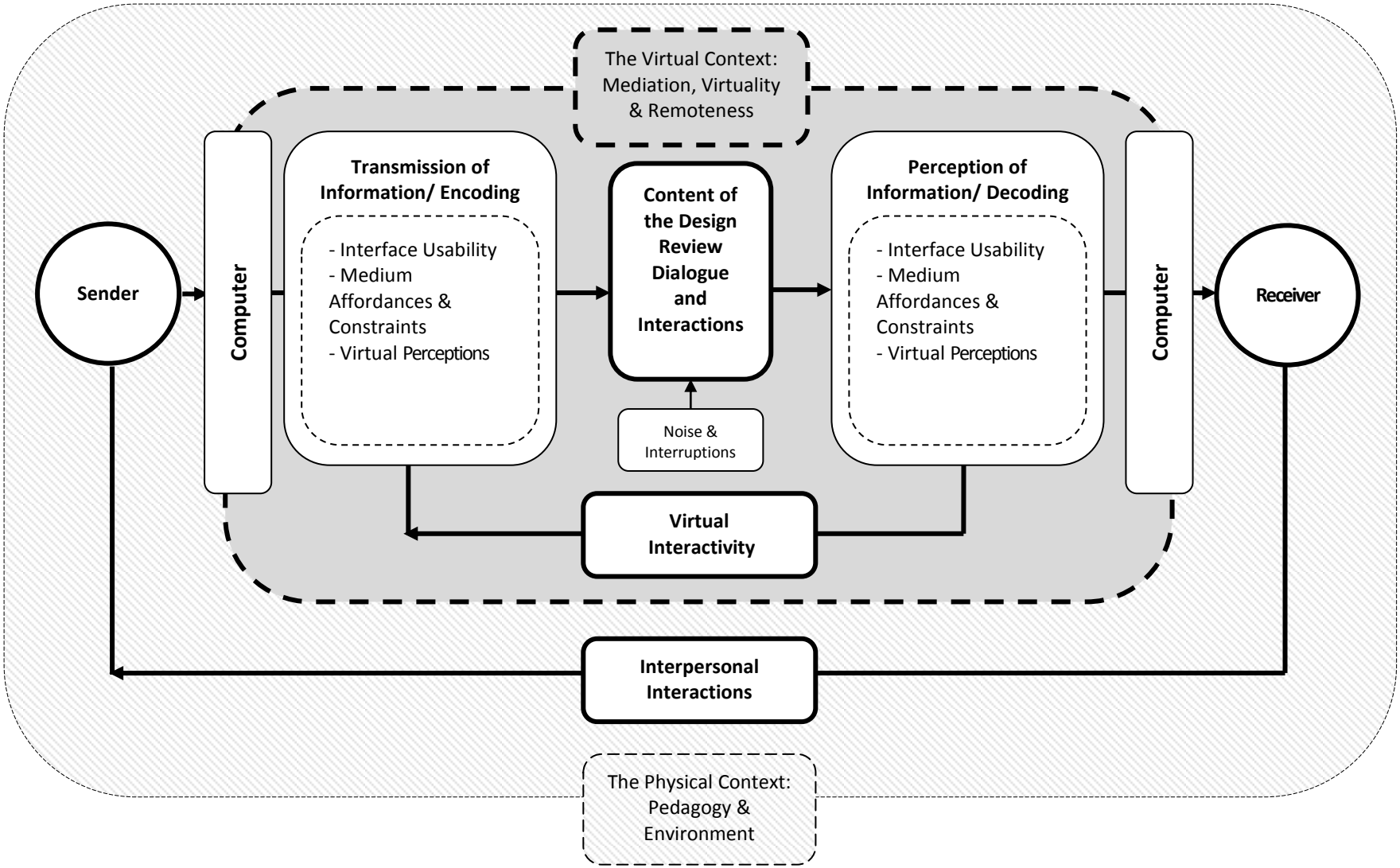


Figure 3-8 A Conceptual Framework of the Learning Process in Mediated Design Reviews

(Based on the Author's Conceptualisation of Wagner's Interactive Information Transport Model)

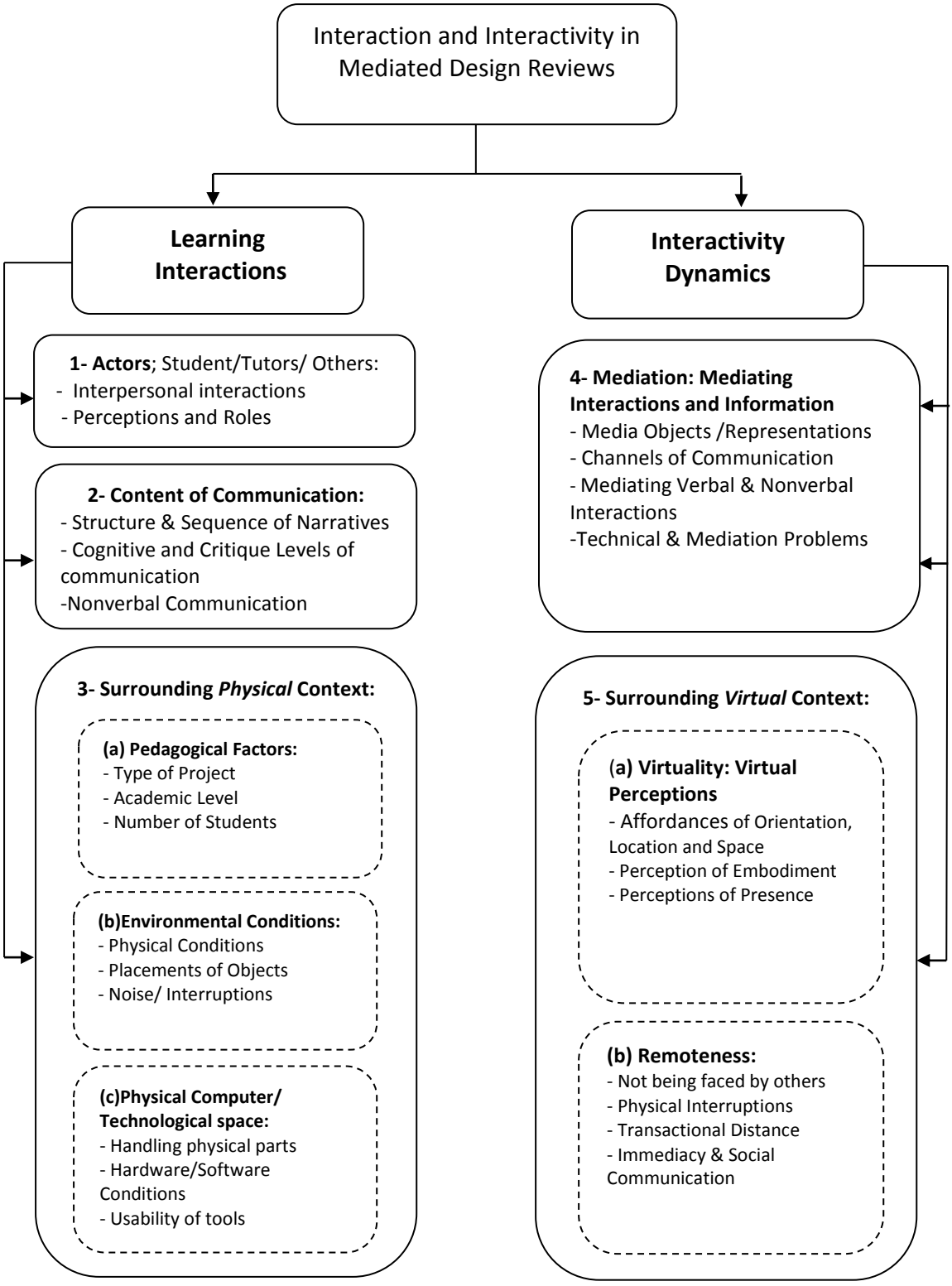


Figure 3-9 Conceptualisation of Interaction and Interactivity in the Mediated Design Reviews

(Conceptualised and Categorised by the Author)

3.6.2 Assessment of the Mediated Design Review Learning Interactions: A Proposed Analytical Framework

Increasing numbers of online courses are developed for delivery via the internet, pressure grows to identify components of online learning environments that contribute to the success of the learning interaction and as a result, deliver effective learning. However, and mainly due to the multi-dimensionality and complexity of the learning interaction process, it was not been possible to locate a standard instrument to evaluate or measure online learning interaction effectiveness for interactional graphical-based disciplines such as architectural design. Many studies cited in the previous review of the literature, have focused on assessing separate components of the learning interaction process individually.

For example, some have presented methods to evaluate learning and knowledge perception and student performances in online learning environments such as the work of (Moody and Sindre, 2003; Chou and Liu, 2005; Wankel and Kingsley, 2009); focusing on the learning outcome rather than the process by measuring learning satisfaction and cognitive learning. While other studies have evaluated the usability of interfaces and software, presenting technical infrastructures of 2D online learning environments (Newman *et al.*, 1997); of which some related to 3D virtual worlds, such as the work of (Conklin, 2006; Warburton, 2009; Shi *et al.*, 2010) but have not looked at the interactional aspects of verbal, visual and nonverbal communication.

Another set of studies have criticised media limitations that lead to poor information transmissions and thus communication frustration among learners such as the works of (Sclater *et al.*, 2001; Jabi *et al.*, 2003), neglecting how users accommodate to create a shared understanding of their messages. And other studies; (Picciano, 2002; Russo and Benson, 2005) have examined virtual experiences such as presence, identity and immediacy in online learning environments and their relation to cognitive and affective learning. While Mennecke *et al.* (2011) focused in their work on the effects of embodied presence, Avatar impersonation, specifically, on affective learning and learning satisfaction. However, a very few studies; (Weidong, 2005; Iordanova *et al.*, 2006; Tang *et al.*, 2011), were found in the existing literature on design learning and interaction that attempt to

assess the effectiveness of communication of online learning in the design studio using interaction-based assessment methods, yet they have not presented a holistic approach of assessment as such.

Educators must explore the complex interrelationships between all components of the learning interaction; the learning task, media attributes and the learner's cognitive and affective processes (Gunawardena and Duphorne, 2000). This research supports the previous statement; however, assessing the delivery of the design review learning goals is quite difficult, as each of them is understood to be a multivariable phenomenon affected by personalities, experience, communications skills, time available for presentation, teacher effectiveness, interpretations, willing to develop skills, among a long list of variables. Therefore, it is necessary to make it clear that this research is not concerned to assess the perceived knowledge itself, but rather, to examine the effectiveness of interactions in mediated design reviews that *may or may not* support the delivery of those intended learning goals, by locating indicators of successful perception of learning.

Furthermore, in order to examine the research conceptual framework, and determine the effectiveness of the mediated design review learning interaction as perceived in a 3D virtual world in this thesis, a criterion for assessment is proposed. This criterion is designed based on theories of social communication, learning effectiveness assessment, technology-mediated learning literature, and design review pedagogy theories. It combines a set of qualitative measuring methods extracted from the current literature and relates them in the context of mediated design reviews. These methods are a combination of content and interaction analysis, direct non-participant observations and users' perceptions and attitudes towards their learning and communicating experience.

As mediated learning interactions occur in a combination of experiences in both physical contexts and virtual contexts, it is therefore necessary to include all aspects of this multi-dimensional process when exploring the effectiveness of the learning interaction. As a result, the proposed assessment framework examines indicators of effectiveness of three components, which represent all together, the final outcome of the mediated learning

interaction; these three processes are illustrated in Figure 3-10 where aspects of investigation are linked with the existing literature.

(1) The communication efficiency; (delivery of information) which is indicated by:

(a) the success of the delivery of verbal and nonverbal information

(b) the preservation of the sequence of the design review narrative

(c) successful management of communication flows

(d) the extent to maintain shared understanding of messages.

(2) Effectiveness of learning perception; (delivery of learning) is measured by:

(a) the cognitive and critical level of the learning content, this indicates the levels of students' learning performances, in addition to students' perceptions of own learning,

(b) affective learning, which measures students' satisfaction and attitudes about the learning climate.

(3) Effectiveness of the learner-technology interaction; (usability and perceptions) which is defined by:

(a) status and affordance of the technology

(b) usability of the computer and interface

(c) interactions with the computer

(d) the employment and appropriateness of embodiment and other virtual perceptions to the review learning context

(e) advantages and disadvantages of 'remoteness'

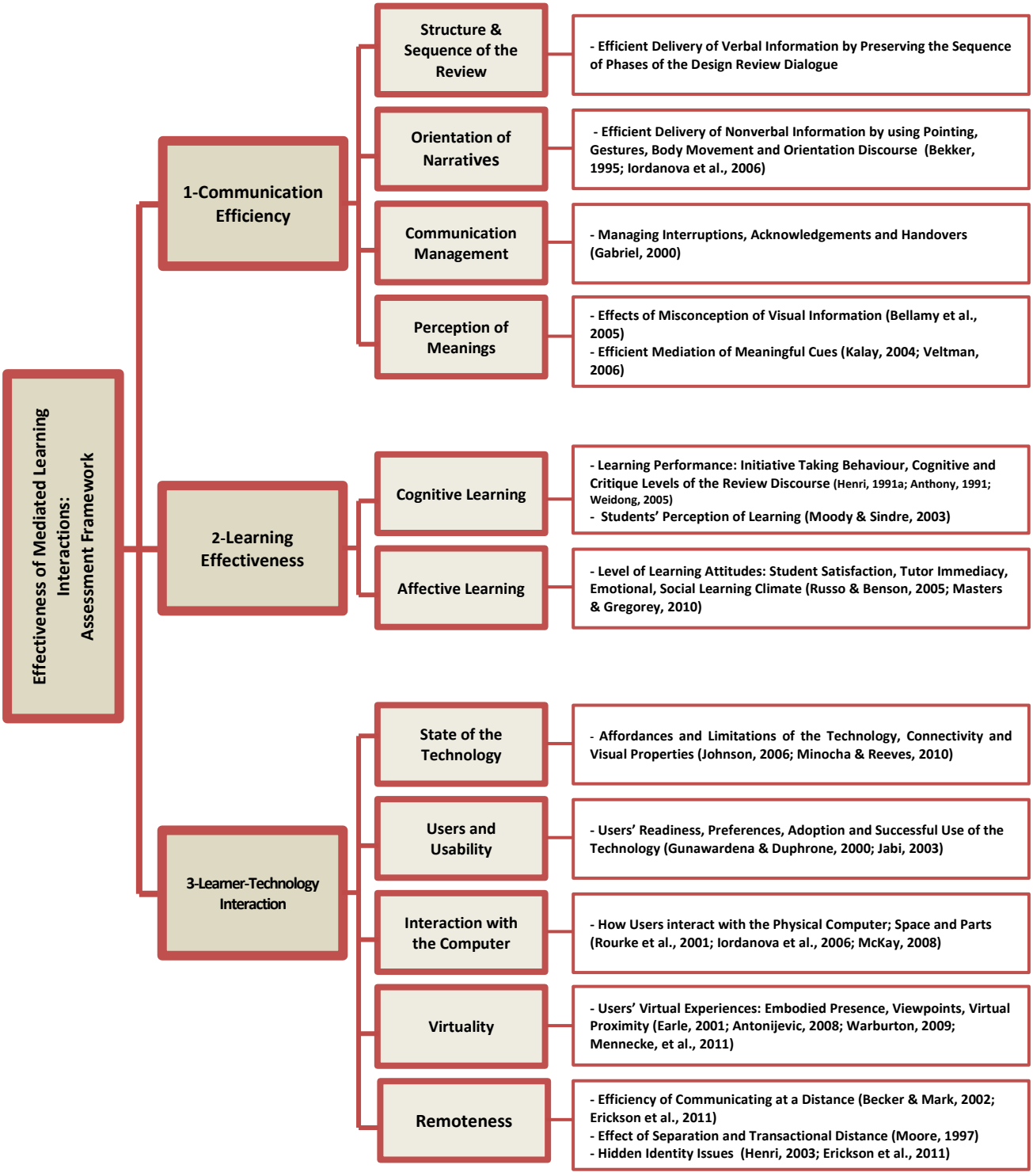


Figure 3-10 The Proposed Research Assessment Framework: Indicators of Effectiveness of Learning Interaction in the Mediated Design Review

(Conceptualised by the Author)

A practical inquiry based on real-time observations is carried out in this thesis to analyse components of both learning interactions and interactivity in computer- mediated design

reviews in virtual worlds. The above interaction outcomes are studied by qualitatively analysing the observed design reviews, direct observation of both face-to-face and virtual interactions and finally the opinions of participants, extracted from transcripts, questionnaires and focus groups. The effects of mediated interactivity are studied and suggestions to develop these virtual properties to work best for mediated design reviews will be recommended as a result of the analytical study.

3.7 Summary

Chapter Three categorised the online interaction process into learning interactions and interactivity dynamics. Here, there are a number of interrelated components clustered into three parallel processes; (1) learning delivery, (2) communication transmission and (3) learner-technology interactions, which contribute to the delivery and construction of the learning interaction process. The interrelation of those components is unique to every individual.

After examining those three processes, this chapter presented a conceptualisation of the mediated design review that specifies the elements and nature of the learning interaction process whereas a set of interpersonal and external technological and pedagogical factors act as intervening factors that influence this experience and thus participates in framing the verbal and nonverbal outcome of the learning interaction.

The chapter concluded with proposing a conceptual framework to assess the effectiveness of such learning activity. Assessment is based upon assessing the effectiveness of each of its three composing processes: learning effectiveness, communication efficiency and the effectiveness of the learner-technology interactions. This framework aims to guide the collection and analysis of the empirical data as well. The next chapter describes the methods used to identify components of the conceptual framework, and examine the verbal and nonverbal content of the mediated design review interaction process by proposing a method of qualitatively analysing mediated interaction.

Section Two

Methodological and Experimental Frameworks

Section Two

Methodological and Experimental Frameworks

The previous two chapters; Two and Three, have set theoretical and conceptual foundation necessary for developing the research analytical framework. The second section of this thesis presents the methodological and experimental part of the study, and consists of two chapters, Four and Five, which contents are summarised in Figure 3-11.

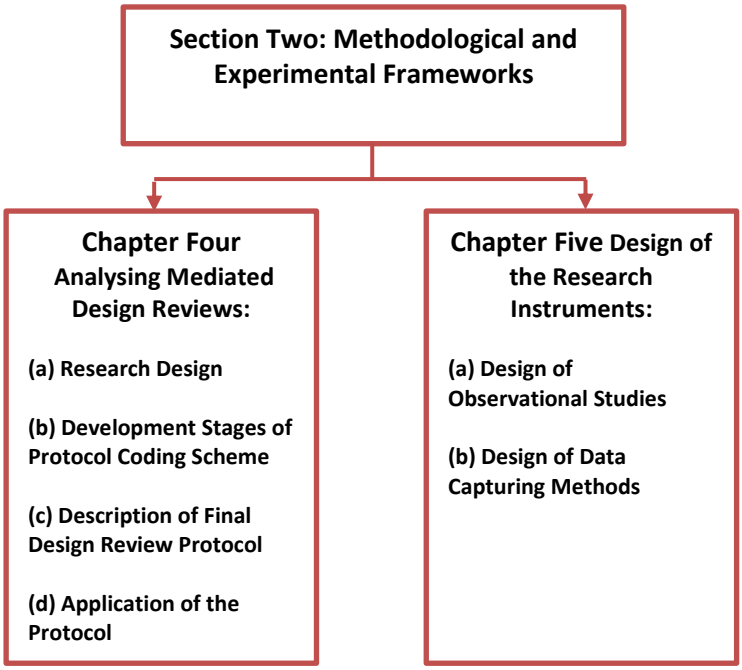


Figure 3-11 Section Two: Methodological and Experimental Frameworks; Chapters Four & Five

Chapter Four discusses the methodological framework, which includes:

(1) The Research Design, stages of investigation and methodological approaches to deliver the assessment of learning interactions.

(2) The development stages of the protocol coding scheme that is designed to analyse primary data.

(3) The description of the final coding scheme which is referred to in this thesis as the 'Review Interaction Protocol'.

(4) The application of the Review Interaction Protocol; transcribing, coding and visualising data.

While the next chapter; Chapter Five, presents and describes the research data collection instruments which include:

(1) Observational research, which includes the design of the mediated design reviews virtual space in the 3D virtual world (SecondLife). In addition to that, the procedures of the experiments are described.

(2) Methods of collecting visual interactional data, as well as participants' views and perceptions using questionnaires and focus groups.

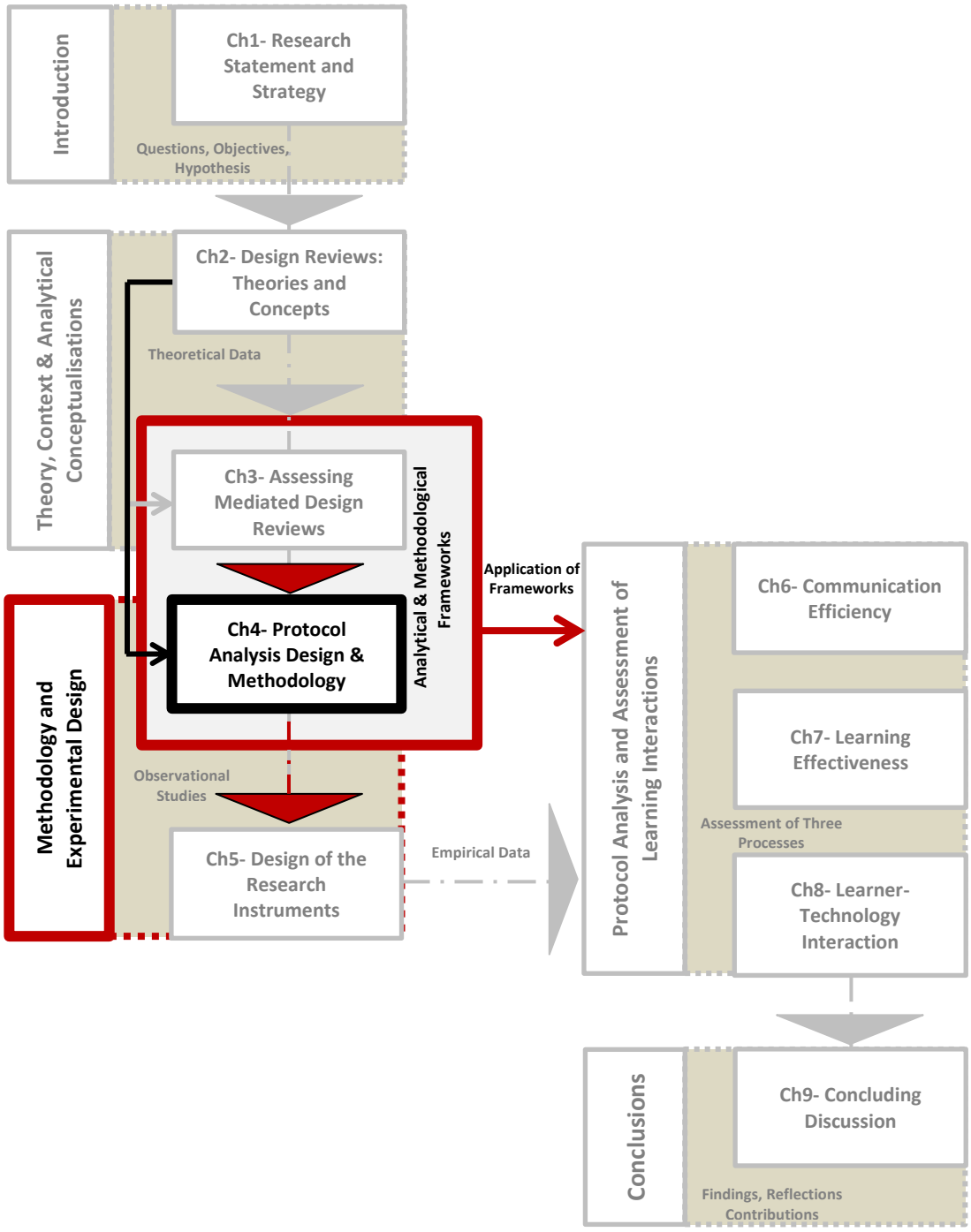
Chapter Four

Analysing Mediated Design Review

Activity: Methodology

Chapter Four Contents

Chapter Four 101
4 Analysing Mediated Design Review Activity: Methodology 104
4.1 Introduction 104
4.2 Research Design 104
4.2.1 Aspects and Levels of Investigation: A Qualitative Approach 104
4.2.2 The Research Methodology: Protocol Analysis 109
4.3 Development of the Research Coding Scheme 111
4.3.1 Exploring Existing Coding Schemes: Externally Derived Structuring 112
4.3.2 Initial Structuring of the Coding Scheme 114
4.3.3 Pilot Observations: Data Derived Structuring 115
4.4 The Review Interaction Protocol 116
4.4.1 The Design Review Structure 119
4.4.2 Cognitive and Critique Levels of the Discourse 119
4.4.3 Communication Facilitation and Management 121
4.4.4 The Nonverbal Dimension of the Review Interaction Protocol 122
4.5 Application of the Protocols: Transcription, Coding and Visualising Data 125
4.5.1 Coding Nonverbal Data 126
4.5.2 Visualising Data 126
4.6 Summary 128


Introduction
Ch1- Research Statement and Strategy
Questions, Objectives, Hypothesis
Theory, Context & Analytical Conceptualisations
Ch2- Design Reviews: Theories and Concepts
Theoretical Data
Ch3- Assessing Mediated Design Reviews
Analytical & Methodological Frameworks
Ch4- Protocol Analysis Design & Methodology
Methodology and Experimental Design
Observational Studies
Ch5- Design of the Research Instruments
Application of Frameworks
Empirical Data
Protocol Analysis and Assessment of Learning Interactions
Ch6- Communication Efficiency
Ch7- Learning Effectiveness
Assessment of Three Processes
Ch8- Learner-Technology Interaction
Conclusions
Ch9- Concluding Discussion
Findings, Reflections Contributions

4 Analysing Mediated Design Review Activity: Methodology

4.1 Introduction

Chapter Four discusses the criteria by which the research was designed where it rationalises and describes the methodological tools used to collect and analyse primary data required to assess learning interactions in face-to-face and mediated design reviews. The chapter then describes the structuring of the design of the 'Review Interaction Protocol', which is purposely developed to sort, visualise and analyse verbal and nonverbal interactional data specific to face-to-face and mediated design reviews. This chapter finally describes the final protocol shown in Figure 4-6, in page 118, and discusses the application of this coding scheme by showing how data will be transcribed, categorised and visualised.

4.2 Research Design

The research design is "*the logical sequence that connects the empirical data to the study's initial research questions and ultimately to its conclusions*" (Yin, 2003:20). It should come after clear identification of the evidence needed to answer the research questions. This thesis performs a rigorous design learning activity analysis, thus, 'protocol analysis' based on real and virtual observations, is the main method used in this study for data collection and analysis. The following subsections discuss the levels of investigation, the research methods, and focuses on the criteria used to carry out the assessment framework proposed in Chapter Three.

4.2.1 Aspects and Levels of Investigation: A Qualitative Approach

This study combines computer-mediated interactivity and design review learning interactions. It aims to explore the link between these two key elements by assessing the on-going learning interaction process and thus understanding the effects of the mediated interactivity on the learning interaction process. In order to carry out an informed exploratory study, this research includes three main levels of investigation following an

inductive approach as Trochim (2006) explains, building knowledge gained from one level to the next and so on; moving from specific observations to broader generalisation and explanation. As it is the aim of this research to illustrate a qualitative interpretation of 'how' mediation in 3D virtual worlds affects the resulting learning interaction; referring to the nature of inquiry of this research and its objectives, it is found that it strongly relates to Creswell's (2003) definition about qualitative methods;

> *"an inquiry process of understanding a social or human problem, based on building a complex, holistic picture, formed with words, reporting detailed views of informants"*

This thesis therefore adopts a descriptive- interpretive- explanatory approach based on observations of learning interaction patterns, where each level focuses to examine specific aspects and requires specific types of data, an illustration of the research approaches are shown in Figure 4-1.

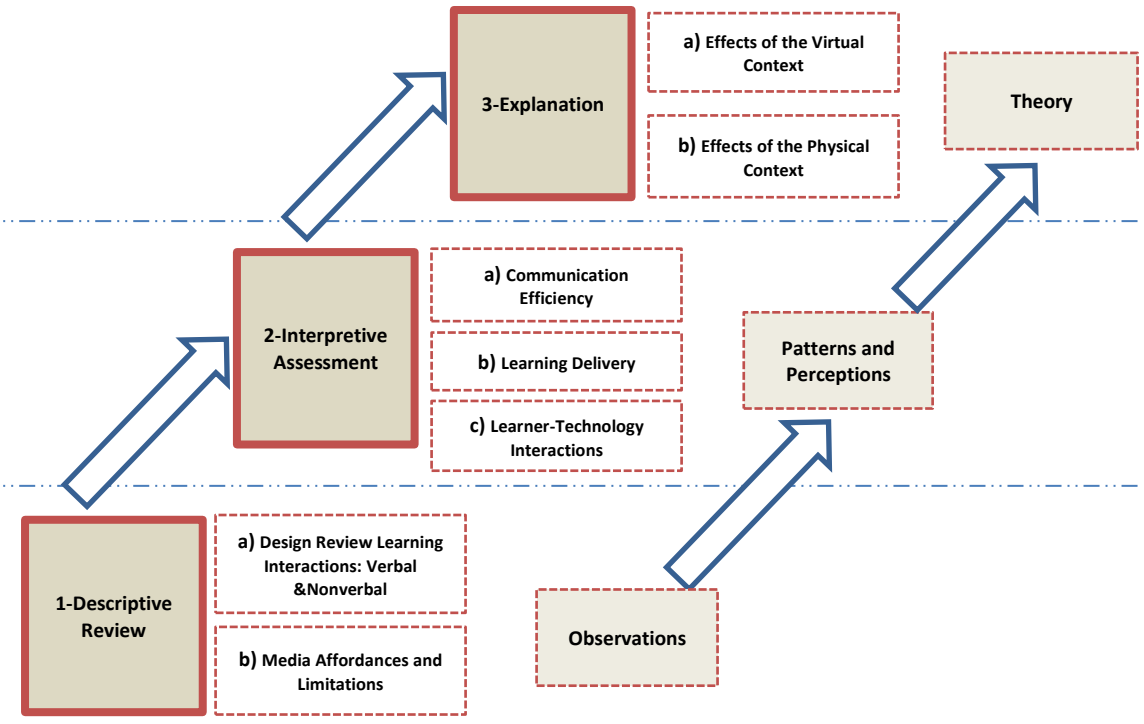


Figure 4-1 A Descriptive-Interpretive-Explanatory Approach Based on Observations and Inductive Reasoning

The descriptive level of the investigation aims to examine the activity of the design review in face-to-face and computer-mediated settings/contexts; by studying (1) the structure of the verbal content of the design reviews, as well as the nonverbal interactions

that are enacted and/or mediated during the communication processes, (2) the affordances and constraints of the used media and the remote context. Data is collected here from review of the literature, conceptualisation of existing theories and observational research.

The interpretive level of the investigation aims to assess the effectiveness of the mediated design review learning interaction process by following the criterion proposed in Chapter Three; which examines indicators of (1) efficiency of transmission and delivery of communication, (2) effectiveness of learning delivery and (3) effectiveness of the learner-technology interactions. This employs a mixed methods approach which includes examination of textual transcripts of the observed via discourse analysis, patterns of interactions via interaction analysis and analysing users' perceptions gained from questionnaires and focus groups.

The explanatory level of the investigation aims to explain the effects of (1) mediation, virtuality and remoteness; (properties of the virtual context) as well as (2) the socio-pedagogical and physical settings; (some properties of the physical context) on the creation and delivery of the learning interactions. This is done by collectively synthesising the results of the assessment and relating the linkages to the conceptual framework of the research and the existing literature.

Table 4-1 summarises the research aspects; levels of investigation and their purposes, required data and their collection and analysis methods.

Table 4-1 Summary of the Aspects of the Research

Level of Investigation	Aspects of Investigation	Purpose of Investigation	Required Data	Methods of Data Collection and Analysis
Descriptive	(1) Learning Interactions of Design Reviews (2) Interactivity Dynamics of The Media	- To understand design review structure and pedagogical factors. - To identify the affordances offered by multi-modal media.	- Verbal content of the learning dialogue -Nonverbal interactions -Characteristics of the virtual worlds.	- Literature review - Observational Research including face-to-face and virtual observations
Assessment	(1) Information Transmission, (2) Learning Delivery (3) Learner-Technology Interaction	- To examine the effectiveness of mediated interactions in virtual design reviews	- Indications of Successful Communication Delivery and Management - Students' Learning Performance and Perceptions of Learning - Users' Perceptions of the Virtual Space and Interactions	- Interaction Analysis - Discourse Analysis - Questionnaires/ Focus Groups -Indicative Data Analysis
Explanatory	The Effects of Mediated Interactivity on the Design Review in 3D Virtual Worlds	- To highlight the role of: - Mediation, - Virtuality and - Remoteness - Socio-pedagogical factors on the Design Reviews	All of the above	- Relating the Linkages between the Data sets in a Collective Data Analysis Approach and Discussion of Findings

The following illustration in Figure 4-2, relates the sources of data and/or methods used to examine each aspect of the assessment framework. This rationalises the design of the methodology, while missing aspects not found in the existing literature have been designed and added to the research coding scheme after conducting pilot observations (discussed in section 4.3.3 of this chapter).

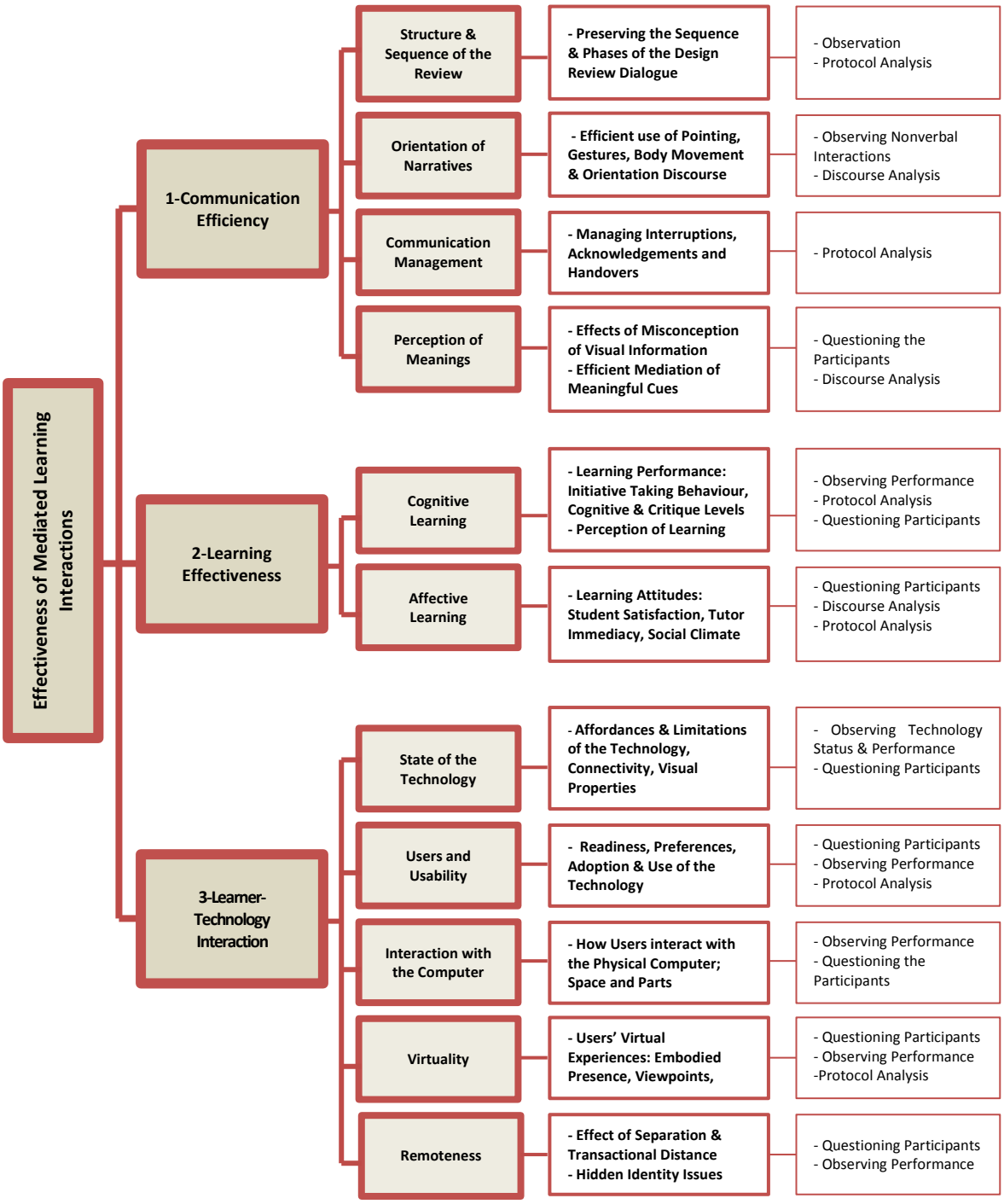


Figure 4-2 Relating Data Sources and Methods of Investigation to the Research Assessment Framework

4.2.2 The Research Methodology: Protocol Analysis

The research design is based on viewing learning communication and interaction in design reviews as an architectural design activity, and referring to Gabriel (2000:49) definition of discussion protocols "*investigating design communication between two architects is not too different from one architect verbalising his/her design thoughts*", thus, this thesis examines the design review by performing a '*Communication Protocol Analysis*' study.

Protocol analysis is a widely used technique within many design disciplines as a form of observational research to study design processes and the cognitive activities. In protocol studies, collected data is coded into coding schemes; where the main purpose of coding is to extract, generalise and abstract meaning from complex data in order to find significant themes and develop theories about the situation that illuminate it (Gero and Tang, 1999).

Twenty two face-to-face design reviews and sixteen mediated design reviews were conducted, observed and recorded under three experimental categories, Face-to-Face Crits, Virtual Crit (1) and Virtual Crit (2); these are described in full detail in Chapter Five. Observational research therefore is the main data collection method in this research; this creates an informed understanding about the learning situation, interactional data and the used technology. However a standard model for analysing the design review activity could not be found, therefore, this research attempts to present a purposely design protocol specific to the design review. Research design of this study involved a series of stages which included the design and the execution of some related tasks as shown below:

- Building the conceptual framework that drives the research methodology.
- Designing a custom coding scheme in which data will be coded, sorted and visualised; the 'Review Interaction Protocol'.
- Designing the activities and settings being observed (experiments i.e. a number of face-to-face and mediated design reviews).
- Recording and saving both textual and bodied interactions and closely observing the activities of the design reviews.
- Collectively analysing data sets and assessing the learning interaction process.

As being an exploratory type of research, the design of the coding scheme was aided with pilot observations of face-to-face and mediated design reviews that helped build the units of observation and guide the categories of data being collected, therefore the design of both, the observations and the coding schemes were carried out almost in parallel. The research methodological design is illustrated in Figure 4-3.

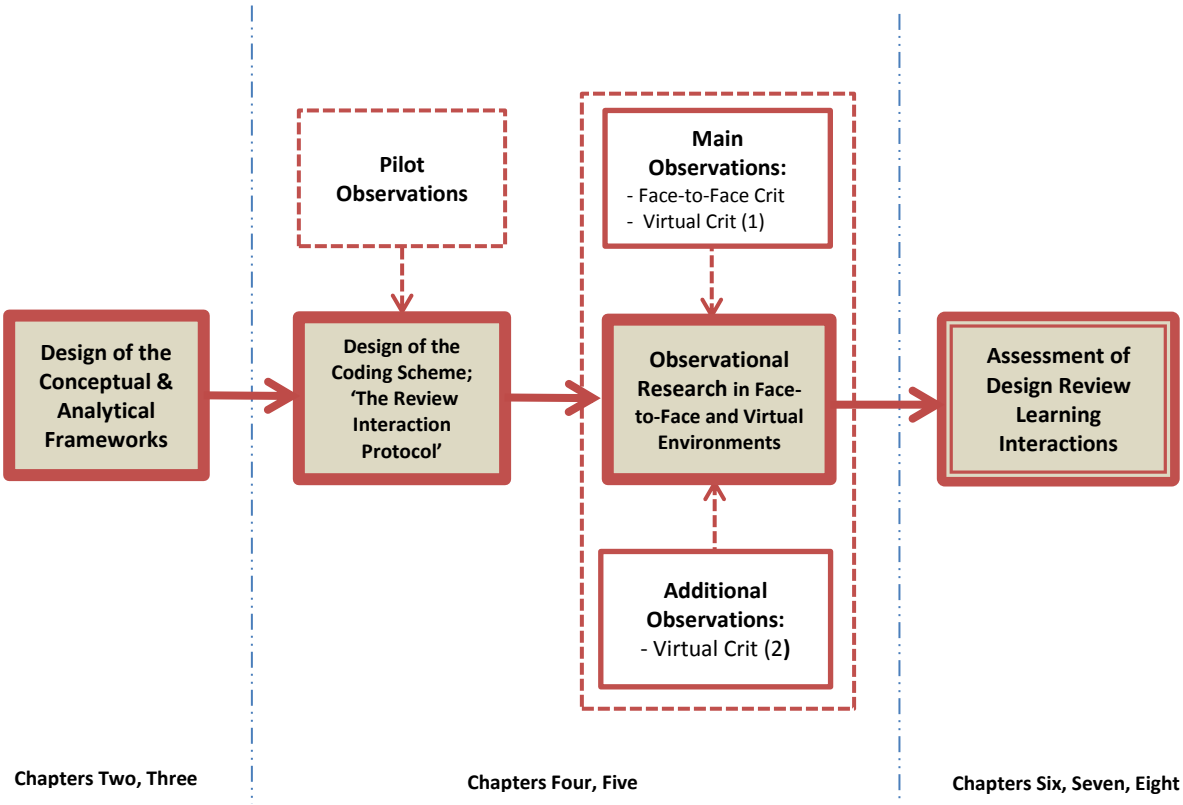


Figure 4-3 The Research Design

After developing the research coding scheme, the main observational cases were conducted to collect and capture primary verbal and nonverbal data. These observations took place in two contexts, the physical 'Face-to-Face Crit', and the virtual 'Virtual Crit (1)'. However an additional experiment was needed in the virtual context 'Virtual Crit (1)'with the need to assess and examine the learner-technology interaction component that had arisen with the development of the research objectives, as shown in the above figure. The participating users were asked about their learning perceptions and their opinions about the virtual/remote communication; this data was needed to assess both learning delivery and learner-technology interactions.

Collected Data from the observations are coded using a visual method designed to reveal patterns of interactions. Referring to Iordanova's *et al.* (2006) techniques of combining and interrelating categories from multiple data sources, this enables us to relate the linkage of all the available data sources. The links between the data produced from the observational cases, textual transcripts along with the users' perceptions and own views – from questionnaires and focus groups- enables a full understanding of the mediated design review under mediated/ virtual/ remote conditions and perceptions.

4.3 Development of the Research Coding Scheme

The design protocol literature indicates that there are four ways of building the structure of coding schemes in protocol studies (Purcell *et al.*, 1996:225-227); (a) data generated structure, (b) externally derived structure (c) theory derived structure and (d) grounded theory approach.

Data generated structure in a coding scheme is generated after the transcribed protocols have been categorised and reviewed. Therefore the data gathered dictates the structure of the coding scheme. However, there has been a tendency towards imposing externally derived structures onto a coding scheme. Those external structures occur when parts of an already established coding scheme are used to develop another one. On the other hand, theory derived structures occur when part of a coding scheme is generated through a particular theory and subsequently tested (Gabriel, 2000). A potentially richer approach cited by Purcell *et al.* (1996: 225), is using a fourth method; which is the 'grounded theory' method by Glaser and Strauss (1967). Grounded theory provides a systematic method involving several stages which is used to 'ground' the theory, or relate it to the 'reality' of the phenomenon under consideration (Scott, 1996). This allows for multiple coding of the data and feeding it back to the coding scheme. According to Radcliffe (1996: 345) the text units are then revisited, with the possibility of each text unit being coded under multiple categories.

The unique activity of the design review meant relying on several sources to construct the coding scheme; which consisted of a number of stages:

- Investigating existing coding schemes and relating them to our research enquiry; using predefined categories, while customising others.
- Recording and observing a number of initial (pilot) face-to-face and mediated design reviews to build and create an initial coding scheme.
- Testing and allowing the initial coding schemes to evolve during preliminary analysis stages; the re-examination and the development of our line of thinking during the research stages and the need of new data sets with the development of the research formation also required adding more categories to suit the study's objectives.
- Finalising the 'Review Interaction Protocol'.

The stages of development are illustrated in Figure 4-4, while the following subsections discuss each of these stages.

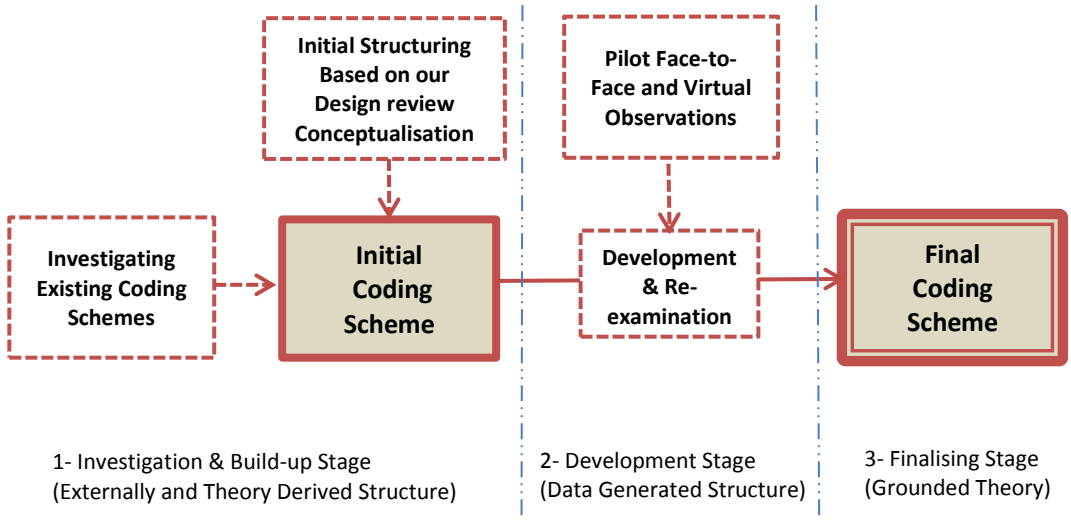


Figure 4-4 Development Stages of the Research Coding Scheme: The Review Interaction Protocol

4.3.1 Exploring Existing Coding Schemes: Externally Derived Structuring

The works of (Cross *et al.*, 1996; Sudweeks and Rafaeli, 1996; Gunawardena *et al.*, 1997; O'Conail and Whittaker, 1997; Olson *et al.*, 1997; Gabriel, 2000; Dorst and Cross, 2001; Weidong, 2005; Tang *et al.*, 2011) were investigated and reviewed to create a bases of our coding scheme, these studies focused on verbal communication in design teams, and design learning. However, most of the studies only related to drawing and sketching as the only nonverbal mode of communication in the design activity and it was found that detailed nonverbal interaction analysis in the learning context was not included in their analyses. Two of those studies in particular presented us with categories similar to the

nature of this research inquiry, and were therefore used with some modifications; these are namely:

(1) Gabriel's (2000) 'Verbal Communication in Collaborative Design' coding scheme, where two dimensions of categorisation were found to address both information delivery and communication management in face-to-face and online environments which relate to some required fields in our investigation. The first category is Communication Control which examines interruptions, floor holding, and acknowledgements. And the second is Communication Technology which examines content in regards to the use of tools, media and the mediated environment.

(2) Weidong's (2005) 'Content Analysis' coding scheme where two other dimensions were best at describing the Cognitive Level of the discourse which describes the quality of the dialogue and indicates learning delivery by describing discourse as descriptive or deliberative, and the Critique Level of the design review which relates to what is criticised and how it is criticised also as indicators of learning delivery.

While another set of studies looked specifically at nonverbal communication in design communications, these included studying 'design actions' (Tang, 1991), 'design gestures' (Bekker *et al.*, 1995) and 'design moves' (Iordanova *et al.*, 2006) but did not combine these actions in one standard coding scheme that relates other embodied communication specific to learning contexts.

In addition, examples of studies that looked into online interaction in design-related areas are the works of, (McLeod, 1991; Tang, 1991; Gay and Lentini, 1995; Brereton *et al.*, 1996; Al-Qawasmi *et al.*, 1999; Gero and Tang, 1999; Rouet and Passerault, 1999; Gabriel, 2000; Ucelli, 2002; Vasques DeVelasco and Zhang, 2004; Bellamy *et al.*, 2005; Weidong, 2005; Tang *et al.*, 2011). Yet these studies also only related to 2D online environments. The research of (Robertson, 1997; Shelden, 1997; Earle, 2001; Manninen and Kujanpää, 2002; Henri and Pudelko, 2003) were the only ones which have been located that studied nonverbal communication of Avatars in virtual worlds and mediated embodied modes. Yet have not as well referred to design communication and learning, and also did not combine interactions in one coding scheme. This prompted the need to rely on actual observations

of on-going face-to-face and mediated design reviews in order to build a sufficient coding scheme.

4.3.2 Initial Structuring of the Coding Scheme

A coding scheme was initially constructed into six dimensions of interactions. The first dimension of the coding scheme described the 'structure' of the design review; and was built according to the logical thematic structure of the design review discussed in Chapter Two, thus, 'theory derived', interactions were categorised to three main phases where each phase consists of the verbal operations that build the dialogue specific to each phase, these phases are: (1) Presenting/ Sharing Information Phase: which includes operations such as; introduction, definition, description. (2) Discussion Phase: which includes operations such as; elaboration, explanation, revisiting, referencing. (3) Evaluation/Feedback Phase: which includes operations such as; acceptance, rejection, direct evaluation, further instructions.

Using Gabriel's, (2000) and Weidong's, (2005) categorisations as explained above, four more dimensions described communication control, technology communication and the cognitive levels of the discourse and the critique level of discourse.

The sixth dimension related to the nonverbal mode of communication, which included basic information from theories on nonverbal communication from the works of (Knapp, 1978; Kendon, 1980; Druckman *et al.*, 1982; McNeill, 1986) and then were customised for design review interactions by the researcher; these included subcategories such as, gesturing, body movements and facial expressions. The initial coding scheme is shown in Figure 4-5.

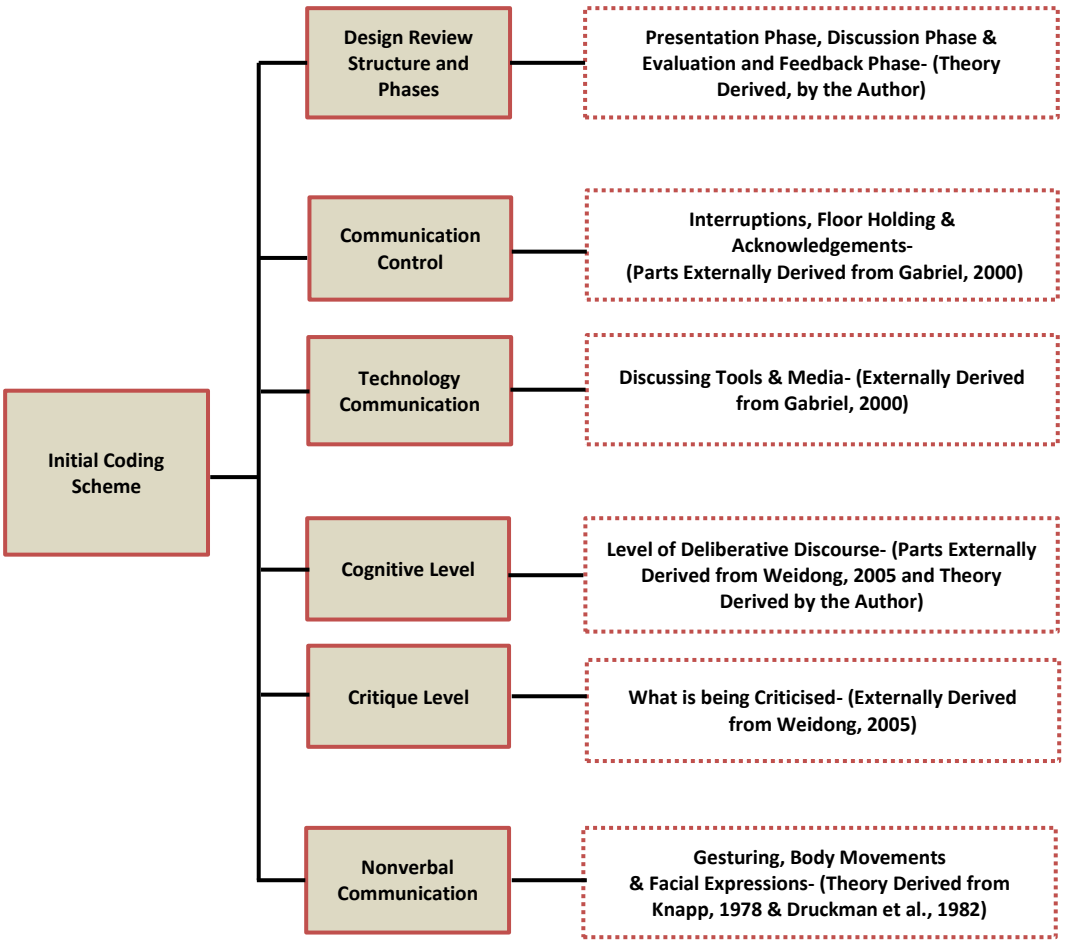


Figure 4-5 Dimensions of the Initial Coding Scheme

While developing the initial coding scheme, random segments of transcribed data from the initial observations were coded as a test, but it was soon realised that some data did not fit any of the developed categories, the observations reviled that several external data and theory derived categories and sub-categories needed to be modified. In addition, data-generated categories needed to be added and/or detailed to allow for accurate analysis. This was particularly relevant to the 'nonverbal' dimension of the initial coding scheme, as well the 'structure' dimensions. The following subsection describes the pilot observations and their role in developing the coding scheme.

4.3.3 Pilot Observations: Data Derived Structuring

As Van Teijlingen and Hundley (2001) discuss; *"pilot studies can inform us about the best research process and occasionally about likely outcomes*". Four face-to-face and two virtual

pilot observational studies were carried out in the physical and virtual contexts. The aim was mainly to 'explore the ground' through observation and evaluation (Sarantakos, 1993) employing smaller versions of the main study. In addition, these observations played a role in developing the coding scheme by adding and/or framing data derived categories.

Four face-to-face design reviews of different academic stages in the school of Architecture, Planning and Landscape were closely observed; hand written notes and quick sketches of the placements in the physical settings were taken. This helped identify how the verbal discourse of the design review is constructed. In addition to that, the relationship between the students, the tutors, gathered students and the drawings was made clear in order to start designing the mediated settings of the virtual design review.

Two pilot studies in the virtual world were also conducted with the help of the researcher's colleagues and technical officers in the university. The initial potentials of 3D virtual worlds as a media for communication were examined in these two studies; by learning more about basic usability problems when using the software. This also created an opportunity to practice how to build and use the interface and learn about virtual data capturing methods. Moreover, preparations for the actual studies were built on the information gathered from these exploratory studies.

The pilot observations proved to be significant by allowing the examination of nonverbal communication in both physical and virtual settings; this allowed adding new categories particularly data about facial expressions and pointing as a subcategory of gesturing. The following section discusses the final coding scheme developed in this thesis; 'The Review Interaction Protocol'.

4.4 **The Review Interaction Protocol**

Due to the complexity of the nature of design review interaction that mixes verbal, nonverbal modes of interaction in a single unit of observation, it was decided to allow multiple coding of the same data unit, therefore the developed coding scheme in this research: 'The Review Interaction Protocol' allows both sets of content; verbal and nonverbal, to overlap and intersect occupying the same unit of observation.

The communication control and technology dimensions of the initial coding scheme were grouped together and a new category which is 'social communication' that describes the social element of interaction, this was observed in the pilot experiments, and found to relate to 'affective learning' and was therefore added to them under the name 'Communication Facilitation and Management'. The cognitive and critiques levels of discourse were also grouped together and were refined to include refined subcategories.

A distinction was made between the verbal data and the nonverbal data; this is shown in Figure 4-6, thus, verbal data consists of three dimensions:

(1) Design Review Structure of Verbal Discourse,

(2) Cognitive and Critique Levels of Discourse and

(3) Communication Facilitation and Management.

While nonverbal data is structured according to types and functions of interactions; as generated from the initial observations, and includes four dimensions:

(1) Embodied Interactions

(2) Visual Displays

(3) Facial Expressions

(4) Paralanguage

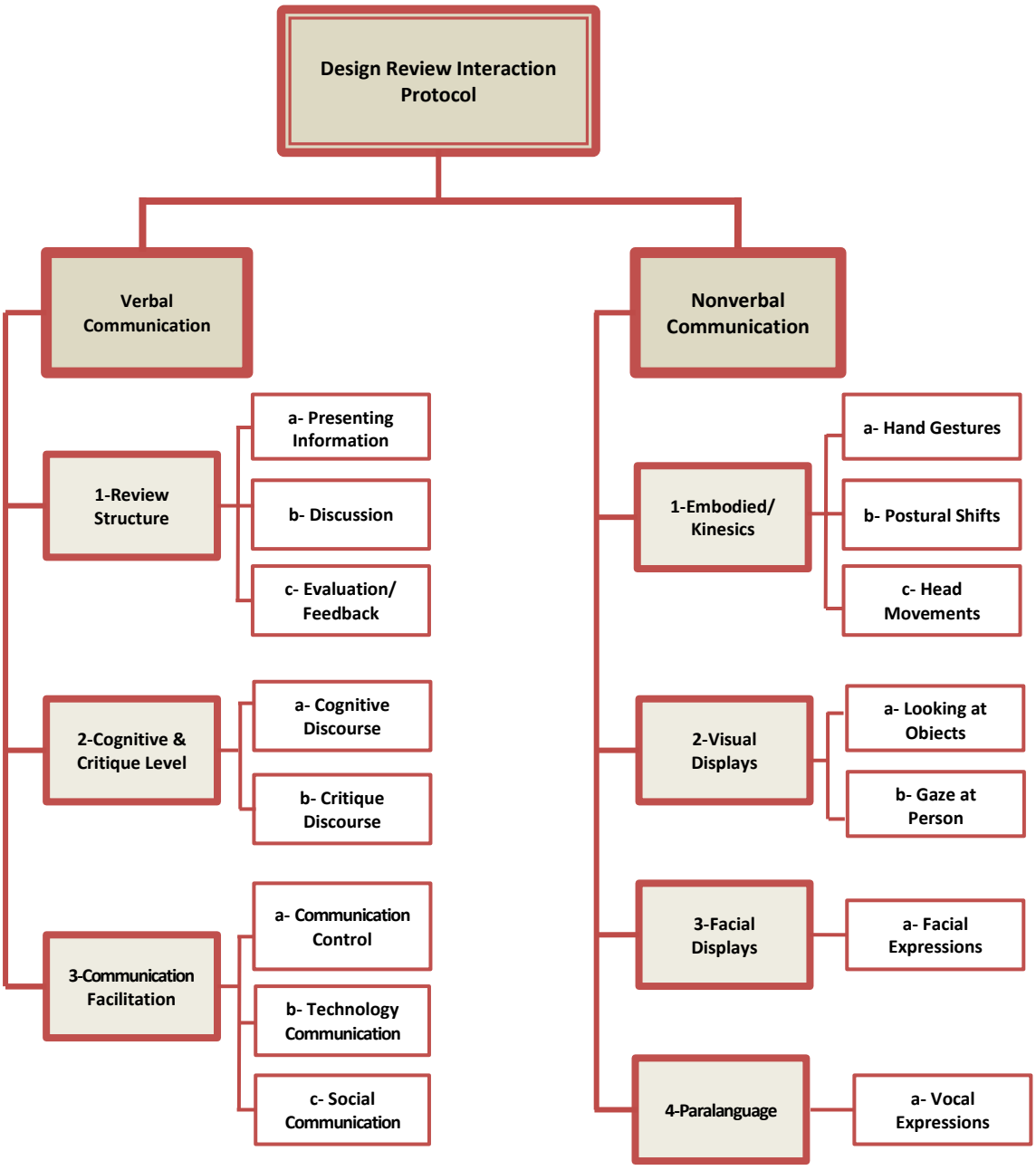


Figure 4-6 The Review Interaction Protocol Coding Scheme

The following subsections describe the main categories of the review interaction protocol, and relate to the sequences of which they were derived and developed.

4.4.1 The Design Review Structure

Following the initial observations this dimension was allowed to evolve and further develop. In addition, following the concepts of the 'Task Area' from Bales's, (1950) 'Interaction Analysis model', that included operations such as 'asking for' and 'giving' specific actions such as opinions, suggestions, orientation…etc., more categories were added to the initial coding scheme. The Design Review Structure can be described Table 4-2 which summarises the different phases, interactions and their descriptions.

Table 4-2 Phases and Interactions of the Design Review Structure

Phases	Interactions	Descriptions
(1) Presenting/ Sharing of Information	Introduction of idea	Clearly introduces an idea
	Definition / Identification of concept or method	Defines, or Identifies problem or solution
	Description of concept or method	Describes or Elaborates / Corroborates examples
	Orientation/ Clarification of terms	Seeks or gives orientation/ Asks or answers questions to clarify details or meanings
(2) Discussion of Perceived Facts	Approves/ Disapproves	Statement of approval/disapproval
	Asks for opinion / Gives opinion	Statement of opinion
	Explaining/ Revisiting concept	Elaborates in detail to explain
	Repetition	Repeats/ Asks or answers questions to clarify source of ambiguity
	Referencing	States source of information
	Agrees / Disagrees	Statement of agreement/ disagreement
(3) Evaluation and Feedback	Acceptance /Rejection of idea	Statement of acceptance/rejection
	Shows solidarity/ Antagonism	Supports/ Agrees
	Propose suggestion/ ask for suggestion or direction	Proposes new directions and solutions
	Direct Evaluation	Evaluates design outcomes
	Summarization of agreements	Summarisation of understandings and evaluations
	Give further instructions	Applications of new knowledge

4.4.2 Cognitive and Critique Levels of the Discourse

The second dimension of the review interaction protocol looks at the quality of learning interactions and determines the cognitive and critique level of the conversation to enable the assessment of learning effectiveness. In order to evaluate the quality of reasoning skills in online learning, Henri (1991a) identifies two levels of reasoning: surface versus in-depth processing. Surface processing is simple repetition or judgment without personal

contributions or explanations. In-depth processing is more complex, and indicates that the communicator has an insight into the information and problems. In this research, the in-depth processing category is classified further into two classes: descriptive statements and deliberative statements (Weidong, 2005). A descriptive statement involves the description of the design work without elaboration, while deliberative statements explain the interpretation or introduce new concept or question, which reflects the higher-level learning process.

This, is an essential part of the design review conversation structure, content that falls into this category will give an insight on how 'cognitive' the conversation is, and how mediating the review may affect the level of learning. Assessing the cognitive learning by identifying student's actual performance in the design review will be carried out through this coding scheme. Therefore, the 'cognitive dimension' as perceived by Henri's (1991a) and developed further by Weidong (2005), is included in the coding scheme with a few amendments as shown in Table 4-3.

Table 4-3 Cognitive Dimension

Coding scheme		Definition
(1) Surface Processing:	Simple statement	Repetition without adding new information
(2)In-Depth Processing:	Descriptive statement	Simple interpretation of design work without elaboration
	Deliberative statement	Introduce new and deeper concepts or questions

The design review is a unique learning environment in which the main form of communication is criticism and critical feedback (Weidong, 2005). Constructive criticism is one of the key factors which determine a successful learning experience (Doidge *et al.*, 2000). Taking this into account, it is rational to add another dimension into the Review Interaction coding scheme: 'criticism', this category is important to analyse the content of the critiques in the conversation, in order to judge upon the success of the structure of the design review conversation.

Different from the cognitive dimension's investigation of the levels of thinking, this dimension aims to study the quality and nature of the critiques and feedback. Criticisms can be constructive or destructive (Anthony, 1991:112). Constructive criticism helps

students understand design problems, and it is phrased in a positive way. Constructive criticism includes not only positive critiques but also negative critiques with further explanations. Three kinds of constructive criticism in terms of 'how to criticise' were defined by (Weidong, 2005) into: positive critiques, negative critiques, and narrative statements that provide some information related to the design work. The content of critiques or 'what is criticised' is further classified into three categories: design knowledge, design skills, and presentation skills. The criticism dimension determines how well informed was the tutor to give a subjective evaluation, this is a result of effective communication of information if the design project, description of the critique level of discourse is shown in Table 4-4.

Table 4-4 Criticism Dimension

<table>
<tr><td colspan="3">Coding Scheme</td><td>Definition</td></tr>
<tr><td rowspan="4">(1) How to criticise</td><td rowspan="3">Constructive criticism</td><td>Positive critiques</td><td rowspan="3">Constructive criticism points out the negatives, but it is phrased in such a way that the students can take further action to improve. (Anthony, 1991)</td></tr>
<tr><td>Negative critiques</td></tr>
<tr><td>Narrative critiques</td></tr>
<tr><td>Destructive criticism</td><td></td><td>Destructive criticism offers few suggestions about how to remedy an unsatisfactory situation. (Anthony, 1991)</td></tr>
<tr><td rowspan="3">(2) What is criticised</td><td rowspan="3"></td><td>Representation skills</td><td rowspan="3">(Weidong, 2005)</td></tr>
<tr><td>Design skills</td></tr>
<tr><td>Design knowledge</td></tr>
</table>

4.4.3 Communication Facilitation and Management

This dimension of the coding scheme examines different characteristics of the content that occur within design review communication but are not necessarily task related, meaning that they may not be directly related to the design review dialogue, yet their importance comes from coordinating, facilitating and showing interpersonal or emotions within the conversation. This content takes the conversation to an interactive level, i.e. by adding joining words and statements, handing over the conversation, using necessary social interactions, or asking about technical issues, tools...etc. The facilitation and management coding scheme interrupts and/or connects the communication in a way, yet is essential to complete the meaning. This dimension is therefore important to enable us to study differences between the face-to-face and the mediated contexts in terms of interruptions, social communication and how the conversation was managed.

Table 4-5 shows the Communication Control coding scheme while Table 4-6 and Table 4-7 show Technology Communication and Social Communication coding schemes. These dimensions build the third part of the Review Interaction Protocol which is Communication Facilitation and Management.

Table 4-5 Communication Control Dimension

Coding Scheme	Description
(1) Interruption	Interruptions are associated with simultaneous speech (Levinson, 1983; O'Connail and Whittaker, 1997).
(2) Floor Holding	Occurs when one speaker tries to take the conversational floor while the other attempts to hold the floor while
(3) Hand-over	Relinquishing floor
(4) Acknowledgement	Indicates that one is following up with the conversation, understands, shows awareness

Table 4-6 Technology Communication Dimension

Coding Scheme	Description
Tools & Environment	Communication in regards to the use of tools and media or environment, technical dialect.

Table 4-7 Social Communication Dimension

Coding Scheme	Description
Social & Interpersonal	Communication content dealing with interpersonal relationships, Self-introduction, Verbal support, Word about self (Sudweeks and Albritton, 1996).

4.4.4 The Nonverbal Dimension of the Review Interaction Protocol

Tang (1991), Bekker (1995) and Iordanova (2006) amongst others have studied the functions of one type of nonverbal interaction which is the use of hand gesturing while designing in teams, some of these functions are:

- Pointing at something: in physical or virtual space - “showing”.
- Pretending to be another body: illustrating the movement of an object (physical or virtual); illustrating the appearance of an object – “imitating”.
- Using/moving an object (object adaptors): in physical space (mouse, pencil, notebook, etc.); in virtual space (cursor, selection, viewpoint, etc.).
- Drawing and Listing.

However the results of the initial observations of face-to-face reviews showed that nonverbal communication in design reviews have a broader range of temporal and spatial richness; such as facial displays, vocal expressions, embodied actions, presented previously in Chapter Two.

According to McNeill (1992), nonverbal actions have a wide range of possible uses than we observe, for instance, according to Bekker *et al.* (1995), spatial gestures could signify more abstract qualities like similarity or other meanings that have a distance-based metaphor. So a more detailed breakdown of the purposes/functions for which nonverbal actions are used in face-to-face reviews resulted in a further classification; the functions of nonverbal actions relate to (1) the design review conversation itself, (2) managing the conversation, and (3) indicating receipt or perception and understanding of information.

Therefore we can add to Tang's (1991), Bekker (1995) and Iordanova's (2006) work more functions of nonverbal communication which are specifically important in the learning interaction of the design review, these are:

- Spatial design gestures (Bekker *et al.*, 1995): which refer to form, location, size, or give orientation and direction such as acting out walking in a path from the left to the right.
- Gesticulation (McNeill, 1986): which is the act of moving the hands while talking to add emphasis or signal some meanings, e.g. while pointing to one hand and another, saying "On the one hand there is one idea, and on the other hand another idea"; (McNeill, 1992) this doesn't necessarily reflect design related ideas but may have impact on the conversation.
- Looking (eye-contact / gaze): at another communicator/an object or person in physical space (Argyle *et al.*, 1973), or at an object/avatar in virtual space (Manninen and Kujanpää, 2002).
- Facial expressions: which are used to communicate certain kinds of emotion (Ekman *et al.*, 1972; Druckman *et al.*, 1982) that act as the unspoken feedback loop in the learning communication process, (socio-emotional area of the conversation).
- Vocal expressions: which have a direct impact on the learning conversation (Mehrabian, 1972), especially one that has the purpose of evaluation and feedback by showing acknowledgement, emphasis, enthusiasm, confidence, antagonism, rejection,...etc.

Guided by the models developed by Ekman and Friesen (1969), Druckman *et al.* (1982) and McNeill (1992) which are used to describe face-to-face communication, and the initial observations of nonverbal actions in design reviews, it was possible to categorise nonverbal actions that are used in design reviews into four main types. These are: (1) Embodied actions, (2) Visual Displays, (3) Facial Displays and (4) Paralanguage. These types of nonverbal actions are subdivided into a number of actions according to the nature of movement or interaction as shown in Table 4-8.

Table 4-8 Nonverbal Communication Coding Scheme

Type of Nonverbal Action		Interactions
(1) Embodied/ Kinesics	Hand Gestures	Pointing
		Illustrator Gestures
		Object Adaptors
	Postural Shifts	Moving Body
		Rocking
	Head Movements	Nodding
		Shaking
(2) Visual Displays		Gaze at person
		Look at object
(3) Facial Displays		Facial expressions
(4) Paralanguage		Vocal expressions

Moreover, it is important here to point out that these four types of nonverbal; communication have a number of functions related to the design activity. In the design review, nonverbal actions may contribute to structuring the context of the review discussion, facilitate the dialogue, explain some information, and aid the conversation by describing, expressing emphasis, orientation, approval, disagreement, etc. As Iordanova *et al.* (2006) express; some gestures “show” by pointing, and other gestures “imitate” by pretending to be a person or an object moving in relation to the design. These different functions relate verbal and graphical data together, and fall under the three phases of the design review structure (Sharing Information/ Discussing/ Feedback) as well as having Communication Facilitation functions.

The previous categories of nonverbal actions are not only convenient for the analysis of interactions intended by this research, but they also have significance for the design of communication technologies in design-based disciplines. The spatial characteristics of nonverbal actions and their importance within the context of describing design ideas and

drawings and giving/ receiving feedback, present challenges to the development of tools of virtual worlds that have potential to be used as communication media in remote design activities.

4.5 Application of the Protocols: Transcription, Coding and Visualising Data

Immediately after video recording the observed face-to-face and mediated design reviews, the recordings were reviewed to coarsely code interesting interactions and feedback to the coding schemes for any missing data. Given the length of the recorded design reviews, and the large number of categories of interest, the data had to be reviewed again in a finer grain to enable meaningful coding.

After repetitive hours spent with each of the verbal transcripts, videos and photos, nine sessions were chosen for full detailed transcription and coding, (three sessions for each experimental category). The selected sessions were seen as being the most consistent and indicative as accurate representations of the data under study. In addition the selections were made on the basis of the quality and angle of recording as well as richness in terms of interactional categories met. The rest of the review sessions are included in the analyses in terms of general activities and students' perceptions, furthermore, any categories not covered in the nine selected sessions will be referred to from the other recordings and analysed in the same manner to cover all themes of the research.

Purcell *et al.* (1996:233) maintain that qualitative research is mostly based on the subjective opinion of the researcher coding the available data, thus resulting at times in possible variations between individuals coding the same data. Therefore the use of more than one individual to code the same data was used as a procedure to ensure accuracy and legitimacy of the results. Two coders, both architects, coded the nine selected sessions individually. This was followed by an arbitration process to resolve the differences in coding to work out a unified coding for each session.

4.5.1 Coding Nonverbal Data

When nonverbal modes of communication are mediated they take a completely different form, this depends on the medium attributes and tools (Earle, 2001); i.e. affordances and constraints. Some nonverbal actions may be transmitted and others may not, this affects the conversation and thus the learning process. Therefore, coding nonverbal communication in the mediated context was carried out over three stages and this in turn leads to a better management, reading and finally, the analysis of the nonverbal data.

(1) An 'initial coding' according to the mere types of nonverbal actions directly into the proposed nonverbal coding scheme.

(2) A 'parallel coding' which is parallel to the 'verbal information layer' that relates to the functions of nonverbal communication, and not to their types, for example 'head nodding' functions as 'giving acknowledgement' which relates to the communication control coding scheme, and 'smiling' functions as 'showing solidarity' which relates to the evaluation phase in the structure coding scheme, and so on.

(3) An 'alternative coding' which will distinguish between nonverbal actions in the physical environment and those when transmitted in the virtual environment, this will enable coding verbal discourse in place of nonverbal actions; as substituting or compensating the absence of nonverbal actions in the mediated context.

4.5.2 Visualising Data

The communication modes and coding categories are much more informative when observed together in a parallel within the timeline of the design review process. This was a challenge because of the multimodality of the mediated communication and the fact that actions within the conversation happen simultaneously (verbal and nonverbal parallel layers of data), accordingly, rich and complex data sets are produced. Therefore a way of visualising the data was designed to help carry out the qualitative analysis, and at the same time, present the data in a readable form.

Unlike regular coding, where each observational unit is given a special code in a table in order to be counted into a quantitative form of calculation, in this research, the observational units are coded visually. Each of the coding schemes described above is extended to the duration of the observed design review sessions, the type and functions of different interactions are plotted on the coding schemes on a time line grid; 'Visual Interaction Timeline grids'. As Bales (1950) constructed his interaction unit, each unit in the coding scheme expresses the primary meaningful action that occurred in that time span whether verbal or nonverbal forms of interaction. Therefore, the timeline grids were divided into a manageable twenty seconds time unit, each represents an observational unit and highlighting the type of interaction that occurred.

Microsoft Excel software proved significant for creating and coding the timeline grids, and as it is the aim to reveal 'patterns' of interaction at a glance, using different fillings for different actors; i.e. tutor interactions are represented by the letter (T) and filled in a thick horizontal pattern, while student interactions are represented by the letter (S) and filled in a thin horizontal pattern, as shown in Figure 4-7.

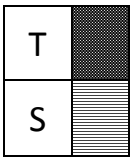


Figure 4-7 Different Filling of the Tutors' (T) and Students' (S) Observational Units in Excel Grids to Distinguish their Interactions

Verbal and nonverbal are plotted on separate sheets for the same timeline. Coding the data into vertically ordered tables in Microsoft Excel software, enabled to plot the interactions as pattern-filled boxes where it was possible to hide/ unhide rows and highlight columns to enable vertical arbitration of time units. The use of the pattern-filled visual interaction timeline grids made the reading and comparison of the interactions prompted, and resulted in a visual outcome of the design review interaction process at the same time. Examples of coding grids that relate actors, time, and functions of the verbal content, cognitive and critique levels of discussion, communication management, social and technology communication as well as the nonverbal interactions can be viewed in Appendix (I).

4.6 **Summary**

This chapter has presented the design of the primary means of data collection and analysis; based on interaction protocol analysis methods and real-time observations. As established, the aim of this research is not to investigate the design process or product as such, but rather the design learning interaction that results from communicating in a mediated design review, a new approach towards protocols is pursued because the current methods reviewed in the literature are not suitable for this research's inquiry.

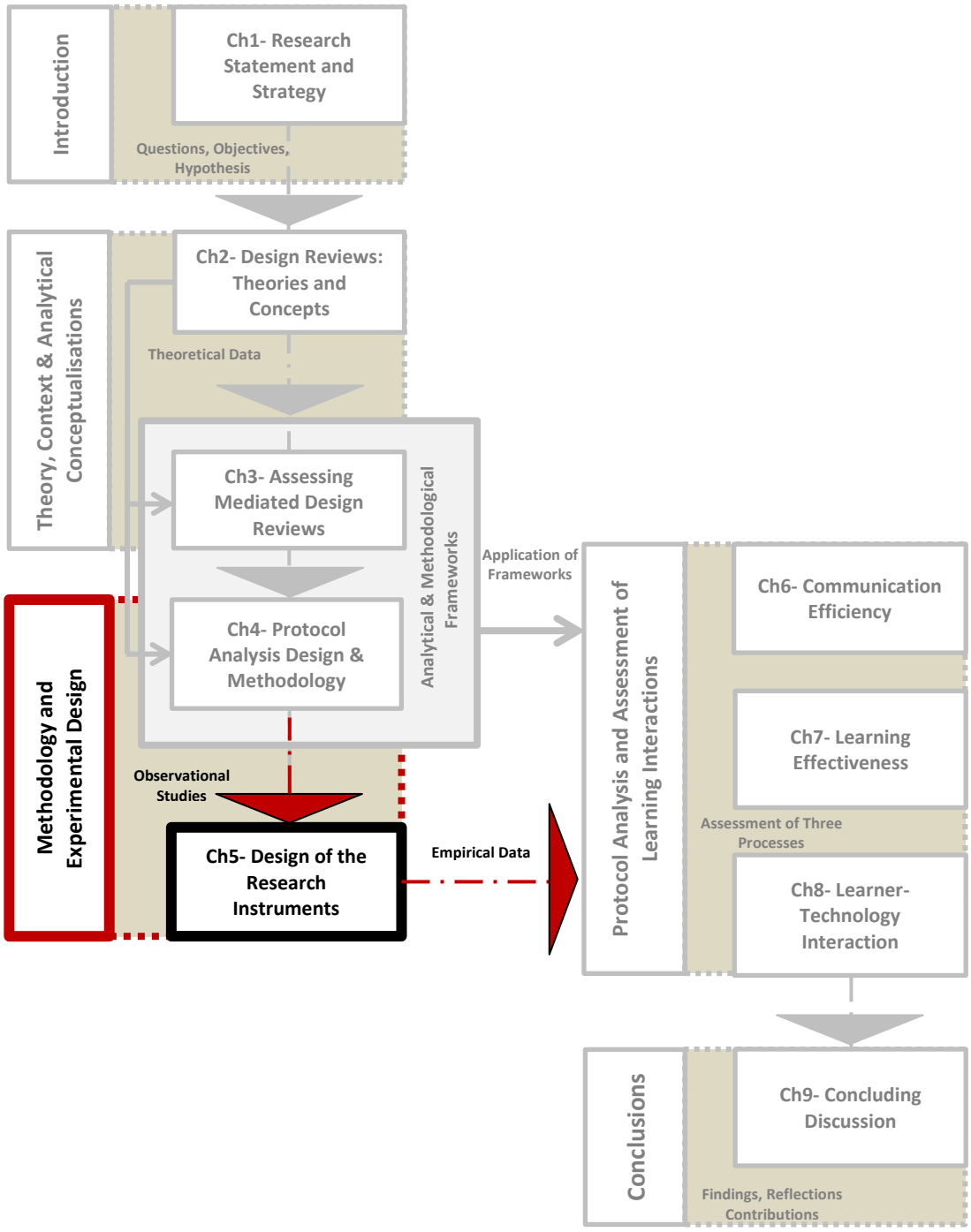
A review of related issues concerning structuring coding schemes for analysing design activity and interaction in social communication and in design contexts was presented in order to develop a protocol method suitable for analysing learning interactions in design reviews. 'The Review Interaction Protocol' is presented as a multi-layered coding scheme for coding and visualising the observed data. Consisting of four layers; (1) structure of the review, (2) cognitive and critique level, (3) communication management and (4) nonverbal communication, the review interaction protocol represents all verbal and nonverbal interactions that occur in the mediated design review in parallel and helps to assess the effectiveness of communication and the learning interactions. The following chapter presents the experimental procedures carried out in this thesis to examine the learning interaction process in mediated design reviews.

Chapter Five

Design of the Research Instruments

Chapter Five Contents

Chapter Five **129**
5 Design of the Research Instruments **132**
5.1 Introduction **132**
5.2 Observing Learning Interactions of Design Reviews **132**
5.2.1 Settings, Participants and Projects 134
5.2.2 Procedures of the Design Reviews 140
5.3 Data Capturing Methods **147**
5.3.1 Capturing Design Review Interactions 147
5.3.2 Capturing Participants' Experiences and Opinions 151
5.4 Summary **154**


Introduction
Ch1- Research Statement and Strategy
Questions, Objectives, Hypothesis
Theory, Context & Analytical Conceptualisations
Ch2- Design Reviews: Theories and Concepts
Theoretical Data
Ch3- Assessing Mediated Design Reviews
Ch4- Protocol Analysis Design & Methodology
Analytical & Methodological Frameworks
Methodology and Experimental Design
Observational Studies
Ch5- Design of the Research Instruments
Application of Frameworks
Empirical Data
Protocol Analysis and Assessment of Learning Interactions
Ch6- Communication Efficiency
Ch7- Learning Effectiveness
Assessment of Three Processes
Ch8- Learner-Technology Interaction
Conclusions
Ch9- Concluding Discussion
Findings, Reflections Contributions

5 Design of the Research Instruments

5.1 Introduction

The previous chapter has described the data coding methods and analytical approaches that were designed to aid the research investigation. As the intention of this research is to study the role of mediation in creating effective design review learning interactions, three sets of design reviews in both physical and virtual contexts were recorded and closely observed. Chapter Five starts by describing these observational cases; the different settings, participants and projects. It then presents the procedures of the mediated design reviews, and finally discusses the methods used to capture the interactions and the experiences of the participants.

5.2 Observing Learning Interactions of Design Reviews

To better understand the structure of the verbal learning discourse and the nature of learning interactions which occur in face-to-face design reviews, twenty two observational studies were carried out in the physical context under the category 'Face-to-Face Crits'. While a simulation of the design review setting was created in the 3D virtual world of SecondLife; sixteen mediated design reviews were conducted, observed and recorded under two experimental categories, 'Virtual Crit (1)' and 'Virtual Crit (2)'. The aim here is to help us understand how the 'remote' learning discourse is structured, as well as analyse in detail the flow and content of the verbal communication, and the 'virtual' nonverbal actions that complement it. Here the researcher was a non-participant observer, however interfered in a few occasions to help with technical issues during the mediated design reviews. The three observational cases; Face-to-Face Crits, Virtual Crit (1) and Virtual Crit (2) were categorised according to the context of communication and the mediated affordances available to the participants. Table 5-1 shows the conditions of these three categories. Settings, participants, projects and procedures are discussed in more detail in the following subsections.

Table 5-1 Conditions of the Three Observational Cases

	Conditions		Face-to-Face Crit	Virtual Crit-1	Virtual Crit-2
1	Medium of Communication		- Face-to-face communication	- Computer Hardware - 3DVirtual World: SecondLife Software	- Computer Hardware - 3DVirtual World: SecondLife Software
2	Time/ Space Distribution		- Same time - Same space	- Same time - Different space	- Same time - Same space
3	Channels/ Modes of Communication		- Full Verbal (audio) - Full Nonverbal (visual)	- Limited Verbal (text only). - Limited Nonverbal (3D World /Avatar body).	- Full Verbal (text and audio-consecutively) - Limited Nonverbal (3DWorld/Avatar body).
4	Data Collecting Methods		- Video recording - Photographs	- Saving Chat transcripts - SecondLife in-world video capturing tool - SecondLife in-world screenshots - Pre and post-test Questionnaire - Post-study Interview	- Video recording - Photographs - Saving Chat transcripts - Screen video capturing - SecondLife in-world screenshots - Post-study Focus group
5	Nature of the Collected Data		- Audio verbal utterances (transcribed) - Video of nonverbal interaction	- Textual verbal utterances - In-world videos of Avatars' interactions - Snapshots of Avatars' interactions - Data from questionnaires and discussion with the tutor	- Audio verbal utterances (transcribed) - Video of nonverbal interaction - Textual verbal utterances - In-world videos of Avatars interactions - Data from Focus group and discussion with the tutor
6	Participants	Academic Stage / Number of Students and Tutors	- Stage 1 = 8 Students - Stage 2 = 8 Students - Stage 3 = 6 Students -Total = 22 Students/ 6 Tutors	- Stage 5 = 8 Students - MSc. = 3 Students -Total = 11 Students/ 1 Tutor	- Stage 1 = 2 Students - Stage 2 = 3 Students -Total = 5 Students/ 2 Tutors
7	Projects	Type of Design	- Stage 1: One Room Design - Stage 2: Student Accommodation - Stage 3: Film Archive Building	Digital Design Project Documentation: 'Unreal Buildings'	Landscape Project: The Moors Exhibition Park
		Scale	Small Design Scale	Small Design Scale	Large Design Scale
		Format of Deliverables	- 3D Models - 2D Drawings - Sketch Books	- 2D Digital images of CAD and Sketch-up Models and Site plans (jpeg)	- 2D Digital images of CAD and Sketch-up Site plans (jpeg)

5.2.1 Settings, Participants and Projects

Motivated by the richness of human interaction in the design review, the research ensured that the observational studies were integrated within the existing teaching pattern and strategy in the School of Architecture, Planning and Landscape- Newcastle University. Students and tutors voluntarily participated in three Face-to-Face Crits, and two Virtual Crits; where live instances of real on-going design reviews were taking place in the school. The diversity of these settings, as will be described below, was intended to create a larger spectrum of interactional material to produce a richer set of data; hence better understanding of different levels of communication and interaction.

- **Face-to-Face Crits**

The traditional design reviews were occurring as scheduled near the end of the first term.

A total of twenty two students and six tutors were involved in the Face-to-face Crits; distributed among three academic year groups; stages one, two and three. Paper-based print outs of the projects were pinned-up on the walls and 3D models were displayed in different crit rooms in the school; the students and critiquing tutors were co-located in the same rooms as in Figure 5-1.

Figure 5-1 Pinned-up projects in one of the Face-to-Face Crits

Academic Stage one design reviews took place in the crit area shown in Figure 5-2 and Figure 5-3, as is the culture of design reviews, the placements of the participants are similar; the critiquing tutors were seated as closely as possible to the pinned-up project to

get a better view of the designs, the student was standing near his/her project and the attending students were gathered at the back of this setting.

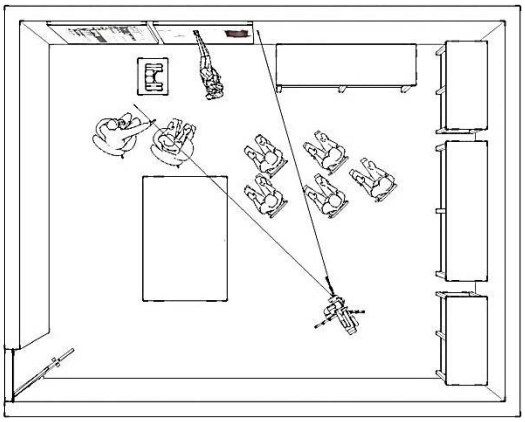


Figure 5-2 Plan of Face-to-Face Stage One Crit Settings

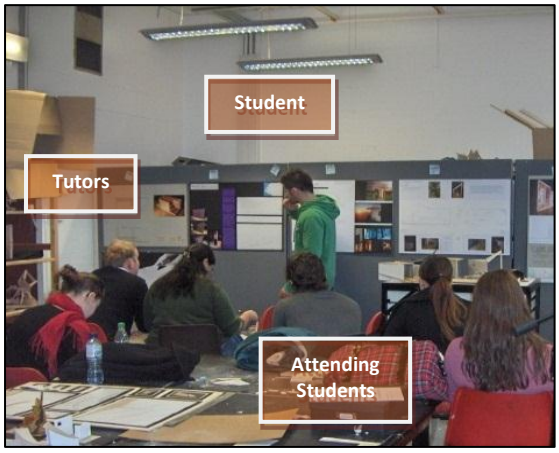


Figure 5-3 Face-to-Face Crit Stage One Crit Settings

A similar placement can be viewed in Figure 5-4 and Figure 5-5 for stage two crit sessions.

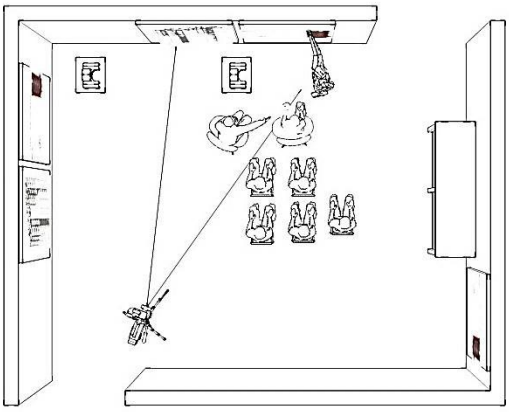


Figure 5-4 Plan of Face-to-Face Stage Two Crit Settings

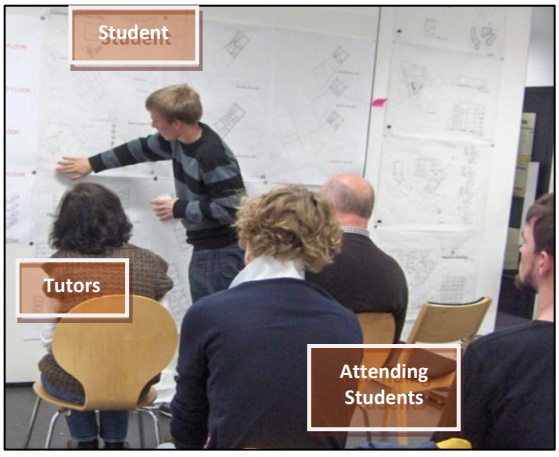


Figure 5-5 Face-to-Face Crit Stage Two Crit Settings

The observed stage three crits took place in a relatively narrower area, as shown in Figure 5-6 and Figure 5-7, and the number of attending students was less than the two earlier stage crits.

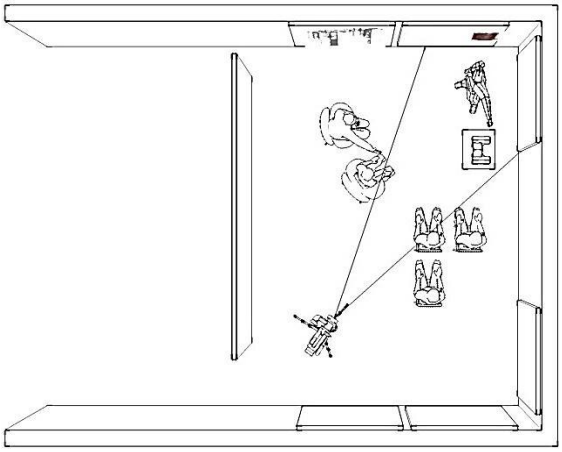


Figure 5-6 Plan of Face-to-Face Crit Stage Three Crit Settings

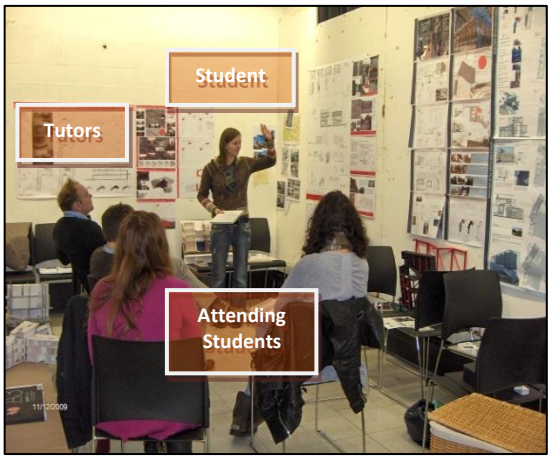


Figure 5-7 Face-to-Face Crit Stage Three Crit Settings

- **Virtual Crit (1)**

This mediated design review was produced out of a real 'distance' learning situation; for the main tutor of a digital design module 'Unreal Buildings' was going to be travelling abroad in an academic related project during the time of the design reviews. The projects were prepared in digital format to be sent to the tutor via email, this in turn created a good opportunity to carry out the design review online via SecondLife to ensure a real-time discussion for better review of the projects. The participating students were in higher academic stages including twelve stage five students and three Digital Architecture Masters students along with the module tutor. All participants were geographically separate and the design review virtual settings were purposely created in SecondLife.

The virtual design review space was built from scratch using in-world building tools in the land "Aelius" which is owned by Newcastle University in SecondLife. The access and permission to build on a particular parcel of this island in the location (202, 32, 23) was given to the researcher for the purpose of writing this thesis. Review of virtual learning settings in SecondLife, (for example Harvard Law School, and Ohio Exhibition Area in SecondLife shown in Figure 5-8 and Figure 5-9) suggested that much existing -and very recent- learning and teaching activity in virtual worlds mirrored physical world classroom activity and spaces; see also (Thackray *et al.*, 2010; Erickson *et al.*, 2011).

Even though it is obvious that chairs and other physical contents will not be used in virtual settings, these rather 'set the stage' and orient the users' attention to the location of the reviewed material.

Figure 5-8 A lecture area in Harvard Law School

Source: (Lagorio, 2007)

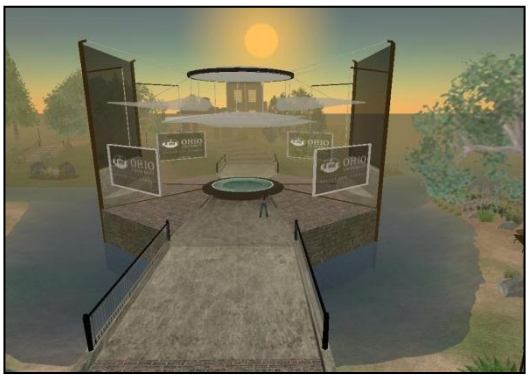


Figure 5-9 Ohio University Exhibition Area

Source: SimTeach.com

Observing face-to-face design reviews, the nature of the on-going interactions suggested that in all design reviews, a number of drawings were to be displayed on walls or boards to be described by the student and viewed clearly by the tutors and the attending students. Visiting a number of educational locations and campuses in SecondLife gave a good understanding about how visual material can be displayed; this includes these methods:

- An Avatar can upload image files to his\her inventory, these are categorised under 'textures'; the idea of displaying the images is by changing the texture of the display screen into the desired (jpeg) image.

- Another way of displaying images is by setting 'scripts', which is a programming language in SecondLife, to an object in order to view a series of images or link to a website.

- There are virtual slide show screens that can be bought in SecondLife where the images need to be sorted in a specific order, and are viewed one after the other.

The first method of displaying (jpeg) images which is uploading them as 'textures' for a small fee per file (10 Linden Dollars; which is equivalent to 0.47 GBP), was chosen because it is quicker and easier for the students than learning script language. Moreover, the nature of presentation of the design review is to display a multiple set of images at the same time, so a slide show screen was not suitable for this type of activity.

Where from experience with using SecondLife, it was found that the camera angles afforded better view in larger open space rather than in room-type closed spaces such as in real design reviews.

The students were asked prior to the design review about the number of images they need to display, most of them said they were from three to six images of the project.

Therefore the learning space for Virtual Crit (1) was designed to be an open area that includes four display screens, and a set of chairs, as shown in Figure 5-10. There were also smaller screens at the back of this setting for students to practice displaying their work on, before their sessions.

Figure 5-10 Virtual Settings of Virtual Crit (1) in SecondLife

- **Virtual Crit (2)**

As a new set of data became required with the development of the research objectives; the importance of investigating the learner-technology relationship became relevant, especially interaction with the computer parts. Hence the participants were co-located to enable recording their physical gestural and other embodied interactions.

The Brae Computer Cluster in the University of Newcastle had the latest version of SecondLife installed on its computers; the cluster was quiet and the seating placements provided that the participants not see each other directly; so it was chosen for running Virtual Crit (2) to simulate a distance learning situation, see Figure 5-11.

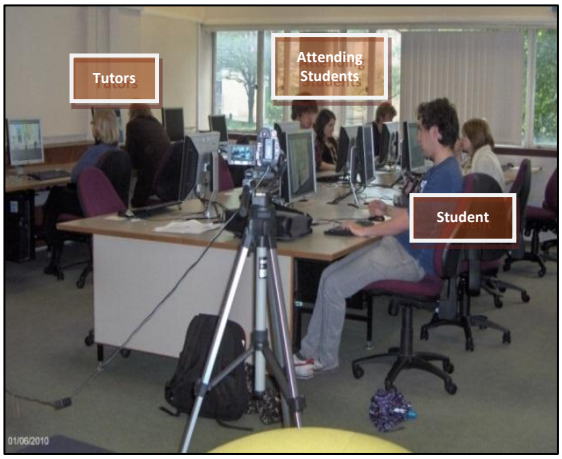


Figure 5-11 Physical Settings of Virtual Crit (2) in the Brea Cluster, Newcastle University

Two tutors and eleven students of academic stages one and two volunteered in this second mediated design review, and their projects were all in digital formats. The students provided information about the type of project and number of images prior to the reviews as done with Virtual Crit (1) students. This information revealed that the projects were about a large scale landscape design of the Moors Park and all had three to four (jpeg) images to display during the design review.

Therefore, based on this information, and how well the sizes of the screens worked previously with Virtual Crit (1), a decision was made to change the number, proportions and sizes of the screens to suit the students' landscape, fairly bigger, projects in Virtual Crit (2).

Three larger display boards were used, while the same overall appearance of the crit space remained the same, smaller sized display boards for practicing were also offered to the users prior to the design reviews. Figure 5-12 show the virtual settings of Virtual Crit (2).

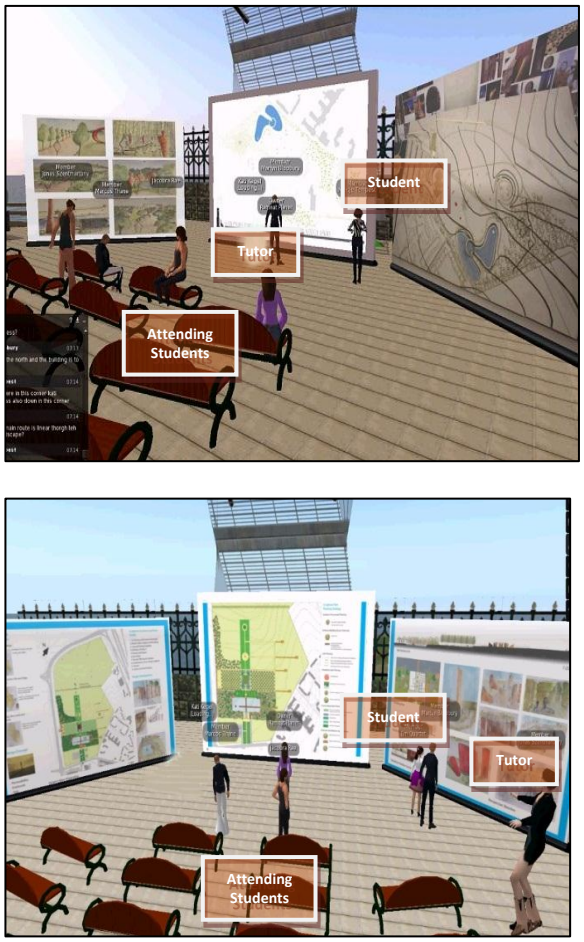


Figure 5-12 Virtual Crit (2) Virtual Settings in SecondLife

5.2.2 Procedures of the Design Reviews

Each of the observed design reviews followed certain procedures that suited the context of each case. This subsection discusses the preparations carried out prior to the observations and also addresses the tasks carried out during the design reviews; this includes describing the afforded communication modes, the completion status of the students as well as the role of the observer.

- **Face-to-Face Crits**

This category of observed design reviews, involved ethical and organisational procedures before the observations were proceeded. Two weeks prior to the final design reviews, the researcher sent out a number of emails addressed to the staff members of the school of Architecture, Planning and Landscape to obtain permissions and approvals to

record the different design review settings. Two personal responses as well as two email replies came back from willing module and program directors indicating agreement to participate; these staff members provided the researcher with times and location of their crits. Tutors of stages two and three, asked for further information about the study and to ask the students for their permissions as well as giving them a chance to opt out, this is shown below in the following email responses.

> Stage Two Tutor*: "my final crits will be on Dec 7-8. the location will be basically all over the first floor…it is ok by me that you record them, but I think I'd like to see a bit more of the protocol and we should probably allow any student who does not want to be taped a chance to opt out."*
>
> Stage Three Tutor*: "I have the last tutorials tomorrow of the project. Reviews are Thursday and Friday 10 and 11, next week all day. I have no objections to others joining in but you may want to ask the students as well for permission, I also welcome you filming - as long as I never have to see the video!"*

Each academic stage of the Face-to-Face Crits were scheduled to be on different days near the end of the first term; some were set on one or more days, giving each student a time slot of fifteen minutes. In order to capture as much interactions as possible, the majority of the students who have given permission to record their reviews were observed and recorded accordingly, some however apologised and opted out of recording, this is shown in Table 5-2.

Table 5-2 Numbers of Observed Face-to-Face Design Review Sessions

	Stage One	Stage Two	Stage Three	Total
Accepted to Participate	10	8	9	27
Apologised prior or during the recording	2	0	3	5
Completed Observation	**8**	**8**	**6**	**22**

On the days of the design reviews, the students and tutors were given a brief description about the intention of the study, ensuring them that they have all rights to withdraw from the study at any time, and were asked to complete and sign a 'Disclaimer Form' in accordance with the policies of the university, (see Appendix A). Immediately after that, the design reviews proceeded as normal, the participants made full use of the

standard set of human verbal and nonverbal modes of communication, allowing the recording and observation of the face-to-face learning interactions by the observer.

- **Virtual Crit (1)**

The participating students in Virtual Crit (1) were approached via their module leader who also participated in this design review as the critiquing tutor before he travelled abroad; they were instructed that their design review will be carried out at a distance, while they all had the choice not to participate, and to email their projects to their tutor instead. As this set of design reviews included the use of SecondLife in a remote context, it was important to ask the students before the virtual crit about their prior experience with using this or other similar Avatar based environments. Therefore a pre-test questionnaire, (described further in a coming section of this chapter), was given to the students who accepted to participate the participants were asked to sign a 'Disclaimer Form' as well. According to the students' responses to the pre-test questionnaire, which revealed fairly good prior experience with using Avatar worlds, an instruction sheet was emailed to them providing additional information about creating an account specifically with SecondLife and preparing and uploading the digital images of their projects, information about the basic hardware and internet specifications needed to run the software on their home computers was provided as well (see Appendix B).

The participants of Virtual Crit (1) had the opportunity to visit SecondLife a few days before the actual crit, they followed the detailed instruction sheet emailed to them, and they were given permission to access the land "Aelius" and all got to explore the virtual world of SecondLife in their own time. The researcher's Avatar paid money to the students' Avatars to be able to upload their images in their SecondLife Inventory, Figure 5-13. Following this, the students practiced how to upload and display their work on small display boards; Figure 5-14 shows the researcher with a student practicing to upload images of his project a day before his crit session.

Figure 5-13 Paying Money to Students to Upload their Images

Figure 5-14 The Researcher with a Student Practicing to Upload Images

Due to the tutor's time schedule, Virtual Crit (1) sessions were distributed across three days giving fifteen minutes to each session. The tutor was out communicating from abroad, while the students were each at their homes. Sixteen students initially registered and created Avatars; but thirteen students actually participated, while due to some technical problems only eleven students successfully completed their sessions. Table 5-3 shows the distribution and completion status of the students participating in Virtual Crit (1), for more information about the participants, see Appendix (D).

Table 5-3 Initial and Final Numbers of Participants in Virtual Crit (1)

	Day one	Day two	Day three	Total
Volunteered	7	5	5	16
Started	6	5	4	13
Completed the Crit	**4**	**4**	**3**	**11**

The communication modes available to the participants in Virtual Crit (1) included verbal and nonverbal forms of 'mediated' interaction; the chat tool was the primary mode of verbal communication; see Figure 5-15, while the Avatar human-like body afforded some nonverbal interactions such as navigation and pointing with its arm. Figure 5-16 shows an interactional feature available in SecondLife in the time of carrying out Virtual Crit (1), this is a white dotted beam that shows the destination of the Avatar pointing position; this was no longer available when Virtual Crit (2) was carried out as will be discussed below.

Figure 5-15 The Chat box as a Primary Mode of Verbal Communication in Virtual Crit (1)

Figure 5-16 A White Dotted Beam Tracks the Destination of Avatar Pointing in Virtual Crit (1)

Following the completion of the Virtual Crit (1) sessions, the participating students, were sent an online post-test questionnaire to provide feedback about their experience, the design of this instrument is elaborated on in more detail in a following section of this chapter.

- **Virtual Crit (2)**

Unlike Virtual Crit (1), this case of mediated reviews was not produced out of a need to run a distant learning communication; the participants were invited to participate in the study after their final term exams; they were asked to volunteer in a simulation of a distant design review to test more virtual and physical forms of interaction. The volunteering students were asked as well to sign a 'Disclaimer Form' and to fill a pre-test questionnaire about their prior experience with the media. Their responses indicated that more instructions and guidance to use SecondLife was needed before the actual crits.

Accordingly, detailed instructions were sent to the participating students and tutors, but the technical specifications were not included as this software will be running on the university computers. Similar to the procedures followed in Virtual Crit (1), the participants were given permissions to the land "Aelius" and were paid money to upload their projects and practice before the day of the virtual crit.

The version of SecondLife used in Virtual Crit (2) had developed a welcoming procedure, once a new Avatar is created; all users would start on "Orientation Island", shown in Figure 5-17, which is an area that is designed to quickly teach the basics of SecondLife.

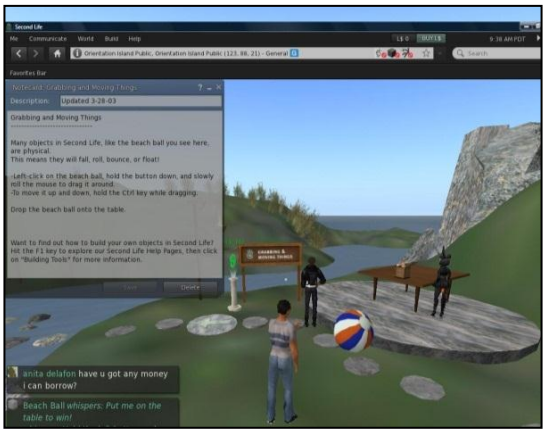


Figure 5-17 Orientation Island, provides practical training to the tools of SecondLife

On the day of Virtual Crit (2), an hour was given prior to the start of the sessions for preparations and practicing; in addition to the previously email instruction sheet, the researcher gave the participants a short power point presentation explaining the procedures and guiding the participants through the tasks of creating an account and uploading their projects, if not done yet.

Feedback from the previous design review; Virtual Crit (1), hinted that longer time slots be considered, and therefore, twenty minutes were allocated for each time slot in Virtual Crit (2). This case of mediated design reviews was set to take place in one day over two sessions, eleven students initially registered and created Avatars; but technical and uploading problems were experienced which resulted in three computers to crash leading three students to withdraw from participating. Communication limitations caused extensions of the durations of the crits in the first session which caused the crits to go beyond the allocated times. This resulted in a fewer number of crits to fit in the time scheduled; thus, five students were able to successfully complete their virtual crits. Table 5-4 shows the completion status of the participating students in Virtual Crit (2), for more information about the participants, see Appendix (D).

Table 5-4 Initial and Final Numbers of Participants in Virtual Crit (2)

	First Session	Second Session	Total
Volunteered	6	5	11
Started	5	3	8
Completed the Crit	**3**	**2**	**5**

The communication channels used in this second set of mediated design reviews varied from those used in Virtual Crit (1), here, the participants used the chat tool for verbal communication for half of each session, and then they used the voice mode/ audio channel. This gave the opportunity to compare different communicative aspects with or without voice. On the other hand, the version of SecondLife used in Virtual Crit (2) no longer provided accurate Avatar pointing features, the white dotted tracking beam showing the pointing destination, available before in Virtual Crit (1), no longer existed here, moreover, the Avatar pointing feature itself was not accurate. Moreover, the direction of the Avatar arm does not relate to the curser selection (highlighted in a red circle), as shown in Figure 5-18. Due to this change in the system of SecondLife, the nonverbal mode used in Virtual Crit (2) was limited to fewer Avatar body movements including navigation and flying modes, Figure 5-19.

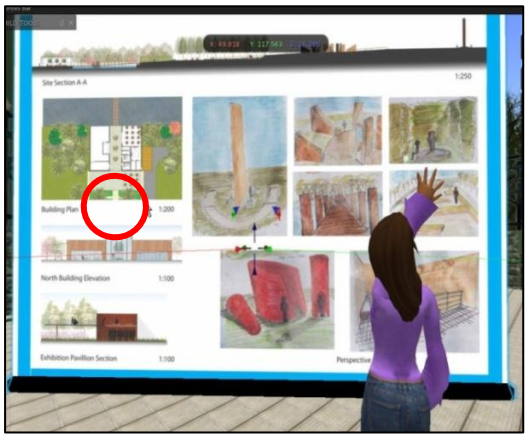


Figure 5-18 Avatar pointing in Virtual Crit (2), no tracking or correlation with the cursor

Figure 5-19 Navigation controls; Walk, Run, Fly

This again gave us a good opportunity to compare more variations in interactional modes in the virtual worlds. Shortly after the design review, and similar to Virtual Crit (1), the participating students of Virtual Crit (2), including the students who had to withdraw for communicational problems, joined a focus group to discuss general and specific aspects about their experience; this procedure is discussed in more detail later in this chapter.

5.3 Data Capturing Methods

As discussed so far, a number of observational studies were carried out to serve the objectives of this research. The aim now is to collect verbal and nonverbal sets of data from these observational studies by recording the learning discourses and embodied interactions along with the experiences and opinions of the participants provided before and after the observations. The following subsections describe the different data capturing tools and the design of questionnaires and focus groups used in this study.

5.3.1 Capturing Design Review Interactions

Video recording the on-going physical and virtual activities produced verbal and nonverbal data, the data capturing instruments used in this research depended highly on the context of communication and the channels used in each of the observed settings.

- **Face-to-Face Crits**

In the Face-to-Face Crit, audio verbal utterances as well as nonverbal interactions were captured via real-life video, the purpose of recording the design reviews is to document the learning interactions (Sarantakos, 1993), and to be able to review the activity several times to capture the targeted data for coding to the review interaction protocol. Therefore, a Sony digital camcorder mounted on a tripod was used to capture the participants' interactions. Knowing the design review may be a difficult situation for some students, it was important to consider that the video-recording equipment is as unobtrusive as possible through strategic placements of the camera, thus, the used strategy attempted to minimise distraction and influence on the behaviour of the participating students; the placement of the camera is shown in three different settings in Figure 5-20.

Figure 5-20 The Camera settings in Three sessions of Face-to-Face Crits

The observer also made sure that the students may choose to withdraw at any time if the feel uncomfortable by the camera settings. Asking the students, informally, after the recording about how they felt about 'being recorded', surprisingly they all confirmed that once they started their design reviews, they completely forgot about the camera. A number of still digital photos were also taken to record the physical settings, and the placements of the participants. The verbal utterances were transcribed and along with the nonverbal interactions, were coded in the design review interaction protocol as discussed previously in Chapter Four.

- **Virtual Crit (1)**

In order to be able to study and explain interactions and performances of participants in the virtual context, it was important to extract data from Second Life that serves the research objectives in high accuracy (Ranathunga *et al.*, 2011). As Virtual Crit (1) was a fully remote learning situation, a method of real-time virtual observation by Hine (2005) was adopted to collect data in the virtual environment. Exploring with SecondLife in the pilot studies revealed that, to some extent similar to real-life, the Avatars enacted several forms of nonverbal communication in correlation with the verbal chat, so taking observational note only, was not enough to extract meaningful data. Therefore recording the virtual interactions was necessary to be able to review the sessions over and over again and find meaningful Avatar interactions that aid the learning discourse.

'Machinima' is the use of real-time 3D computer graphics rendering engines to produce cinematic production inside the virtual world of SecondLife. A number of (avi) video clips were captured using the SecondLife Machinima tool in the virtual learning space of Virtual Crit (1).

These clips recorded activities such as Avatars' body movements, pointing, uploading and removing images, navigating, etc. Still photos were also captured using SecondLife Snapshot tool as well. While chat transcripts, which produced the verbal discourse, were saved as Word documents by selecting the text entered in the 'Chat History Box' shown in Figure 5-21.

Figure 5-21 Verbal Communication is Saved from the Chat History Box in Virtual Crit (1)

- **Virtual Crit (2)**

As explained before earlier in this chapter, both physical and virtual settings were recorded in Virtual Crit (2). The physical settings were video recorded in full using a Sony digital camcorder mounted on a tripod; this captured verbal discourse as well as nonverbal interactions of the participants.

Figure 5-22 Video Camera Placements in the Physical Space of Virtual Crit (2)

Recording of the virtual settings included similar steps as carried out in Virtual Crit (1); these were saving the chat transcripts as Word documents, and recording the virtual Avatar interactions.

Due to the latest copyrights policy at the time of recording Virtual Crit (2), the creators of SecondLife had restricted the use of Machinima virtual capturing video tool, and therefore an available commercial screen capture video software; 'Debut Video Capture' was used to record the virtual in-world interactions.

Figure 5-23 Debut Video Capture Software used to Record Virtual Interactions in Virtual Crit (2)

Asano *et al.* (2010) have emphasised on the use of screen shot recording to understand activity in the learning process, so a large number of screen shots were taken of the virtual activity using SecondLife snapshot tool shown in, while snapshots were also taken from the 'virtual' videos using the windows Print Screen tool.

5.3.2 Capturing Participants' Experiences and Opinions

Another important instrument used to capture data not revealed from the observations, is questionnaires and focus groups aiming to obtain information directly from the participants about their experience. As this research is mainly student-focused, the participating students who have experienced the mediated, remote and virtual interactions in the two mediated design reviews; Virtual Crits (1) and (2), were the focus of attention in this study. This does not mean that the participating tutors were not involved in our inquiry; continuous discussions with the three tutors who have participated in the two mediated design reviews as well as other staff members in the school, took place during different stages of the preparation of this thesis, where almost all of their opinions directed the design of the observational studies and guided the analysis of the data. This subsection discusses the design of both pre-test and post-test questionnaires, and the focus groups used in this thesis.

- **Virtual Crit (1)**

Prior to Virtual Crit (1), a pre-test questionnaire of twenty questions, focused to ask the participants about some information regarding three main themes:

(1) Information about their home computer properties to assess whether they can run SecondLife on their machines or not.

(2) Information about their deliverables, i.e. formats, scale and sizes of the images and number of files to be presented. This guided the design of the learning settings and display boards inside SecondLife, and indicated the money needed to pay for uploading files.

(3) Information about the students' opinions about using the technology; this aimed to ask about their prior experience and skills with regards to using online communication and 3D virtual worlds, specifically SecondLife, and their opinions and preference to use text-based media over other kinds of media as well. The students' enthusiasm and interest to use this kind of technology for learning communication was sought by asking them how they felt about presenting their projects via SecondLife before the actual mediated design reviews.

The pre-test questionnaire was relatively short; Likert responses were mostly pooled into yes and no categories, and other questions asked to select from a list, or to give short opinion about certain aspects; see Appendix (C).

The participants' own views on specific interactional aspects that occurred during the mediated review, as well as their perceptions of both; the virtual settings and learning delivery, are types of data that can only be derived directly from the participants. Therefore, shortly after Virtual Crit (1), an online questionnaire consisting of fifty-five questions was created to evaluate and capture the students 'virtual' and learning experiences while they were still fresh in their minds, this also included the students who faced technical problems and had to withdraw from participating.

The questions were a mix of Likert scale, 'yes' and 'no' questions, multiple choice questions, rating (from 1 to 10) questions and open-ended questions (Bradburn *et al.*, 2004); see Appendix (E). The post-test questionnaire aimed to ask about information regarding the following themes:

(1) Reasons, if relevant, for withdrawing or not completing the mediated design review.

(2) Computer Self-efficacy and Usability: This dimension of information is essential to maintain attitudes, confidence and interest towards the use of computers and this type of online communication.

(3) Student's Virtual Perceptions: This asks about how it felt to use an Avatar that can move, point and fly, including asking about their sense of presence and perceptions of the 3D learning space to create a full picture about the students' perception of the online environment and their overall attitude.

(4) Student's Communication Satisfaction: This asks about students' attitudes and how they felt towards the communication method and the learning environment in specific areas such as communicating through the chat-only mode, or voice, not being able to point.

(5) Users' Perceptions of Learning: This, in the context of the design review, is how well the tutor perceived information about the presented projects, and how well the students understood and perceived their tutor's feedback comments on their projects.

(6) The Remote Learning Climate: Here the focus is on the well-being (Alavi *et al.*, 1995) of the students as they interact in the online environment, the extent of tension, anxiety, relaxation, enjoyment, how they perceived remoteness when communicating with their tutor compared to face-to-face interaction...etc.

(7) Future use: The students were asked about their overall opinion and rating of the learning interaction in the virtual world, and how they considered it useful for other learning situations in the design discipline.

The participants of the first mediated design review completed the online questionnaire in full, however, not all of them gave detailed opinions about their experience and learning perceptions, this led us to think about another way to complete data collection for the second mediated review; Virtual Crit (2).

- **Virtual Crit (2)**

The choice between questionnaires and interviews came to mind; questionnaires can consume less time and involve less work, but on the other hand, they may guide the participants to a narrow scope of options, in addition to that, they lack to afford ways to express real feelings compared to interviews (Sarantakos, 1993; Floyd and Flower, 1995). Interviews on the other hand are time consuming give richer data about experiences. Furthermore, interaction between the individuals who have participated in the same experience, enhances the interview and opens up new areas of discussion, this is carried out in focus groups with the involved participants.

Focus groups are group discussions, commonly used to examine the 'effect' element of any research objective, discussion is not focused on what people think, but rather it focuses on how and why they thought or did as they did while they are 'focused' in the sense that they involve some kind of collective activity (Kitzinger, 1994; Krueger and Casey, 2000).

Therefore, it was found that a focus group with the students involved in Virtual Crit(2) is the best method to draw upon their attitudes, feelings, beliefs, experiences and reactions in a way that would not be feasible using other methods. Similar to Virtual Crit (1), the focus group discussion revolved around the previously presented themes.

Figure 5-24 Focus Group Settings for Virtual Crit (2) Students

However, an additional theme aimed to relate to the students interaction with the computer, and their gestural behaviour in the physical space compared to the virtual space. Furthermore, the researcher asked the students during the focus groups to answer some of the questions used in the first mediated review post-test questionnaire, such as the (1 to 10) rating questions and the Likert scale questions to produce comparable results with Virtual Crit (1) responses.

5.4 Summary

Chapter Five has presented a description of the main instruments of data collection; this included several contextual observational cases, questionnaires and focus groups. The Chapter started by describing the settings of three Face-to-Face Crits, and then proceeded to describe how the virtual settings were designed and created in the virtual world of SecondLife. The participants and their projects varied in the three observational cases, this served the objectives of this research inquiry by providing a rich array of interactional and discourse data in physical and virtual settings. The preparations and procedures of the observed design reviews were also presented in detail, highlighting the variation in communication modes and the available affordances. Finally this Chapter presented how data was captured, describing the media and apparatus in the three observed design reviews as well as the design of the questionnaires and focus group. The raw data that was extracted from the observational cases included, the observer's real-time notes, real-life

video recordings, in-world video capturing, chat transcripts, photographs, screen captures, and quotations from the questionnaires and focus groups, see Appendix number (D), (F), (G) and (H) for more details on the collected raw data and verbal transcripts.

After collecting such data, the following chapters (Six, Seven and Eight), attempt to visualise and analyse the verbal and nonverbal outcomes of the observed design reviews in order to perform an assessment of the efficiency of communication, learning performance and perceptions and the effectiveness of the learner-technology interaction.

Section Three

The Effectiveness of the Mediated Design Reviews: Discussion and Analysis of the Results

Section Three

The Effectiveness of the Mediated Design Reviews: Discussion and Analysis of the Results

The third section of this thesis, which includes Chapters Six, Seven and Eight reports on the results of the observations of the three categories of design reviews; Face-to-Face Crit, Virtual Crit (1) and Virtual Crit (2), described in Chapter Five where it presents a detailed assessment of the effectiveness of the learning interaction process of the observed design reviews. The assessment is carried out by studying indicators of effectiveness which is based on the assessment criteria proposed and discussed previously in Chapter Three that suggests assessing three constituting processes: (1) Communication efficiency, (2) Learning efficiency and (3) Learner-technology interaction

Thus, each chapter of this section will examine the effectiveness of one of those three processes. Contents of the three following chapters are shown in Figure 5-25.

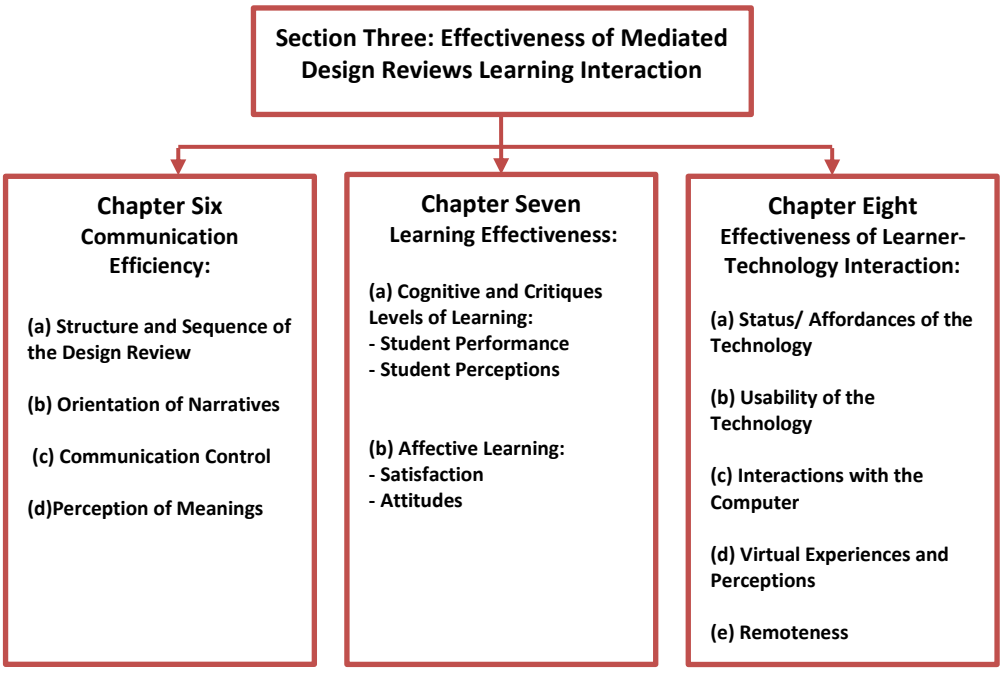


Figure 5-25 Section Three: Assessment of Learning Interactions of Mediated Design Reviews; Chapters Six, Seven & Eight

Content and discourse analysis of the verbal content and interaction analysis of the nonverbal communication are presented in the form of observed similarities and/or differences in interactions between the three observed categories of design reviews, while highlighting the effects of mediated interactivity on the learning interaction process.

As for the reading of the analysis in the chapters of this section, particularly Chapters Six and Seven, first an overall comparison between the interactions of the three categories of experiments is presented; this is demonstrated by relevant strips of the visual timeline grids that represent the observed interactions. Then a detailed analysis of these interactions in each of the three design review categories are presented separately, while mentioning any relevant comparative details (see Figure 5-26). The distributions, purposes and relevance of the observed interactions are studied; how they were affected by mediation, and whether they indicate learning effectiveness or not, are examined as well.

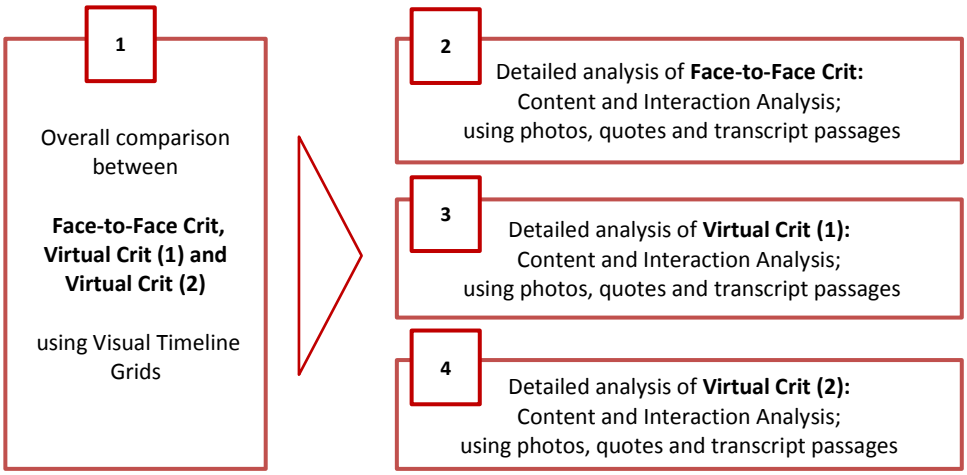


Figure 5-26 Reading of Chapters Six and Seven

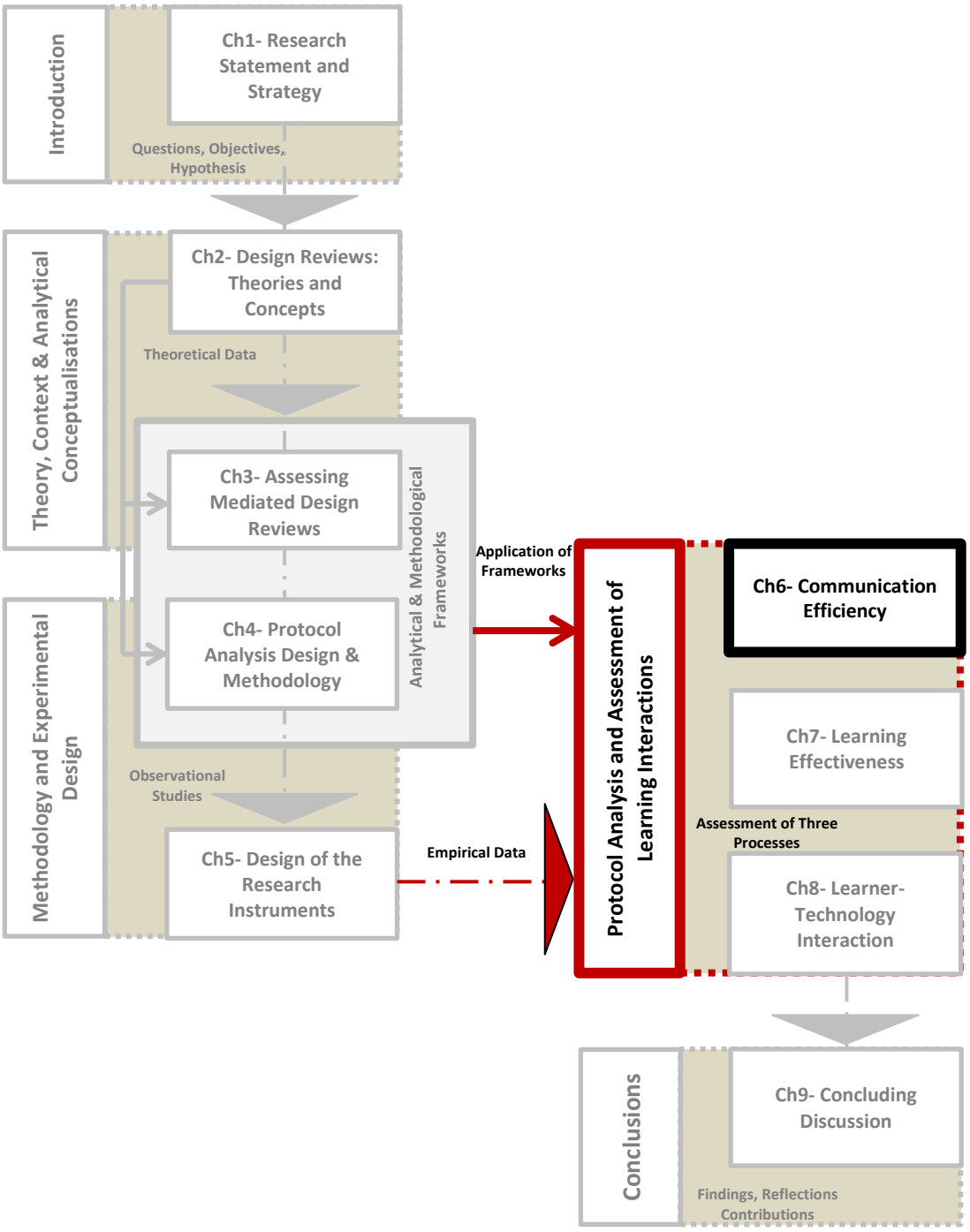
Visual timeline grids, snapshots from face-to-face and virtual recordings, selected passages from the transcribed textual discourse are used to illustrate particular content and interactions. Quotations produced from the open-ended questions and focus groups with the participants are correlated with the data extracted from the review protocols and are presented as well when relevant in the following three chapters. To follow a consistent trend in Chapters Six, Seven and Eight, when quoting a statement from the recordings, the tutors and students in all sessions are referred to as (T) and (S) respectively, and any specific points of emphasis in the quotations are underlined.

Chapter Six

Communication Efficiency

Chapter Six Contents

Chapter Six **159**
6 Communication Efficiency **162**
6.1 Introduction **162**
6.2 Structure and Sequence of the Design Review Phases **162**
6.3 Orientation of Narratives **170**
6.3.1 Pointing 172
6.3.2 Illustrator Gestures 175
6.3.3 Moving the Body (Navigation) 180
6.3.4 Orientation Discourse 184
6.4 Communication Control **188**
6.4.1 Interruptions 188
6.4.2 Acknowledgements 192
6.4.3 Hand Over and Floor Holding 196
6.5 Perception of Meanings **199**
6.5.1 Missing Information 199
6.5.2 Misconception of Scale and Space 202
6.5.3 Compensating Nonverbal Cues to Convey Meanings 203
6.6 Findings on Communication Efficiency **206**


Introduction
Ch1- Research Statement and Strategy
Questions, Objectives, Hypothesis
Theory, Context & Analytical Conceptualisations
Ch2- Design Reviews: Theories and Concepts
Theoretical Data
Ch3- Assessing Mediated Design Reviews
Ch4- Protocol Analysis Design & Methodology
Analytical & Methodological Frameworks
Methodology and Experimental Design
Observational Studies
Ch5- Design of the Research Instruments
Application of Frameworks
Empirical Data
Protocol Analysis and Assessment of Learning Interactions
Ch6- Communication Efficiency
Ch7- Learning Effectiveness
Assessment of Three Processes
Ch8- Learner-Technology Interaction
Conclusions
Ch9- Concluding Discussion
Findings, Reflections Contributions

6 Communication Efficiency

6.1 Introduction

The first component of the proposed assessment criteria of mediated design reviews is Communication Efficiency. Communication in the design review involves communicating verbal discourse, nonverbal actions/cues and graphical-based information. This chapter presents how effectively and successfully these sets of information were delivered in the observed design reviews in terms of communication, based on what appeared from the observations, the transcripts, and from the discussions and responses of the participating students.

Four indicators, are used in this study to examine communication efficiency, these are namely; (1) the consistency of the structure and sequences of the review phases, (2) efficiency of orienting the narrative which studies mediating nonverbal communication, (3) the level of communication control, (4) the extent of maintaining a shared perception of meanings.

6.2 Structure and Sequence of the Design Review Phases

As described in Chapter Four, the first dimension of verbal data; the 'Design Review Structure', proposes that verbal discourse in the design review follows a certain sequence of phases, this starts with (1) Sharing Information followed by (2) Discussion, then finally (3) Evaluation and Feedback. The time-line grids revealed some differences between the three categories of design reviews regarding the structure and durations of verbal discourse; the described sequences may have remained as proposed by the Review Interaction Protocol, but the durations and consistency of these phases varied over the three cases.

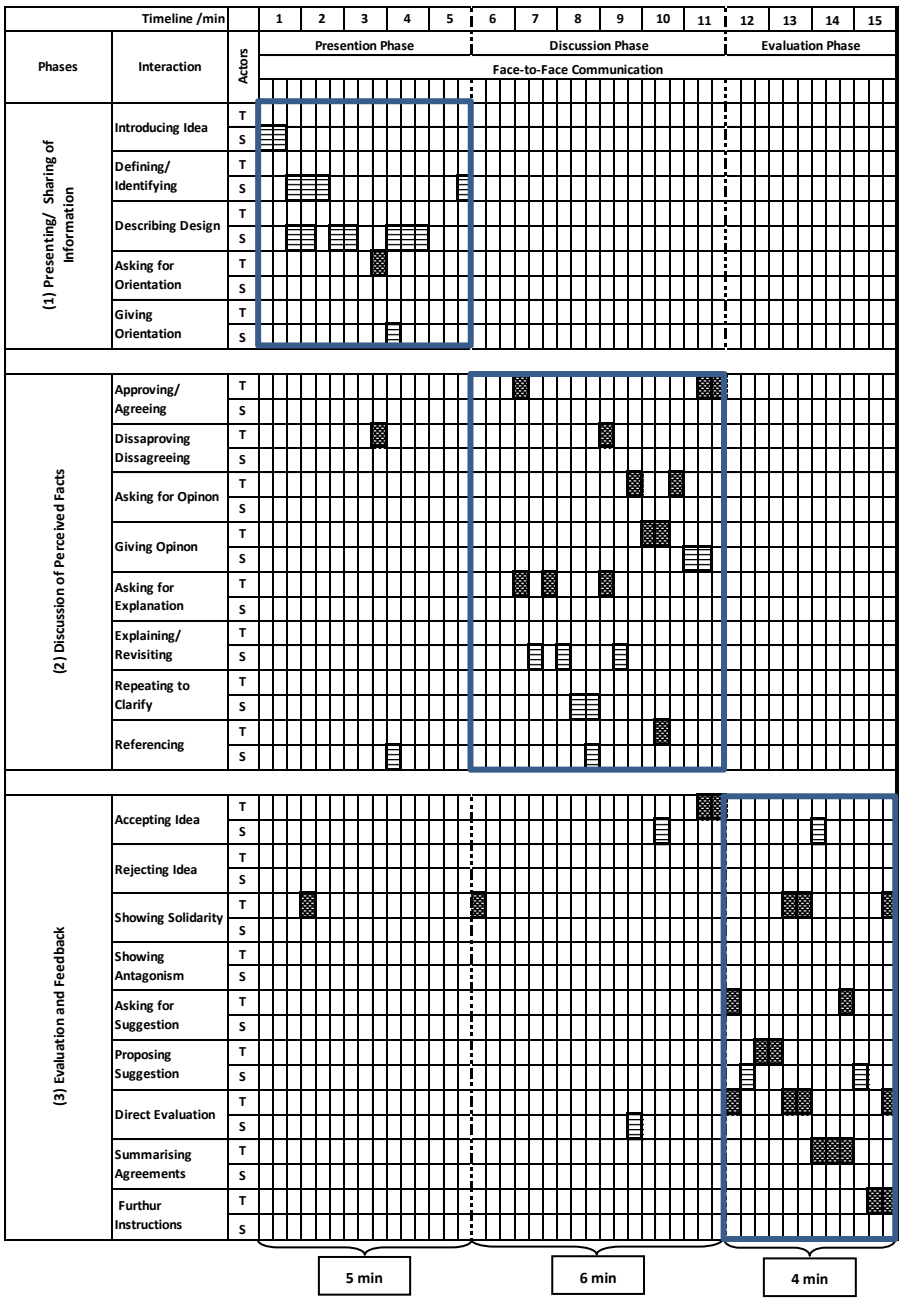
Face-to-Face Crit. Patterns of interaction in the Face-to-Face Crit sessions confirmed the proposed structure and sequence although not always as distinct as the Review Interaction Protocol suggests. Looking at Figure 6-1, which represents a session from one of the Face-

to-Face Crits in the academic stage one (F-Y1S8), there is broadly three distinct sequenced phases (highlighted in a shaded diagonal pattern) that can be seen during a design review, these are, sharing information, followed by discussion and then finally evaluation. Despite some occasional differences where parts of a conversation were returned to or the general pattern of the review was slightly disrupted the three academic stages of face-to-face crits followed the suggested sequence to a great extent. Figure 6-1 and Figure 6-2 show examples of the structure of verbal communication for academic stages one and three.

Figure 6-1 and Figure 6-2 also show a number of instances where discourse of discussion and evaluation took place outside of the main shaded areas; this indicates that design reviews seem to be less structured than one might expect, and also, not all tutors follow specific criteria for review and evaluation. However these instances were relatively very few in the Face-to-Face Crits.

For each phase, the allocated duration of the sessions was fifteen minutes, however, not all sessions met this restriction. In some sessions the discussion phase was longer than expected; this led to the extension of the session's duration. These extensions in time were mainly caused by a number of observed personal or design project-related situations, but are mainly a consequence of poor time management that could be related to; (1) an unclear presentation from the student's behalf that led to request of more explanation, revisiting and thus repetition, or (2) a rich design situation or idea that provoked discussion and enriched feedback but consumed more time.

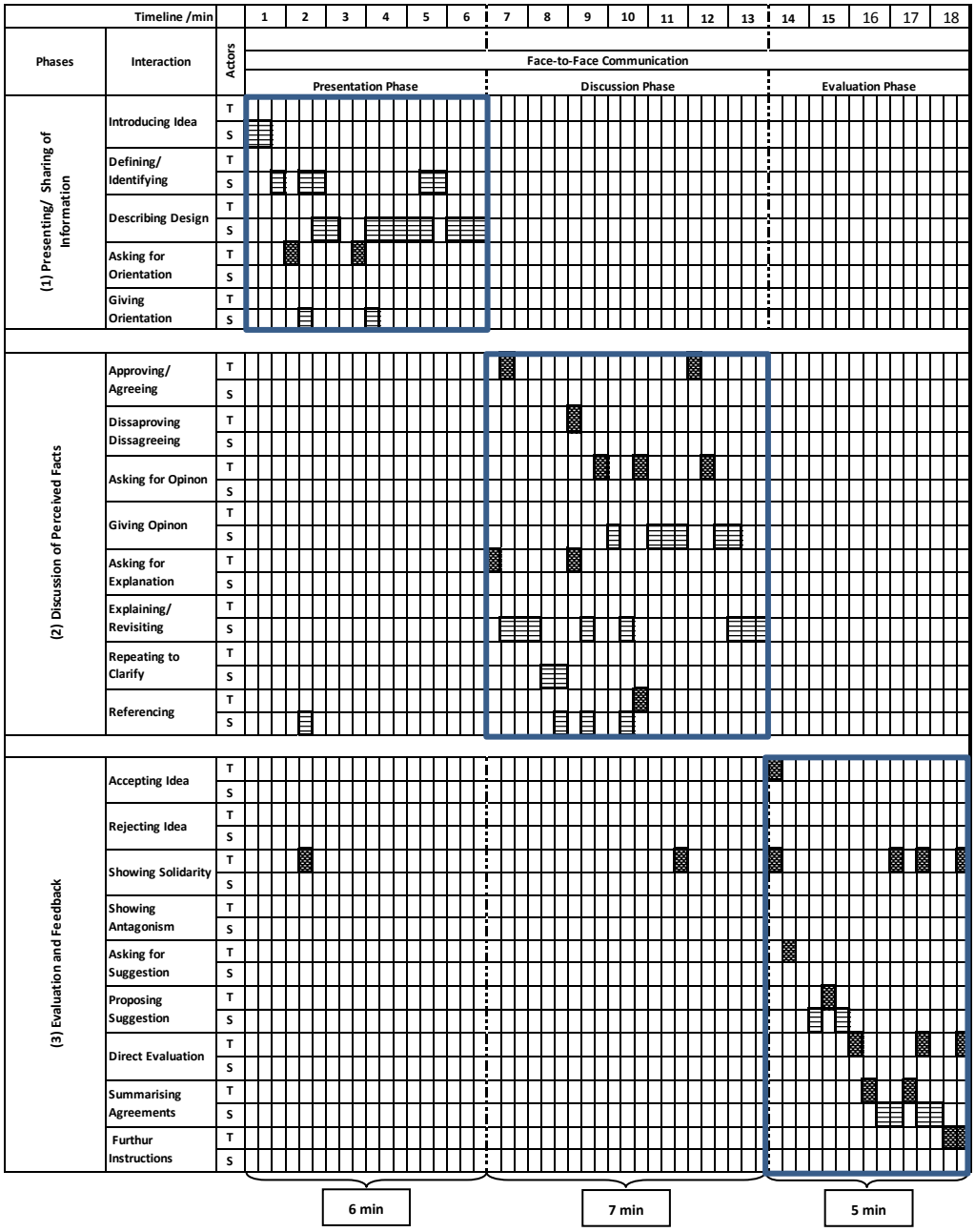
Design Review Structure: F-Y1S8



Patterns of interaction show distinction of the three phases of the design review; thus following the suggested sequence of the communication structure.

Figure 6-1 Distribution and Durations of Verbal Communication in the Review Structure Dimension for Face-to-Face Crit, Academic Stage One: (F-Y1S8)

Design Review Structure: F-Y3S6



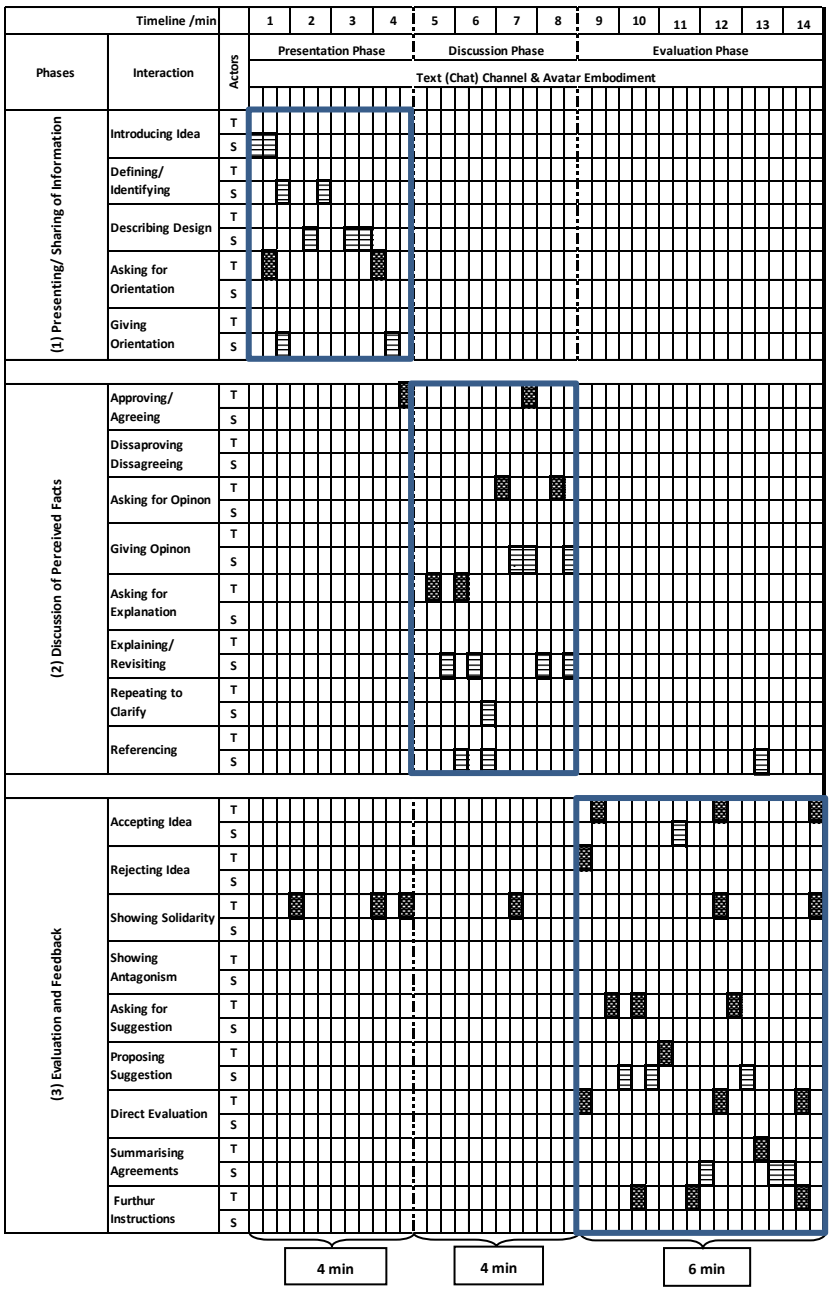
Patterns of interaction show distinction of the three phases of the design review; thus following the suggested sequence of the communication structure.

Figure 6-2 Distribution and Durations of Verbal Communication in the Review Structure Dimension for Face-to-Face Crit, Academic Stage Three: (F-Y3S6)

Virtual Crit (1). Patterns of distribution of the verbal discourse in Virtual Crit (1) sessions shown that all sessions followed the sequence of the design review phases proposed in the Review Interaction Protocol, similar to the Face-to-Face crits, some individual differences caused a few units of interactions to occur outside of the main area of the distinctly marked phases, however, these were very few as shown in Figure 6-3.

The sessions all followed the sequence of the review phases proposed in the Review Interaction Protocol. However, Virtual Crit (1) sessions varied in duration, the longest session lasted approximately 25 minutes, while the allocated times were 15 minutes for each session. Delay, particularly in four sessions, was caused by the extra time consumed to upload student's projects who did not manage to upload their work on the previous day. In addition to that, uploading some heavier images caused two cases of computers to crash and/or disconnect; those two students were moved to another allocation where they had the chance to complete their reviews.

Design ReviewStructure: V1-Y5S3



Patterns of interaction show distinction of the three phases of the design review; thus following the suggested sequence of the communication structure.

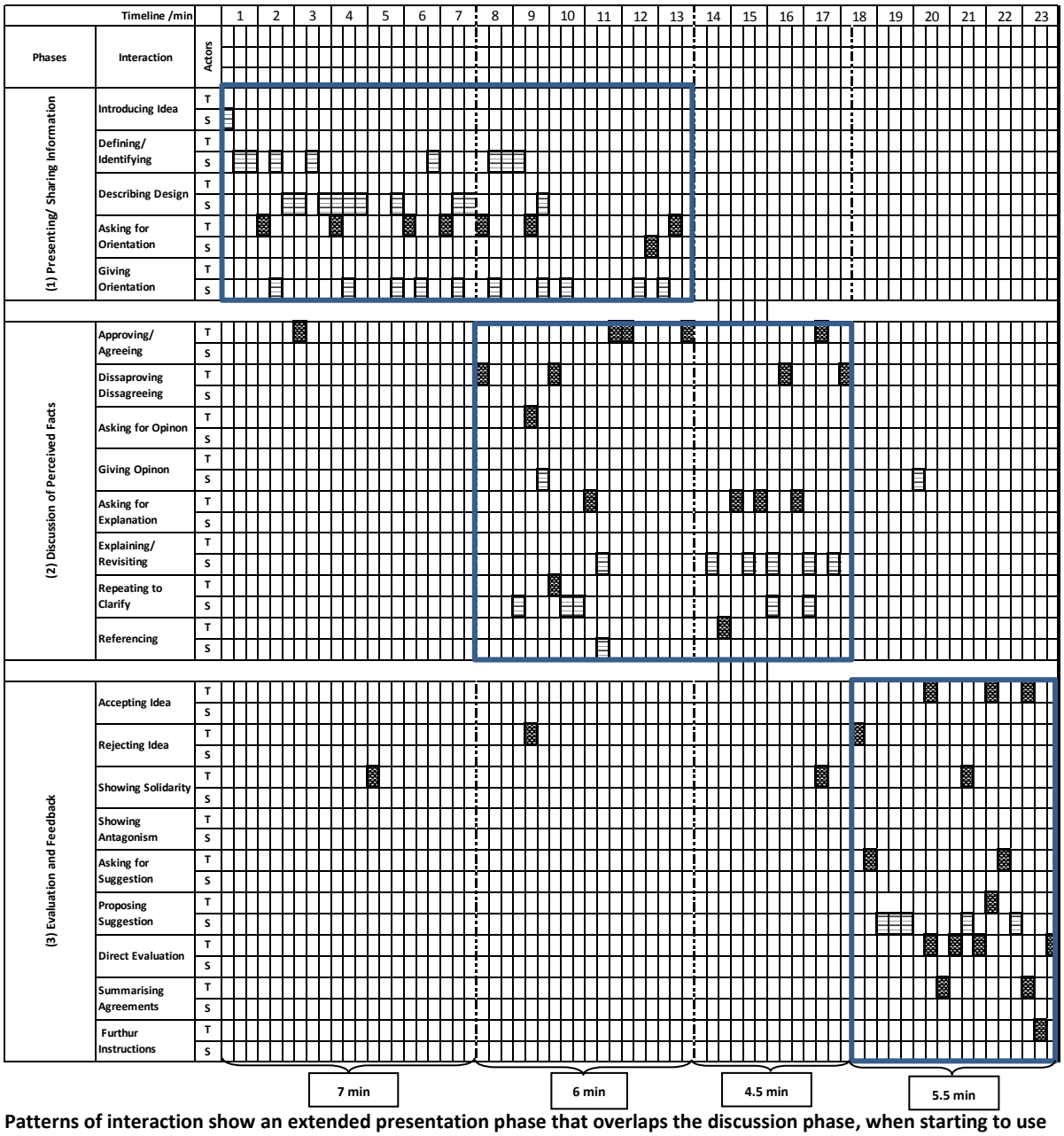
Figure 6-3 Distribution and Durations of Verbal Communication in the Review Structure Dimension for Virtual Crit (1): (V1-Y5S3)

Virtual Crit (2). The second mediated design review; Virtual Crit (2) restricted the use of Avatar pointing while allowing the use of voice after the sharing of information phase. Patterns of verbal discourse in the time-line grid shown in Figure 6-4 show that the review structure followed the sequence of phases proposed in the Review Interaction Protocol. However, it was noticed that there was an extended overlap between the first two phases; sharing information and discussion, repetition of shared information was caused due to a number of media-related reasons.

In Virtual Crit (2) sessions, it was fairly difficult to determine when the discussion phase began due to the repetition of share information that caused the extension of the first phase, however, once all information was clarified to the tutor, the verbal discourse started to have clearer characteristics that distinguished the discussion phase, this is shown in Figure 6-4.

The time schedule prepared for Virtual Crit (2) was designed to avoid the time delays that occurred in Virtual Crit (1); therefore, one hour was given before the start of the actual crits, to practice uploading images, navigating and using different tools of the software. The appointed times for each session in Virtual Crit (2) were 20 minutes; however, the shortest session lasted 22 minutes, while the longest session lasted approximately 32 minutes.

Design ReviewStructure: V2-Y2S5



Patterns of interaction show an extended presentation phase that overlaps the discussion phase, when starting to use the voice channel at minute 8.

Figure 6-4 Distribution and Durations of Verbal Communication in the Review Structure Dimension for Virtual Crit (2): (V2-Y2S5)

6.3 **Orientation of Narratives**

Nonverbal actions in a face-to-face communication enable communicators to create and maintain shared meanings that are understood and perceived by others; this is why orienting the spoken narrative is vital to interpret interactions that relate to the context they occur in. In architectural design communication, an interesting shift in orientation and perception of orientation is enacted subconsciously, in one instance the speaker is in an egocentric reference frame, locations are represented with respect to the particular perspective of a perceiver, so he/she are located outside the drawing or model talking about its position in the site using hand gestures, and moving around it, and in the next instance the speaker projects him/herself in an allocentric reference frame inside the model and walks through it independent of his or her actual position.

The natural shift in narratives does not in many cases interrupt the flow of one's narrative or thoughts, nor affects the perceptions of shared meanings as it is assisted with tools of orientation such as pointing and illustrator gestures. The efficiency of communication in Virtual Crits (1) and (2) depended partially on maintaining an intact structure and sequence of narrative with fewer interruptions. As Shelden (1997:17) describes:

> *"when appropriately applied to serve the intended interactions, the communication medium can improve communicative events, in the same sense, introducing unwanted interruptions and separation of narratives, results in the system getting in the way of the interactions it is intended to support"*

It was found that the availability and proper use of certain modes of communication such as Avatar gestures in Virtual Crit (1), and the use of voice in Virtual Crit (2) had a positive effect on maintaining the sequence of narratives, and thus the overall interaction outcome. And in the same sense, the restriction or difficulty to use these modes resulted in interruptions, hence, separation in sequences of narratives. Those interruptions were found to be mainly associated with asking for and giving orientation.

From the following time-line grids shown in Figure 6-5, the instances of *asking for and giving orientation* seems very minimal in the Face-to-Face Crit session, while it relatively increases in Virtual Crit (1) and increases even more in Virtual Crit (2).

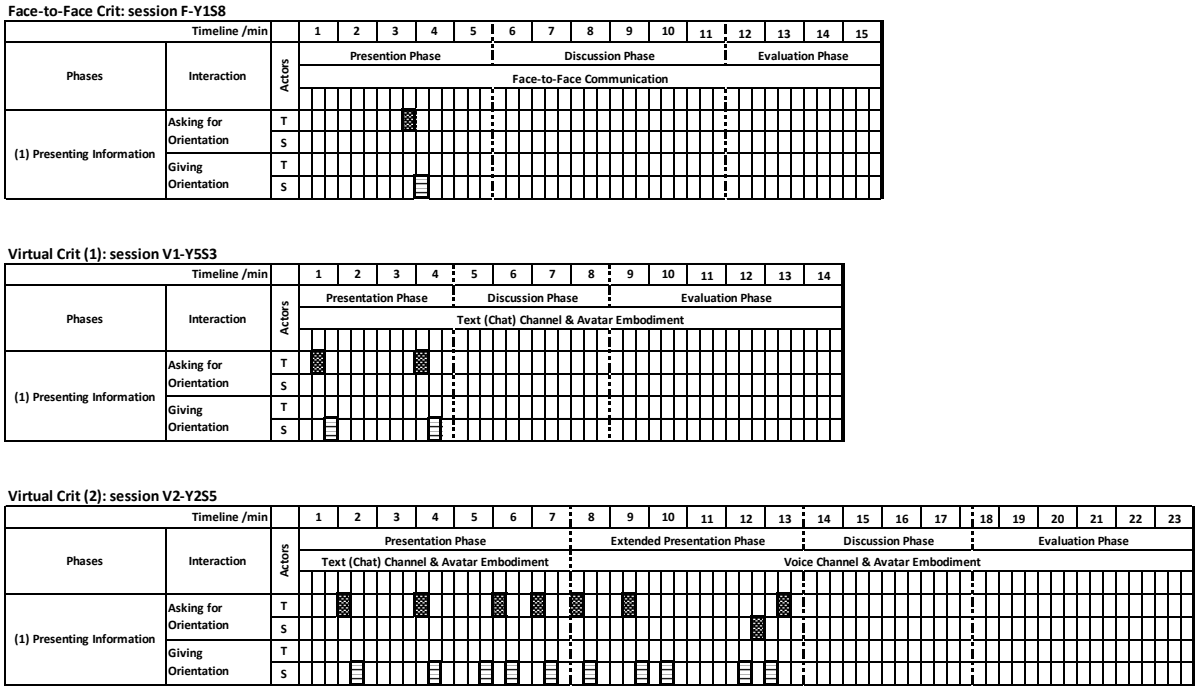


Figure 6-5 Asking for Orientation in Three Sessions of the Three Design Review Categories

This need to ask for orientation that increased in the virtual crits as in Figure 6-5, indicates that mediating nonverbal modes of communication has not been entirely successful, this in turn affected the consistency of the narratives produced. The following paragraphs examine how participants managed to orient their narratives by using tools of orientation available to them which were mainly; pointing, hand gestures and placement of the body. These acted as the unspoken narrative that aided the spoken narrative. The analysis the following subsections, will present nonverbal modes of communication categorised in the Review Interaction Protocol into (1) pointing, (2) illustrator gestures and (3) moving the body (navigation) as well as (4) the use of verbal orientation discourse specifically in the two Virtual Crits (1) and (2).

6.3.1 Pointing

Figure 6-6 shows the use of pointing as a nonverbal tool of orientation in the Face-to Face Crits, Virtual Crit (1) and Virtual Crit (2).

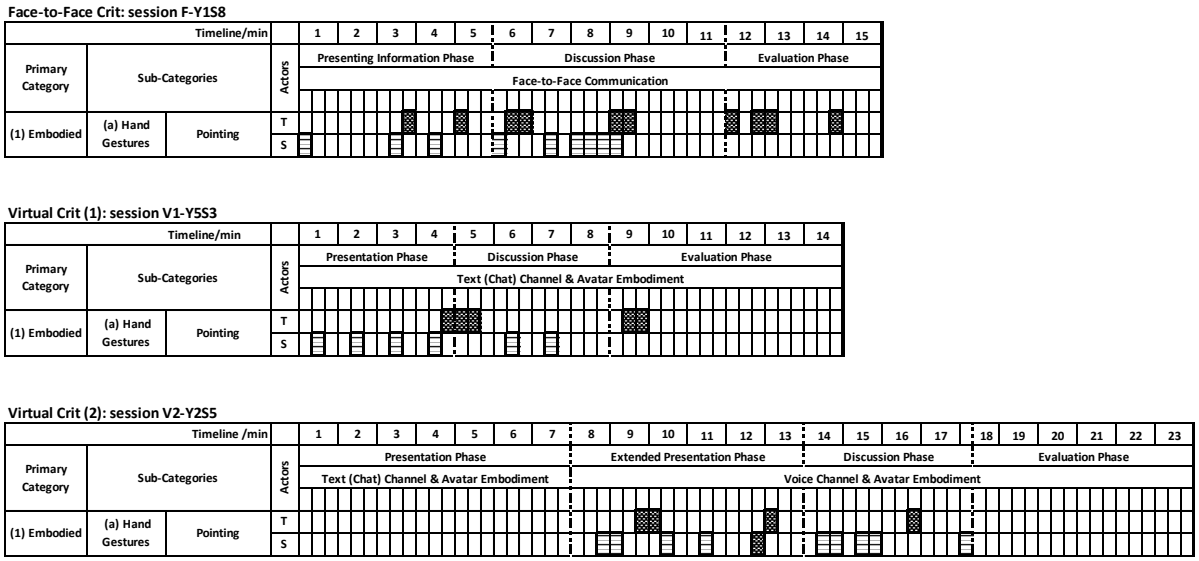


Figure 6-6 Pointing in the Face-to Face Crits, Virtual Crit (1) and Virtual Crit (2)

As the above figure shows, pointing has been used in the Face-to-Face session during all the phases of the review. The same observation is true for the Virtual Crit (1) session, and here, pointing refers to Avatar pointing which was used effectively and thoroughly during most of that design review sessions. On the other hand, in Virtual Crit (2), no Avatar pointing was used during the chat-only stage, while as shown in Figure 6-6, physical pointing became accessible to the participants in the audio stage. In all cases, the use of physical and Avatar pointing decreased in the evaluation phase, where there is less need to orient one's narrative. The following analysis show how effectively pointing was used and mediated in the three observed design reviews.

Face-to-Face Crit. Pointing as a primary function of hand gestures was observed to be specific and in relation to the drawings and/or the model in all of the Face-to Face Crits. In the following example some functions of hand gestures used by the student to orient her narrative and describe her project, can be signified (the underlined text refers to verbal discourse co-occurring with different hand gestures and pointing).

"... And as you come here you see the wall it catches your eye and the reflection of copper in the sunlight also depending of course on how the sun is directed, if it is East the rays will create an intriguing pattern which make the visitor want to explore further and go around this corner and find out what is more to excite. And from this part you get into this area which basically, as the site is created, there is water around, so I brought water into the site which enhanced the reflection... also I wanted a tree inside to bring nature inside"

Figure 6-7 Pointing gestures accompanying the passage:

"...come here you see the wall...", "...and from this part you get into this area..."

In this example, pointing seemed to be used in specific instances of the conversation to orient and call the attention of the listener by referring to the whereabouts of the description. Moreover, verbal discourse here becomes incomplete if not accompanied by seeing where pointing is referring to; if one tries to read the verbal transcript without seeing where "*here*" and "*this*" refer to as in Figure 6-7, one will be missing out on relevant comprehension. Here, pointing is completing the meaning rather than acting it. This clearly indicates that it is important to not only see pointing gestures, but to see them in relation to the sketches and other objects or people in the drawing space.

Virtual Crit (1). When the conversation was mediated in Virtual Crit (1) Avatar pointing was used efficiently by the users. These were the main means of orienting the narrative; which lowered the level of repetition and asking for orientation, creating to some extent, an intact sequence of narrative in general. A consistent flow of narrative aided with Avatar pointing can be seen in the following example; showing that Avatar pointing as a nonverbal communication input tool was used throughout the entire session to orient the narrative effectively, pointing was accompanied by words such as "*this*", "that" and "here"...etc. as in the following example.

T: t<u>hat's</u> ur main building isn't it?

(Tutor pointing to a building in one of the screens)

S: <u>no that is</u> the main one.. <u>this</u> one in light shade is the existing building

(student moves his avatar close to the screen and points to another building, shown in the top figure)

S: and <u>this</u> one <u>i am pointing</u> to is also existing

(student points to a third building)

T: ok
S: and <u>that's</u> the new block

(student points with his avatar's arm to the block)

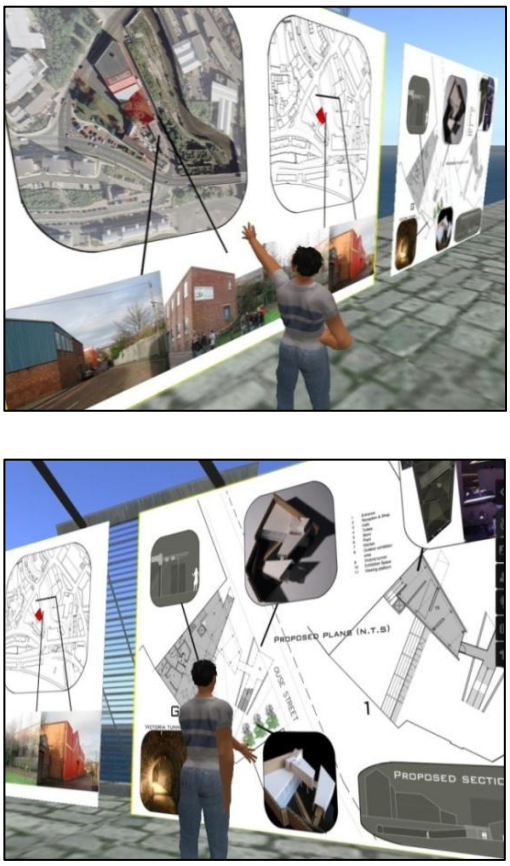


Figure 6-8 Student's Avatar Pointing at images Virtual Crit (1)

Virtual Crit (2). Unlike Virtual Crit (1), in Virtual Crit (2), the Avatar pointing feature was no longer accurate, and therefore was not used as the primary tool of orientation.

This affected to a great extent the ability to orient the narrative despite the use of other means of orientation such as Avatar navigation and verbal orientation discourse, as will be explained further in a coming subsection. However, the virtual observations captured students successfully using Avatar pointing in four instances, as shown in Figure 6-9, in this example, the students uses the word 'here' and 'this'.

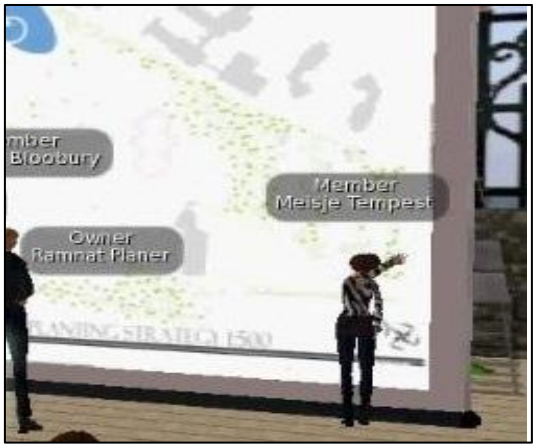


Figure 6-9 Avatar Pointing was Successful in some occasions in Virtual Crit (2)

T: Where is the access?
S: the access is here in this corner

As shown above, the first tool for orienting the narrative used in the three design reviews is pointing; this feature of human interaction came very naturally in the Face-to-Face Crits, and aided the structuring of the students' narratives. While in Virtual Crit (1), Avatar gestures were the substitute, and were shown to be used effectively. In Virtual Crit (2) however, not using Avatar pointing was one of the main reasons for having to ask for orientation throughout the sessions.

6.3.2 Illustrator Gestures

Although gestures do not leave behind any persistent record in the drawing space, some evidence suggest that they can be used to help store information and are commonly used to express ideas (Tang, 1991). It was found that spatial illustrator gestures that refer to size, location and spatial orientation were among the hand gestures used to orient the students' narrative in the Face-to-Face Crits, however, this changed in the two Virtual Crits (1) and (2); the students did not use Avatar gestures despite getting the chance to practice them before the crits. Recording the physical settings of Virtual Crit (2) allowed capturing

the use of physical gesturing during the audio stage, similarly to what was observed before with physical pointing.

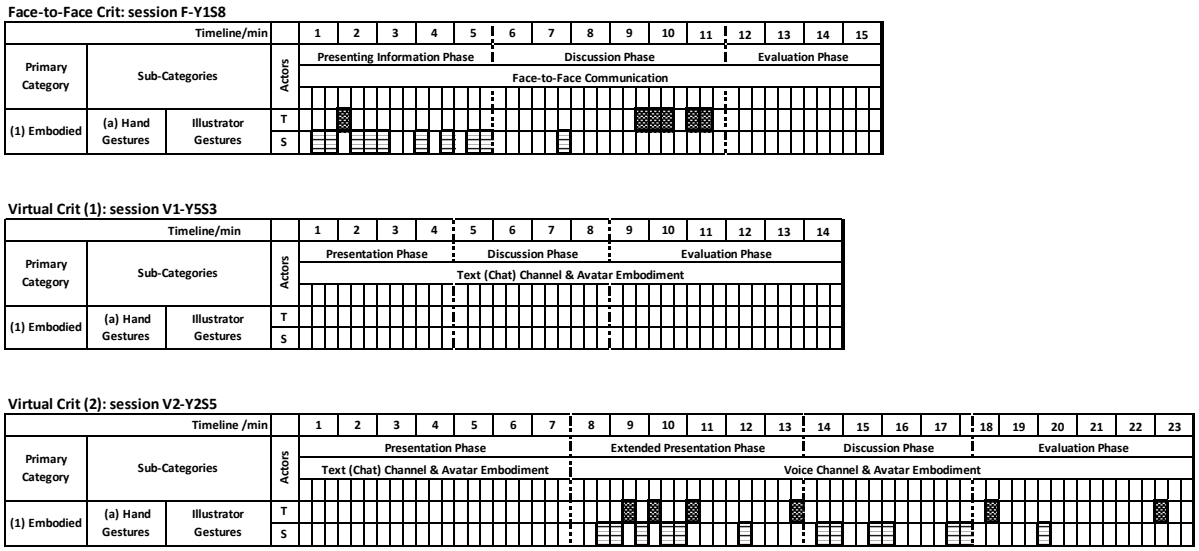


Figure 6-10 Illustrator Gestures in the Face-to Face Crits, Virtual Crit (1) and Virtual Crit (2)

Face-to-Face Crits. Illustrator gestures seemed to help the students express their words and ideas. As shown from Figure 6-11 the student gestures as she speaks:

S...depending on <u>how the sun is directed, if it is East</u> the rays will create...

In this line, the student *pretended* to be an imaginary sun coming from the East, this gives more depth to her description and shares in conveying the message by the visual enactment of the spatial hand gesture, for she makes a round shape with an open hand, and directs her arm from the East to the West, repositioning the model to mimic the real orientation of the site.

Figure 6-11 Spatial illustrator gestures accompanying the passage:

"...depending on how the sun is directed, if it is East the rays will create..."

Figure 6-12 Kinetic- Metaphorical gestures accompanying the passage:

"...there is water around, so I brought water into the site..."

Following that in this line, shown in Figure 6-12:

S...there is water around, so I brought water into the site...

She *imitates* the flow of the water coming into the site using kinetic gestures that describe the path in a *walkthrough* sequence. This spatial and kinetic illustration characterises some aspects of the verbal utterance and is believed to make its perception closer to the audience (Feyereisen and DeLannoy, 1991). Other verbal discourses were accompanied by pointing to refer to certain parts of her model; words such as: "*here*", "*from this part*" and "*around this corner*" could not be understood without seeing where she is pointing. Other spoken sentences such as "*reflection of copper*" and "*more to excite*" were supported with gestures that create a flashing illustration by opening her fingers in a forming a moving circle, this spontaneous gesture relied on the common understanding of gestures between communicators.

The intact relationship between both pointing and illustrator gestures supported the student's verbal discourse, and did not appear to hinder her ability to convey communication.

The following example, from a stage two review session, shows a sequence of pointing while enacting a path and a direction to illustrate the concept of the design and make it

easier to understand, Figure 6-13. This enactment was accompanied by the following passage:

> *S: On the first floor you have a linking area, a central area that overlaps here and connects these two spaces together*

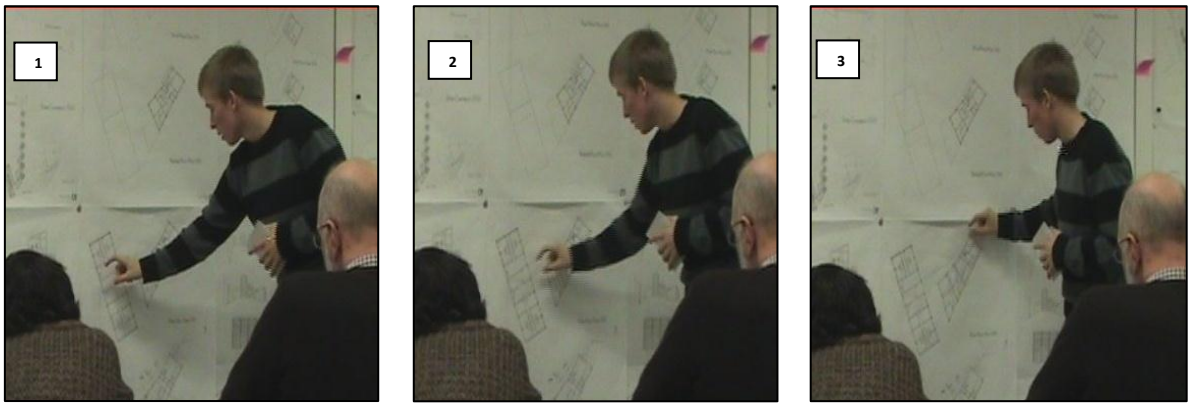


Figure 6-13 Enacting a Path and a Direction, using Hand Gestures (sequence from 1 to 3)

Virtual Crit (1). As this design review was fully mediated, illustrator gestures here refer to Avatar gestures, which are a range of predefined cues and actions afforded by the medium, i.e. SecondLife. However, interestingly, none of those gestures were captured at all during the actual sessions, as show in the empty time-line grid that belongs to one of the Virtual Crit (1) sessions in Figure 6-10.

Virtual Crit (2). Similar to what was observed in Virtual Crit (1), Avatar predefined gestures were not used during the chat-only stages of the sessions, but some students were using them for fun during other students design review sessions. Again in the audio stage, as shown above in Figure 6-10, some physical illustrator gestures accompanied verbal discourse, such as moving one's hand with a path on the computer screen, '*pretending*' to be the user or an object, and '*imitating*' users or sizes of objects. The following line from the review transcripts accompanied by the enactment of gestures in Figure 6-14 sets an example:

> *S:... two of the contours in this case are being pulled together, and help by retaining a wall to create height differences*

Figure 6-14 Student V2-Y2S5: Using Illustrator Gestures while Speaking

Another example in shows a student observed enacting a different set of hand gestures explaining the direction of the corridor and describing the two walls in an imitation action; the accompanying sentence was:

S: here there is a corridor that heads up towards the double walls...

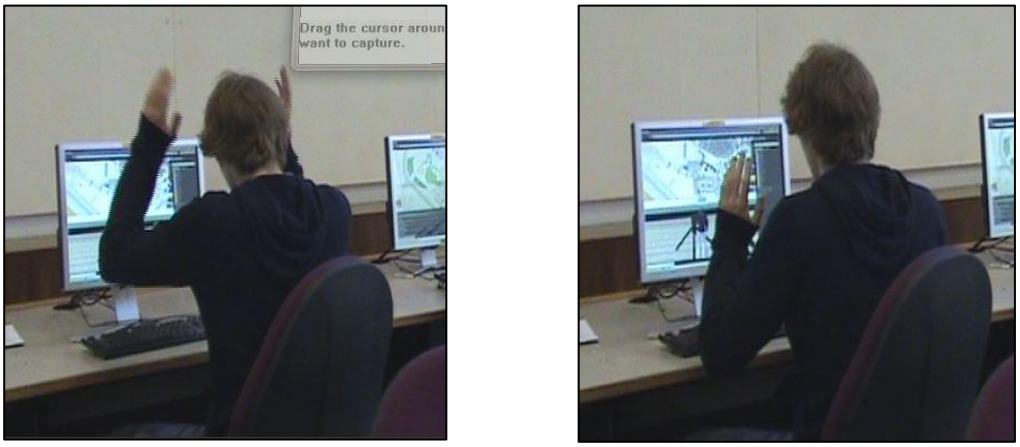


Figure 6-15 Student V2-Y2S3: Using Illustrator Gestures while Speaking

These students regained the ability to use their hands here, and performed a number of illustrator gestures that came out naturally, while knowing these gestures are not seen by the tutors. However, not all of the students used that much gesturing in their crits, as only three out of five students were observed to use gesturing while speaking in Virtual Crit (2), this may be due to individual differences in nonverbal behaviour for some, as some people do not gesture in their normal speech.

6.3.3 Moving the Body (Navigation)

Moving the body in the design review context may serve as a tool for orientation as pointing and gesturing do, walking from one end of the drawing boards to the other while speaking moves the location of the spoken narrative along. In the two Virtual crits (1) and (2) participants were obviously sitting at their computers, so moving here refers to Avatar navigation inside the virtual world. The timeline grids shown in Figure 6-16 reveal that not much physical moving was enacted in the Face-to-Face reviews, either than moving to get a closer look at the models or small detail on the drawings, while Avatar navigation was used throughout the two virtual crits mostly as a primary means of orientation and view.

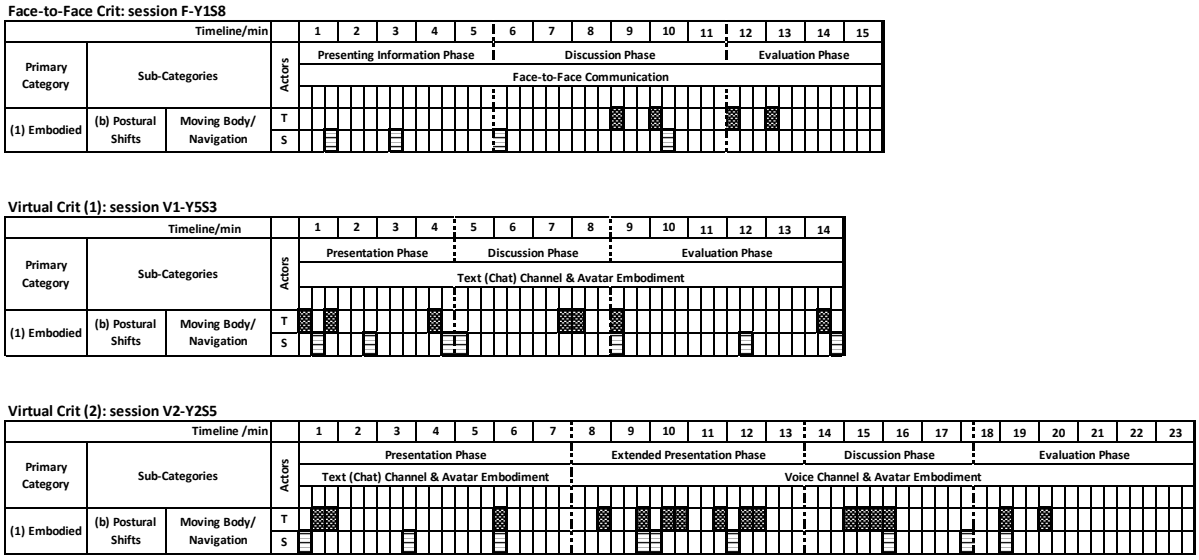


Figure 6-16 Moving Body/ Navigation in the Face-to Face Crits, Virtual Crit (1) and Virtual Crit (2)

Face-to-Face Crits. In addition to pointing and illustrator gestures, students sometimes moved between their pinned-up drawings, to orient the location of their narrative, they sometimes picked up or handed the tutors the model or sketch book, such as in Figure 6-17.

S: ...to see the tree from behind this wall….

Figure 6-17 Moving Whole Body to Pick Up the Model

T: Which wall? let me see the model

However, moving was not needed most of the time, and as the crit space allowed the participants to be proximal and already 'close' to the drawings as they could possibly be, the tutors only moved towards the drawings sometimes to get a closer look, or to pick up the models while speaking or listening.

Figure 6-18 Moving Closer to the Pinned-up Drawings

These actions did not appear to cause stopping the speakers from speaking, or disrupting the sequence and flow of the conversation by any means in the observed Face-to-Face Crits.

Virtual Crit (1). Navigating the Avatar body was considered and understood among the communicators in Virtual Crit (1) as showing orientation; here the Avatar itself was used to indicate spatial reference during the conversation, the relation between asking for and giving orientation, and Avatar navigation in Virtual Crit (1) can be viewed in Figure 6-19.

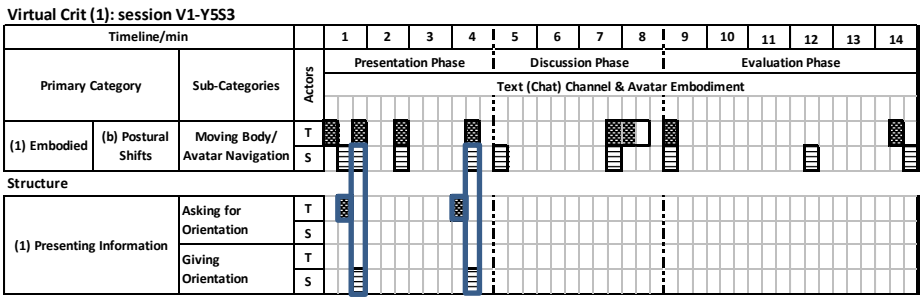


Figure 6-19 Correlation between 'Asking for/ Giving Orientation' and 'Avatar Navigation' in Virtual Crit (1)

As shown in the above figure, as the tutor asks for orientation, the student moves his Avatar to a position and expresses the whereabouts of his narrative. The following example illustrated in Figure 6-20 and Figure 6-21 shows the tutor's Avatar navigating between boards as he types; first, standing at the board number (2) in Figure 6-20, that shows the project site plan, he types:

T: "i can see the location of the school on this mesh...."

The narrative continues, and then the tutor moves his Avatar towards the board number (4) in Figure 6-21, that displays the textures used in the project and types:

T: " ...but you haven't shown, only a display, how are you going to use these textures?"

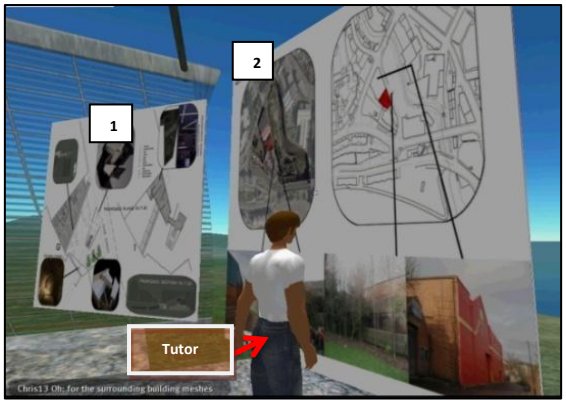


Figure 6-20 The tutor's Avatar first stands at the drawing board number (2)

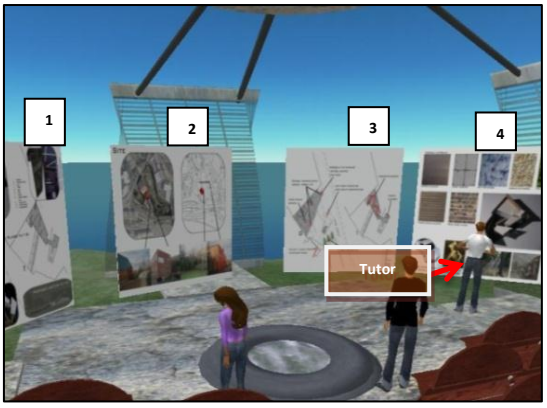


Figure 6-21 The Tutor's Avatar moves to stand at the drawing board number (4) to perform spatial reference

The use of the words "this", and "these" in the above two lines while positioning the Avatar closer to the boards and moving him from one place to the other, knowing the other party can see this action, indicates that this was an understood form of giving orientation among the users of Virtual Crit (1).

Virtual Crit (2). Moving the orientation of the conversation was enacted here, as in Virtual Crit (1), by using the Avatar, either by walking or flying. Figure 6-22 shows the correlation between asking for/ giving orientation, and Avatar navigation in Virtual Crit (2).

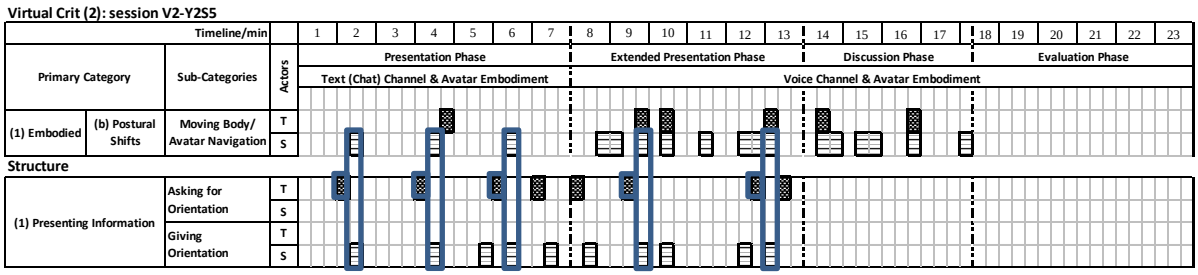


Figure 6-22 Correlation between 'Asking for Giving & Orientation' & 'Avatar Navigation' in Virtual Crit (2)

Participants on Virtual Crit (2) were observed to navigate the Avatars closer to the screens while zooming in and out (scrolling the mouse) to get a closer projection, or to move the focus of the dialogue to a different display board. This was carried out throughout the entire Virtual Crit (2) sessions.

The following example shows a student using the flying feature to 'point' with his Avatar's feet to a particular place in the drawing, in Figure 6-23.

T: can you fly to the drawing you are referring to?

(The student flies his avatar body to a specific point on the screen)

S: this one here
S: beside my feet
T: yeah I get the idea..!!

In the previous example, the Avatar's body was used as a means for spatial reference; as a virtual pointing device.

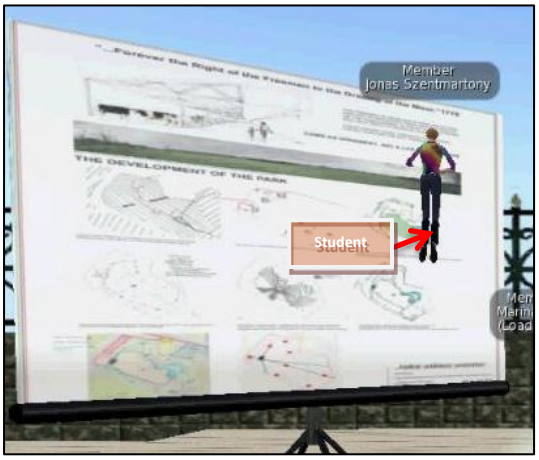


Figure 6-23 Avatar Flying to point to the Drawing: a Virtual Nonverbal Interaction

In another instance, as the student describes where he is referring to, he flies his Avatar to point at the image, the tutor then confirms that he follows his narrative.

S: but if you look at the top left...(starts to fly to point to the image)
T: ok, yeah I'm looking at the top left

In Figure 6-24 the tutor asks about the entrance of the site, so the student walks her Avatar to the right corner of the board, and states the position of the entrance as in the following passage:

T: Where is the access?
S: The access is in this corner, here

Figure 6-24 The Student Moves from One Spot to the Other to Give Orientation

6.3.4 Orientation Discourse

Textual discourse functioned differently in the observed mediated design reviews; 'giving orientation' by using words such as '*here*', '*there'*, along with referral words to objects '*top left of the drawing'* or using global directions '*north, south'* within the discourse compensated the limitation of orientation cues in the virtual context. As shown below in Figure 6-25, the need to use orientation discourse differed between Virtual Crit (1) and Virtual Crit (2), this was related to the degree of utilising Avatar pointing properties in the two virtual crits as explained below.

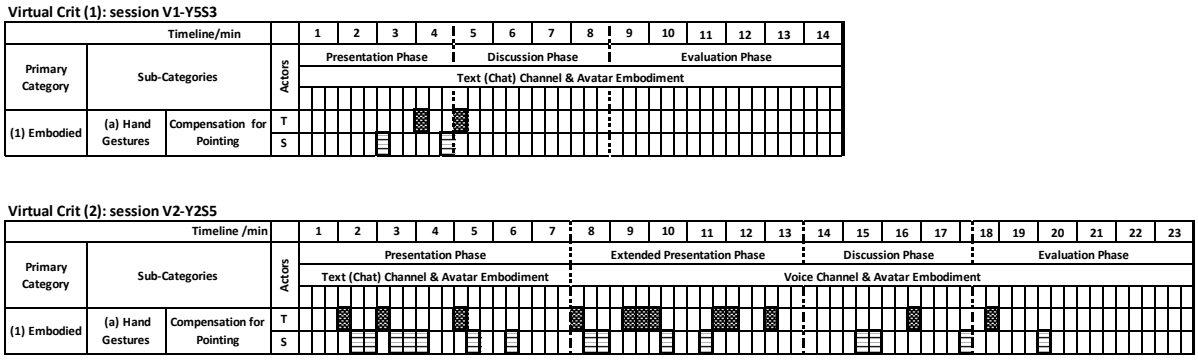


Figure 6-25 Orientation Discourse (Text Compensation) in Virtual Crit (1) and Virtual Crit (2)

Virtual Crit (1). In addition to Avatar pointing, other tools of orientation were used such as using deictic discourse to refer to specific parts of the images described as 'Text Compensation' in the interaction timeline grids, as they were used to compensate the occasional inaccuracy of pointing to some specific details.

S: and then you will find this big entrance, the one just in front of you
T: which big entrance?
S: the one that looks like a long corridor in the middle
T: yeah I see it

In one project in Virtual Crit (1), the different spaces on the building plans were numbered and key referenced, and this aided the presentation in a way but description was not dependant on it in all of the cases, e.g. Figure 6-26. The numbered areas functioned as orientation discourse that aided the presentation, as in the following passage:

Figure 6-26 Numbers used as Orientation Discourse to aid the presentation of the project

S: ...within the temple number (3) on the routes and at number (7) there are hidden.

It was shown from the previous examples, how participants in Virtual Crit (1) successfully oriented their narrative by using mainly, Avatar pointing and navigation. The need to describe using deictic discourse was minimal, but was not neglected. This produced lower instances of asking for orientation compared to the Face-to-Face Crits as can be viewed in Figure 6-5 shown earlier in this section.

Virtual Crit (2). For specific details on the drawing boards, Avatar navigation was not always accurate; in addition to that, performing the act of navigation or flying interrupted typing in the Chat-only stage, so it was only manageable to orient the conversation using deictic verbal discourse. This took different forms, either by referring to the colour of a specific detail, or describing it through a spatial relation with a fairly recognised object in the reviewed drawings. And in some cases pointing out a resembling feature to a known object to make it clear, for example:

S: No, that one right in the middle of the park, opposite the stonehenge.

and:

S: the longer of these lines on the top left drawing shows the trees and the other one next to it shows the effect of the surrounding road

However, the use of verbal discourse as an orientation tool resulted in separations of the participants' verbal narratives which in turn, became separate perspectives. And this is why participants in Virtual Crit (2) had to open each sentence with descriptive deictic discourse to orient the dialogue towards the position being described, as an alternative to pointing such as:

S: looking at the first render, the top right of the first image shows the buffer between the surrounding land, and the moors...

When they forgot to do that, they would be asked by the tutor, and find themselves shifting to a different projection of narrative, and then going back to their original projection.

S: basically it is a journey through the sculptures that talks of man's development
T: Man's development from ape?
S: yes, the second sculpture is a sun dial
T: Wait, I think you need to orient us to where you are referring to.
S: ok so directly above me is the building and entrance to the park
S: the building provides a view straight through to the birch forest
T: Where exactly is the building?
S: as you leave the building you turn right and follow a path into the birch forest, a means of escape from the urban world from where you have come from...
S: near to where I am standing

The student in the previous passage was focused to explain the concept behind selecting his design idea to the park (the first three lines), but an obvious need of orientation let him pause, and explain locations of the entrance and the building (the next five lines).

Then the student picks back his narrative and continues to explain the previous line of thought, but then he is asked again by the tutor to confirm the orientation of his presentation.

T: ok, go on

S: OK, sundial where people can sit down on grass banks
S: represents passage of time
T: this is at the bottom of the plan right?
S: No, the semicircular shape on the middle right
T: or is it the left hand side building?
T: right ok - take me for a walk from here.
S: you found the sundial yes?
T: yes..!
S: so you leave the sundial and follow the path round to a modern Stonehenge, 9 large sandstone blocks
S: these represent the planets of the solar system
S: and the equilibrium that exists between them
T: to the north?
S: yes
T: i get the idea

Witnessing this separation in narrative, and the use of repetition in some places, are evidence of interruption of thought for some of the students and not just in verbal narrative this sometimes led to misinterpretation of the meanings as will be discussed in a further section of this chapter.

When the use of voice started in Virtual Crit (2), verbal discourse was still used to orient the narrative, but orientation became easier after freeing the hands from typing, spoken deictic discourses were quicker than typing them, in addition to that, performing navigation, and flying the Avatar to give orientation became easier. This resulted in a much more intact sequence of narrative in the audio stage.

The differences in orientation of narratives observed between the three design reviews show the effects of mediation as a property of technologically mediated communication. While Kalay (2004a:84) describes mediated communication in architecture, he states that the medium that is used to transmit the messages not only provides the connection between the sender and the receiver, but also dictates, to a large extent, the nature of the message, and hence the level of abstraction that must be used to encode it, as well as the level of interpretation needed to decode it. Nonverbal modes of communication used in the design review; such as pointing and hand gestures, create a large part of the communicated message, but not all of these can be mediated effectively, if mediated by the technology.

The three categories of design reviews observed in this study varied in their reliance on technological mediation for communication and therefore, the mediation of nonverbal modes of orienting the narrative also varied. The analysis of individual tools of orientation showed that the effective use of pointing, illustrator gestures and moving/ Avatar navigation, resulted in an intact sequence of narrative and minimum asking for orientation. This was true mostly for the Face-to-Face Crits, and the Virtual Crit (1) sessions. However, the absence of Avatar pointing in particular, in Virtual Crit (2) resulted in more *asking for orientation*, which led to interruptions and separation in the sequences of narratives. The following section examines communication control, this is necessary to assess the management of the conversation, the number of interruptions, and the need to confirm attentiveness.

6.4 Communication Control

Communication control describes how the conversation was managed. This dimension examines (1) interruptions, (2) giving acknowledgments and (3) hand over.

6.4.1 Interruptions

In all sessions, interruptions in the Face-to-Face Crits were minimal compared to the two virtual crits. Figure 6-27 shows the patterns of interruptions in the time-line grids of three sessions of each design review category. It is obvious from the figures that interruptions increased in the two virtual design reviews; however the type of interruptions and the effects they had on the conversation were quite different, the next paragraphs will explain how interruptions affected the conversation in Virtual Crits (1) and (2).

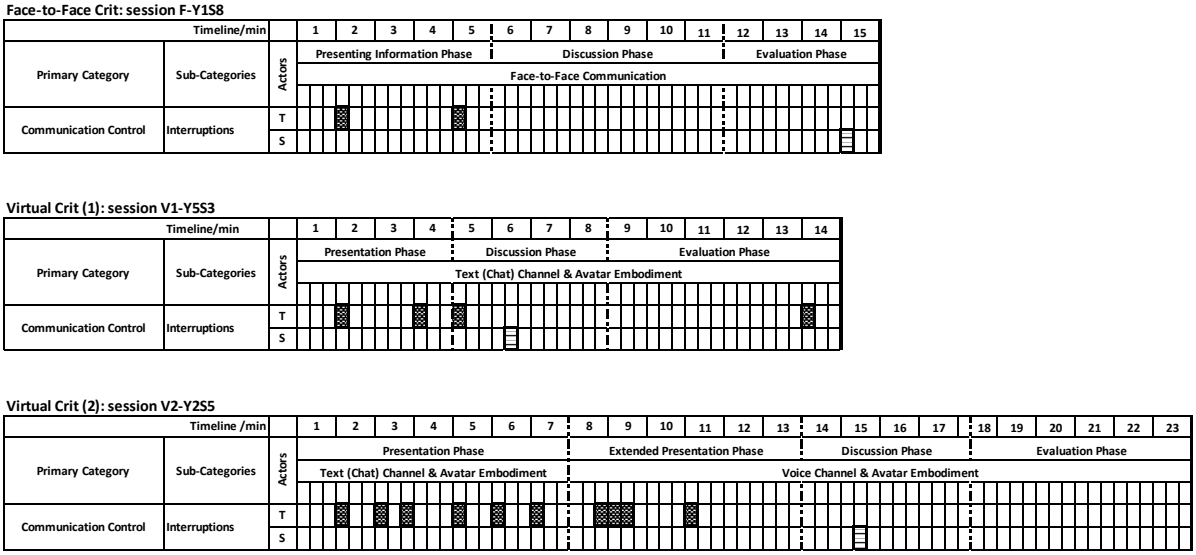


Figure 6-27 Interruption in Three Sessions of the Three Design Review Categories

Face-to-Face Crits. A low number of interruptions in the Face-to-Face Crit session were observed, in most cases, these interruptions seemed to be facilitated with a gesture or a louder vocal tone, this decreased the level of trying to 'hold the floor' from the other parties. The following passage shows one instance where the student interrupts the tutor while he is evaluating the design idea, yet following the same line of speech to explain more about her design intension; the underlined statements show where the interruptions occurred and the brackets on the left of the text show the sequence of turn taking:

> *T: I think the relationship between these two worked, it's beginning to read because you've got the wooden frame going out and you've decided to take it over the back passed the couple of...*
> *S: ...Yes I was thinking of it to be more like a threshold to mark the different spaces... but...*
> *T: ...Yeah, absolutely, and I think that that does start to rationalise out these different elements a bit*

After the second line, the tutor takes the conversation back again after the student hands it over using voice tone and eye cues, he then finalises his statement of evaluation. This form of interruption as long as remaining in the same line of thought, did not appear to have affected the flow and sequence of the conversation.

Virtual Crit (1). In Virtual Crit (1), interruptions appeared quite different from the Face-to-Face Crits. Although it was argued by Gabriel (2000) that interruptions are not possible in online chat communication formats because the medium does not allow the overlap of

text messages, it was evident from the observations in Virtual Crit (1) sessions, that interruptions did occur a number of times. Here the nature of the chat format caused a delay in the reception of information, this led the tutor to interrupt and ask a question before the student's incoming (rather long) message appeared on the tutor's screen. One of these instances of interruption, caused by 'time lag', is shown in the next passage, intersection of the brackets on the left hand side of the passages show where there is interruption:

S: ...then once at the site you are free to roam
T: the routes and events on the maps are very clear
T: one question...
S: and then within the temple number 3 on the routes and at number 7 there are hidden passages to find objects….
T: how are u directing visitors on those choice points? U didn't tell me,.. for instance
S: ok
T: in the number six and number 4 areas, are they shown here?
S: no, there is a colonnade route through number 5

If this were to happen in a face-to-face situation, there would be speech overlap for a couple of seconds (floor holding), then one of the speakers would have to hand the turn over. However, in the online situation, the statements appear as if the interruption is physical. While in fact, the student would be only typing his own 'long' message, before he sees the incoming message/s as he raises his eyes to the screen, and that is when the interruption to his thoughts occurs as he dismisses his current thought trying to think of the incoming question or comment. It can be clear here that this disassociation created by the remote context adds a burden on the communicators; they must try to focus on the incoming messages, as well as reduce the lengths of their own sentences to ensure efficient communication. Nevertheless, in some sessions, the interruptions did not break the line of thought as appears from the continuous thread of communication in many of the reviewed sessions.

Virtual Crit (2). As for Virtual Crit (2), during the Chat only stage, interruptions from the tutor's side occurred quite often, because there was a constant need to ask for orientation during the sharing of information phase, due to the limitation of Avatar pointing. This

caused some '*interruptions of thought*' as Johnson (1997) describes them, rather than interruptions of speech.

And as the nature of the medium would only allow for one message to show at a time as revealed earlier, these interruptions as from what appears to us in the examined chat logs, caused many breaks in the line of thought. So for example, in the following passage from the chat transcripts of a session in Virtual Crit (2), the student was looking at his keyboard while typing his reasons for choosing a particular design concept, but when he raised his eyes to the chat box and saw the tutor's request for orientation, it appears as if he was interrupted. The student didn't finish his description (he could have also erased a current line being prepared to be sent) and to take a new line of thought where he started to give orientation of his description.

S: there are several external factors that affected the way I approached the site such as the road around the edge
T: I think that you need to guide us as to what the drawings are first.
S: as well as surrounding buildings and the
S: ok so starting from the top left of the first page are a few site analysis sketches…

In the previous example, the brackets show the continuous threads and the intersection of the brackets mean there is an interruption. Interruption of thought processes has been shown to cause ideas to be lost according to Johnson (1997). In some cases of Virtual Crit (2), the interruption led to dismissing the idea and not returning to that thought again as in the following example, here, the separated 'broken' brackets indicate the interruption to this line of thought with no return:

S: and to the right are a few developmental sketches with ideas of design process
S: so as you can see the plan next to the centre is where…
T: Very axial?
S: yep
T: Why?
S: this was really determined by the axis found in the site analysis

From what shows in the above passage, we can see that the student never finished her first sentence, and dismissed the thought without returning to it again, as after this

instance, she started to discuss the axial concept of her design, and then moved on to answer another question from the tutor. In the following quote from the focus group discussion with Virtual Crit (2) students, this student criticises the disassociation from the narrative that the chat mode creates.

> *V2-Y2S5: "a very big time lag between entering the chat and it appearing on the screen and then you'd be typing something head down looking at the keys then one of the tutors would ask a question past that point or back to a previous point, so you had to go back and look for the text…"*

The student along with his colleagues agreed upon two reasons for the separation in narrative from using chat input tool; first through the time lag it brings, and then through missing a question or a comment entered by the tutor as he is directed to look at the keyboard while typing.

6.4.2 **Acknowledgements**

The time-line grids in Figure 6-28 show 'Acknowledgement' in three sessions of the design review categories. It could be shown from the patterns of distribution in Figure 6-28, that both, the need and the frequency to show acknowledgement increased in the Virtual Crits (1) and (2), as a result of remoteness. Most of the giving of acknowledgements in the Face to Face Crits however was shown nonverbally. But as participants in Virtual Crits (1) and (2), did not have the opportunity to show acknowledgements using nonverbal cues in the virtual world, they were obliged to type words in every occasion instead. A quite large number of words such as "OK", "sure", "right", etc., were distributed throughout the chat logs to indicate attentiveness and presence throughout the online conversation.

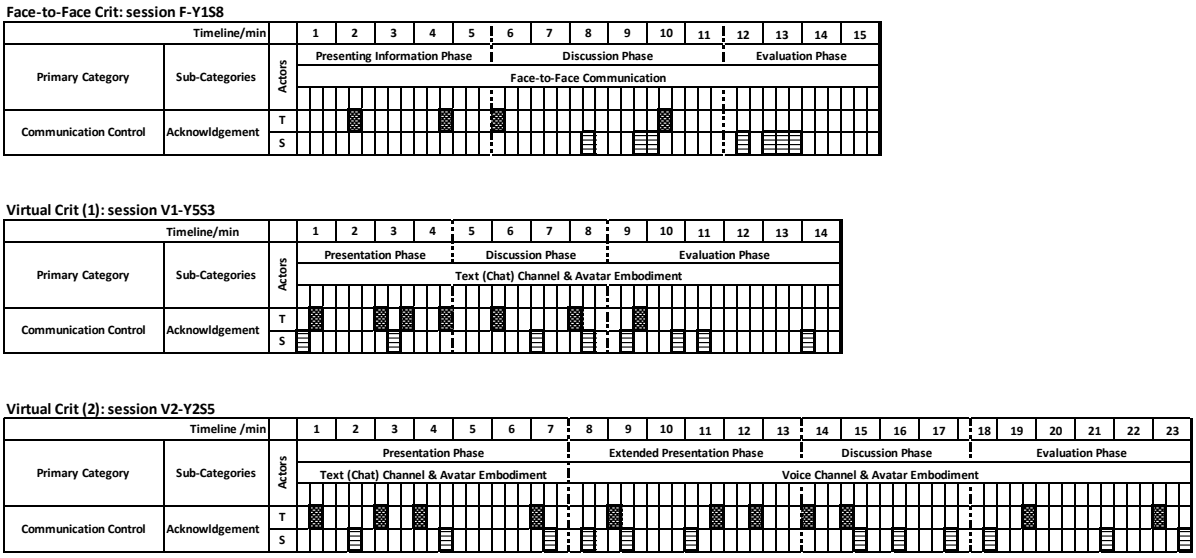


Figure 6-28 Acknowledgement in Three Sessions of the Three Design Review Categories

Face-to-Face Crits. Participants in the Face-to-Face Crit used positive and negative acknowledgment keywords that are commonly perceived among communicators, and as described by Brandle and Evens (1997:14) as "*discourse markers*" that indicate acknowledgment. In general, the conversation was spontaneous and users would constantly use utterances such as "*mmm*", "*aha*" and "*yeah*" among others to indicate their attentiveness to the other party. In addition to that, the participants used nonverbal cues such as facial expressions and/or nodding in a spontaneous manner to indicate acknowledgement as well as attentiveness throughout the sessions; these acted as indicators of understanding and receipt of information as well. As it is far well established in many researches on learning perceptions that tutors need to sense their students' reactions to their instruction, as Fox (1993) states:

> *"Tutoring involves constant, and local, management. This requires a pervasive mutual orientation and acknowledgement between tutor and student, such that every session (indeed, every utterance) is a thoroughly interactional achievement, produced by both tutor and student"*

This implies that showing attentiveness as a tutor-student mutual form of interaction is required to create an efficient learning experience. Janet Bavelas and Nicole Chovil, cited in (Earle, 2001) have investigated the linguistic function of facial expressions. They have claimed that facial expression is in fact the only form of nonverbal communication fast enough to keep up with speech. Facial expressions expressed their role in punctuating

discourse in Face-to-Face Crit, for example, frowning was observed accompanying disapproving/disagreeing with an idea, such as in this example:

T: Can you treat copper in a way that it won't end up going green?
S: Yes you can.
T: You can? Not quite sure about that. (with a frown and a head shake)

Raising both eyebrows indicated an exclamation in some instances, and a simple smile gave positive feedback and confirmation that encouraged the student to proceed in the direction of presentation. It can be seen from the following timeline grids in Figure 6-29, of *acknowledgement* that it was almost co-occurring with *head nodding* in the Face-to-Face Crits.

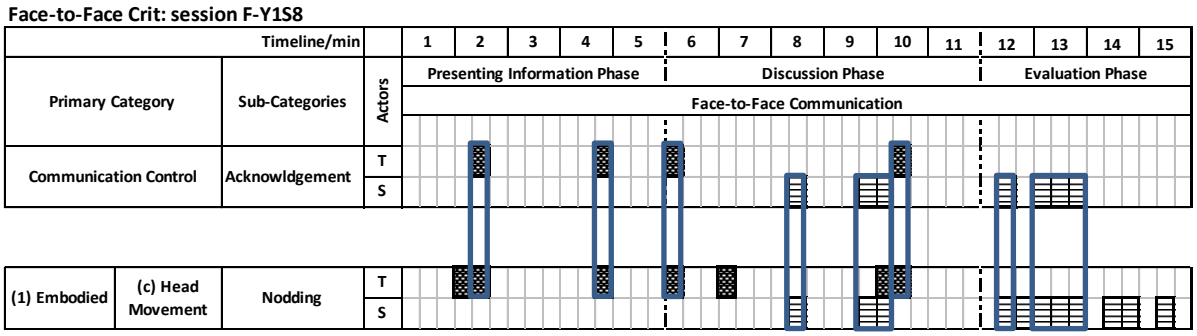


Figure 6-29 Co-occurrence between Acknowledgements and Head Nodding in the Face-to-Face Crits

Virtual Crit (1). It could be seen in Figure 6-28, that the number of times and frequency of giving acknowledgements increased than in the Face-to-Face Crits, however, there were no Head Nodding associated. All acknowledgements were given in the form of verbal communication. It could also be captured from the chat transcripts that there was a need to establish a sense of mutual attentiveness and acknowledgement in Virtual Crit (1). On a number of occasions, the tutor was deliberately asking the students to confirm their attentiveness; especially in the discussion and evaluation phases when there were some moments of silence during the conversation; the following example illustrates this notion.

T: u see what I mean...?
... (silence for 30 seconds)...
T: hello? you are either a slow writer or write long sentences
S: yes

T: my question was; did u understand what I said?
S: yes sir
T: confirm every once and a while please, ok?

The tutor then made it clear that text should be followed by confirmation of attentiveness and presence.

This notion of asking for and giving 'online acknowledgement' is a common method used by most online communicators to maintain 'online presence' to overcome the feeling of online distance (Gabriel, 2000). It is believed that the participants in the two virtual crits felt the necessity of establishing and maintaining this online presence to bridge the distance created by the remote situation.

Another example that relates to the need to show perception of information in Virtual Crit (1) is when the tutor asks the students to repeat what they have agreed upon in the crit.

T: so <u>what did we agree on regarding the park</u>???
S: I should focus more on the animation

This method of confirmation of perceived information emerges from the need to compensate the lack of nonverbal cues in the remote context, where the tutor cannot see the student's facial expressions and/or nodding as an indication of understanding.

Virtual Crit (2). Similar to our observations in Virtual Crit (1), the participants in Virtual Crit (2) constantly showed acknowledgements by typing "*discourse markers*" that indicate acknowledgment during the Chat only stage. However in the Audio stage, in addition to verbal acknowledgement; "*yeah*", "*ok*" and "*I get it*", they were observed sometimes to nod or shake their heads as means of acknowledgement and receipt of information despite knowing the other party cannot see their nonverbal actions. It seemed that these interactions came more naturally when accompanied with speech rather than with text in Virtual Crit (2).

6.4.3 Hand Over and Floor Holding

Good conversation management facilitates the meaning and aids the learning communication; handing over and floor holding were enacted differently between the three categories of design reviews as revealed in Figure 6-30, and explained below.

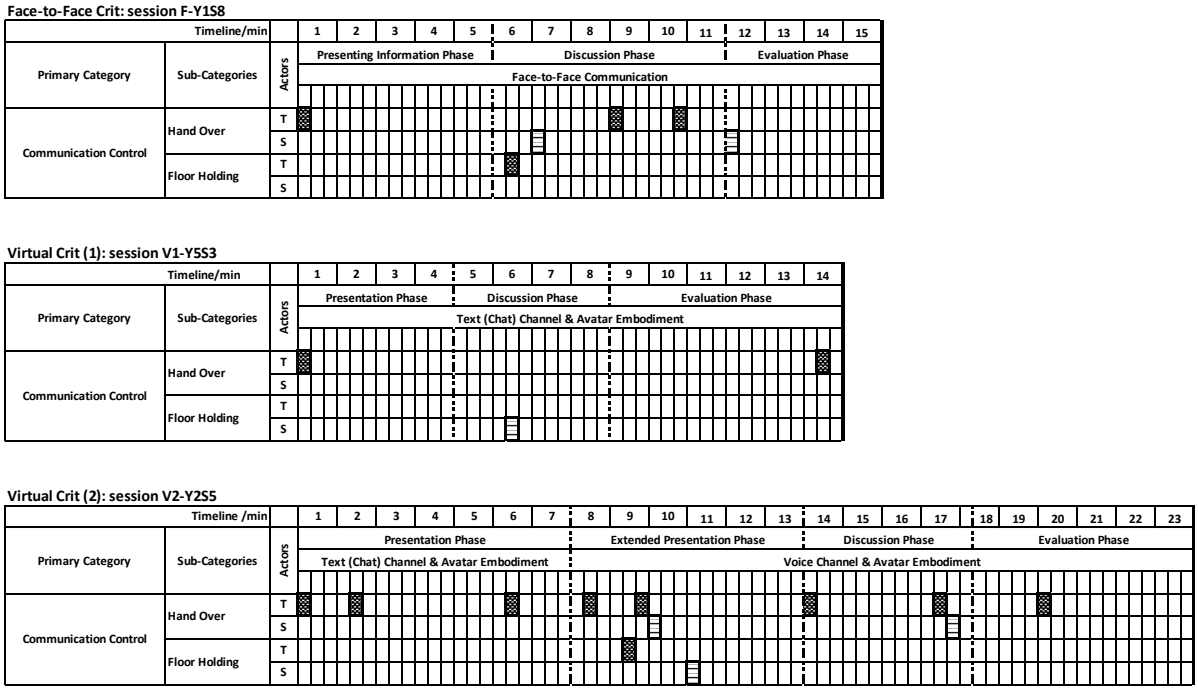


Figure 6-30 Handover and Floor Holding in Three Different Design Reviews

Face-to-Face Crits. The participants of Face-to-Face Crits had control and management over the communication to a great extent, they established to hand over the communication smoothly, with few attempts to hold the floor in the discussion phase. Handing over in the Face to Face Crits was often determined in this session using nonverbal cues; vocal expression, gesturing and eye signals. Direct verbal discourse for handing over the conversation occurred in the form of questions or direct invitation to talk accompanied with an eye signal to take the turn.

T: Go ahead, please

and,

T: But what is this space intended for? (with eye signal)

Virtual Crit (1). In Virtual Crit (1), typed messages appeared each at a time; however one occasion of floor holding could be detected from the chat transcripts. On the other hand, hand over was enacted in an obvious and clear way. So for the beginnings of the sessions, it was noticed that the tutor initiated the start of each session by asking the next student to show his identity.

For example where the student Avatar's name is (Chris13 Oh);

T: is this Chris?
S: yes

Another student's Avatar named (Rolo Raymaker);

T: ok you can start Richard
S: no this is Martin

and:

T: Ok, which one is next, Vivek?

and:

T: who is next? Is this Matthew?
S: yes
T: ok go ahead... upload ur images please

This was interesting to witness, as unlike in face-to-face reviews; the hidden identity of the Avatars (either by name or by appearance) created this demand of identification at the beginning of each session and functioned as a way of handing over the conversation.

Direct questioning was anther method of handing over the conversation; typing the question mark at the end of the question helped to distinguish questions.

Virtual Crit (2). Hand over was expressed in the Chat only stage by using punctuation such as question marks that clearly handed the conversation over to the other party. On the other hand, in the audio channel stage, because no direct eye-contact was available to give hand over, (due to the seating positioning of the tutors and students in the computer

cluster) there were times where there were silent moments after the student finished talking.

The tutor in Virtual Crit (2) had created a general arrangement on how to manage the conversation by asking the students to send short messages at a time.

T: ok, let's try short bursts of communication no more than two lines
T: followed by response from the others

This method prevented the participants from being caught in long periods of silence waiting for long sentences being prepared to be sent.

As the participants in Virtual Crit (2) were co-located in the same physical space; this made the need to ask for the identity of each Avatar at the beginning of the sessions, as experienced in the fully remote Virtual Crit (1), not relevant. So starting the sessions was carried out with a simple invitation to speak, e.g.:

T: OK, go ahead

and

T: We're on

However, in one instance, one (male) student had a problem with the uploading of his Avatar, so he used his (female) colleague's Avatar instead. This Avatar's female appearance confused the tutor, here he asked for identification.

T: Is this Jacob?
S: Yeah I had to use Emma's Avatar because mine isn't working for some reason…
T: Oh, ok

So here, despite the tutor being aware of his student's identity and the fact that communication is carried out through chat and voice, the appearance of the Avatar 'talking' to him still mattered. It could be understood from this example that there was some kind of association with the presence and identity of the Avatar.

6.5 Perception of Meanings

The result of communication in any medium is the development of shared understanding of the communicated messages. So meanings are the core of human interaction, as so many factors are involved in the communication process, conveying the right meaning is not always achieved (Ehninger *et al.*, 1986). Many interpersonal, social, pedagogical factors, as well as the nature of the message itself, the medium of communication, mutual understanding of codes, and instant feedback, contribute all in conveying the right meaning. As Kalay *et al.* (2008) explain further, the capacity of the transmitting medium to carry more or less information affects the abstraction needed to encode the message. The richer the medium is, the less effort needed by the sender to encode and the less effort needed from the receiver to decode the meaning.

So, as the reliance on the receiver to fill in missing information grows, so does the potential for the message to be misinterpreted. The design review aims at judging the student's design work, the student tries to deliver his/her work as clearly as possible, misinterpretation of the design from the tutor definitely results in dissatisfaction with the project and an unjustified mark.

6.5.1 Missing Information

In the two Virtual Crits (1) and (2), mediation and abstraction of the messages affected to some extent, the communication of the meanings, and at times the misconception of sizes and scale, resulted in misinterpretation of the designs. This was related to three reasons: (1) missing information, (2) unclear information and (3) unclear orientation. However, in many cases, the meaning got through, and communication was to some extent successful. This section examines the participants' perception of meanings based on the level of technological communication efficiency, and their mutual understanding of codes in the virtual design reviews.

Virtual Crit (1). In the following example in Virtual Crit (1), one of the student's images took a while to upload; he started his review anyway, but the missing information led the tutor to misinterpret the design.

S: the purpose of the building is to allow the tenants to enjoy the desirable view
T: so why does it need to revolve? I don't get it
S the landscape will not be homogenous...
S: the desert is going to be transformed to a green place
T: well u need to show that transformation
S: the mesh that shows the transformation is taking a while to upload, it will be ready any second now I hope

In the previous example, the missing information resulted in an unclear perception of the idea, leading the tutor to ask for clarification during the sharing of information phase. We can read from the student's response in the last line, that the drawing that completes his project '*is taking a while to upload*' and it seems as if he is trying to buy some time, by saying '*it will be ready any second now*'. Once uploaded, the conversation carried on, but it can be clear that some anxiety was caused for the student, from his last statement '*I hope*'. The tutor's passage as well revealed that he doesn't understand the concept of the project, and asked that all information to be showed to allow a proper conception; in the two underlined lines: '*I don't get it'* and '*well you need to show that transformation*'.

Virtual Crit (2). Some instances of misunderstanding also occurred in Virtual Crit (2) due to missing information. This example shows the tutor realising he had been confused, but when he receives clarification, the meaning starts to '*make more sense'*:

T: did you mean the black hexagon shaped plan on the far right? is this your shed?
S: Yes
T: ok, that makes more sense

In the above line, if not corrected, it could have been possible that the tutor's perception of information used to evaluate and criticise the project would have been affected by the unclarity of shared information.

The chat transcripts showed as well how the tutor was worried in many occasions that he had misinterpreted the presentation, and in a number of times he had to repeat what was being said for confirmation, or ask to confirm if he '*got it right*' as in the following passage.

S: beside my head on the centre picture is the glass box and frame, that is the cafe...and if you look down to the side you can see the view and the restaurant.
T: just to make sure I got it right now, so this is the box on the left? the top rendering is the cafe suspended on the span frames structure?
S: yeah, and there are some steps just behind where the cafe is.

Another example reveals that a point of disapproving / disagreement with the design from the tutor's behalf was caused by uncertainty of some presented information, this refers to the semantic problem of information transmission observed by (Chiu, 2002) which is when the original meaning of the message is disturbed by inaccuracy of conveying information. The following passage shows the tutor misinterpreting the design due to the unclear resolution of the drawings that affected the line weights of the contour lines.

T: I'm still not clear
T: how do the contours change?
…..
T: So…you have created this very very formal structure,
S: Yeah
T: but it doesn't appear that you have used the natural contours of the site at all, which is quite strange, the contours seem very informal, you haven't got that in your design; the structure would have been distributed in three dimensions, but I don't see that as successful I'm afraid,
…
S: sorry yeah, it is a bit unclear what is drawn because of the line weight. what I've actually done is that I've worked on two existing contour lines in the site, that you can see in the third image down on the left hand side of the first page,
…..
T: …it looks as if they are sort of cutting through your terrace there, as normal, and so it looks just like a natural slope
S: sorry actually, the dashed lines are the existing contours, it's just that the proposal lines are lighter and you can see them on the bottom left corner.
….
T: it looks a bit confusing; you'd probably need an analytical drawing that shows the original site.
S: I tried to show them using dashed lines.

The previous conversation is shown from V2-Y2S5 time-line grid, the boxed interactions refer to Asking for Orientation and Asking for Explanation, followed by Repetition to clarify

from the student, and it can be seen that the tutor's Disapproving and Negative Feedback in the two lower grids are a result of misconception of information in some occasions.

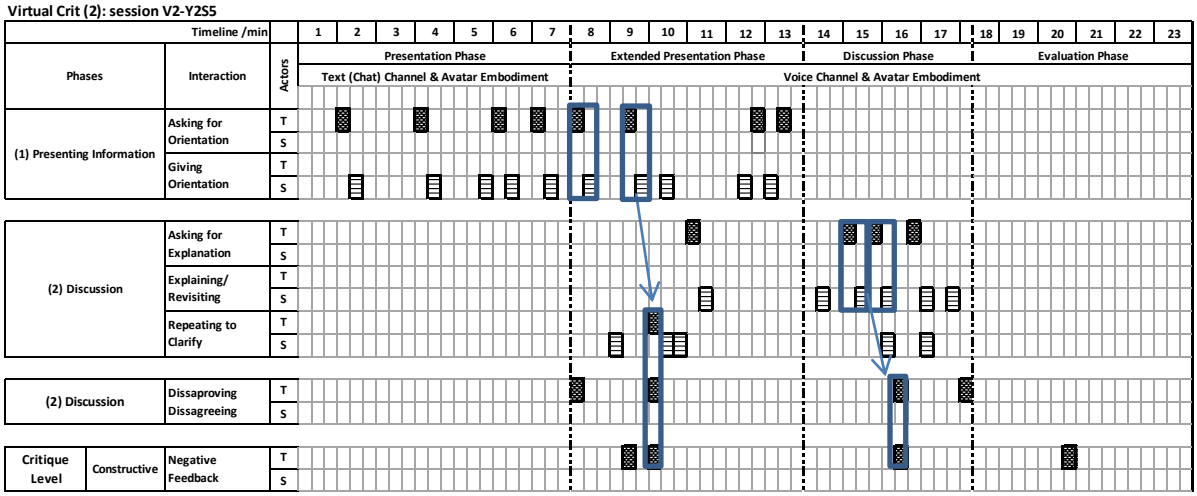


Figure 6-31 Relation between Asking for Orientation, Repeating, Disapproving, and Negative Evaluation in Virtual Crit (2): session V2-Y2S5

6.5.2 Misconception of Scale and Space

The chat logs revealed that participants in the virtual crits had unfortunately lost sense of scale and perception of size in the mediated review. It is true that the virtual world affords a three dimensional environment that has significant spatial opportunities for visualising, but there are no spatial standards unfortunately; sizes and scale are relative.

Virtual Crit (1). This loss of reference to scale led the tutor in Virtual Crit (1) to think, mistakenly, that the lift in the design is a room, as understood from this passage:

> *S : and u can also enter the lift and go to upper level*
> *T: which lift?*
> *S: this one, in the hashed area*
> *T: Is this a close-up, I thought those were rooms*
> *T: and not sure I understand what the site map is.. here.*

Virtual Crit (2). In another example, the tutor in Virtual Crit (2) referred to the absence of scale and size perception, which led him to build his understanding of the project differently, this is shown in the underlined passages in the following example:

> *T: I can't get a sense of the scale in this context, is the scale of these trees right?, are we talking football pitch sized layout?*

And in another instance:

> *T: the form of the building because the problem here is all the renderings are quite stretched and looks a bit low profile so it looks like a type of land form building on its own rise.*

This issue of size and scale perception is highly significant to the perception of the design review information, and affects how the tutor evaluates the project; misinterpretation may lead to unfair evaluation of the project.

6.5.3 Compensating Nonverbal Cues to Convey Meanings

The participants in the two virtual crits managed to overcome the absence of some nonverbal cues such as vocal expressions that express questioning and emphasis as well as other interactions/ emotions such as smiling or laughing, by using a compensating form of language, punctuation and symbols to convey their messages.

Vocal expressions in Virtual Crit (1) and (2) were expressed using punctuation as shown in Figure 6-32; this was done by the tutor and students to compensate limited nonverbal communication.

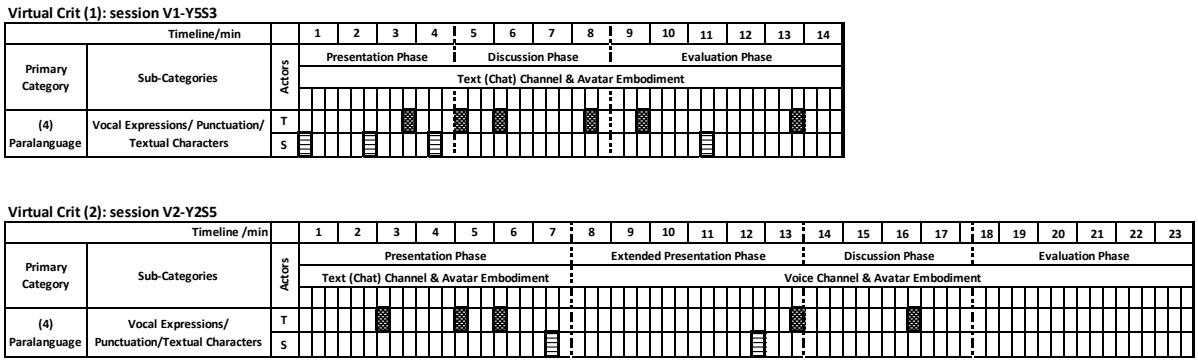


Figure 6-32 Distribution of Using Textual Punctuation in the Mediated Reviews

The above time line grids show that punctuation was used more in Virtual Crit (1) than in Virtual Crit (2), as text was the only means of communication in Virtual Crit (1); the users made full use of capitalisation, punctuation and symbols. The following examples present the different formats of textual punctuation used in the different review sessions.

Virtual Crit (1). The tutor in the following example has asked the student about a certain point, but did not get the answer he was looking for so he rephrases his question and adds emphasis using punctuation to replace vocal expressions.

> *T: how are u directing visitors on those choice points? U didn't tell me,..*
> *S: well you can see it here (Avatar points to location)*
> *T: ok, I get ur point, but for instance when u get here...what REALLY happens then?*

Other uses of punctuation that could be extracted from the transcripts of Virtual Crit (1), are use of commas to indicate pause in speech as well as the question mark that clearly represents a question, and the use of capital letters that emphasises which part of the statement is meant.

> *S: there are three possibilities...first,*
> *S: the narrower space gives a sense of importance ...and sacredness*

In some occasions the participants used special words as tools to convey their emotions by using acronyms such as 'lol' for 'laughing out loudly', and smileys '☺'. The use of commonly known alternative letters or short words, among chat users, to refer to other words was also noticed the virtual crits, so for example 'are you' is written 'r u'. This example from Virtual Crit (1) shows this concept:

> *T: r u all working together?... ☺*
> *S: lol….no, but it's a good idea*

Virtual Crit (2). Participants also made use of common textual punctuation in the chat-only stage, however those were fewer than what was observed in Virtual Crit (1). Mostly were questions marks associated with 'asking for orientation' as in this example:

> *S: and the equilibrium that exists between them*
> *T: to the north?*

When they started using voice however, vocal expressions were used to express different emphases.

When asked in the focus group, one student from Virtual Crit (2) expressed that adopting a certain text language to compensate the lack of nonverbal cues may not be an ideal method especially for those who are unfamiliar with some acronyms:

> *V2-Y2S3: "Everyone has developed txt language for the ease and speed, so we can adapt to a similar method of texting, but it won't be very professional in the crit... it's the degree to the level of txt they understand as well, so you get tutors who are not updated with the common txt language used by students, and you also get foreign students and tutors who have txt language in their own language, and are not familiar to the English texting".*

Another concern was raised by one of the students in Virtual Crit (2), he has expressed in the focus group discussion the significance of the missing emphasis in text-based communication.

> *V2-Y2S1: "In a real crit you could tell where the tutors real emphasis and stress really are, a simple jokey comment or if it was a serious question, they came across of being in the same importance of text, where if it came with a facial expression and a voice, you could have told that the other one is a bit of a joke, I missed it coz I just couldn't come across".*

This student reveals that what some users found as a joke, he thought it was a formal statement, and misinterpreted the meaning due to lack of textual emphasis.

6.6 Findings on Communication Efficiency

Communication Efficiency of the mediated design reviews was examined in this chapter, assessing the levels of (1) communication control, (2) sequences of narratives and (3) perception of meanings. The efficiency of communication in the mediated design reviews was shown to be affected by interruptions and separation in sequences of narratives. It is particularly relevant to argue that conveying location and orientation as properties of the verbal discourse of narratives is specifically important in a mediated design review due to the significance of orientation and location when describing and/or criticising parts of a drawing. It was shown from the observations and confirmed by users in Virtual Crit (2) that there was a need to use additional wording or embodied actions to keep participants oriented while performing in the mediated design reviews.

The limitation of nonverbal cues created the desire to use verbal discourse to control and manage the conversations. Despite that, the participants in the virtual crits could not avoid interruptions, whether these were intentional interruptions; to ask for orientation- as in many cases of Virtual Crit (2), or interruptions in lines of thought caused by the nature of typing in the chat mode that does not show that the other party is 'typing now'.

Some misconceptions of information and meanings were caused by, missing information, unclear information, or unclear orientation of information. This resulted in a number of instances of delay caused by asking for clarification and confirmation of perceived information. Missing another important dimension of information such a facial expressions that give instant acknowledgement of understanding, helps manage the conversation and shows emotions at a glance, forced the participants to compensate these missing cues. In a number of occasions, the students have revealed that they had experienced some communication frustration for not being able to discuss all the information they wanted to show in the mediated reviews. However, the participants created a shared understanding of the way they approached some communicational problems, and also managed to overcome limitations of the media by compensating nonverbal cues and actions in the form of orientation discourses, punctuation and using the other available Avatar embodied actions, such as navigation and flying.

The findings of this chapter may conclude that the communication efficiency of the two Virtual Crits (1) and (2) depended mostly on the mediation of nonverbal means of communication, especially pointing for their significance in orienting the narrative. Trying to overcome the absence or difficulty of managing this means of communication, relatively more in Virtual Crit (2) than Virtual Crit (1), resulted in the extension of the sessions durations, and disorientation that caused some misunderstandings of the meanings.

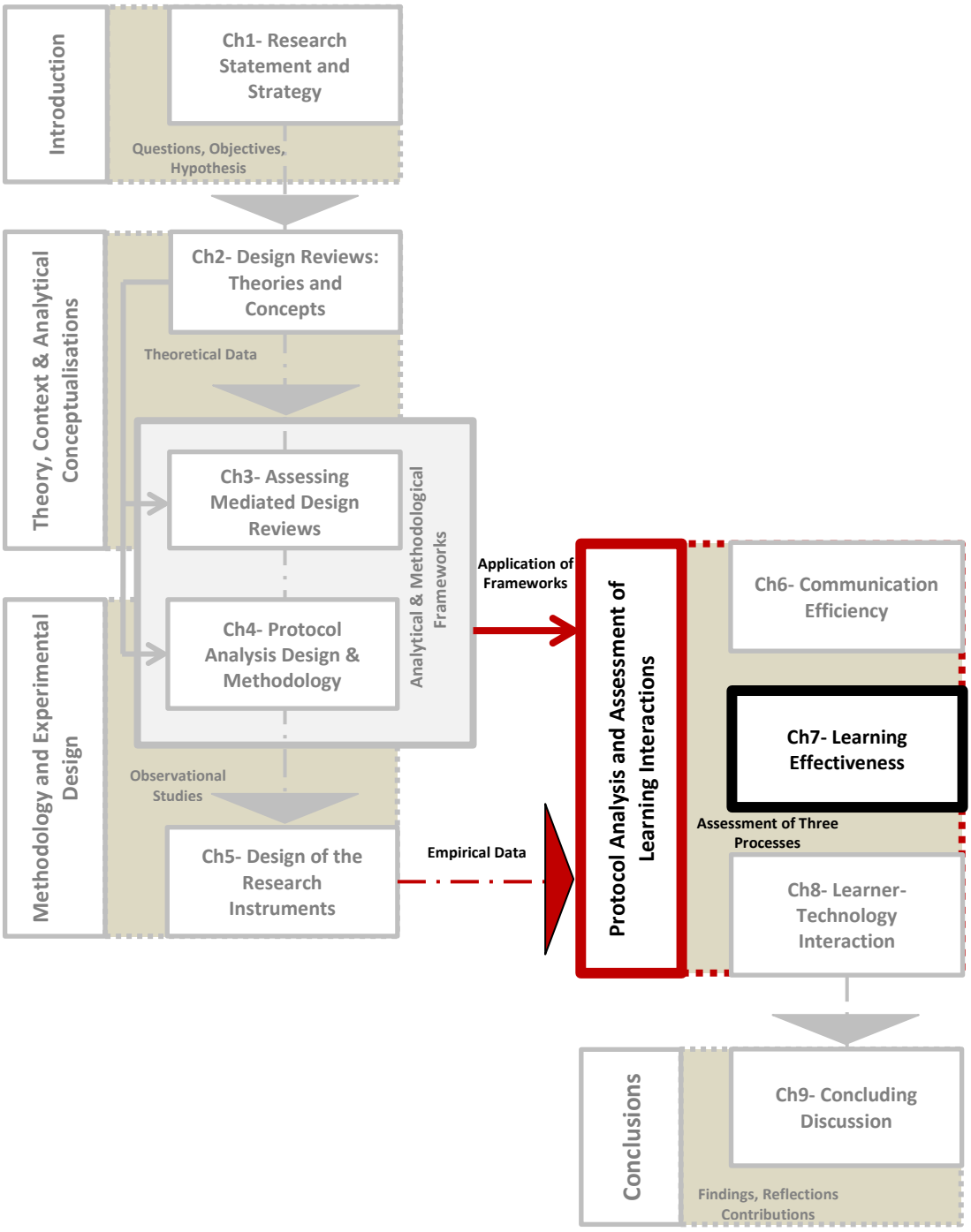
The next chapter examines the Learning Effectiveness which is the second component of the proposed assessment framework. This involves studying the cognitive and critiques levels of the verbal discourse of the design reviews, as well as the levels of affective learning as perceived by the participating students.

Chapter Seven

Learning Effectiveness

Chapter Seven Contents

Chapter Seven 208
7 Learning Effectiveness 211
7.1 Introduction 211
7.2 Cognitive Learning 211
7.2.1 Student Initiative-Taking Behaviour and Speaking Time 212
7.2.2 The Cognitive Levels and Characteristics of the Verbal Discourse 220
7.2.3 The Critique Level of the Discourse 231
7.2.4 Students' Own Perception of Learning 243
7.3 Affective Learning 246
7.3.1 Showing Solidarity, Immediacy and Emotions 246
7.3.2 Social Communication 249
7.3.3 Stress-Free Crits? 251
7.3.4 Satisfaction 255
7.4 Findings on Learning Effectiveness 258


Introduction
Ch1- Research Statement and Strategy
Questions, Objectives, Hypothesis
Theory, Context & Analytical Conceptualisations
Ch2- Design Reviews: Theories and Concepts
Theoretical Data
Ch3- Assessing Mediated Design Reviews
Analytical & Methodological Frameworks
Methodology and Experimental Design
Ch4- Protocol Analysis Design & Methodology
Observational Studies
Ch5- Design of the Research Instruments
Application of Frameworks
Empirical Data
Protocol Analysis and Assessment of Learning Interactions
Ch6- Communication Efficiency
Ch7- Learning Effectiveness
Assessment of Three Processes
Ch8- Learner-Technology Interaction
Conclusions
Ch9- Concluding Discussion
Findings, Reflections Contributions

7 Learning Effectiveness

7.1 Introduction

As Bloom (2001) declares, effective delivery of the learning goals is an indicator of the effectiveness of the learning process. This chapter is focused to assess the extent to which the mediated interactivity process and the use of technology has supported the delivery of the learning goals in the observed mediated design reviews. For that, this section examines how well the students were able to present and discuss their projects at an in-depth level, and how well the tutors were able to provide informative feedback and to evaluate the students' designs, skills and learning as expected in the design review. The level of student satisfaction with the learning experience as well is examined. Learning Effectiveness of the mediated design review is categorised here into two dimensions, these are namely; (1) cognitive learning, (2) affective learning.

7.2 Cognitive Learning

Cognitive learning represents the students' learning performance and perceptions of own learning, this is studied by examining three sets of information obtained from the collected data:

(a) Active student interaction and participation; which is examined by the students' speaking time and their initiative-taking behaviour and leading of the discussion (Weidong, 2005).

(b) The cognitive levels of the verbal discourse; that makes use of actual statements delivered by the students and tutors during the design reviews and is considered evidence of the level of learning delivery in online learning communication (Henri, 1992).

(c) The critique level of the discourse describes the level of evaluation and feedback, as one of the design reviews' learning goals (Anthony, 1991; Weidong, 2005), content analysis is used in this examination.

(d) The students' own perception of learning; and this, according to Picciano (2002) and Russo and Benson (2005) studies how well the students believed they had presented their projects, and understood their tutor's feedback. And this is obtained from students' responses to the questionnaires and focus groups.

7.2.1 Student Initiative-Taking Behaviour and Speaking Time

From a constructivist point of view, Weidong (2005) related the students' initiative-taking behaviour in architectural design reviews, to the effectiveness of learning. As this active participation results in practicing presentation skills, and promotes deeper processing of information for future learning (Hooper, 1992) which are among the intended learning goals of design reviews. For this, both, speaking time and students' initiating and leading of the discussion behaviour were monitored in the three phases of the observed design reviews, to act as indicators of cognitive learning.

Four different design review sessions are examined in this section, as they were the most indicative of interactions in the observed sessions; the first two are Face-to-Face Crits, but represent different academic levels; Stage One and Stage Three respectively. The third one is from Virtual Crit (1) which represents a Stage Five level review, and the last is from Virtual Crit (2) which represents a Stage One level review. The tutor's speaking units are labelled 'T' and shown in blue, while the student's speaking units are labelled 'S' and shown in red. Interactions are examined in each of the three phases of the review; sharing information, discussion and evaluation.

- **Sharing Information Phase**

The four time-line grids shown in Figure 7-1, reveal the distribution of the tutor's speaking time opposed to the student's speaking time in the sharing information phase of the observed design reviews.

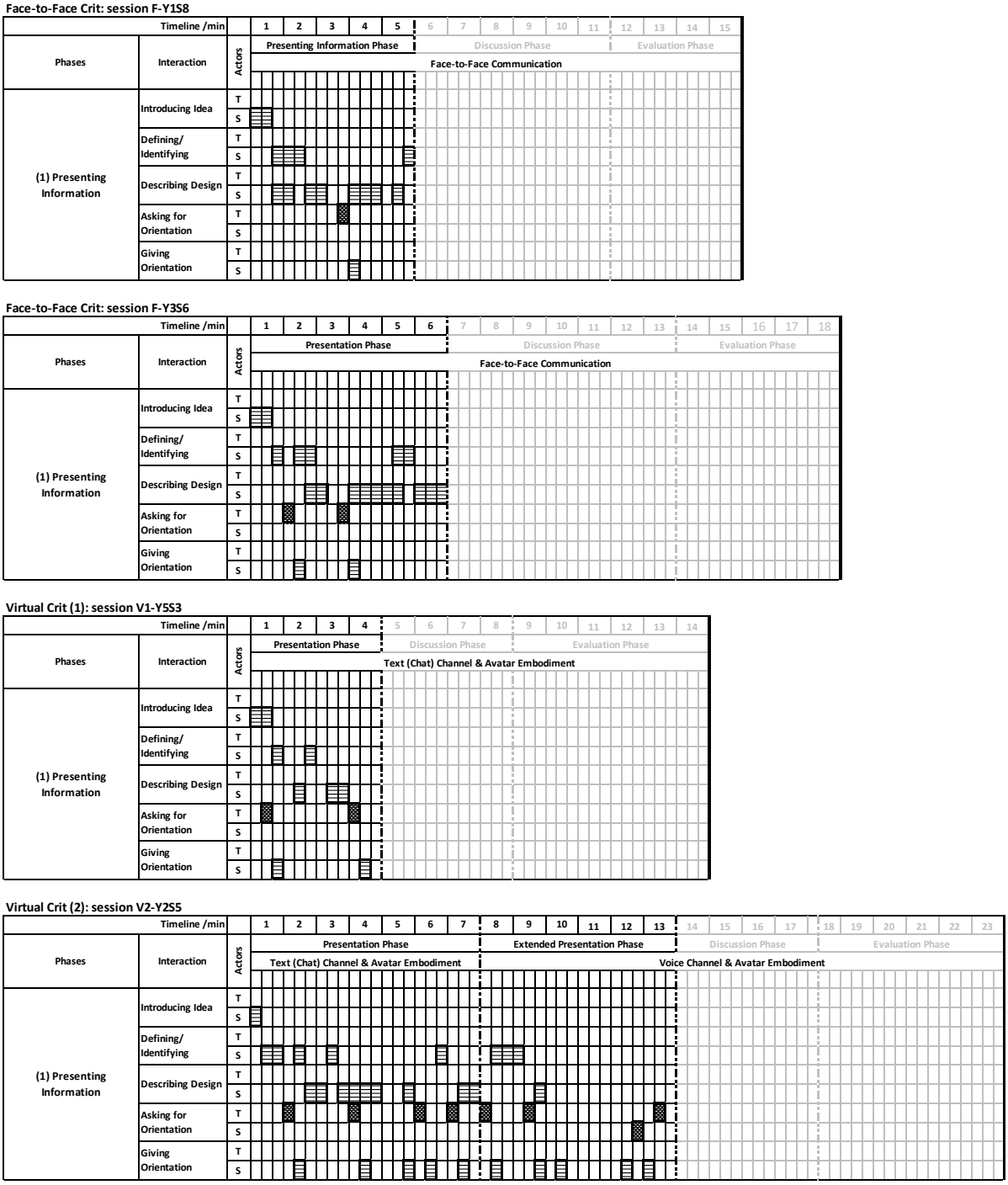


Figure 7-1 Distribution of Tutor/Student Speaking Time in the Presentation Phase of Four Different Design Reviews

The above timeline grids in Figure 7-1 show that the students speaking time occupied almost all of the sharing of information phase, and this was true for all of the academic stages of the observed reviews, not necessarily related to the academic stages of the

students. However the medium of communication did play a role in the distribution of the tutor's speaking time in the Virtual Crits.

Face-to-Face Crit. The student's speaking time shown in the first two time line grids of Figure 7-1 occupied almost all of the first phase, leaving one or two instances where the tutor asked for clarification. This is exactly the pattern we would expect in the context of a design review, as the student's role here is presenting and describing his/her project as clearly and deliberately as possible.

Virtual Crit (1). The distribution of students' utterance in Virtual Crit (1) was concentrated in the first phase, again as expected. Students gave relatively shorter presentations with more confidence and the tutor asked for orientation a couple of times in this session.

Virtual Crit (2). As explained before, participants in Virtual Crit (2) did not have the opportunity to use Avatar gestures for pointing; this produced a quite different distribution of tutor's speaking time opposed to the student's speaking time than that of the Face-to-Face and Virtual Crit (2). The last time-line grid in Figure 7-1, shows the tutor interrupting several times to ask for orientation of the described projects. The medium of communication affected the distribution of speaking time, nonetheless, the student's verbal discourse still occupied most of this, relatively longer phase.

- **The Discussion Phase**

The discussion phase in particular, revealed noticeable differences in the student/tutor speaking times than that observed in the sharing of information phase. It was noticed that the speaking times were balanced between the tutors and the students. Here the medium of communication was not of noticeable influence in most of the observed reviews, however, in Virtual Crit (2) as expected, more instances of 'repetition' by the students added to their speaking time, this is shown in the time line grids in Figure 7-2.

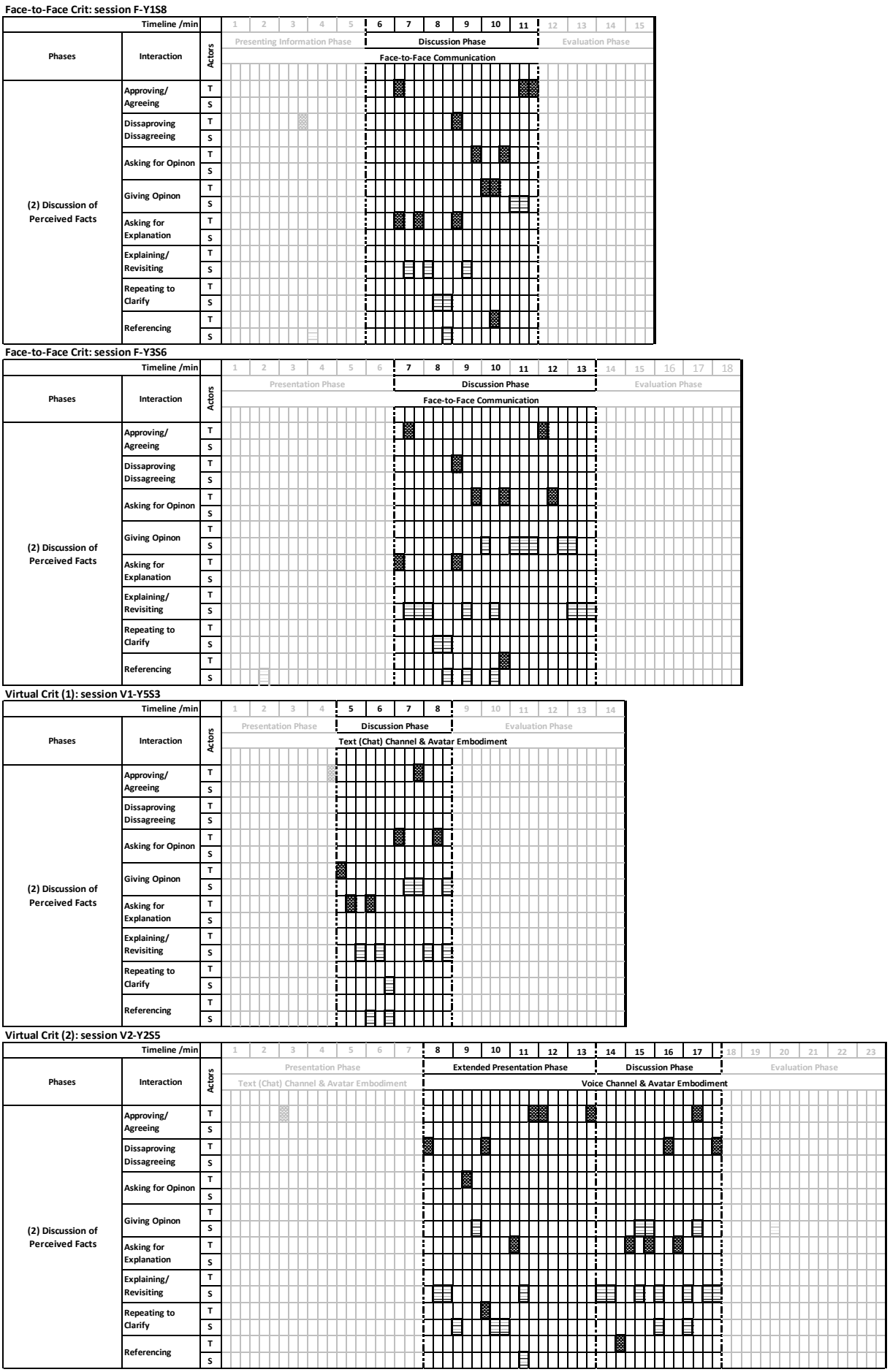


Figure 7-2 Distribution of Tutor/Student Speaking Time in the Discussion Phase of Four Different Design Reviews

The initiative-taking behaviour of the students also varied in the discussion phase between the three design reviews. However, these differences were not directly related to the medium of communication, but rather, they differed according to personal skills and the academic level of the students; probably related more to their experience with design reviews over the years of study, this is shown in the following paragraphs.

Face-to-Face Crit. The discussion phases of Face-to-Face Crits consumed most of the crit duration, and was noticed that the tutors led the discussion in the early academic stage reviews (represented by F-Y1S8 timeline grid in Figure 7-2). The tutors took the initiative in the discussion phase by expressing points of agreement and/or disagreement, asking for opinions, and then giving opinions themselves, also referencing to some examples of work in a teaching method of discussion. The students waited for tutors to open discussion with questions, and they only answered or gave explanations when asked. Some instances of detailed revisiting and referencing were noted.

For the later academic stages (represented here by F-Y3S6 timeline grid in Figure 7-2), the discussion phase was the longest phase, and was student-led mostly. It was also observed that it was much richer in revisiting and referencing, but this time from the students' sides. The nature of the projects may also have contributed to the richness of interaction, as the more details and complexity in the designs, the more discussion it provokes.

A higher level of student confidence was sensed in the later academic stage reviews as well, as experience is an important factor; the more design reviews students perform throughout their academic years, the easier it gets (Anthony, 1991).

Virtual Crit (1). The discussion phase, in Virtual Crit (1) was similar to what was observed in the later academic stages of Face-to-Face Crits. The discussion was mainly student-led, and took a conversational style of communication employing an asking–answering style which in turn resulted in a direct although not always shorter dialogue. The medium of communication here may have affected the lengths of the sentences, as they were shown in the chat transcripts to be short and direct. This was true for most of the cases observed in Virtual Crit (1).

Virtual Crit (2). Once the description of the project became clear to the tutor, and the discussion phase began, the distribution of tutor/student speaking time was similar to those observed in the earlier academic Face-to-Face Crits, where it was tutor-led most of the time. This finding may suggest that the academic level of the students may have had an influence on this way of interaction. Again the chat only stage forced the participants to be concise with shorter sentences, but this changed when the audio stage began.

- **The Evaluation Phase**

Again it can be noticed that the difference in speaking time as well as the use of reflective discourse in the evaluation phase by the students varied between the four studied design reviews. Here, as it is the nature of the evaluation and feedback phase discourse, the tutors did most of the speaking, however the later academic stages three and five initiated to '*summarise of agreements*', unlike the earlier academic stages; this is shown in the time line grids in Figure 7-3.

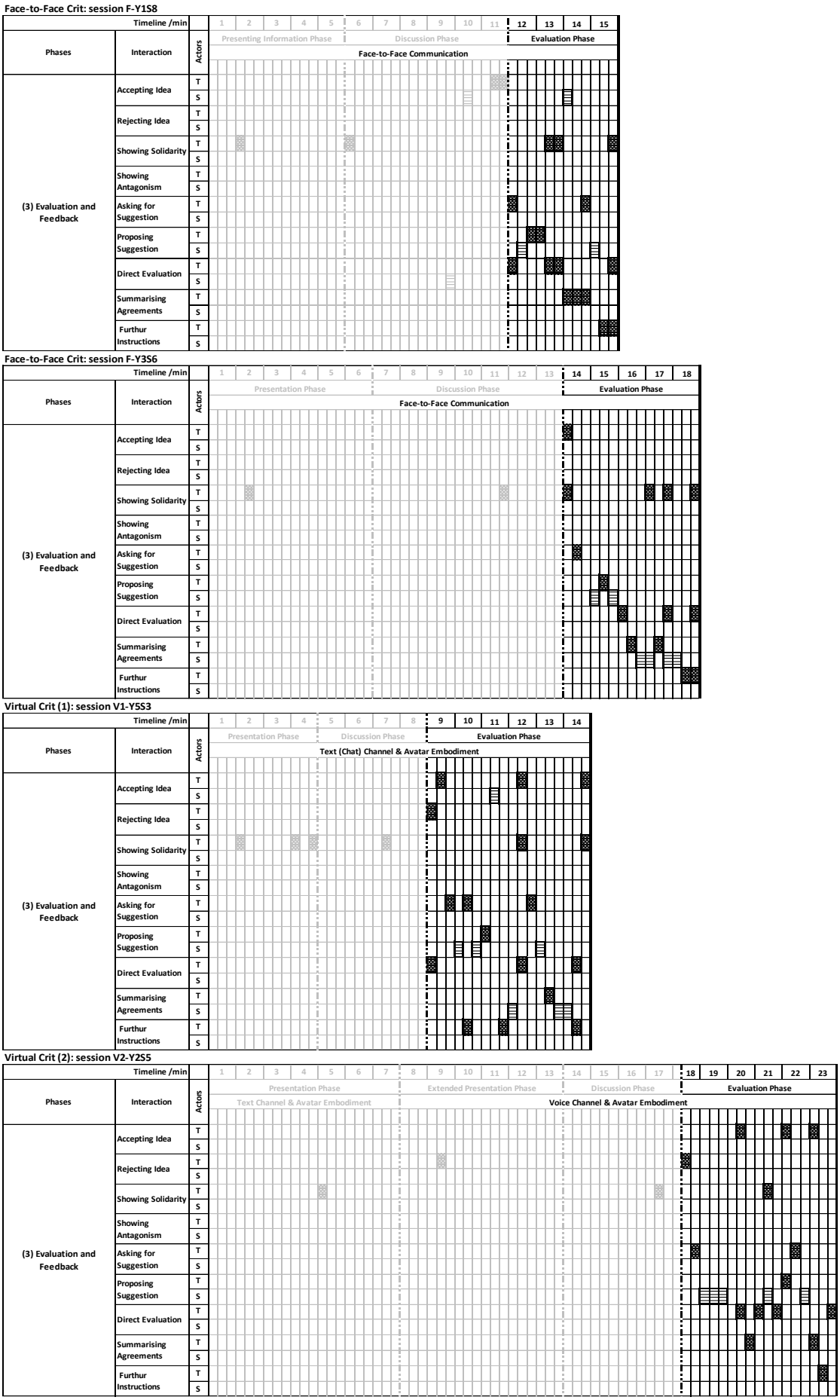


Figure 7-3 Distribution of Tutor/Student Speaking Time in the Evaluation Phase of Four Different Design Reviews

Face-to-Face Crit. The evaluation phase was mostly occupied by the tutor asking and giving suggestions. He gave further directions, summarizing of agreements and direct evaluation. The earlier academic year students' participation was relatively low in the evaluation phase (represented by F-Y1S8); mostly giving suggestions only when asked, and were observed to show acknowledgements of understanding throughout that last phase.

However, again the later academic level students (represented by F-Y3S6); showed more participation by proposing suggestions and another form of reflective discourse which is '*summarising of agreements'*. This reflective way of learning was not observed in the stage one reviews to be initiated by the students, however, it was shown in the Virtual Crit (1) later academic level students as well. This may as well relate to the older student's experience with crits, and their focus to make full use of reflection as a method of design review learning.

Virtual Crit (1). The evaluation phase was the longest phase in most of Virtual Crit (1) sessions, where the tutor's speaking time also occupied most of this phase. But the students tended to elaborate on *proposing suggestions*, and followed the method of *summarising of agreements* as observed in the later academic level students of the Face-to-Face Crits.

Virtual Crit (2). The tutor gave evaluation as intervals within the discussion phase, and was not direct in many observed cases and sometimes it was hard to distinguish between the beginning and end of each phase.

A similarity with the earlier academic stage Face-to-Face Crits was noticed to a great extent in the evaluation phase, where the tutor's speaking time and initiation of discussion. Here, it is clear that the academic level of the students was the factor that caused these relatively similar patterns.

From the above analysis, some general differences were found in the students/tutors speaking time between the three phases of each design review (sharing information, discussion and evaluation) the medium of communication can be related to this finding to some extent; by leading to the increase of the '*asking for orientation'*, and '*repetition*'

verbal discourses in the first two phases of the Virtual Crit (2) design reviews. However, the variations in initiation and leading of the discussions were associated with the academic level of the students, as they reflected their experience and communication skills in the design reviews.

7.2.2 The Cognitive Levels and Characteristics of the Verbal Discourse

The cognitive level of the discourse reflects, among other indicators, the nature and quality of online learning (Garrison, 1993). The analysis of the cognitive level in the Review Interaction Protocol, in this research is based on Henri's (1992) online learning content analysis model, and explained earlier in Chapter Four. It categorises verbal discourse into (1) Simple processing, and (2) In-Depth processing of information which is further categorised into Descriptive discourse and Deliberative discourse. Content analysis revealed the influence of the technology and other pedagogical factors on the variations of the cognitive level of the review sessions.

In addition to that, following a method of discourse analysis by Titscher and Jenner (2000) and Dong (2007) and implemented by Earle (2001) in online communication, it was found that functions and characteristics of the verbal discourse varied between the three observed sets of design reviews; some functions were used extensively while others were neglected.

The timeline grids in Figure 7-4, show three different sessions of the three categories of experiments Face-to-Face, Virtual Crit (1) and Virtual Crit (2). What could be captured from comparing the cognitive level of discourse at a glance from these timelines is that verbal discourse in the three examined sessions of the three experiments fell within the in-depth level. However most of the discourse in the sharing of information phase in the three sessions started as descriptive, and then became more deliberate as the discussion phases start. The evaluation phases continued to be deliberative as well. It can be noticed also that patterns of cognitive discourse in the Face-to-Face Crits and Virtual Crit (1), combines descriptive and deliberative discourse together along the timelines, while Virtual Crit (2)

remains mostly descriptive, and then the discourse moves to the deliberate level when the audio stage begins throughout to the end of the review.

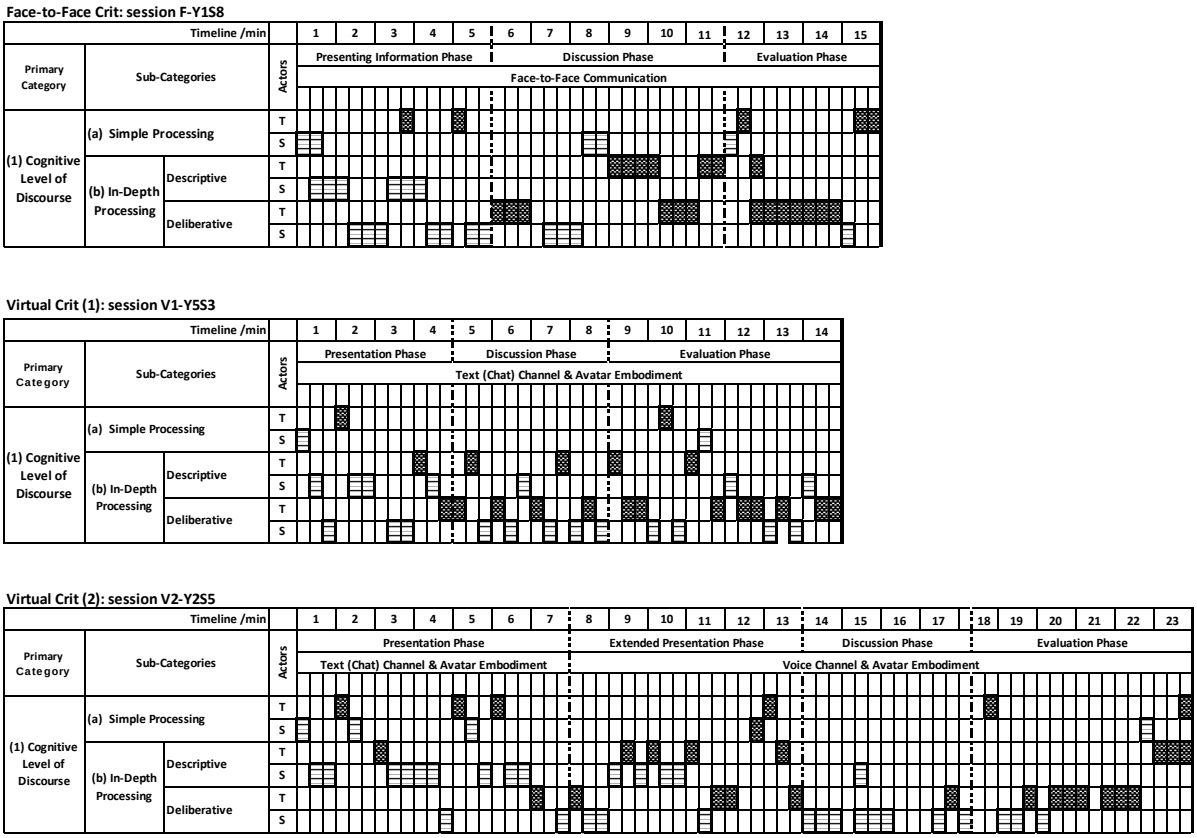


Figure 7-4 The Cognitive Level of Discourse of the Three Design Reviews

The following paragraphs discuss, in more detail, what was found from observing the first two phases, sharing information, and discussion in terms of characteristics and levels of cognitive discourse in the three design reviews. The evaluation phase is examined in the next subsection of this chapter under the critique level of discussion.

- **Presentation Phase**

The cognitive levels of discourse in the presentation phase of the three design reviews are distributed quite differently as shown in the following analyses.

Face-to-Face Crit. Verbal discourse appeared to fall mostly in the two In-Depth Processing categories; Descriptive and Deliberative, and almost all verbal discourse revolved around the development of the ideas and the design. The presentation phase

included mostly *definitions* and *descriptions* of the project, and one instance where *asking for and giving orientation* were needed as shown in Figure 7-5.

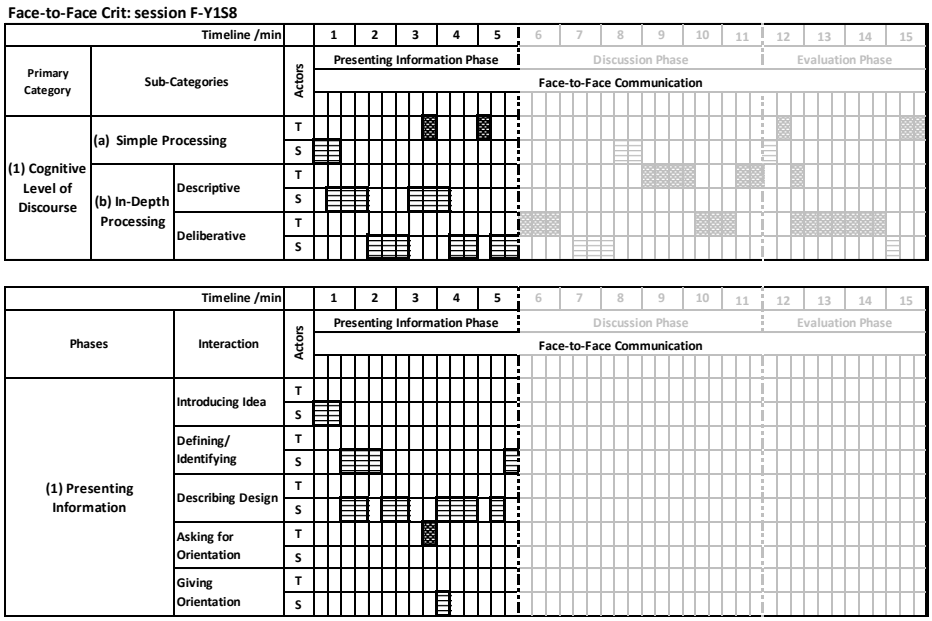


Figure 7-5 Characteristics and Cognitive Level of Discourse in the Presentation Phase of Face-to-Face Crit

Students generally proceeded to *introduce the idea* straight after they were signalled to start by the tutor, in many of the Face-to-Face reviews; the discourses containing introducing the idea were relatively long and descriptive. This example from a Face-to-Face Crit (F-Y1S8) shows in-depth detail when introducing the design idea:

> *S: When I was little my family rented a house in the Swedish countryside in the forest virtually in the middle of nowhere, one winter we had a power blackout and it got all dark so my mother lit candle all over the kitchen and we all sat down…. And I remember feeling very, mm…anticipation the world outside which I can barely see because of the reflection in the window glass because of the candle light, I could barely see it but it was mysterious and I was imagining anything that would be out there.*

The following passage shows *definition* of concepts:

> *S: My keywords are Earthly and mysterious, I wanted to show that contrast between the known and the unknown…. this part represents the Earthly, and it chose to represent this particular space in stone which has a sense of maternity which is dependable and ..It is also very tough and also wood oak because it has a warm solid feeling...*

This passage *describes* the development of the design idea with more deliberate explanations of the purpose of her choices:

> *S: A change I made from an earlier model was to elevate this area to distinguish one space from another more clearly and also to cut off this wall to make it possible to have flow around the side and not just shut you off and create a dead space here... And as you come here you see the wall it catches your eye and the reflection of copper in the sunlight.*

Virtual Crit (1). The cognitive level of this crit session fell mostly in the *In-Depth Processing* categories, both *Descriptive* and *Deliberative* statements were used, but mostly the sessions focused on deliberative details of the designs as Figure 7-6 shows.

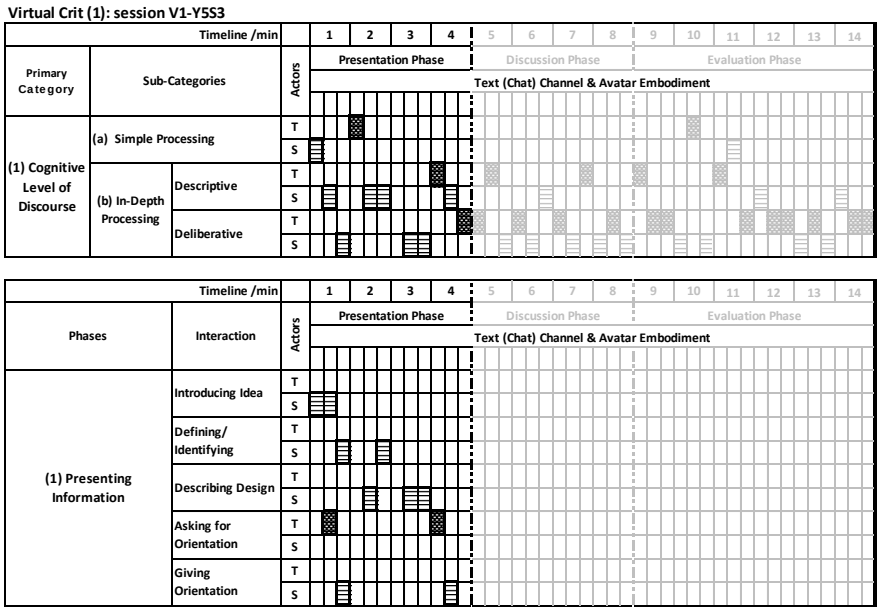


Figure 7-6 The Characteristics and Cognitive Level of Discourse in the Presentation Phase of Virtual Crit (1)

The sharing of information phase like the Face-to-Face crits included *definitions* and *descriptions*, with two instances of *asking for orientation*.

Starting with *introduction* of the design idea, it was noticed that unlike the Face-to-Face crits, introducing the idea here was short and right to the point, this example shows the student typing very specific and short sentences:

> *S: that's my site plan*
> *T: both images?*
> *S: that's the new development marked*
> *S: and i have used skechup and google earth to incorporate*

T: ok
T: so it is the one in red?
S: yes

Another example of introducing the idea:

S: right, here, the aim is to create an Egyptian educational tool
S: here r some aims of that tool
S: i'm using Luxor temple and recreating it to what it used to be
S: within the temple u will be able to find artefacts and learn about Egypt
T: good

It can be noted here that the student, like most of the students in Virtual Crit (1), typed and sent short sentences at a time and were clear about their concepts, not spending much time on wording, and spelling. In other words, they were less structured than users of Face-to-Face Crit.

The student then continued on *identifying* and *describing* his design concept and drawings.

S: this image here shows the relation between the spaces,
S: the entrance is like a huge pavilion that takes you to a linear pathway…

S: then you are met with a narrower space, which is the library...

From the above lines, it was noticed that the student started to elaborate on his ideas and designs in more depth.

Virtual Crit (2). The cognitive level of this review appeared to fall mostly in the In-Depth Processing categories, but looking t the timeline grid of Virtual Crit (2) in Figure 7-7, clear distinctions in this category between Descriptive and Deliberative processing can be viewed between using the chat channel and the audio channel, more deliberative discourse could be found associated with the audio channel.

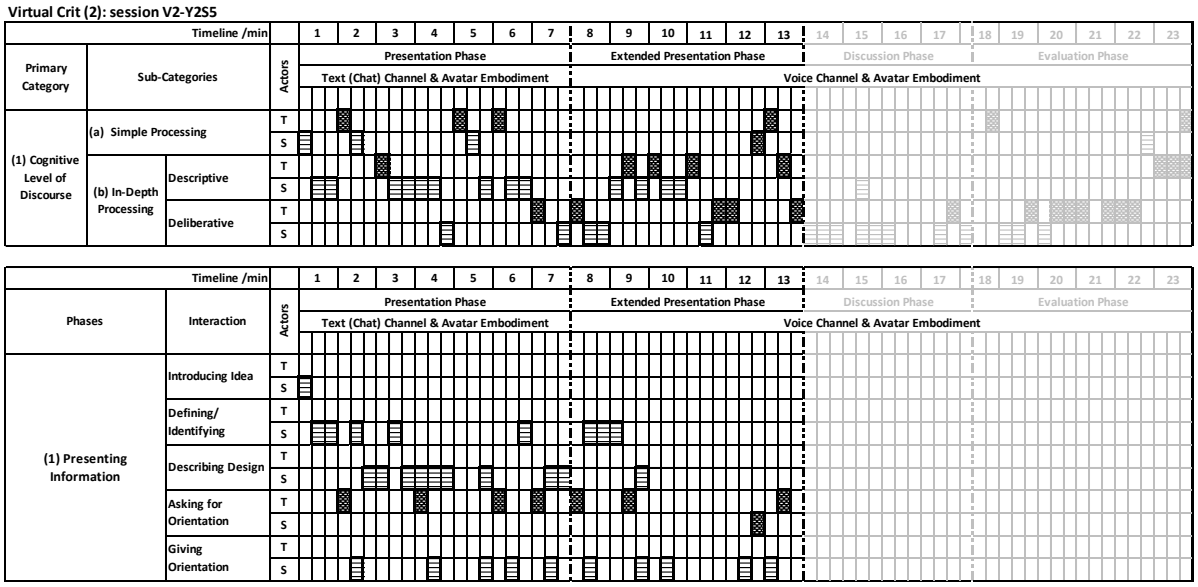


Figure 7-7 The Characteristics and Cognitive Level of Discourse in the Presentation Phase of Virtual Crit (2)

In this design review, contrary to Virtual Crit (1), and to some extent similar to the Face-to-Face crits, *introducing the idea* was expressed using relatively longer and detailed sentences in Virtual Crit (2), despite using chat only for communication; this can be viewed in Figure 7-7, and in this textual passage:

> *S: ok these are the plans for the sculpture park on hunters moor, the park is based around a central open field*
> *S: that is surrounded by ash planting and Ha-has to enclose the cows that currently inhabit the space*
> *S: the building (which won't upload) is an inverted barn roof structure that houses the cows and a Milkshake Cafe/steak restaurant*
> *T: could you take me through the sequence of images*

It can be seen also from the previous example that the student separated his messages to a number of intervals by hitting the enter key, to avoid longer times of waiting to receive an incoming message. Another example of *introducing the idea* from another review session where the statements seamed shorter and rather descriptive:

> *S: Ok, so the concept stemmed from the Newcastle Science City that is currently under construction near St James Park*
> *S: This led onto the idea of using the park as an educational tool to explore mankind's position within the universe...*

and

S: ...these were the most important factors in relation to how I responded to the site...
S: there are several external factors such as the road around the edge
S: as well as surrounding buildings

Describing and *defining* are expressed after the introduction of ideas as in the following example:

S: the park's doughnut shape gives people a prescribed route through the sculpture park for people to follow
S: at intervals there are little hidden path ways into the main cow field in the centre

These *defining* discourses were mainly more deliberative than the *introduction* of the ideas. Due to not being able to use Avatar pointing in this crit, a considerable amount of time of the sharing of information phase was spent on *asking for* and *giving orientation;* defining the location of the described areas, as this example:

S: as you can see in the third image down on the left hand side of the first page
T: are you referring to the middle drawing here?

What can be drawn from these observations is that despite the similarities in the characteristics of verbal discourse in the sharing of information phase in the three experiments, a difference in the cognitive level has been created when using the technology. Although most of the verbal discourse is distributed in the In-Depth dimension, it was found that discourse Virtual Crits (1) and (2) tended to be more descriptive than deliberative in the sharing information phase.

- **The Discussion Phase**

The cognitive levels of discourse in the discussion phase of the three design reviews are distributed quite differently in the three observed design reviews.

Face-to-Face Crits. The discussion phase fell mostly in the in-depth deliberate dimension, which was characterised by many instances of *asking and giving opinions,* as well as *revisiting and explaining* with very few notions of *repetition,* see Figure 7-8.

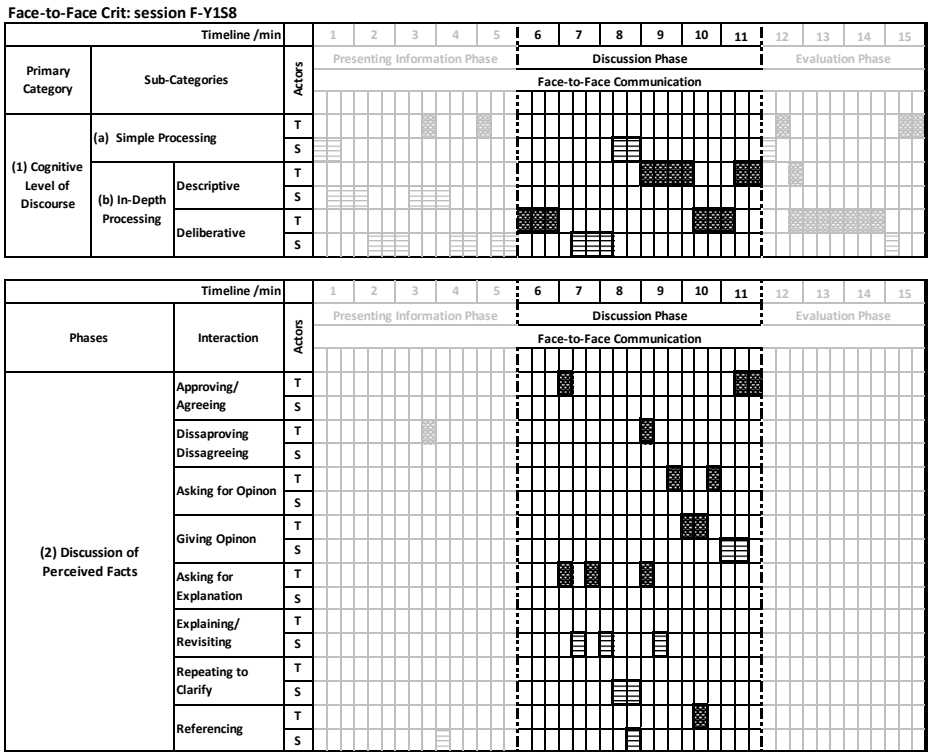


Figure 7-8 The Characteristics and Cognitive Level of Discourse in the Discussion Phase of Face-to-Face Crit

The following example shows the function; *asking for and giving opinions:*

> *T: So what is your decision, do you want to treat it? Or?*
>
> *S: Probably I would want to treat it because the reflection itself is so important from the concept, so yes.*

Other functions of*: Asking for explanation*, *revisiting* and *defending* while *explaining* are shown below:

> *T: ...but I'm not sure about the different materials and the number of them because every wall is treated differently and because one uses this material in a smaller scale, I'm just not sure here, so convince me.*
>
> *S: Ok, My concept of using materials that the earthly part would be natural easy to mould and shape with my hand, and the other part would be manmade, more artificial, not colder I would say but definitely more artificial. And it should be a big break between these two spaces, so that's why I made these two in relation to each other and these two in relation to each other.*

From the previous passages, it could be noticed that the student's and tutor's sentences became relatively longer, deliberate and full of detail in the discussion phase.

Virtual Crit (1). Looking at the discussion phase of Virtual Crit (1), shown in Figure 7-9, unlike the Face-to-Face Crits, it was noticed that verbal communication involved relatively shorter and precise sentences mostly question and answer style right after the sharing information phase ended, they also appear to be more deliberate in details of the design:

T: ok when people get here...what happens?
S: you can see it here, there are three possibilities
S: these areas are more open areas, they link to the outside where the platform rises
T: but u got to guide them to the routes first
T how do they see this open space?
S: well, this is a glass wall
T: ok

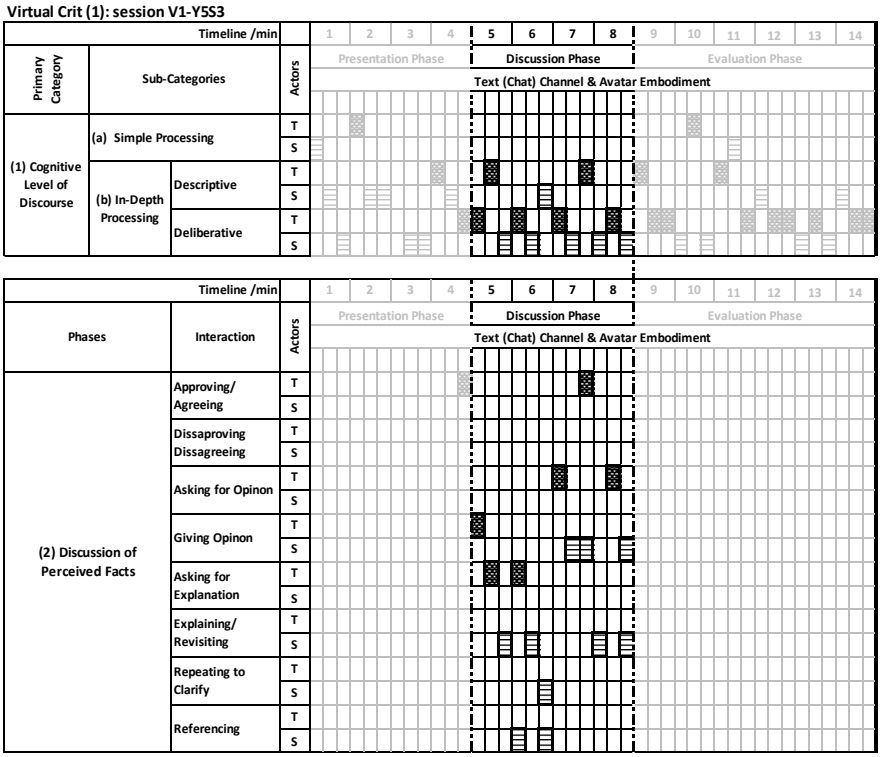


Figure 7-9 The Characteristics and Cognitive Level of Discourse in the Discussion Phase of Virtual Crit (1)

This next passage shows the *asking for and giving explanation*:

T: <u>it is very linear</u>…from a starting point to a finish point..??
S: yes it is, <u>that's just the way the temple is, it is linear</u>
T: so how is it exciting to the visitors?
S: the gadgets i am using here, and here

The discussion phase in Virtual Crit (1) became more deliberate, as the student led the conversation towards explaining the details of his project not covered in the sharing information phase.

Virtual Crit (2). Once all information became clear to the tutor, deliberative characteristics of text in the discussion phase can be distinguished clearly in Figure 7-10, surface processing statements, and descriptive in-depth statements were no longer used, discourse became more detailed.

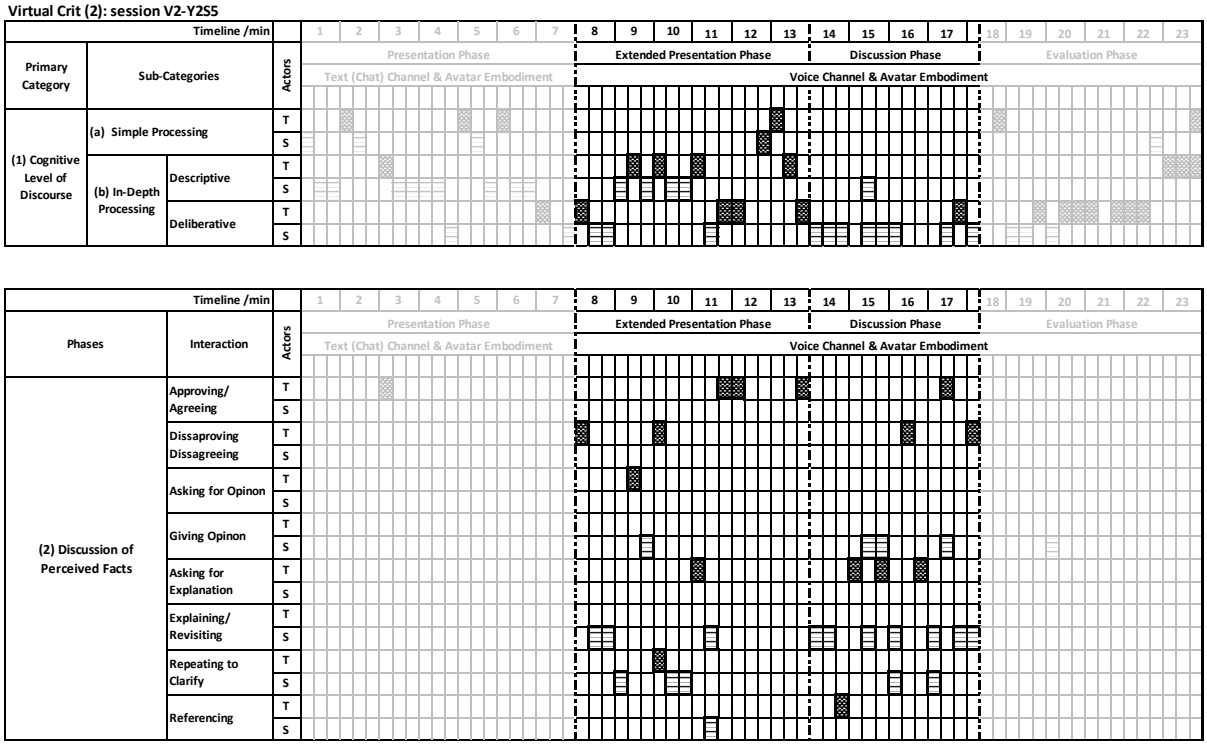


Figure 7-10 The Characteristics and Cognitive Level of Discourse in the Discussion Phase of Virtual Crit (2)

Participants used voice in the discussion phase, and here, the statements of *revisiting and explanation* started to take a longer deliberate style compared to the first phase.

> *S: basically the sculpture park is based around this huge centre field, which is going to be for a guest sculpture, the sculptures change every year or six month. There will still be a huge field that the cows will be left as they are. And as we leave the site driving up north, if you look at the left image, just at the top right hand corner there is a little exit. There is this path way that goes around the field, and when you walk in you see the view from a distance. Along the pathway you can see far small view*

points across the hall, just from top the hill, then you see the cows in the middle.

and

S: I've worked on two existing contour lines in the site, that you can see in the third image down on the left hand side of the first page, I tried to work on the contour lines to create a formal terrace idea, mm, so what is actually happening is; two of the contours in this case are being pulled together, and help by retaining a wall to create height differences, which you can see if you look at the top of the third page in the side section.

It was noticed that the previous spoken dialogues are longer and more structured than those which were typed in the sharing of information phase. Repetition here, using voice, did not seem to consume the time it would have if typed, in addition to that, hearing one's self while speaking structured the formulation of the narrative to a greater extent, as expressed by this student in the focus group:

V2-Y2S5: "…so you had to go back and look for the text and you've lost where you were saying in the overall structure…which in a real situation, you would just answer quickly and then go back to what you were saying before because you hear yourself and the tutor talking aloud and you have the information still in your memory".

Using voice in the discussion phase, also gave space to extend on verbal discourse that focused on expressing areas of *asking and giving suggestions and opinions*:

T: What would you imagine the roof structure to be made of?

S: it would just be (pause and think.....) it would just be the typical barn roof, structure, probably in this case it is some form of corrugated steel with smooth visual impact. But I wanted to let the box shape contrasting with the surroundings.

and,

T: So what is the roof doing there, other than just covering the cafe area and providing some sort of shelter, what else?
S: it...

T: seems an old space to be under it somehow, It feels like an aircraft type (zooms in and out)

> *S: it is like an aircraft, i wanted to clearly define this idea of, mmm (pauses...and navigates around the drawings) keeping the views restricted as you go through the site.*

The examples shown here after the use of the audio channel reveal an extended deliberation and use of detail on each of *revisiting and explaining*, and *asking and giving suggestions* in the discussion phase.

From what has been discussed so far, the cognitive level of the first two phases of the three observed design review sessions, showed some variety between the three experiments. This variety is surely expected in the context of design reviews, as pedagogical (project type, academic level...etc.) and individual communicational differences may influence the nature and structure of the conversation. However, what could be distinguished, and what is the focus of this research is the influence of the technology, it seemed that being able to orient one's narrative effectively had an effect on the cognitive level of the design reviews. Discourse in Virtual Crit (2) in particular, remained mostly descriptive as the focus to orient the conversation in the sharing of information phase, was a priority to ensure a clear understanding of the projects. Once all information was clear, the conversation became more deliberative, longer and full of details, as what would be expected in the design review conversation.

7.2.3 The Critique Level of the Discourse

Effective educational criticism means holding in mind and pondering continuously the design review's educational process: the quality of procedure and criticism, the level of discourse and appropriateness of communication. Effective teaching through design reviews implies acting upon these as well as offering design criticism itself.

Meeting the learning goals of the design review requires producing effective constructive feedback of the students' project and knowledge, this includes evaluating three dimensions; presentation skills, designing skills and the design knowledge (Farivarsadri, 2001). The Critique level of the design reviews represents what students are expected to learn; this studies the content and quality of 'critiquing' as the main learning activity in the design reviews, i.e. what is criticised and how it is criticised (Anthony, 1991;

Weidong, 2005). The reflective characteristics of feedback are among the sought learning goals as well, and therefore, this subsection also studies the cognitive level of discourse in the evaluation phase. The timeline grids of the observed design review sessions shown in Figure 7-11, show instances of both positive and negative criticism which covered all three dimensions of evaluation and feedback of design skills and knowledge.

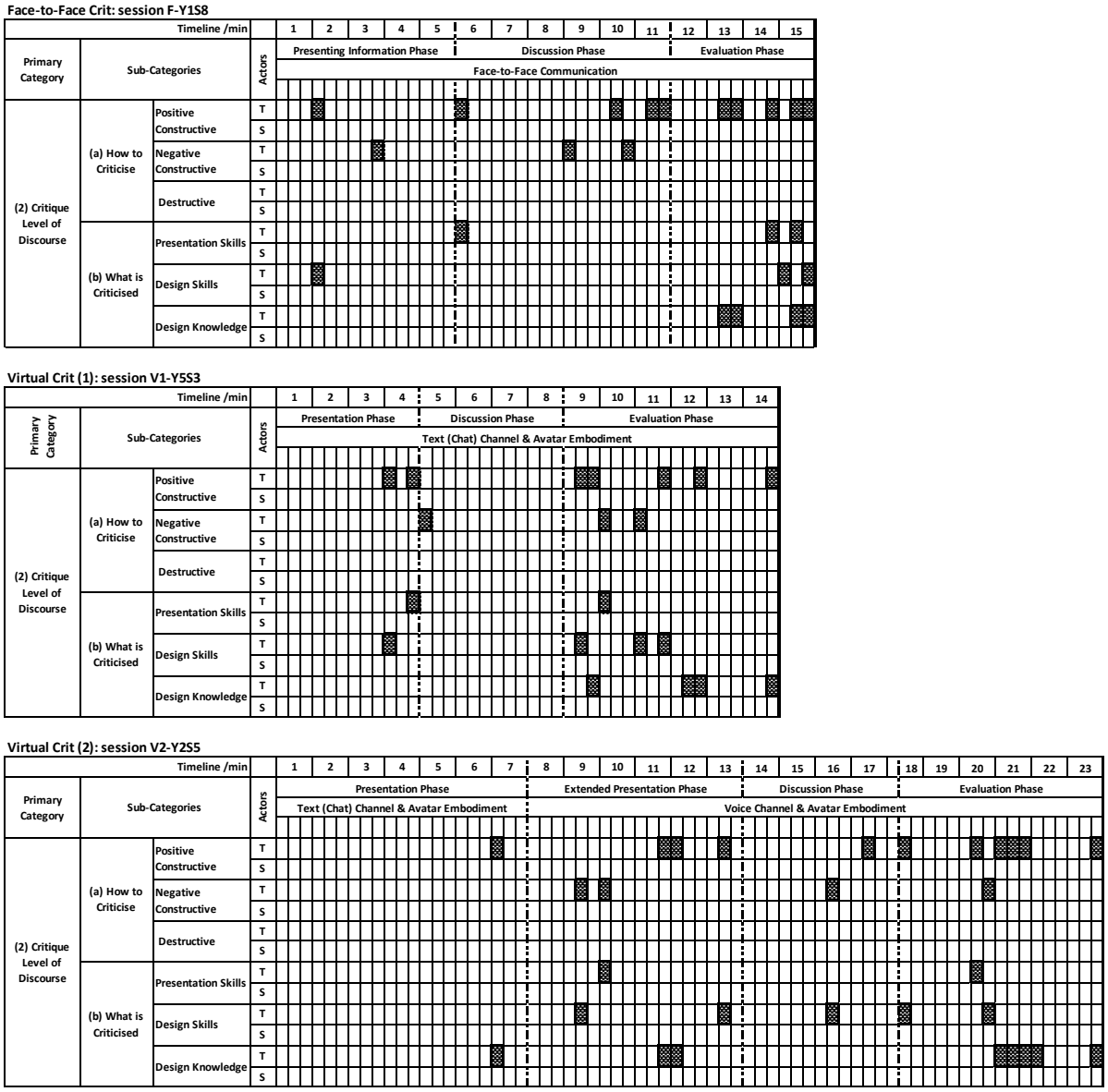


Figure 7-11 The Critique Level of Discourse in the Three Design Reviews

Distinct differences in the critique level of the discourse could not be detected, from the above Figure 7-11, in addition to that, the cognitive levels of the discourse in the evaluation phase of the three design reviews are to some extent also similar, as they seem to fall

mostly, in the in-depth deliberate dimension. The following paragraphs discuss the cognitive level of the evaluation phase, as well as the characteristics of 'critiquing' as the main function of verbal discourse in this last phase.

Face-to-Face Crit. Evaluation and feedback throughout the Face-to-Face Crits included positive and negative criticism that fell mostly in the deliberative zone, see Figure 7-12 which show the cognitive level of discourse and characteristics of the Evaluation phase of a session of Face-to-Face Crit.

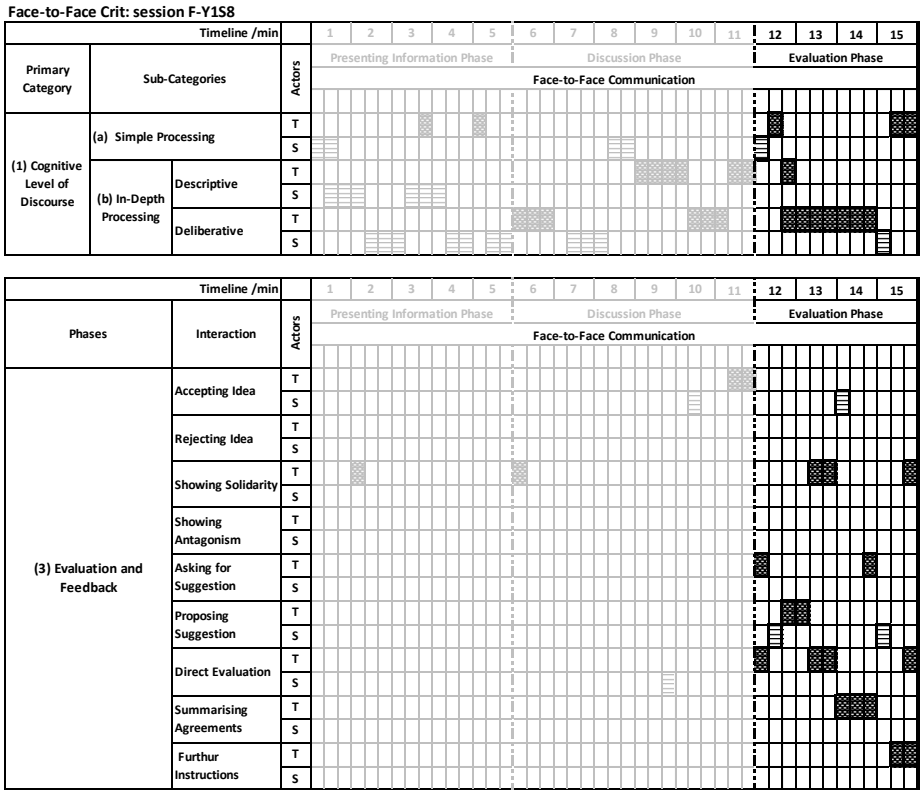


Figure 7-12 Characteristics and Cognitive Level of Discourse in the Evaluation Phase of Face-to-Face Crit

Some instances appeared very direct forms of evaluation and others were different forms of *showing solidarity*, *agreement or disagreement*, the tutors *gave and asked for suggestions* as well, as in the following examples.

T: Good, the continuity of the two materials was a good decision.

and

> *T: I think that this change in orientation, this formalisation process that you have gone through does work very well, you are being very rational in the way that you've designed it,… I believe it's a very bold decision.*

The tutor elaborates in detail how he believes the design was successful, and concludes with a direct positive evaluation.

Constructive negative evaluation was *given as opinions* about designing in some instances such as in this example:

> *T: ...so you get the shape of the stone but in copper...but it kind of confuses people and blurs the line between the natural and artificial, I would not take that approach in that way*
> *S: I was thinking of it to be more like a threshold to mark the different spaces, as a transition.*

Here the tutor expresses his disagreement stating his rational, and the student gets a chance to explain why she took her design decision. It is also noticed that a level of detail and deliberate evaluation of the concepts and designs are found in these statements.

Near the end of the phase, evaluation took a direct form of summarising agreements by the tutor, after indicating that the discussion phase has to come to an end as in this passage:

> *T: We are spending a long time in this bit of detail because this is the most critical part of the architecture, Ok, to conclude,....most of the tree is going to be read from behind this wall, which I think that is very successful indeed...and the choice of these materials served your concept.*

And,

> *T: I've noticed in your presentation, you've actually stood in front of your A1 sheet most of the time, but the drawings are very well conceived, the focus is on the model, but just try not to do that next time.*

Here, the tutor giving an example of good evaluation as he gave a quick summary of the positive and negative presentation and designing skills as well as the drawings.

The following examples from sessions in the Face-to-Face Crits, show all areas of constructive criticism being covered in a direct form of 'criticism'; (1) presentation skills, (2) design skills and (3) design knowledge, these are illustrated in Figure 7-13.

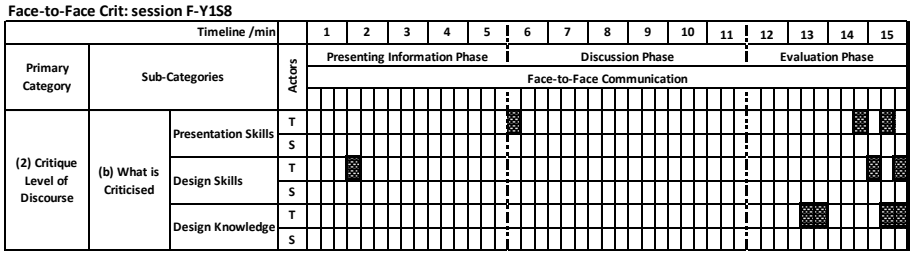


Figure 7-13 What is Criticised in the Face-to-Face Crit session

- **Presentation Skills**

In this example, the student asks to add more information, yet the tutor criticises her presentation skills:

> *S: Can I add something, regarding the materials...*
>
> *T: Can I add that your oral presentation needs to be more better structured and a bit more contained, I know you want to tell us everything, you talked for about 7 minutes and we let that go, but you really want to get to the things that are really important, you can write down some key notes, there is this anxiety to tell us everything, we don't want to know everything, let the drawings and models show the concept.*

The tutor continues to give the student notes for better oral presentation and time management in future design reviews.

- **Design Skills**

In the following passage, the tutor sums up his understanding of the design concepts, and praises the student's design skills at the same time:

> *T: there is a distinct and subtleness and the change in spatial experience is given really by the change in scale and orientation so that you've got the long bench where you do feel this is a real transition space where this now with addition to this porch, which is why i was really interested in that, becomes a private space just by changing the scale, so I think that is quite a sophisticated and quite subtle thing too.*

Summarising the important qualities of the design here, is a form of reflective discourse that also aims to abstract and reinforce knowledge (Kvan and Jia, 2005) and teach other gathered students from their peer's project.

- **Design Knowledge**

In the following passages, the tutor criticises the design decisions in the first line and questions the student's ability to conclude her progression and precedents shown in development stages, on her final design:

> *T: you do have the precedents and you do have developments and progression of everything you worked with later with the materials, so all the work is there. And it is just looking at your intensions shown in early designs and how they reflect on your design is what made me question some of those decisions*
>
> *S: in terms of the very closed space, i didn't like to have a cave very closed limited space, like some people imagined an enclosed space to be a small thing under the chair, but I knew if i created a space like that that it would feel like the main idea and what was amazing about this feeling is that suddenly being completely aware that "I am" and then this reverse of role of space and that everything is open and I'm here enclosed not hidden but enclosed*
>
> *T: Yeah*

The student then gets the chance to explain the changes made from the developmental stages and rationales her decisions, where the tutor agrees to this rationalisation, in a form of a convincing discussion.

Virtual (1) Crit. Similar to what was observed in the Face-to-Face Crits, the tutor covered the areas of *Evaluation and Feedback* focusing on *giving suggestions and further instructions* for future learning. However, as the use of technology influenced the need to ask for confirmation of acknowledgement as shown earlier in Chapter Six, the tutor asks the students to *summarise* his feedback in a few occasions.

Looking at Figure 7-14, constructive feedback was deliberate in the examined sessions; the tutor started evaluation early during the discussion phase by stating instances of *agreement* and *showing solidarity*:

> *T: yes..I see this is very good*

Also deliberate detailed discourse shows in the *further instructions* given by the tutor in the evaluation phase:

T: you must see the whole experience as an exploration...<u>when designing with game engines in the future u need to</u> discover things.. u need to provide clues and play with the space and the possible routes...as well as the interactions….it is really important to show excitement in the routes as well.

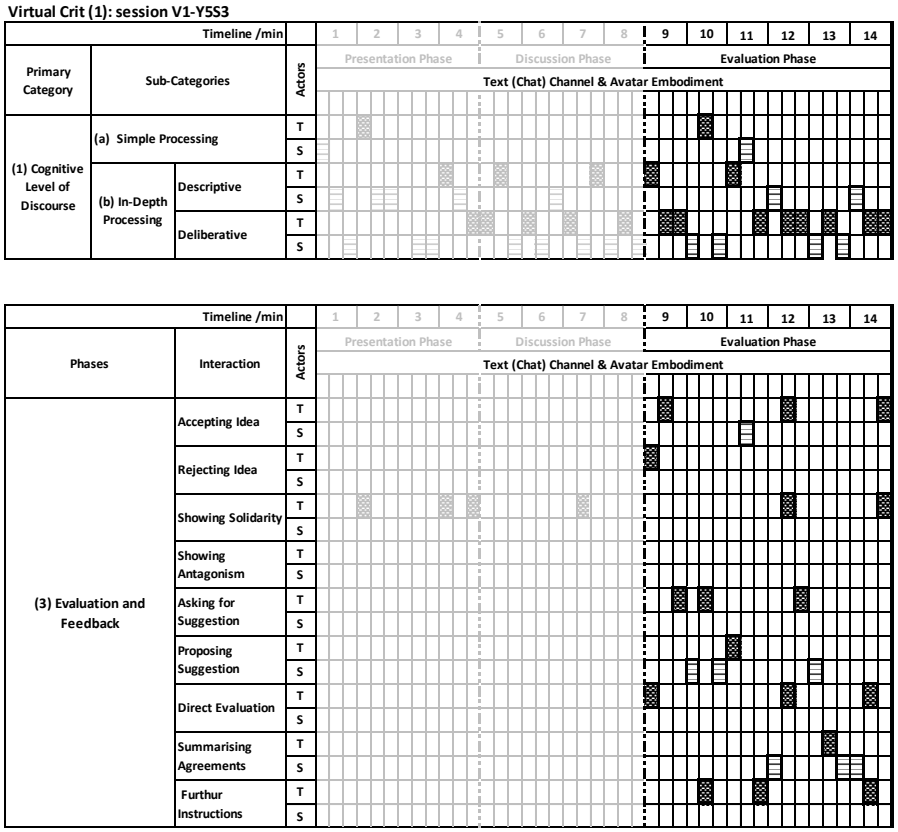


Figure 7-14 Characteristics and Cognitive Level of Discourse in the Evaluation Phase of Virtual Crit (1)

In the next example, the tutor summarises his evaluation and gives the student a collective feedback on his design decisions.

T: <u>I think you needed to work more on those paths...playing with the space and the possible routes,… for instance add a maze, I like the textures but they are not enough</u>
S: ok
T: <u>and for the choice points, u got to understand why people go there and whether or not...u r forcing them to get there...or if they have a choice and why</u>
T: what you have done <u>here clearly goes back to the concepts you had at the beginning which is really clear, and good.</u>
S: sure

It was clear in Virtual Crit (1), that the students had adopted a method of *summarizing of agreements* to show online attentiveness more than a way of confirming knowledge, this occurred in a number of instances, such as:

> *T: it is more important to design as a whole and not just separate episodes,*
> *T: ok, to recap,*
> *S: sure*
> *S: ok, I'll work up the whole route to look into the visitors interactions more carefully and add objects and textures to create a puzzle*

In another student's review session, the tutor ends the crit session while asking the student to summarise points from the agreed discussion.

T: *any way and to wrap things up, what have you picked up from our discussion?*

In the previous line, the tutor reinforces learning by promoting a reflective conversation, and makes sure the students has understood their discussion, as no other means of showing understanding could be detected in the remote context.

The three areas of criticism; presentation skills, design skills and design knowledge, have been also covered in this virtual review session as shown in Figure 7-15.

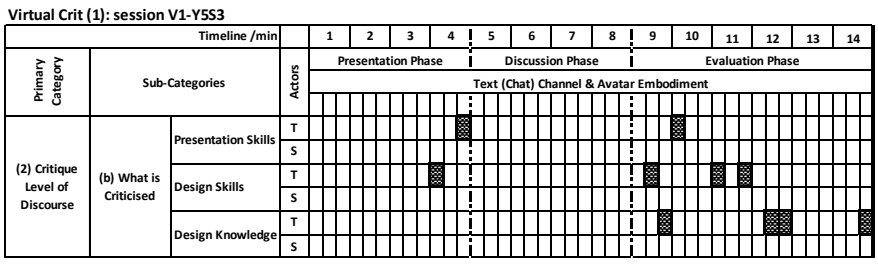


Figure 7-15 What is Criticised in the Virtual Crit (1) session

- **Presentation Skills**

> *T: the routes and events on the maps are very clear*
> *T: and so was your explanation*

These lines represent very direct forms of evaluation, that could be distinguished mostly in the Virtual Crit (1) sessions.

- **Design Skills**

T: you have not considered the return journey
T: or for instance...you must see the whole experience as an exploration.

In the previous lines, the tutor criticises the student's method used in his design giving him further directions to consider 'the whole experience'.

- **Design Knowledge**

The tutor encourages the student in this example by praising his judgement and criteria, referring to decisions on other further projects:

T: I trust your criteria for u to know what is relevant and what is not, from our discussion, I feel you are confident with your decisions

In this example on the other hand, the tutor shows his disapproval with the 'choice points', giving negative criticism to the concept of the project, while maintaining to produce positive evaluation to the 'design efforts':

T: good design effort, but all I see is a linear journey with some choice point that are not clear enough

However after that, the student defends his design decision, explaining his concept once again:

S: that is because the temple is meant to be linear,
S: they is a level of attraction in the secret routes and hidden pathways, they are not shown on the plan but they are triggered when visitors interact with the artefacts.
T: ok

While evaluation and feedback covered the three dimensions: design knowledge, presentation skills, and designing skills, statements in Virtual Crit (1) remained short and focused; dictated by the communication method, chat-only. However from the content analysis of the cognitive and critique levels of the discourse shown above, this did not affect the fact that they were detailed, concise and met to a great extent the learning goals intended from the design review.

Virtual Crit (2). As Figure 7-16 shows, the evaluation phase in Virtual Crit (2) sessions were relatively shorter than the other two phases, but information had become clearer so evaluation was detailed and direct most of the time. Another reason for this is the use of the audio channel. Patterns on the timeline grids show that criticism covered in this review was mostly of an in-depth, deliberative characteristic. Similar to the Face-to-Face Crits, the tutor would indicate the end of the discussion phase and start to evaluate the project:

T: I think we can bring it to a close now,

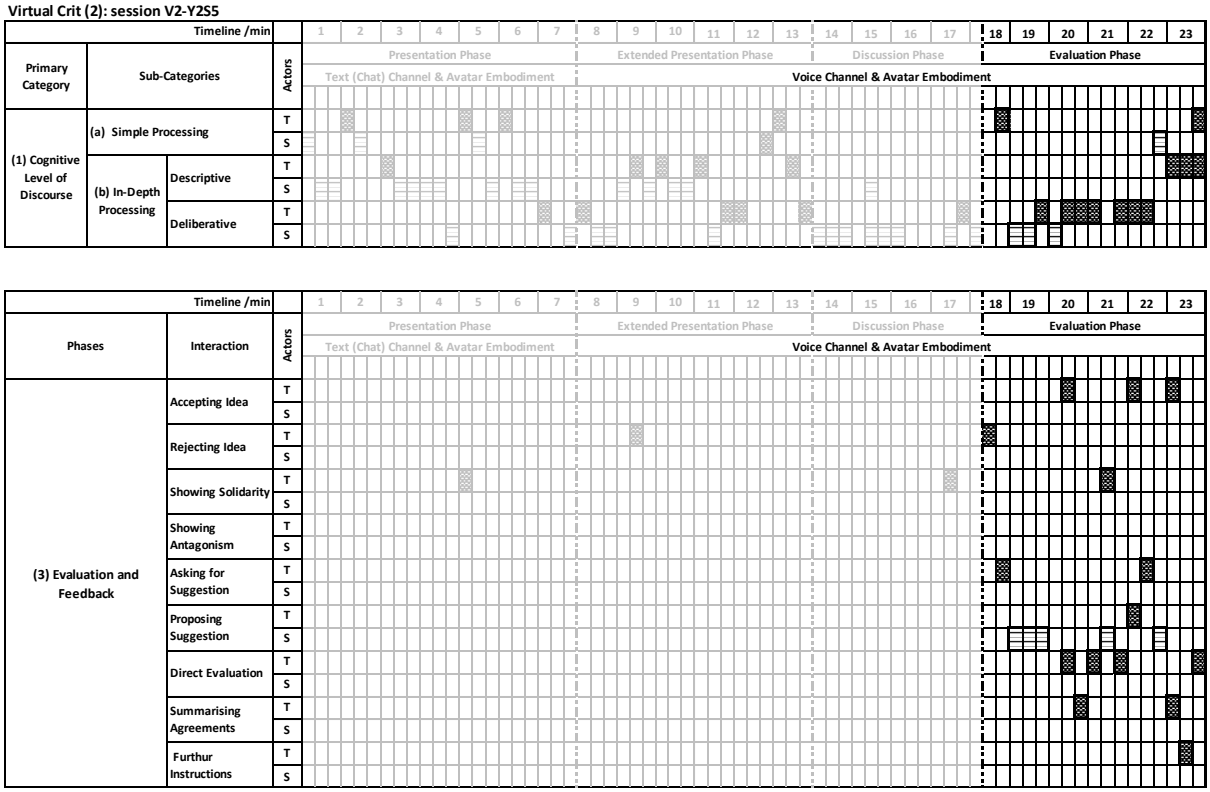


Figure 7-16 Characteristics and Cognitive Level of Discourse in the Evaluation Phase of Virtual Crit (2)

It was not noticed though any forms of student *summarising of agreements* as performed in the Virtual Crit (1) sessions discussed previously. However statements of feedback and evaluation were rich in expressing *acceptance and rejection of ideas*, *asking for and proposing suggestions* and direct e*valuation*, the following example involves rejecting an idea:

> *T: it's about creating a journey, which can be done with the land form itself, or with wall structure, not necessarily need to be roofed, and then you've chosen what appears to be a flat roof , because by inverting the structure, you've lost the potentials for the sloped roof throwing off water*

…
S: the reason for why i left it so featureless i guess in a sense, was because it is the highest point and there is no viewpoint on the site, and this is very much a building where you view from below. (navigates and flies to point to a place) as if you....., see this little part on the top here is out shadowed across the ceiling, I'm trying to give it an interest and it's very much what's below it rather than the actual ceiling.
T: well yeah

The tutor then seems to agree with this explanation.

Figure 7-17 shows that the three areas of criticism have been covered in this virtual review session early in the Presentation and Discussion phases.

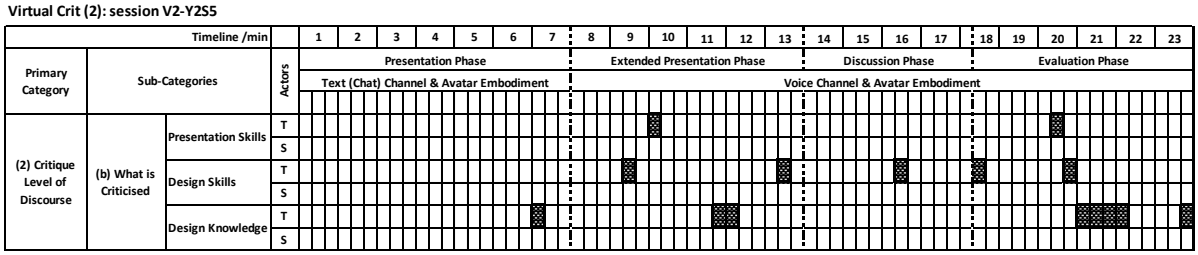


Figure 7-17 What is Criticised in the Virtual Crit (2) session

- **Presentation Skills**

This example shows a positive evaluation of the student's drawings:

T: there is a lot of potential, i do like the images, the ones that work best for me in this format are the ones on the top left of the third panel, and the first rendering in the middle panel that shows the view. There is something interesting, but needs to be developed more.

It can be seen here, that the tutor relies on his ability to read the drawings as they appear in the format of the virtual world, saying: '*in this format*', so the evaluation is partially affected by the visual format dictated by the medium. This can also be detected from this other example in another session of Virtual Crit (2):

T: I think we really go to yours, the images worked really well for this kind of context, it demonstrates that when you've got good graphics they work wherever you are.

This evaluation on the other hand, disagrees with the way the student presented his drawings, and does not relate to how it appears in the virtual world:

> *T: That's a quite unusual way of presenting it, having the original contour lines on the design plan itself, you'd probably need an analytical drawing that shows the original site next time*

The tutor, in the above line gives *further directions* for future learning as well to the student, as he suggests to add an '*analytical drawing,…next time'.*

> *T: The design is well, and the reception is very well designed, but you can't cookie cut the trees, they vary and it is worth trying to find a digital method of variation in pasting your trees.*

In this example, the tutor focuses also to give *further directions* on the digital drawing techniques of the trees. This indicates the cognitive level of in-depth discourse in this review.

- **Design Skills**

In this example, the tutor disagrees with the student's designing approach, that has not worked in line with the concepts of 'park design' and cause confusion to the visitors by his way of designing the main path of the park.

> *T: My objection is that there is some confusion because you have one main axis in the park, but then it is not continued and you are free to go to the left or right while you go along and that's it, without a leading path or axis*
> *…*
> *S: there is quite an open space more on the top right, you are walking on the main axes and then you have many points which you can deviate from the path; I mean there is the water body, and a path leading to the forest through the first pavilion which gives you kind of a glimpse of the others, so the reason that sort of worked is that, I wanted that axis to be continued but at the same time I didn't want to ruin the side line around the edges.*

It can be seen from this example that the tutor disagrees to the design, however, the student explains his concept deliberately, giving examples to support his explanation.

- **Design Knowledge**

In the following two examples, the tutor specifically relates his positive evaluation of the project to the successful approach and design thinking by the students:

T: I really like the variation in your design, each of the elements are very distinct, different from each other, and you are in control of the concept and how you treat each one on their own

T: ...there is a real sense that this has some very clearly thought through structure and preparations, having made decisions of the material level

Here, the tutor expresses his acceptance of the design idea, praising the students' abilities to control the design in the first example, as well as how the student approached the design in the second example,

The analysis of the cognitive and critique levels of evaluation and feedback reveal similar distribution of constructive feedback covering all of the intended dimensions of feedback in the design review. The cognitive levels of the critiques mostly fell in the in-depth deliberative phase, in all three experiments.

This was not an expected result though, as the influence of the media in Virtual Crits (1) and (2) had created differences in the ability to orient the narrative, creating moments of interruptions and disorientation, as discussed in the previous chapter. This in turn created different cognitive levels of discourse in the first two phases, however, when the need to ask for and give orientation was no longer required focus on the project grew stronger in the last phase of the two virtual crits.

7.2.4 Students' Own Perception of Learning

The students' own perception of learning examines how well the students believed they have presented their projects, and understood their tutor's feedback. For this, the students of the two Virtual Crits (1) and (2) were asked about their own learning perceptions and the effect of the media that influenced their presentations and perceptions. Table 7-1 shows questions and answers used to obtain students' learning perception as well as their perception about the effects of the medium of communication on their ability to share information, discuss, and receive feedback.

Table 7-1 Students Perception of own Learning and Communication

Q No.	QUESTION	Virtual Crit (1) (11 students)	Virtual Crit (2) (5 students)
Q34	Was there any information you wanted to present but could not?	3 students answered 'yes'	4 students answered 'yes'
Q35	Did you tutor show signs of misunderstanding of your presentation at any point?	2 students answered 'yes'	5 students answered 'yes'
Q36	Did you Fully understand your Tutor's Feedback?	9 students answered 'yes'	4 students answered 'yes'
Q37	Rate on a scale (1 to 10) your perception of information/ understanding of feedback in the virtual crit	7	6.4

When asked if they felt there were any additional information they wished to present, but were prevented by the technology, only (3 out of 11) students from Virtual Crit (1) stated that they couldn't express their ideas, this may indicate some successfulness in the ability to communicate in this format. However the students who disagreed with this statement referred to the time wasted in typing and affected their ability to 'say everything in detail' as this student states:

> *V1-Y5S1: "some of the time was wasted by typing which image I was referring to, I was told to keep brief by the tutor so I didn't get to say everything in detail".*

Another student indicates that his narrative was dictated by the tutor's questions most of the time, as in the following quote:

> *V1-Y5S10: "The multiple layers of questions confused me so I had to start describing according to the tutors questions"*

The reason for this goes back to the chat format that does not support handing over cues; the tutor's questions interrupted the student's lines of thought, as examined in the previous chapter.

In Virtual Crit (2), on the other hand, the majority of the students (4 out of 5) stated that they could not express all their ideas using the format provided, and the reasons for that were mostly due to the ineffective ability to orient their narratives, as in this student's comment:

> *V2-Y2S5: "Typing and thinking.. trying to type and type, and describing what is on my mind, creates these long paragraphs, and you find yourself disjointed from your project and want to go back and give orientation, so you miss out on some stuff you want to show"*

The students were also asked if they had received any signs from their tutors of misunderstanding and whether they fully understood their tutor's feedback. Only (3 out of 11) students of Virtual Crit (1) stated that they felt their tutor could not understand their description, either by directly telling them, or by the misinterpretation he expressed.

While as expected all (5) of the Virtual Crit (2) students did see that their tutor had missed points of their projects due to poor orientation as observed and analysed in the previous chapter as well.

But when asked if they had understood their tutors' feedback, the majority of both Virtual Crits (1) and (2) said that they have, Virtual Crit (1) students rated their ability to perceive feedback with (7 out of 10), which is fairly a high rating having only using the chat mode for communication. While Virtual Crit (2) students who used the voice mode in the last phase gave a rating of (6.4 out of 10), which is also relatively high comparing to the difficulty they faced in the sharing of information phase as observed and expressed by the students.

In addition to that, students participating in Virtual Crit (2) were asked about the differences they have experienced after allowing the audio channel, one comment from a student was:

> *V2-Y2S1: "When you type something and then see it, and realise you've made a mistake, so you delete and type again, makes you take longer time and slowed things down, so you want to go on with a general description and not go into detail because we had to type more and more words to describe which place we wanted to point"*

This reasons what was found from the previous analysis on the cognitive levels of discourse, and explains why the discourse mostly *in-depth descriptive* rather than *deliberative* in a number of cases in Virtual Crit (2) especially in the chat only stage.

7.3 Affective Learning

Based on research about face-to-face classes, it can be argued that behaviours that support student engagement are likely to contribute to both positive attitudes about the learning session and to enhanced learning (Russo and Benson, 2005). In particular, student perceptions that their tutors in the online course are immediate, present, and supportive, may help establish an environment in which students are interactive and satisfied (Short *et al.*, 1976; Picciano, 2002). Design reviews, as they are a method of examination, tend to be a formal type of communication and even a 'stressful' one for many students; Doidge *et al.* (2000) declare that facing the tutors and being observed by fellow students are among the causes of stressfulness. The two Virtual Crits (1) and (2) were conducted at a distance; it was believed that removing the element of proximity that the level of formality and stressfulness would drop and thus increase the level of satisfaction. The information obtained from the students' responses did not necessarily co-relate with our observations which revealed interesting behaviour regarding the level of tutor-immediacy and social interaction in the mediated reviews. The following subsections examine the components of affective learning; (1) tutor-immediacy and showing support and solidarity, and (2) level of social communication, as observed in the mediated design reviews, as well as the (3) levels of formality, enjoyment, stressfulness, and (4) student satisfaction as revealed by the participating students.

7.3.1 Showing Solidarity, Immediacy and Emotions

Verbal and nonverbal immediacy behaviours (giving praise, physical proximity humour, eye-contact, positive facial expressions...etc.) are believed to lessen the psychological distance created in the classroom, and may lead to learner satisfaction and appreciation (Swan, 2003:11). The remote context is likely to contribute to the elimination of these behaviours, however the observed interactions revealed different ways of showing solidarity, either by enacting nonverbal cues in the face-to-face crits, or as using special textual symbols and words in the two virtual crits, but was not completely eliminated in the remote context as shown in Figure 7-18.

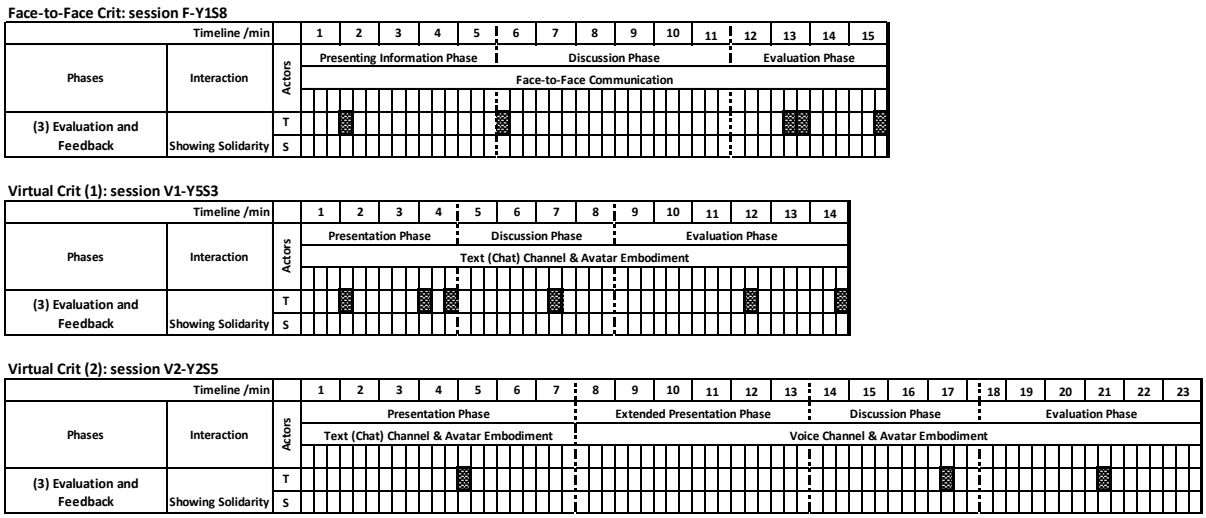


Figure 7-18 Showing Solidarity in Three Different Review Sessions

Moreover, the level of persistence to 'show solidarity' and show tutor immediacy differed in the two Virtual Crits (1) and (2), this was related to the level of remoteness/ separation of each review as explained below.

Face-to-Face Crit. Showing solidarity in this category of design reviews was enacted almost completely using nonverbal signals and cues i.e. facial expressions, and was noticed to have high correlation with *approving* and *positive feedback* as shown in Figure 7-19.

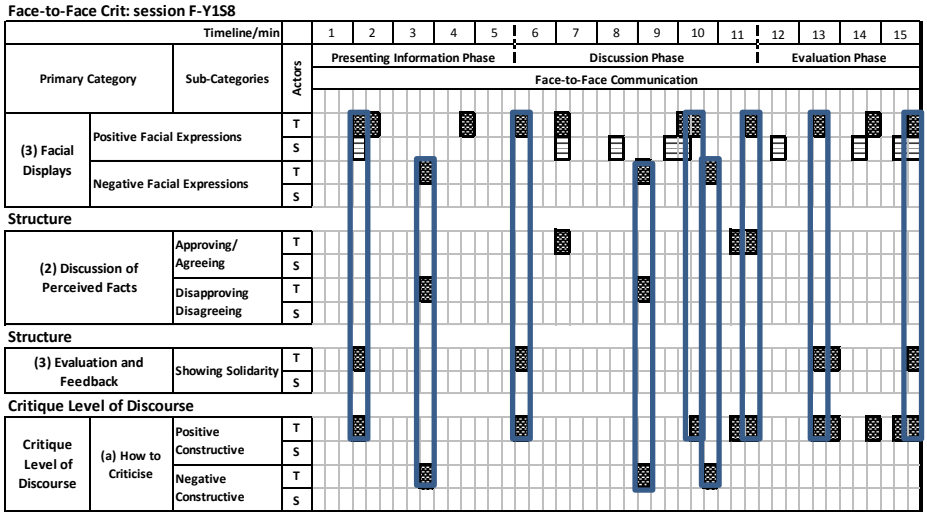


Figure 7-19 Correlation between Facial Displays, Approving/ Disapproving, Showing Solidarity and Positive/ Negative Constructive Feedback in a Face-to-Face Crit session

Virtual Crit (1). Looking back at Figure 7-18, in this category of design reviews particularly, the tutor was keen to 'show solidarity' throughout the sessions; this was done using words such as "*this is very good*" and "*it is a good idea"* and "*great..!"* which was a way of indicating both, receipt of information as well as positive evaluation and praise throughout the sessions.

As for the end of the conversations also in Virtual Crit (1), the tutor thanked each student for taking part in the virtual crit, expressing a friendly attitude and a smiley symbol, as shown here:

> *T: ok, we're done for now ...thanks for taking part in this...and hope u have enjoyed the experience... :)*

Although it can be argued that simply 'signing off' from the virtual world could have been enough to 'end the conversation', but monitoring this attitude led us to believe that the tutor may have wanted to increase the level of tutor-immediacy to establish a better learning experience for the students.

Compensating of emotions may be true in most online conversations, but in the online learning situation it has been proven to lessen the psychological distance between tutors and their students, leading, according to (Gunawardena and Duphorne, 2000) to greater learning satisfaction. Walther and Burgoon (1992) note that some textual cues may compensate for reductions in nonverbal forms of immediacy that are associated with online contexts. Observing this persistence by the tutor to end 'each' conversation in a friendly and rather intimate way in Virtual Crit (1) sessions may have been created as well, out of the necessity to gap the physical distance.

Virtual Crit (2). What supports our previous explanation; about the need to show tutor-immediacy in Virtual Crit (1), is that in Virtual Crit (2), where the participants were proximally closer, the need to gap the distance was not really an issue. In other words, the motive to over-show tutor immediacy and presence had lessened in Virtual Crit (2), despite the fact that the tutor and students could not see each other's facial expressions.

Showing solidarity, was expressed as well in Virtual Crit (2) as shown in the above timeline grid in Figure 7-18, but seemed to be more of a '*giving acknowledgment'* type of statements; the tutor said words like, '*cool'* and '*good'* throughout the sessions. Besides the fact that the sessions of Virtual Crit (2) appeared more relaxed and casual in general, there were very minimal instances in Virtual Crit (2) that showed solidarity and/or intimate emotions from the tutor as such.

7.3.2 Social Communication

Despite the fact that Virtual Crit (1) and Virtual Crit (2) were at different levels of remoteness, the level of humour and joking and other means of social/ interpersonal communication still found room in both design reviews. Figure 7-20 shows that social communication occurred more in Virtual Crit (2) here the use of technology contributed to this result, however it may also be concluded that the level of physical proximity played a role as well.

Although these interactions were communicated differently and for different reasons in the two virtual crits, they did not change the feeling of the students in both crits about the level of 'formality' of the communication as shown in the following discussion.

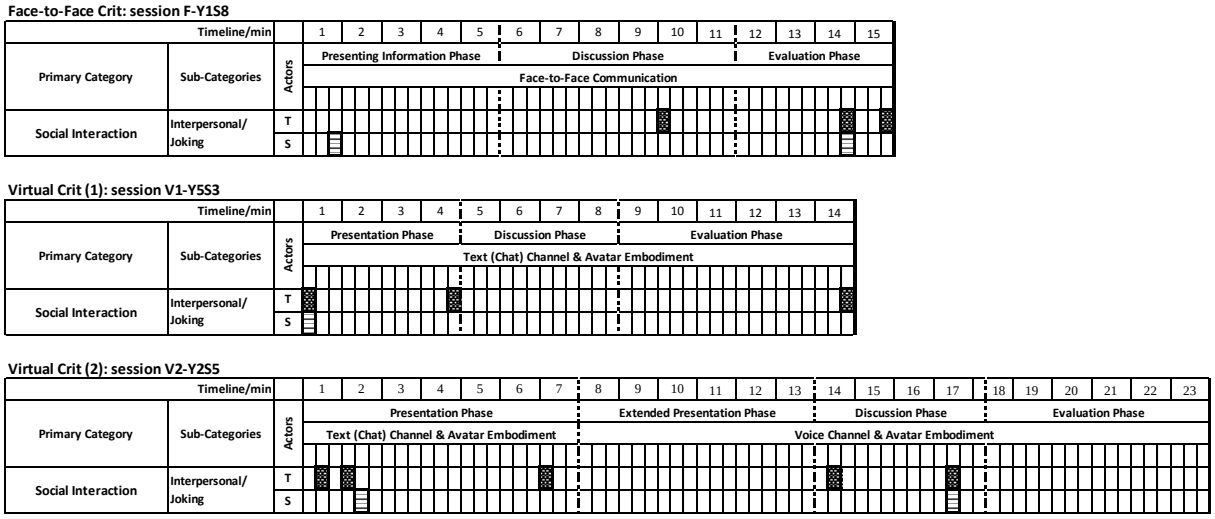


Figure 7-20 Social and Interpersonal Interactions in Three Different Design Reviews

Virtual Crit (1). Looking at Figure 7-20 , Social Communication seemed to occurr a number of times during Virtual Crit (1) sessions, despite the loss of two communication

channels (voice and video) which are thought to have been vital in reproducing face-to-face interactions such as humour and joking (Harrison, 1993). One example detected from the chat logs, was this humorous comment expressed by the tutor when he found a number of similar designs:

T: this is another one
T: is this a conspiracy?
S: lol
S: if that's ok ☺

Virtual Crit (1), despite described by the majority of the students (seven out of eleven students) that the virtual crit was 'as formal as real life crits', this did not inhibit the exchange of some social interaction that may have temporarily eased out the formality of the sessions.

Virtual Crit (2). More instances of humour were detected in Virtual Crit (2) sessions as seen in Figure 7-20 above; these were mostly about the way students controlled the Avatars and other tools, this again may be associated with the level of remoteness in this crit, as well as the number of communication faults experienced by the participants that led them to joke about it. This example shows a joke made after referring to a missing image that would not upload:

S: unfortunately the drawing that would really help hasn't uploaded
T: that's no excuse (Laughing)....

T: you should be better prepared for a crit!!
S: in the real world, tru... (Laughing)

Another instance here, when the tutor mistakenly calls the student using his real name, and then corrects himself using the Avatar's name, this led all participants to laugh.

T: Right, Jake could you tell me, sorry Jonas, (all laugh) *...could you tell me about the image at the top.*

This rather unfamiliar context of virtual worlds which also led to uncontrolled Avatar navigation and flying sometimes created many instances of humour in Virtual Crit (2) sessions.

However not all jokes referred to the use of technology:

> *S1: the first render is where you enter the main building*
> *S1: you are immediately welcomed by the presence of the cows*
> *S1: the aromas, the sounds, the visuals*
> *T: and cow dung*
> *S2: aromas...? lol (all laugh)*
> *S1: the reason for the vast height of the barn is to keep the building well ventilated…*
> *S1: oh no, the aromas, would be fairly minimal, on hot days they would increase in intensity ☺*

Warburton (2009) identifies in virtual world education a tension between playfulness and professionalism, this was particularly experienced while observing Virtual Crit (2). Despite the high numbers of humorous instances compared to Virtual Crit (1), and shown above in Figure 7-20, it was not expected at all that (four out of five) of the students when asked, would describe Virtual Crit (2) sessions 'as formal as real life crits'.

7.3.3 Stress-Free Crits?

Lane (1994) states that remote communication gives students the ability to open up when they are not being observed by others; it allows them to participate more without feeling stressed. Doidge *et al.* (2000) have suggested that managing psychological and physical self is vital to a successful design review performance. This research proposes that stressfulness, anxiety, and fear of design review in situations where some students encounter lack of courage and low level of language fluency can be avoided in the mediated review. Having the opportunity to organise one's thoughts and control over the communication is believed to make communicating at a distance an advantage. According to (Anthony, 1991; Jones, 1996), the students' performance during his/s her design review session is found to be affected by psychological aspects such as student lack of courage to participate, shyness, communication skills...etc., therefore asking the students after the virtual crits about their experience aimed to determine whether performing the design review at a distant had made any difference in this matter.

Some of the participating students in the two Virtual Crits (1) and (2), were asked about their design review experiences, some students gave their opinions about how they managed to overcome the bad crit performances after a number of practices, indicating that this way of learning sets them to facing future situations.

> *V1-Y5S4: "We learn to ease out of it from the first few times, there is a point in us facing tutors, we are not just doing it in university, but later in life with clients and stuff, so it is a good practice to do it".*
>
> *V1-Y6S9: "a crit will always be a crit, but the fact that I'm at home makes it easier, and without the technical problems, this could be an ideal way to do crits for those who are not that confident in front of people"*
>
> *V2-Y2S1: "your first crit in university always goes bad, your voice goes away, you can't look to anyone in the eyes, sometimes you cry, but the more you practice the better you get"*

The students admit in the above quotes, that 'this is the way it is'; the design review must be an overwhelming experience at the beginning to most of the students, but as they believe, this method is beneficial to them as it enhances their future performances.

As discussed so far in the previous sections, tutor immediacy, represented in showing solidarity and social interactions, was believed to be lost in the mediated design reviews due to eliminating physical proximity and nonverbal cues such as facial expressions, however, what appeared to us from the examinations is that they haven't disappeared entirely. This may create a relaxed and more casual learning climate for the students. In order to confirm our observations, the students were asked a number of questions about their feeling of stressfulness, and the formality of the design reviews.

Table 7-2 shows the students opinions about feeling stressful in the virtual crits in relation to facing their tutors and facing their peers.

Table 7-2 Students Opinions about Feeling Stressful in the Virtual Crits (1) and (2)

	Question	Virtual Crit (1)	Virtual Crit (2)
Q41	How did you feel, in terms of stressfulness, about not being in the same place (face-to-face) with your tutors?	3 Students answered: More stressed than Real Life 2 Students answered: Same as Real Life 6 Students answered: Less stressed than Real Life	0 Students answered: More stressed than Real Life 2 Students answered: Same as Real Life 3 Students answered: Less stressed than Real Life
Q42	How did you feel, in terms of stressfulness, about not being observed by other students?	0 Students answered: More stressed than Real Life 3 Students answered: Same as Real Life 8 Students answered: Less stressed than Real Life	0 Students answered: More stressed than Real Life 0 Students answered: Same as Real Life 5 Students answered: Less stressed than Real Life

Virtual Crit (1) When asked about how anxious or stressed they felt during Virtual Crit (1), while not facing their tutor, (6 out of 11) students expressed that the experience felt 'less stressful than a real-life crit', while (2 out of 11) rated it as 'same as a real life crit' and (3 out of 11) rated it as 'more stressful than real life'.

And when asked about the level of stressfulness in relation to being observed by other students, (8 out of 11) students said the remote communication was 'less stressful than a real life crit', while (3 out of 11) rated it as 'same as a real life crit', and no students expressed it was 'more stressful than a real life crit'.

The students felt more comfortable presenting and describing their work when not being faced by their tutor and observed by their peers, yet here, more students have associated the 'less feeling of stressfulness' to 'not being observed by other students'.

Two students gave their opinions on this matter as in the following quote:

> *V1-Y5S6: "If you are a first year, and even if the tutors are understanding and very professional, your peers would be there staring and you would still be nervous, so it can be a good alternative in that stage to have a distant review"*
>
> *V1-Y5S1: "Not facing the tutor and other students took off some pressure, but it still remained a formal kind of conversation"*

The students rating and opinions confirm to some extent Doidge's *et al.* (2000) conclusion that the number of students 'observing' in the crit would not affect managing the conversation itself, as only one student will be talking, rather it would contribute to the

nervousness of the presenting student and may affect his/her presentation. Interestingly, this was also confirmed from the opinions of Virtual Crit (2) students as shown in the following paragraphs.

Virtual Crit (2). When the issue of stressfulness in design reviews was discussed; the students were asked whether they had thought that not facing their tutor or being observed by fellow students affected their crit performance, in both physical and remote settings. Many of the students have agreed that statements such as 'feeling relaxed', 'not stressed' and 'not being stared at' best describes what they felt in the online communication (underlined in the following quotes). Another notion brought up by the students was the ability to be more focused, and oriented once the level of stressfulness drops. These following examples reflect their feelings that varied about performances in the design reviews in general, and in the remote context:

> *V2-Y1S6: "it can be comfortable when you know that no one can see you, then you can be in your home even wearing what you want, and the nervousness of being in front of people staring at you would be lost, I think this makes you more focused and oriented in your presentation as well"*
>
> *V2-Y2S3: "it could make you relax a bit and be more focused and productive, as in the normal crit, they are all staring at you, but in SL, they are there but you can't feel them looking".*
>
> *V2-Y2S5: "I wasn't expecting to feel nervous in the virtual crit, as it is just an experiment, but the instance the tutor said let's start, I found myself feeling nervous as if it was a real crit, but not feeling the pressure of people looking at me made it a bit relaxing I guess"*

As it shows from the previous selected quotes, some students praised the remote communication as a way of easing out the pressure of 'facing' others for those who lack the confidence and are not good face-to-face performers, while still having the formality of the normal crit. Others, however, were in favour of face-to-face communication to have control over the conversation by receiving instant feedback through facial expressions of the tutor, despite being '*scary*' as one of the students puts it.

> *V2-Y2S1: "I am usually nervous at the beginning of the crit, because that's the nature of it, but then I stop paying attention that my peers are looking at me because they don't join in the conversation and they are mostly worried about their own crits"*
>
> *V2- Y1S2: "I'd rather face a scary tutor to see his facial expressions, which give insight of how I'm doing, if I'm going in a totally wrong direction, I'd start focusing on other aspects instead. I prefer being updated with his reactions while I speak"*

When asked to rate the level of stressfulness they have felt in the remote communication, Virtual Crit (2) students gave similar opinions to those given by Virtual Crit (1) students. (3 out of 5) students said the virtual crit was 'less stressful than a real life crit' in regards to them 'facing their tutors'. However all five students confirmed that less feeling of stressfulness goes back to 'not being observed by other students' more than for 'being faced by the tutor'. This again depends on the personality and presentation skills of the student, and the level of experience and confidence, and may contribute to developing these skills and characteristics.

7.3.4 Satisfaction

Affective learning is highly associated with satisfaction, Russo and Benson (2005) studied learner satisfaction and attitudes in an online environment, where they have reported correlation between tutor immediacy, showing praise and instant feedback, and feeling less stressful, which in turn leads to reaching higher degrees of learning satisfaction. Chou and Liu's research showed that online learning satisfaction is related to the degree the online communication contributed to the students learning experience, and created a positive, less stressful environment.

The students were asked a number of questions in order to assess their enjoyment, learning climate and overall satisfaction about the learning experience.

As revealed in the previous subsection, despite the relaxed atmosphere experienced in Virtual Crit (2), very few students rated the virtual crit as a 'casual' conversation. Asking the students about the level of enjoyment they have experienced in the mediated design reviews (rating on a scale from 1-10), Virtual Crit (1) students gave an overall rating of (7.55

out of 10), while Virtual Crit (2) students rated their overall enjoyment by (7.2 out of 10), as shown in Table 7-3.

Table 7-3 Rating of Enjoyment and learning satisfaction

Q No.	QUESTION	Rating of Virtual Crit (1) (11 students)	Rating of Virtual Crit (2) (5 students)
Q38	Rate on a scale (from 1 to 10) your overall Enjoyment	7.55	7.2
Q55	Rate on a scale (from 1 to 10) your overall Satisfaction	6.4	5.2

When asked if their attendance of other students' review session has contributed to their learning, most of Virtual Crit (1) students (6 out of 11) answered with 'yes'. And when asked if they had developed new skills from the online experience, (7 out of 11) students answered with 'yes'.

Some students gave their overall opinion about their online learning experience, as shown below:

> *V1-Y5S3: "I appreciate the need to experiment in new areas and enjoyed the experience despite the wrapping problems I was overall satisfied"*
>
> *V1-Y6S7: "I thought the process was good and a unique way of communication"*
>
> *V1-Y5S4: "It did increase the interactivity because nervousness was not an issue, and was of greater use than e-mail because the images were in front of us while we talk and point to it"*
>
> *V1-Y5S1: "Hiding behind the screen and typing is not a solution to being shy, but overcoming this by practice, is better"*
>
> *V1-Y5S7: "don't know how much more beneficial this is to messenger other than providing a more attractive and interactive interface"*

As some of these opinions reflect appreciation and satisfaction felt by most of Virtual Crit (1) students, other opinions were less enthusiastic. The students overall satisfaction on a scale from 1-10, however was 6.4.

On the other hand, asking students of Virtual Crit (2) the same questions about learning new experiences, they gave different answers than those of Virtual Crit (1). The majority

answered with ‘no’ to both questions. This can be related to the communication and media problems they have experienced, as well as the fact that Virtual Crit (2) was just a simulation of a design review.

Some students gave overall opinions about their experience as following:

> *V2-Y2S3: “It still needs development but I enjoyed the experience, I would do it again if the pointing issues are developed”*
>
> *V2-Y2 S5: “it was unusual but fun”*
>
> *V2-Y1S2: “i think it is important that crits are to be practiced by talking in front of others and presenting ideas verbally, it is too much work to use technology”*

Even with the overall enjoyment (7.2 from 10), the students of Virtual Crit (2) rated their overall satisfaction with (5.2 from 10). In a few students’ words; practicing more face-to-face crits is a better way to prepare for meeting with clients in the future in practical life as architects.

7.4 Findings on Learning Effectiveness

First, this chapter has examined the Learning Effectiveness of the observed mediated design reviews, by studying two components of learning in the reviews; (1) cognitive and critique level of learning and (2) affective learning. It was shown from the discussion, that there had been evident variations in the initiative-taking behaviour adopted by the students, this variation was linked to the academic levels of the students and is believed to relate to their experience with design reviews and building their confidence and communication skills, this interpretation was confirmed by the students as they commented on their crit experiences. However individual differences here have played a role as well, so has the tutor's encouragement for communication.

When relating the cognitive levels of the discourse to the effects of the media, there were fewer variations between the three experiments in terms of cognitive level, but the mediated reviews however appeared shorter and less structured. The mediated communication here affected the discourse in the sharing of information and the discussion phases by allowing more descriptive orientation discourse. The cognitive levels in Virtual Crit (2) however, became longer, more structured and deliberate when using voice.

On the other hand, the analyses revealed that the critique level of the discourse in all three experiments were to a some extent similar, the tutors covered all areas of critiquing, summarised agreements, and gave further directions as expected in a design review. Evaluation and feedback as the primary learning goal in the design reviews were met to a great extent as the tutors discussed presentation skills, designing skills, and design knowledge deliberately in all the observed design reviews.

Affective learning in the mediated design reviews involved studying social communication, tutor immediacy and student perceptions on stressfulness and satisfaction. The analysis revealed a relatively high appreciation to the remote context, for not facing the students and tutors in the mediated design reviews. The students of the two Virtual Crits expressed that they felt less stressed, while still seeing the sessions as a formal conversation. The level of social communication appeared to depend on the physical

proximity of the participants, and therefore it was relatively more likely to happen in Virtual Crit (2), however, Virtual Crit (1) was not without moments of joking and expressing some humour as well, and this was not an expected result. What could be distinct, on the other hand, is the persistent need to show solidarity and friendliness in the tutor's comments in Virtual Crit (1), this reflected the urge to compensate the separation sensed as one of the characteristics of the remote context in that design review.

As a general conclusion, the level of affective learning may be seen as high in the two virtual crits, while the cognitive and critique levels of discourse were relatively acceptable referring to the students rating on ability to discuss their projects and their own perception of learning. This may take us back to the '*no significant difference'* debate which compares online learning levels to traditional ones based on performances and learning perceptions. The method used to examine the performances and perceptions showed that the cognitive and critique levels became more in-depth deliberate and detailed, when the participants used convenient tools of orienting their narratives, i.e. efficient Avatar pointing in Virtual Crit (1) and voice in Virtual Crit (2). Therefore, it is only relevant to conclude that the differences in learning effectiveness were minimal only when using convenient tools on orientation.

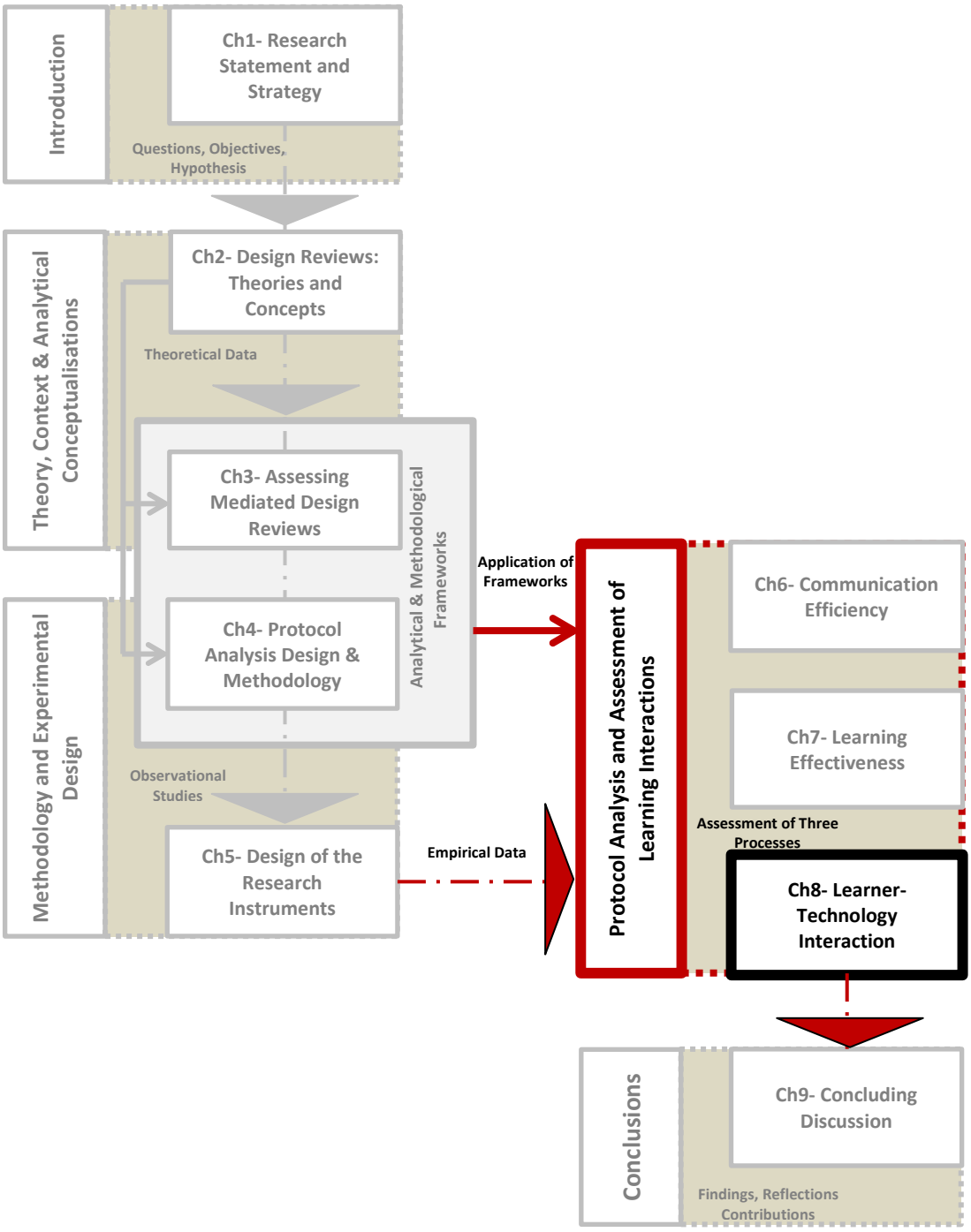
The next chapter examines the effectiveness of the third component of the mediated learning interaction process which is the learner-technology interaction. This views the effects of the direct relation with the technology on the learning interaction process; virtual experiences, use perceptions, and the remote context.

Chapter Eight

Effectiveness of Learner-Technology Interactions

Chapter Eight Contents

Chapter Eight 260
8 Effectiveness of Learner-Technology Interactions 263
8.1 Introduction 263
8.2 Status and Properties of the Technology 264
8.2.1 Connectivity and Capacity 265
8.2.2 Properties of the Avatar 266
8.2.3 Visual Properties 269
8.3 Users and Usability 270
8.3.1 Usability and Preference of Modes of Communication 271
8.3.2 Technology Communication 274
8.3.3 Readiness, Adoption and Enthusiasm- to the Technology 276
8.4 Interaction with the Computer 282
8.5 Virtuality: Experiences and Perceptions in the Virtual World 285
8.5.1 Embodied Presence 285
8.5.2 Visual Displays and Camera Viewpoints 290
8.5.3 Virtual Proximity 293
8.6 Remoteness 294
8.6.1 Being 'in' a Virtual Crit 294
8.6.2 Separation and Disassociation: Transactional Distance 295
8.6.3 Identity Issues 297
8.7 Findings on Learner-Technology Interaction 299


Introduction
Ch1- Research Statement and Strategy
Questions, Objectives, Hypothesis
Theory, Context & Analytical Conceptualisations
Ch2- Design Reviews: Theories and Concepts
Theoretical Data
Ch3- Assessing Mediated Design Reviews
Ch4- Protocol Analysis Design & Methodology
Analytical & Methodological Frameworks
Methodology and Experimental Design
Observational Studies
Ch5- Design of the Research Instruments
Application of Frameworks
Empirical Data
Protocol Analysis and Assessment of Learning Interactions
Ch6- Communication Efficiency
Ch7- Learning Effectiveness
Assessment of Three Processes
Ch8- Learner-Technology Interaction
Conclusions
Ch9- Concluding Discussion
Findings, Reflections Contributions

8 Effectiveness of Learner-Technology Interactions

8.1 Introduction

The third component of the proposed learning interaction effectiveness assessment criteria of mediated design reviews is the effectiveness of Learner-Technology Interaction. The conceptualisation of the 'learner-technology' interaction in this research extends the 'learner-interface' interaction relation proposed by Rourke *et al.* (2001) to include the (a) computer hardware, (b) the 2D interface, (c) the 3D virtual world and (d) the remote communication, see Figure 8-1.

From the examination of the mediated interaction discussed so far in the previous chapters, it can be proposed that the technology used in the observed mediated reviews was not just the means of communication, but rather, it was a 'part' of the experience. The status and properties of the technology, and how users used the tools affected the efficiency of communication as discussed in Chapter Six, and thus effectiveness of cognitive and affective learning as shown in Chapter Seven; dictating the overall learning interaction eventually. For not all what was afforded by the technology was used effectively; the success to utilise these affordances turns them into advantages. This chapter discusses the effectiveness of the learner-technology interaction, looking collectively at the findings of the previous two chapters, and in an attempt to assess this relation and explain its effects on the learning interactions. In this chapter, it is proposed that the technology and the users each play a role in the effectiveness of the learning interaction process, as illustrated in the relation shown in Figure 8-1.

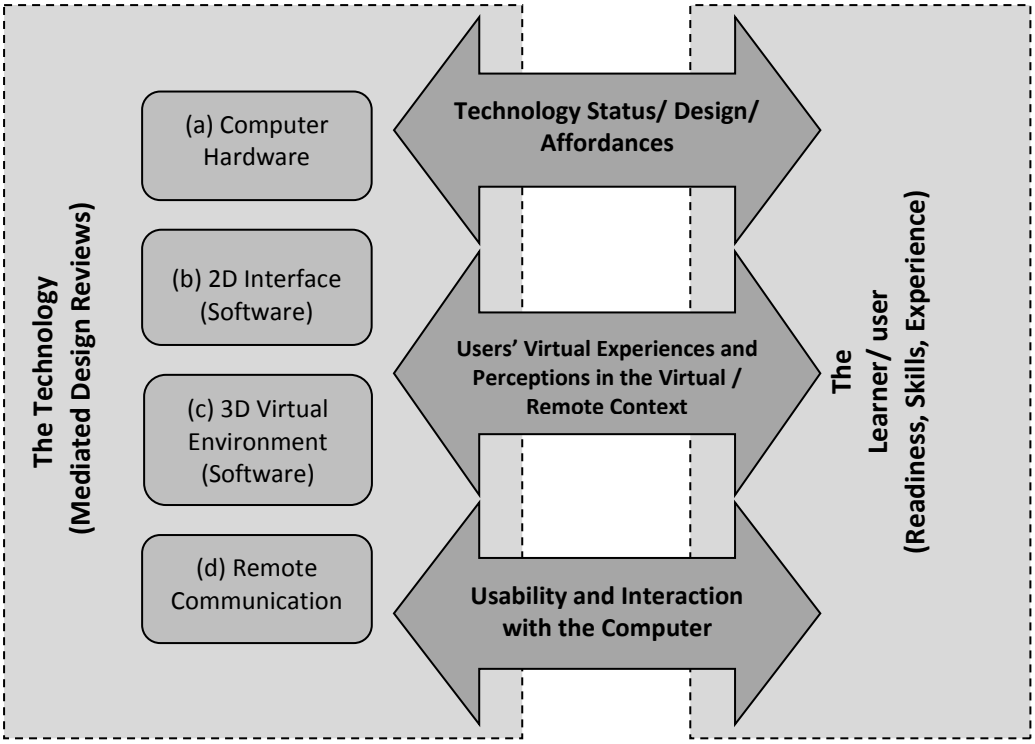


Figure 8-1 Relations within The Learner-Technology Interaction in the Mediated Design Reviews

The following sections discuss the status and properties of the technology, the users' readiness and their usability, interaction with the computer, virtual perceptions, and finally perceptions in the remote context.

8.2 Status and Properties of the Technology

The ability of the computer hardware and internet bandwidth to run the software used for communication is one of the main factors of maintaining smother communication and less interruptions (Warburton, 2009; Erickson *et al.*, 2011). While a high-end piece of technology such as SecondLife used for communication in the two Virtual Crits (1) and (2) required certain computer and internet specifications, failing to meet those conditions caused some connectivity and communication problems. These problems spanned from machine-related client-side issues of bandwidth, hardware and firewalls, to server-side issues of down time and lag, machine crashes, logging on difficulties, and slow uploading of files. On the other hand, there were some media-related limitations that relate to the current state of the art of the used software. However, these problems varied from being intermittent and manageable to work around, despite causing some frustration to both the

students and the tutors, to being completely inhabitant; to the degree that a few participants were forced to withdraw from the virtual crits.

8.2.1 Connectivity and Capacity

Participating students in Virtual Crit (1) connected via their own computers and laptops, some of the students who initially showed interest to participate in the virtual crit could not connect to SecondLife due to either not having the minimum computer or Internet requirements to run the software, shown in Appendix (B) or because they had connected via a private network, where the software did not provide an application proxy for private networks at the time of running Virtual Crit (1). In addition to that, two students joined but could not complete the experiment; one of them has stated that he had encountered a slow internet connection that caused difficulties in logging on and the other student had difficulties using the interface and had to drop out.

On the other hand, for the majority of students who did complete the virtual crit, technical problems were not very much of an issue, as only two out of eleven students experienced slow uploading due to bigger file sizes.

Participants in Virtual Crit (2) on the other hand, were connected in one of the university's computer clusters that run SecondLife; the problem here was with the low capacity of the student's roaming profile size on the university's network that prevented the uploading of large file sizes to SecondLife. This problem caused some of the machines to crash or take longer time to upload files, hence depriving three students from joining in Virtual Crit (2).

Another type of connectivity issues experienced in Virtual Crit (2) was the slow uploading of some Avatars or parts of Avatars i.e. clothes, which may have not caused any communication problems, but affected the visual experience of the users by showing a blurred cloud in place of the Avatar as shown in Figure 8-2.

Figure 8-2 Slow Loading of an Avatar

Figure 8-3 shows an image that took a fairly long while to be uploaded on one of the screens in Virtual Crit (2); it appeared blurred for an extended period of the duration of the crit which caused a general delay in the duration of the crit session.

Figure 8-3 An image in Virtual Crit (2) appears blurred for a long while.

These limitations in capacity and connectivity are common shortcomings of using technology, whether they are related to specific software or not, avoiding these issues are a matter of continuous development and upgrading.

8.2.2 Properties of the Avatar

The Avatar's virtual body properties were limited in Virtual Crit (2) as explained in Chapter Five; the absence of pointing affected the input of information, however, the users created an alternative way to manipulate the Avatar body and overcome this by using the Avatar body to 'fly' and point with its head or feet to the meant position in a way of compensating for this medium limitation.

V2-Y2S1: "I think it worked though, the fact that you can walk with your character to the screen, or fly to the place you are pointing at"

When communication opportunities were aided with the audio channel on the other hand, communication was observed to be more fluent and having good typing skills was no longer an issue, participants started to claim their use of 'physical' gesturing back while speaking even though they knew these gestures and pointing are not seen by their tutor.

Another limitation of the Avatar was the ability to perform gesturing and facial expressions. It could be evident in Virtual Crit (2) that not using this feature lessened the interactive and communicative value of the Avatars in general. It is true that there is a list of predefined facial and body expressions as shown in Figure 8-4, but these were found to be inappropriate to the context of the observed learning activity.

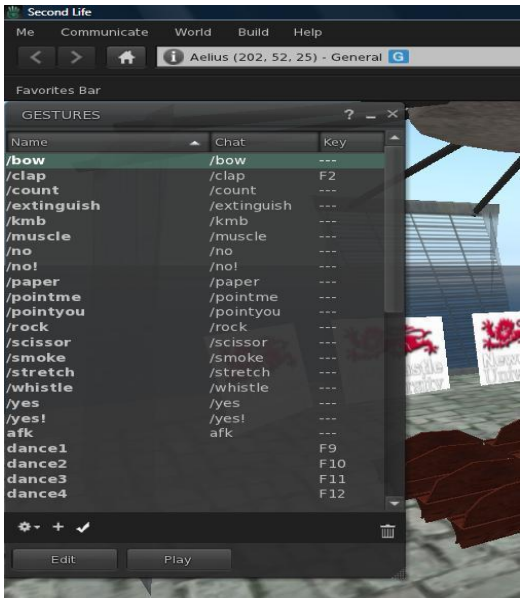


Figure 8-4 Gestures List in SecondLife

As observed, this can relate to a number of reasons:

(1) Setting up or memorising the keyboard shortcut of a gesture, or performing 'a select from a pull-down menu' action, to enact such actions during the conversation was found to be interrupting and unpractical during the conversation.

(2) As Earle (2001) found in early versions of 3D virtual worlds, once the novelty has worn off and users become engaged in the conversation, they rarely use the gestures during a conversation.

(3) Although virtual worlds have gone under many developmental studies, gestures and facial expressions as simple interactive features were shown to be underdevelopment still.

The students of Virtual Crit (2) expressed their experience regarding the use of gestures in the virtual world; the following quote represents their overall opinion;

> *V2-Y2S1: I think none of us were using gestures in the crit, I think we weren't using SecondLife avatars as we were supposed to do, because we've got this huge list of emotions that you can do, but we just stood there and typed, because you don't have time to think plus you can't type fast enough and it almost needs to be intuitive, because if you're presenting in the real life, you don't think, 'I'm going to point with my left arm here, you just do it as you talk.*

This student here explains that nonverbal cues as intuitive actions were difficult to perform via a conscious act.

(4) The limited time offered for presentation in the design review, as well as the use of typing to communicate cause the students to neglect the use of the available Avatar features.

(5) The unsuitability of the available facial expression and embodied gestures to the design review learning context.

The Face-to-Face Crits have shown an extensive and meaningful use of head nodding/ shaking, and positive/negative facial expressions for communicating acknowledgement, agreement, positive feedback, showing solidarity, among other actions that provide meaningful messages between the tutor and the students. However in the virtual context, these sets of gestures were not found in the SecondLife interface at all. These rather important actions can be added to the 'missing nonverbal cues' as classified by Antonijevic (2008) explained in Chapter Two.

On the students' perception about the Avatar as a human representation, some students reveal their opinions about the Avatar in the following quotes:

> *V2-Y2S5: "Representing a real person as an Avatar in SecondLife was really pointless, as he was showing no facial expressions, and you can't see where the tutor is looking, which makes you feel lost... Maybe in a better advanced sort of program, you may have these eye sensors/ trackers where you could see where the tutor and students are looking, combined with a pointer system"*

> *V2-Y1S4: "I think it would be almost as useful if you had your project on a shared screen with a pointer, so you won't need the Avatar, maybe only just a little box with your name on it or your face like with the webcam to identify who is talking now"*

In the previous two quotes, the students strongly criticise the lack of interactive properties they have expected to be effective in the Avatar. The 'missing' features such as accurate pointing, and facial expressions were exactly why the Avatar was not a successful tool for orientation of the narrative in Virtual Crit (2).

8.2.3 Visual Properties

The 3D visual properties of the medium were also among the factors that affected the learner-technology interaction in the observed reviews. Affording a visual representation of the surrounding environment that creates an experience of presence, gives virtual worlds an advantage over other media. But sharing visual information in virtual worlds unfortunately limited the resolution of the shared drawings and eliminated the level of detail required for the reviewed material.

The virtual crit space was designed to orient the users' attention to the location of the virtual design reviews and give a sense of realism and setting the stage as explained before in Chapter Five, the participants were therefore asked about their opinions of the space, and whether this sense of realism affected their learning experience. The majority of students participating in Virtual Crit (1) and (2) commented on the suitability of the crit area, the size and the locations of the presentation boards/screens, saying they were mostly suitable, however, two students had pointed out that the proportions should have been made to fit the projects. The following quotes from three in the two mediated reviews students commenting on the proportion and direction of the presentation boards:

> *V1-Y5S1: "One of my panoramic sized pictures was squashed and distorted because it was in a different proportion size as the canvas"*

> *V2-Y2S3: "mine was working vertically, so each of the lines ran into each other and wiped a progression".*

> *V2-Y2S5: "It is a matter of proportions and scale also, because architecture is all about scale. You can't feel the texture, so you can't get the design".*

The last quote from one of Virtual Crit (2) student's confirms the importance of being able to relate to the scale, proportions and textures in the design project. Normally, in design reviews, the proportions and directions of the presentation boards are left to the student to decide as long as it is within the number limit announced by the tutor. In both cases of Virtual Crit (1) and (2), the design projects were finalised before the call for volunteering in the virtual crits. Although the pre-test questionnaire had asked about the properties of the deliverables, but none of the students had indicated that their deliverables include special properties.

When asked about their opinions about the design of the virtual crit space and how would they consider revising it, the students suggested insightful responses on how to present their work in SecondLife and how to exploit the '*virtualness/ virtuality*' of SL:

> *V1-Y6S6: "In a world where there is flying avatars, a crit space could allow avatars to fly across and present their work with no rigid settings".*

> *V2-Y2S1: "There is a great potential in the virtual world, because there is no limit to the walls or sizes of projectors, so you can create an entire curved surface, and if you get the proportions, graphics and scale right it can be a really powerful presentation that actually stretches up an entire wall without having to print huge banners".*

> *V2-Y2S5: "I think we are the ones who should design the screens that we would present on in the virtual world, like we design our drawing boards, vertically or horizontally to support the presentation".*

It is important to address the previous feedback to improve the design of the virtual crit space, one suggestion is to actually ask the students themselves to design their presentation boards to be suitable for their designs; scale, size, proportions.

8.3 Users and Usability

This section examines some aspects regarding the participating students, their communication preferences and the way they used some tools of the media. From the chat transcripts, a number of students asked about tools of the media, and how to execute

certain interactions during the mediated reviews, this discourse was coded under 'technology communication' and indicated some difficulties of usability. This section studies as well the students' prior experience and enthusiasm about the technology and relates how these factors might have affected their usability and ability to communicate effectively.

8.3.1 Usability and Preference of Modes of Communication

The participating students in the two mediated design reviews were asked about the use of some tools of the medium, such as using chat, voice, Avatar navigation and teleporting to the virtual learning space. While the majority of Virtual Crit (1) and (2) students stated that the use of both teleporting and navigation were not difficult at all, their opinions varied completely about the use of the chat tool. In Virtual Crit (1), only (3 out of 11) students have expressed that they had difficulties using chat to describe their work. However, students of Virtual Crit (2) all have said that using chat was difficult, they referred to the following reasons; (1) chat fades away quickly, (2) the font size is too small, (3) they type slowly and (4) they find it difficult to read off the monitor. The students were also asked about how they felt in regards to their ability to present their projects, using the chat mode only and not being able to 'physically' point to their drawings. Table 8-1 shows the questions asked and the students' ratings to using chat only.

Table 8-1 Students' Usability of the Chat Mode to Describe their Projects

Q No.	QUESTION	Virtual Crit (1) (11 students)	Virtual Crit (2) (5 students)
Q29	Did you feel at any point that you cannot describe your project?	3 students answered 'yes'	5 students answered 'yes'
Q30	How did you find describing your project without the ability to physically point at the images?	2 students answered Very Difficult 5 students answered Difficult at some point 4 students answered Not Difficult	2 students answered Very Difficult 3 students answered Difficult at some point 0 students answered Not Difficult
Q32	Rate on a scale (1 to 10) your overall ability to present your work in the virtual crit using the chat tool	6.2	4.6
Q33	Did you Open the Chat History Box to catch up with the conversation at any point?	6 students answered 'yes'	2 students answered 'yes'

When asking the students whether they were able to describe their projects as expected in a design review, (5 out of 11) stated they found not being able to physically point at the drawings 'difficult at some point' whereas (4 out of 11) found it 'not difficult', rating the overall ability to describe their projects on a scale form (1 to 10) with (6.2). This matches to some extent the observations made on Virtual Crit (1) sessions, the main factor influencing their ability to describe their work was the use of the Avatar pointing tool.

On the other hand, all five students of Virtual Crit (2), found difficulty to describe their project, with the majority stating it was 'difficult at some point' (3 out of 5) to 'very difficult' (2 out of 5) to describe without the aid of physical pointing. They have rated the overall ability to describe their design ideas and drawings with (4.6) on a scale form (1 to 10). This result also confirms the observations made on interactions in Virtual Crit (2) sessions.

As for the preference of voice over chat, when asked, opinions of Virtual Crit (1) students varied, some preferred voice, and others based on their experience with many programmes, preferred chat over voice, some of their quotes were:

> *V1-Y6S3: "It would have been easier and quicker to use voice chat like skype or any messenger"*
>
> *V1-Y5S4: "Typed messaging is an easily recognised format and allows for more time for you to familiarise yourself with the other functions required"*
>
> *V1-Y6S6: "The sound quality is not that good in many messenger programmes"*
>
> *V1- Y5S7: "Voice would have been more expressive"*

Some of those students have raised some points about the bad sound quality that may result in miscommunication, despite increasing interactivity in voice chat programmes, while others praised chat as it allows time to frame one's narrative. Although the (6 out of 10) rating for chat given by seven out of eleven students may not allow us to claim it as significantly preferred, however, the shorter durations of the Virtual Crit (1) sessions compared to Virtual (2) sessions, and the higher cognitive level of discourse shown in

Chapters Six and Seven, indicates that chat is a successful method of input, *only* when it is used with efficient Avatar pointing.

The five participating students of Virtual Crit (2), on the other hand, who have used both text and voice modes preferred using voice; giving the rating of (2 out of 10) to the use of chat. Some students gave their opinions as seen in the following quotes:

> *V2-Y2S3: "adding voice is better, so you add the vocal emphasis and you know whose turn it is to talk"*
>
> *V2-Y2S4: "in many voice and video conferences, the voice quality is not that good so you go back to chat, but it is still easier to communicate your ideas using voice especially when you can relate to your drawings instantly"*

From the above quotations, students in Virtual Crit (2) were not in favour of the chat mode, as it is slower than voice and lacks the vocal emphasis and user recognition feature needed in a learning conversation. Some students mentioned that the use of voice as well may substitute the need to point with the Avatar completely, as one can vocally orient the description of the drawings instantly.

On another basis, typing errors were detected in the chat logs of many sessions; as a consequence of fast typing, rushing to say everything, either for poor typing skills of some participants or the pressure of trying the create a coherent narrative of the review in a limited type, unfortunately, these errors were not avoidable. Most of the typing errors were mainly either missing a space between two words, or switched letters in one word and as the norm in chat-style text, some words were substituted by letters, this example form Virtual Crit (1) shows typing errors and some textual features:

> *T: u cannt model teh outdoors if u don know ur experiental map*

An important note worth adding here is that despite these errors not affecting the meaning, some students expressed in the focus group, that going back and correcting those typing mistakes would take longer to get the message through, as expressed by this student from Virtual Crit (2) in the following quote:

V2-Y2S7: "the problem with chat for example was that i had to check the sentence before i entered it so there was no spelling mistakes that may change the meaning, or make me look bad"

While pressured by the formality of the design reviews; the student indicates that she needed to ensure her sentence was entered without spelling mistakes so it doesn't affect the meaning, this resulted in longer periods of silence, distraction or losing line of thought sometimes.

8.3.2 Technology Communication

Technology communication refers to discussing properties of the technology during the design reviews; how to use certain tools or carry out certain acts. Figure 8-5 shows a higher use of technology communication in Virtual Crit (2) than that in Virtual Crit (1), this was observed and confirmed by the users to relate to the difficulty experienced during the use of the technology.

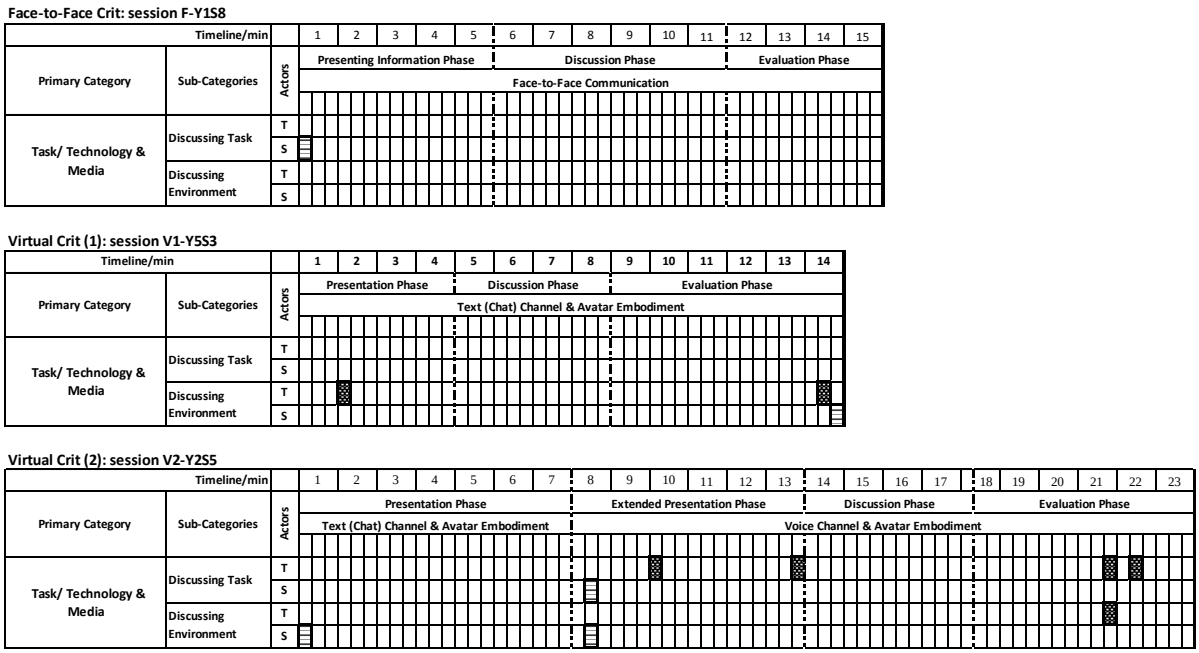


Figure 8-5 Technology Communication in Virtual Crit (1) and Virtual Crit (2)

Virtual Crit (1). In Virtual Crit (1), this verbal content referred to either the tools of SecondLife, or the properties of the virtual settings. This communication about the technology diverted the discussion away from the design review dialogue for an amount of time. Four students were observed to spent some asking about how to use tools of the

virtual world, this confirms Rouet and Passerault's (1999) statement that relates the longer duration of online communication with the attempt to learn using some of the media tools. This example shows a conversation with the researcher/observer (referred to as O) about using the 'bulk upload' tool:

S: I want to upload my files, how do I do that?
O: ok, did u open 'My Inventory'?
S: Yeah and I am trying to upload the first one.
T: ok upload all in one go
S: how can I upload all?
O: use 'bulk upload' option and select all files, it may take more time though

This student asks how to point in the virtual world.

T: can u point that out on the map?
S: how do i do that here?
T: just click on the part you want to show on the screen.

The tutor explains how to use Avatar pointing, and then resumes the design review dialogue.

Virtual Crit (2). Participants' discourse about tools and media consisted of asking about the tools as well as remarks about the media limitations, for example about the lack of clarity and sense of scale, and about uploading the images.

S: sorry yeah, it is a bit unclear what is drawn because of the line weight in this context

Here the student refers to the unclarity of the drawings relating this to the context of the virtual environment.

T: just to check here, I think I'm missing a context, is the plan uploaded?
S: it is too big to upload, had to give it up

As seen in the above line, the participants were discussing the technology limitation regarding the media itself which caused the drawing not to upload. However, it was obvious in Virtual Crit (2), that asking about the usability of the tools was less than observed in Virtual Crit (1), this may be due to two reasons; (1) Virtual Crit (2) participants

received more instructions on how to use the tools prior to the sessions and (2) they faced more technological problems related to the low capacity of the used computers.

8.3.3 Readiness, Adoption and Enthusiasm- to the Technology

From the previously presented discussion about the status, properties and usability of the technology, it can be clear that these factors can act in combination with each other and impact differently on different users; this unfortunately makes the online communication experience not consistent for all the participating students, some may have good experiences while others may encounter a number of frustrations and problems with the technology.

However, as Eastmond (1994) observes, student *readiness* relates to the various personal factors that influences online learning effectiveness, and was proven by Gunawardena and Duphrone (2000) to be a predictor of learner satisfaction in online learning. Those personal factors may prepare the students to use the technology effectively, and be able to handle some minor technical problems. These include the students' prior familiarity with the technology and learning experiences, computer skills, comfort with using the technology, interest in the technology, self-efficacy in mastering the technology as well as the student's adoption of technology and their belief in the medium's potential and capacity for academic discussion.

The participating students in Virtual Crits (1) and (2) were asked how they felt about the technology and their enthusiasm to the virtual world; the majority of the participants showed enthusiasm to share in the virtual design reviews in SecondLife prior to the two virtual experiments. The following quotes describe some students' feelings towards using this technology for the design reviews:

> *V1-Y5S3: "I appreciate the need to experiment in new areas"*
>
> *V2-Y2S5: "I think it's an innovation; I would like to see how we can use and develop it"*

On the other hand, other students were not as enthusiastic of this new environment; as demonstrated in these quotes:

V1-Y5S8: "I think it is an awkward way to present a crit"

V2-Y1S3: "Not ideal as real life"

V1-Y5S13: "Slow Connection, unfamiliar environment, reluctant to use an unfamiliar environment, unknown problems getting in the way to teleport and upload, had to drop out"

The last comment reveals that the unfamiliarity with the environment caused one student to withdraw from the experiment; this provides that not all students may be ready to learn and adopt new media. When asked, the students considered themselves comfortable with using computers in general, online communication, 3D virtual worlds and other innovations. However, the majority of the participating students in the two mediated reviews have not used SecondLife before; nevertheless, they did not mind to explore it and learn to use it for the study.

The importance of readiness and prior experience of the technology appeared in the degree of focus and ability to handle navigation in SecondLife, so for example, this was observed to be relatively better in Virtual Crit (1) than it was in Virtual Crit (2), it is believed that this relates to the difference in technical experience and background of the two groups of students; as student in Virtual Crit (1) were studying a digital architecture module, where their projects were entirely digital-based designs using game engines. Their experience in using digital environments and Avatars gave them confidence and control when dealing with Avatars and 3D virtual environments.

V2-Y1S4: "as first years, we are encouraged to do everything by hand; drawings and presentations, so if I haven't done this project on the computer, then I wouldn't be able to present it virtually, even if your drawings were on the computer but were too light, then you couldn't see it in this format".

Despite giving more time before Virtual Crit (2) to practice and gain familiarity with the environment, students of Virtual Crit (2) expressed that they needed more time to practice and get used to the different tools:

V2-Y1S2: "If we had more practice, it would have come more naturally, it is easy to get used to"

V2-Y2S3: "with more practice, the use of gestures would be easier, and may be used in the future for educational purposes"

One occasion revealed that some physical constraints can affect the usability of some tools, in Virtual Crit (1) a student who has revealed afterwards that he is Dyslexic (has difficulty with recognizing written words), was slow in his responses, the chat tool for him was in a way difficult for communication, despite that; he completed the crit fully online. When this student was asked about his adaptation to the chat tool and how he managed communication, his answer was:

V1-Y6S6: "you use chat in all online communication software, the solution for me is to enlarge the text size and the result is slow response, but using voice chat would have made it easier"

Although such physical ability was only observed once in a total of sixteen mediated design reviews, it is important to address the need to have an option to increase text size in the technological interface.

As stated before, the successful utilisation of the technology's affordances fall partially on the users. Here we find that the user's readiness and enthusiasm, typing skills, academic stage, etc. may have played a role in the way they managed to use the tools of the medium of communication. Looking at relations between readiness, enthusiasm about the technology, prior experience with the technology and the satisfaction with using the tools and opinions about future use of the technology, as shown in Table 8-2, it could be possible to conclude that the students who were familiar with SecondLife or similar Avatar environments and chat programmes were to some extent enthusiastic about the experiment, and this in turn influenced their ability to use the different tools of the technology (as observed) and thus, they gave higher rating of usability and positive opinions about future use of the technology. So for example, relating information in Table 8-2, a student from Virtual Crit (1); V1-Y6S2 strongly agreed to participate in the experiment, and stated that he is familiar with similar technology; his opinion prior to the experiment was positive and showed a fair deal of enthusiasm:

V1-Y6S2: "I think it is going to be an interesting experience and a good way of getting feedback"

After the experiment, he gave a rating of (8 out of 10) for the usability of the tools of SecondLife, and agreed to use this technology again:

V1-Y6S2: "I appreciate the need to explore new technology"

In another example from Virtual Crit (2) students; V2-Y2S3 had no prior experience with the virtual worlds, and expressed some enthusiasm to the technology;

V2-Y2S3: "I'd like to experience new technology"

While after the virtual crit, this student gave a rating of (5 out of 10) to the usability of tools, and agreed to use the technology again, however, through voice chat, and if it is the only way to reach a distributed audience;

V2-Y2S3: "To use for a spread audience only, communication should be in voice though"

On the other hand, some negative opinions can be shown in Table 8-2. For example, student V1-Y5S8, from Virtual Crit (1) who expressed less enthusiasm about using the technology and revealed he does not prefer online communication in general, thought there was no point in learning new technology:

V1-Y5S8: "Why do we need to learn about other technology?"

He rated the usability satisfaction with (4 out of 10) and strongly disagreed about using this technology again:

V1-Y5S8: "Awkward, not accurate, no point in using it"

Another student participating in Virtual Crit (2) had 'never' used this type of technology; she was not so enthusiastic about the virtual world as could be detected form her statement;

V2-Y1S2: "First time to hear about it, could work, why not"

She did not manage to use the technology very well and gave a (3 out of 10) rating, and after the review, her opinion reflected her experience;

V2-Y1S2: "it is important to practice talking in front of others"

Other examples show that students who were enthusiastic about the technology but had no prior experience, gave less ratings of usability, however not all maintained a positive opinion about future use as shown in Table 8-2.

Table 8-2 Relation between Readiness &Enthusiasm about the Technology and Usability and Future Use

	Student ID	(Pre-test-Q6) Prior Experience with Avatar & 3D VWs	(Pre-test-Q17) Frequency of using Chat	(Pre-test-Q20) Opinion about using SecondLife for Design Reviews	(Pre-test-Q20a) Why?	(Post-test Q16) Rating of Usability of Tools	(Post-test Q53) Opinion about using SecondLife for Future Design Reviews	(Post-test Q53a) Why?
Virtual Crit (1)	V1-Y5S1	No	Never	Agree	good way of communicating with people situated far away	4	Strongly Disagree	difficult to manipulate avatar
	V1-Y6S2	Yes	Usually	Strongly Agree	I think it is going to be an interesting experience, and a good way of getting feedback	8	Agree	I appreciate the need to explore new technology
	V1-Y5S3	Yes	Everyday	Agree	we should be taught to utilise technology that allows greater flexibility	7	Agree	tutorials-only for intermediate stages, not for final crit
	V1-Y5S4	Yes	Sometimes	Strongly Disagree	I haven't used it before	6	Strongly Disagree	messenger would have been easier with same benefits i.e. transfer of files and ability to chat
	V1-Y5S5	Yes	Everyday	Agree	not sure, but it sounds as it would work	7	Disagree	only if there is no other way of communication
	V1-Y6S6	No	Never	Agree	to communicate with distant people	5	Agree	it was unusual but fun
	V1-Y6S7	Yes	Everyday	Agree	I think it will be fun	7	Agree	for tutorials not final crit
	V1-Y5S8	No	Sometimes	Disagree	why do we need to learn about other technology..?	4	Strongly Disagree	awkward, not accurate, no point in using it
	V1-Y5S9	Yes	Everyday	Disagree	not sure, never tried SecondLife	7	Agree	
	V1-Y5S10	Yes	Usually	Agree	seems like a good environment for tutorials	7	Agree	attractive interface, interactive avatars, but lacks accuracy
	V1-Y5S11	Yes	Usually	Agree	seems interesting and useful tool to present our work in a distant course	8	Agree	-
Virtual Crit (2)	V2-Y2S1	Yes	Usually	Strongly Agree	I think it would be interesting	6	Agree	useful if u cannot get the lecturer in person
	V2-Y1S2	No	Never	Agree	first time to hear about it, could work, why not	3	Strongly Disagree	it is important to practice talking in front of others
	V2-Y2S3	No	Sometimes	Agree	I'd like to experience new technology	5	Agree	to use for a spread audience only, communication should be in voice though
	V2-Y1S4	No	Everyday	Agree	-	4	Disagree	Avatar was useless
	V2-Y2S5	Yes	Usually	Strongly Agree	it's good to know about new and interesting ways of communication	6	Disagree	technology is under-developed, more for social interaction not formal learning

8.4 Interaction with the Computer

Moving from the virtual to the physical contexts, lies the physical computer space; the tutors and the students interacted with the computer; screen, mouse, keyboard, hardware, software, bandwidth...etc. Referring to the chat transcripts and direct observations of the two virtual reviews, it was possible to note a few issues related to this kind of interaction, some observations reveal that the physical space of the computer played a role in the creation of the design review interactions. Referring mostly to the physical computer parts; these instruments were the means to visualise, navigate, zoom and communicate. However using these parts while trying to communicate using chat mode, made communication quite difficult for the students.

Although the majority of the Virtual Crit (1) students have referred to Avatar pointing as being not difficult and accurate to a great extent, many of the students used orientation discourse to describe their projects nevertheless. From the following student's statement, it can be indicated that there may be some difficulty not in the use of the tools, but in trying to manage a number of simultaneous actions during communication;

> *V1-Y6S2: "I had to type and then use the mouse to point and then type again, and sometimes pointing was not really accurate, so it was easier to describe which place I wanted to point with words"*

This student was constantly changing between keyboard typing and mouse navigation or selecting a place to point with his Avatar. The relative complexity of these actions resulted in periods of silence or affected the fluency of the narrative to some point. Therefore he tended to compensate nonverbal expressions using other available types of input such as text.

An example from Virtual Crit (2) could be captured in Figure 8-6, Figure 8-7 and Figure 8-8. This student was observed spending most of the first phase looking at the keyboard, focusing on typing in Figure 8-6, he looked at the drawings inside the virtual world to describe his project, or at the 'chat box' when he received a question, sometimes scrolled back in the Chat History Box to view a previous comment; Figure 8-7. The student dealt with the computer screen, at times, as an independent object; moving closer to it to get a closer look at virtual objects instead of using the zoom-in tool in the 3D Virtual World a number of times, see Figure 8-8 that shows the student 'physically' zooming-in.

Figure 8-6 Looking at the Keyboard while Typing

Figure 8-7 Looking at the 'Chat Box' on the Screen

Figure 8-8 Zooming-in, 'Physically'

Interestingly, a form of direct physical interaction between the students and the screen was observed in Virtual Crit (2), they appeared to consider the screen as a modality device that exists in its own right, the students dealt with the screen as explained by Dade-Robertson (2011:16) in the following quote:

> *"The screen has often been considered as a neutral 'window on the world' rather than a material presence in its own right, and as a modality device that frames the objects it displays and sets up a direct and specific relationship with the person who is viewing it".*

This particular kind of interaction was observed to increase after using the audio mode, in Virtual Crit (2), while Avatar pointing was disabled, here we could see the participants 'physically' pointing at the drawings inside the virtual world as they spoke, see for example Figure 8-9.

Even though the participants knew that they could not be seen by the others (due to the placements if the students and tutors in this design review), pointing came as a natural action that accompanies speech after freeing the hands from typing in the chat-only stage, yet, the accompanied speech did not include words such as "*this*" or "*here*" and "*that*".

Having said that the participants did not have the opportunity to see each other, using those deictic words would be pointless. Instead, the participants in Virtual Crit (2) had to 'describe' where they are pointing verbally as they spoke using orientation discourse.

Figure 8-9 Physical Pointing at the Computer Screen Accompanied the Use of Voice

There was a quite interesting blend of physical nonverbal actions that were captured to be used all simultaneously while using voice to communicate, these were navigating and/or zooming in and out with the mouse or keyboard controls with one hand, while pointing or

gesturing with the other hand, or gesturing with one hand and pointing with the other to the computer screen. This can be shown in the following timeline grids of nonverbal communication in one of the Virtual Crit (2) sessions; V2-Y2S5 in Figure 8-10.

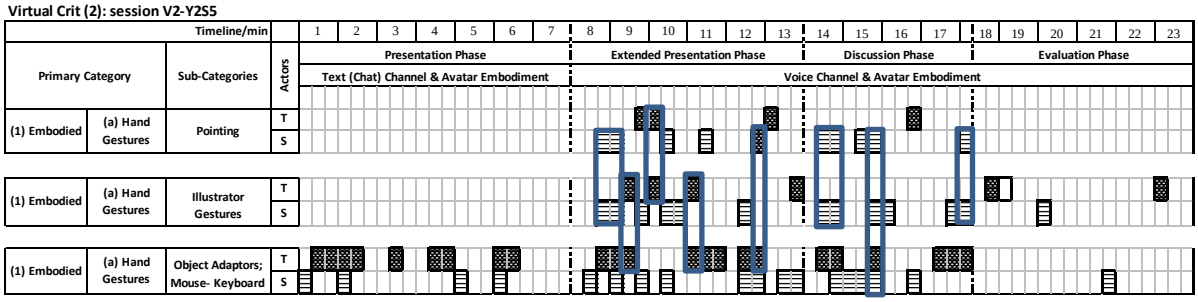


Figure 8-10 Co-occurrence between Pointing, Gesturing and Mouse/Keyboard Navigation while using Voice in Virtual Crit (2): session V2-Y2S5

Yet still and confirming Ishii's (2008:xv) following statement:

> *"Windows to the digital world are confined to flat, square screens and pixels, or painted bits.* Unfortunately, one cannot feel and confirm the virtual existence of this digital information through one's hands and body*".*

It was found that the screen was preventing the feeling of the existence inside the virtual world, depriving the participants from exploiting the main affordance of the 3D virtual world; this virtual experience; 'virtuality' is discussed in the next section.

8.5 Virtuality: Experiences and Perceptions in the Virtual World

This section focuses on the two mediated design reviews, where it examines the participants' perception of some virtual properties afforded by the medium of communication; these are, namely, (1) embodied presence, (2) location and orientation, (3) navigation and camera views and (4) virtual proximity. This section analyses the effects of these virtual perceptions and experiences on the learning interactions of the mediated design reviews.

8.5.1 Embodied Presence

User embodiment concerns the provision of users with appropriate body images so as to represent them to others and to themselves in a virtual system (Benford *et al.*, 1995). The

following sections discuss key themes relevant to the experience of embodiment in the mediated design reviews. Yee *et al.* (2007) elaborates on the degree of feeling present which measures how real one believes a mediated environment is, in terms of nonverbal behaviours, physiological responses and other measures one can act in the mediated environment. In a visually oriented system, this involves associating the user with a graphical object that represents them, in the case of virtual worlds these representations are Avatars. So the Avatar may be considered a tool of presence as well as a tool for orientation. Observing students and tutors in the Virtual Crit (1) showed that enacting nonverbal cues in a spontaneous and continuous way gave a more established feeling of connection and presence.

It can be argued from the students' opinions about feelings of presence, and direct observations of performances in the two virtual crits (1) and (2), that there is more to presence than the three layers of presence Warburton (2009) has presented, as discussed in Chapter Three. Warburton (2009) described how SecondLife affords three forms of presence by affording physical, communicative, and status properties that promote and stimulate the sense of presence. It can be argued that while these properties do make it easier to feel the sense of presence, the actual feeling of presence may not be experienced unless the students are focused in a highly engaged task and are fully attentive in their communication with their tutor without any interruptions. The reason that led to this conclusion is the fact that the sense of presence was easily weakened despite the availability of those presence-stimulating affordances described by Warburton. The main interrupting factor, besides technical glitches, that caused this weakness as observed in Virtual Crit (2) are the lack of both; spontaneity, and simultaneity in Avatar pointing and other nonverbal cues which led to the use of compensating text; and thus dividing the narratives of the design review. In addition to this, the results of the questionnaires support this finding, as when asked about the sense of presence associated with the embodiments of the Avatars, students of Virtual Crits (1) and (2) gave completely different ratings.

The majority of the students in Virtual Crit (1) indicated that they had felt the sense of engagement and 'being there', (average rating on a scale from 1 to 10 was 6), more than

those who have participated in Virtual Crit (2), (average rating on a scale from 1 to 10 was 3.6). A student in Virtual Crit (1) who described using Avatar gestures to point, '*not difficult'*, gave the feeling of presence a rating of (6 out of 10). However, he made a comment about '*distraction'* in his questionnaire, even though he could effectively point with his Avatar:

> *V1-Y6S6: "I could point with my avatar, but the fact that I have to control the avatar to point and then go back to typing was a bit distracting though"*

From the above discussion, it is clear that participants of the virtual crits used their Avatars as a tool for: (1) orientation and (2) embodied human representation of self, however, the sense and utility of those two functions varied according to the level of proximity experienced by the users. Virtual Crit (1) participants were completely remote, they had relied almost completely on their Avatars as a method of orientation, as well as an engaging representation of themselves in the virtual world. However, the distraction that was caused by controlling the Avatars may have affected the sense of presence and engagement as we proposed.

On the other hand, students from Virtual Crit (2) who were proximally close, did not rely on their Avatars for engagement and presence, the following statement, from a student in Virtual Crit (2), explains how the perception of the Avatar did not really matter in the virtual crit, except as for a tool of orientation, successfully used to some extent by flying and navigation.

> *V2-Y2S1: "I didn't pay attention at all to the appearance of the avatars, my focus was only on the project that was on the board and that I desperately needed to type so quickly to explain my work, i just forgot I had an avatar, only when the tutor asked to fly to the place I wanted to point at, only then I realised and remembered I had an avatar and could fly"*

Another student commented about felling '*disconnected*', despite being in the same room; this quote from one of the students confirms this notion:

> *V2-Y2S3: "not being able to point is a drawback, what is the use of an avatar if you can't use its body like your own, i felt disconnected and preferred to type where i was pointing because it was just faster"*

This disassociation the participants felt from their Avatars due to not being able to perform nonverbal actions, confirms that depending on the Avatar for representation may not relate with the sense of presence as much as depending on him for enacting nonverbal communication. This finding strongly supports the arguments of Becker and Mark (2002) and Mennecke *et al.* (2011) that the greater the ability to communicate a range of nonverbal cues in a virtual environment, the stronger the sense of presence and embodied presence that would be created, with respect to the different tasks and contexts.

The following example also supports this notion, as an interesting interaction was captured in the virtual crits as well, this was '*co-navigation*', or '*waking together*' as an interactional experience which involves others rather than one's self only. This form of social interaction was 'virtually' experienced in a few occasions in the Virtual Crits (1) and (2). It is a good example of the rising sense of co-presence that is only associated with a focused activity enacted together in the virtual worlds.

This was far from expectations as the subtle cues of proximity that enable people to co-navigate in a virtual space are missing here. Nevertheless, this form of virtual interaction was perceived by the users as a means of orientation which can be illustrated by this example from Virtual Crit (2). In the following example, represented by the chronological sequence of figures: Figure 8-11, Figure 8-12 and Figure 8-13, the tutor and the student both move their Avatars almost together from one location to another, and this in turn moves the conversation also from one location to the other, in a sequenced narrative in context with the displayed images.

Here, the tutor and the student stand close to the first display board; number one, while having this conversation:

S: ok this is my interpretation of a memory theatre
S: that is meant to hold all the worlds knowledge
T: tell me about the techniques you used to construct the model here.
S: i started with circles and just kept dividing them into 7....
T: That makes sense...

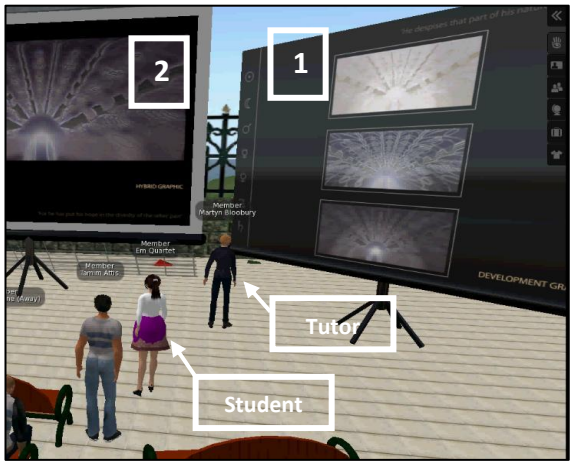


Figure 8-11 Both the Tutor and the Student have the conversation at board number one.

After some more lines, the tutor moves the course of conversation while moving his Avatar towards the third board and says:

T: ok, I'm interested more in the hexagon platforms here…where did they come from?
T: and what are they?

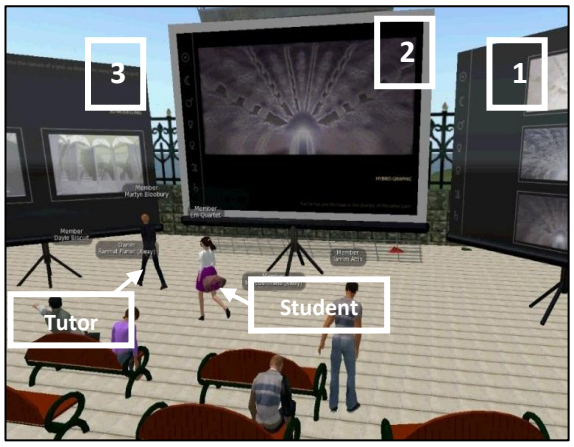


Figure 8-12 The Tutor and the Student Move their Avatars to board number three

The two Avatars move together towards the third board as in Figure 8-12.

After positioning the Avatars closer to the third board, Figure 8-13, the student resumes typing:

S: these are cabinets and because they are hexagonal they have a drawer on every side
S: so that they are never ending and can store as much knowledge as is necessary
T: never ending...?

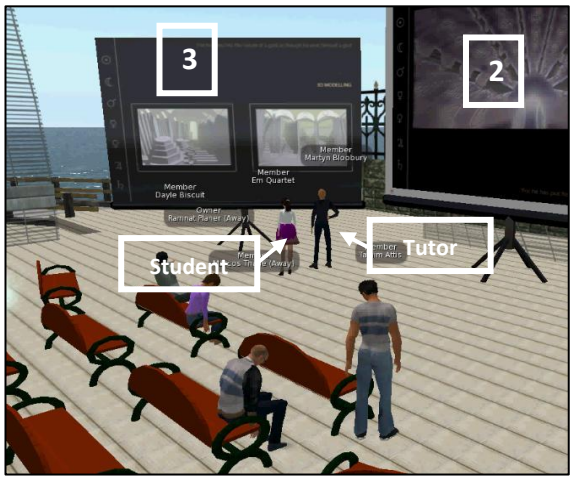


Figure 8-13 The Tutor and the Student resume the conversation at board number three.

Participants in that example, used words such as '*here'* and '*these'* (underlined in the previous passage), in line with the drawings they have positioned their Avatars at together. This employs the notion of feeling of engagement and presence when focused in an activity carried out together. Although participants in Virtual Crit (2) were physically proximate, here, performing co-navigation as a virtual form of walking together during the conversation seemed more spontaneous than other nonverbal actions in the virtual world such as pointing or flying. Virtual proximity was sensed in Avatar co-navigation, and here it did not *distract*, nor *disassociate* the users' focus from their continuous narrative.

8.5.2 Visual Displays and Camera Viewpoints

Embodied actions, according to Robertson (1997) are performed in relation to objects, other bodies and the surrounding space and it is important for an embodiment as Benford *et al.* (2001) suggest, showing the location of a user which may involve conveying both position and orientation within a given spatial frame of reference. Position and orientation of the user in the virtual world can indicate which activity that user is doing and which data he/she is accessing. This information is important in co-ordinating a learning activity and encouraging awareness and co-presence.

Therefore the significance of viewpoints in the virtual worlds relates to it providing this kind of information, and thus, makes it important to address the properties of the Avatar as a tool for orientation and its relation with camera viewpoints. However, the studied virtual world in this thesis; i.e. SecondLife, as a non-immersive virtual environment, does not represent the actual viewpoint of the user by any eye-tracking devices; it only provides options for the user to view the environment and focus on the objects around him/ her. SecondLife provides a view tool which affords two camera views which are object view and mouse look view and three present views which are front, side and rear views, in addition to an orbit pan zoom option that provides rotation and expanding the view in three dimensions and is controlled using the mouse.

Knowing where the other communicator is looking gives orientation and supports the perception of the meanings. However in the virtual context, it is only possible to predict

the direction of looking of the other party of communication from what shows to the users of the appearing status and movements of the Avatars. Indicating the missing information about the real user's status can be done in these ways:

- When the real user is typing, his/her Avatar acts out a 'typing' action and this is one of SecondLife's predefined embodied actions, so it would be assumed that the real user is either looking at the keyboard or the chat box while typing, Figure 8-14.
- When the real user is pointing at an object or another Avatar (and would be also looking at them), his/her Avatar looks at these objects, this is also a predefined nonverbal cue, Figure 8-15.
- Moving the Avatar towards the screens indicates that the real user is looking at the screen aiming to focus on something by pointing or describing.
- A 'listening' Avatar takes a body posture that puts its arms to its waist and looks around, the real user could be staring in the void, or waiting to receive a message, probably looking at the chat box, or preparing a new statement, so there is no actual association with the real user's actions, Figure 8-16.
- When the real user is away, the Avatar enters a 'sleep' mode and stands still while looking downwards.

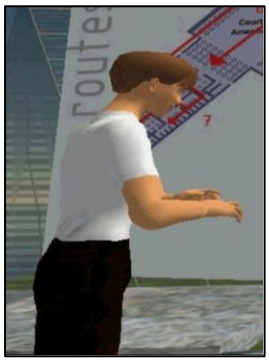


Figure 8-14 Typing mode

Figure 8-15 Looking mode

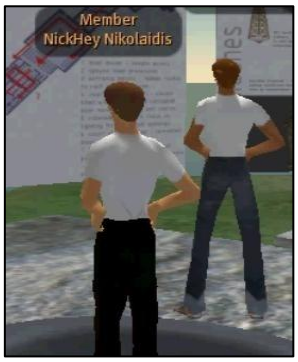


Figure 8-16 Listening mode

However, except for supporting the orientation of one's narrative, these indicators of visual displays in the virtual world were to some extent not accurate in the context of mediated design reviews.

Other than depriving the ability to see the communicator's facial expressions to indicate understanding, the lack of this important source of information about the communicators made it difficult for the tutor to know where the student is looking at and/or referring to while speaking, and thus interfered with the '*foundation of predictability*' as perceived by Heath and Luff (1991) which refers to people's ability of predicting what others will see and

hear by what they see and hear when communicating in the same place. This affected the understanding of the messages negatively.

Looking at this opinion by one of the students in Virtual Crit (2) shows that the affordance of the Avatar as a spatial tool of reference was misleading because of the different perception of viewpoints experienced by different users.

> *V2-Y1S4: "But the fact that you cannot see the same perspective as the one who is pointing makes you see him pointing to another place, unless he is touching the screen, and he is probably really looking at some other place"*

It is therefore difficult for users to know where others are looking exactly, or pointing as the previous quote relates, and this may make it difficult to indicate other users' access to information through the direction they are looking at and/or pointing to. So for example, Figure 8-17 shows three different viewpoints of three users in one if the Virtual Crit (2) sessions, each user selects his/her own viewpoint and views the details in his/her own way.

Figure 8-17 Three Users Viewing Three Different Viewpoints for the Same Project

It has been agreed that the Avatar is a tool of orientation and reference in the virtual worlds, but there is more to perception of orientation than just the placement of the Avatar by navigation, as from the virtual observations and experience in this research, the camera view moves separately to the Avatar, and the actual viewpoints that users look

through are different to one another, this causes a separation of fames of reference and thus divides the narrative into a number of groups of sequences, which may cause instances of misunderstanding or disorientation.

8.5.3 Virtual Proximity

How can technologically mediated communication extend or contract proximity and social interactions in learning? Do people in a virtual learning environment feel proximally closer to each other than they would feel if connected via voice chat or the phone for example? Findings from the studies of (Kauppinen *et al.*, 1998; Becker and Mark, 2002; Antonijevic, 2008), confirm that positioning an Avatar close to another Avatar in 3D virtual worlds, provoked responses that showed annoyance from the users and forced them to move their Avatar away. This suggests that the users felt that their social distance was being violated. This in turn, implies that a perception of such an interpersonal space does exist in the virtual worlds. Users participating in Virtual Crits (1) and (2) have also shared their view on this matter saying that they would move their heads as a quick reaction to this kind of closeness, and as some responses explained, the annoyances came from an Avatar blocking one's view, either by moving uncontrollably or teleporting right in front of the virtual drawing boards. This reflects the nature of the medium and is particularly noticed in group online communication in general as explained by Erickson *et al.* (2011), these quotations from the focus group with Virtual Crit (2) participants confirms the above:

> *V2-Y1S4: "whenever any of the other avatars signed in or did a movement....and if they appear in front of you, it could be annoying as they can block your project as well, so you have to move".*
>
> *V2-Y2S5: "yeah, like when you enter a tunnel"*

The following dialogue shows an interruption in one of the sessions due to an uncontrolled navigation from another student's Avatar:

> *T: Take me through the sequence of the journey*
> *S: Ok*

(all observe one Avatar moving around uncontrollably before the tutor ask about this annoying behaviour)

T: What is Dayle doing?
S2: wanted to get a closer look at the render, sorry ☺

This suggests that some sorts of interruption occurred during the conversation.

(Jeffrey and Mark, 1998) and (Schroeder, 2002) among other researchers have questioned the existence of virtual proximity in virtual environments, the previous passages and quotes along with the observed virtual interactions can confirm that virtual proximity, does exist and affects the verbal narrative of the mediated design review.

8.6 **Remoteness**

Remoteness experienced by the participants who have communicated in the two virtual reviews has had some impact on their conversation and interactions. The degree of remoteness differed between Virtual Crit (1) and Virtual Crit (2) and as a result, is was noticed that the impacts on the interaction outcome had differed as well.

8.6.1 Being 'in' a Virtual Crit

It is necessary when discussing mediated settings, to understand the passing from the real to the virtual and vice versa (Iordanova *et al.*, 2006). As Erickson *et al.* (2011) have experienced in their studies that being in a virtual meeting does not always mean you are in a virtual meeting. For example, when a phone rings at work, or your child cries at home while you are in a virtual conference, your engagement then is broken, you are withdrawn from the virtual to reality. This suggests that students and tutors physically at their homes or the university while engaged in a virtual crit may encounter distractions in their physical settings. In a mediated design review, the course leader or facilitator cannot control these factors and therefore it is a matter of commitment from the participants' end.

In textual communication, users tend to use abbreviations such as 'BRB': Be Right Back and 'AFK': Away From Keyboard to indicate the temporal absence from the conversation. In SL, the Avatars show a 'sleep' mode as a form of a predefined nonverbal cue afforded by the medium, this indicates that a participant is away or has been temporarily distracted in the real world but intends to return soon. It is important to convey this state to

conversation partners so that they are aware that a sudden absence of messages is not due to technical breakdown.

One student who has participated in Virtual Crit (2) was observed to physically point at the computer screen and use gesturing when the voice mode started, but after a few minutes she deliberately stopped. This student was asked about this gestural behaviour, she indicated that:

> *V2-Y2S4: "It came out naturally at the beginning, but then I realised that nobody can see me, so what's the point?"*

In the above example, the student being 'remote' and away from the sight of others influenced her gestural behaviour, as in her own words; "what's the point?", this confirms that gestures may be to some people a primary means of communication, and less important for others, so if not seen, then there is no need to enact them.

8.6.2 Separation and Disassociation: Transactional Distance

Gabriel's (2000:21) observations on different communication channels in collaborative design sessions between architects concluded that:

> *"the successful collaborative design studio does not necessarily mean emulating close proximity environments, in order to communicate and convey the message effectively in the VDS, communication can be achieved using a less bandwidth text based channel with a shared drawing space".*

This statement is proven to be true in many cases of Virtual Crits (1) and (2), giving that we consider communication as a mathematical relation between a sender and a receiver. However, this is not the case in the design review; the human to human learning interaction process involves a set of meanings, emotions and cues, attached to the 'messages'.

A level of transactional distance occurred despite the participants creating a shared understanding of communication symbols. Generally speaking, we have based our understanding of social interactions on our understanding of direct notions of physical

distance and proxemics that rule the way we communicate; this is why the simplest emotion in any online communication is made hyper-real. Using symbols acronyms or punctuation to communicate our emotions and emphases may be misinterpreted due to the exaggeration is carries.

What was witnessed in Virtual Crit (1) confirms this; for example, it is generally accepted that the use of capitalization of letters and exclamation marks, is a kin to shouting in online communication, where in a real life learning environment, shouting would be considered aggressive behaviour and non-acceptable especially from the tutor in a learning context.

In an observed session of Virtual Crit (1), a student had mistakenly created an object and placed it in front of the presentation boards; the tutor asked him to remove the object and used to emphasis his words. See Figure 8-18:

T: Please DELETE that OBJECT....!

And then repeating the whole sentence with all words in capital letters:

T: CAN U PLEASE DELETE THAT OBJECT?

Figure 8-18 Using Capitalisation to Emphasis Text is Perceived as Shouting:

T: *CAN U PLEASE DELETE THAT OBJECT*?

As the student was trying to remove it, he did not give acknowledgement that he saw the tutors' message, and therefore the tutor repeatedly asked. However, when asked after the experiment, the student confirmed that he had asked the tutor how to delete the object but in a private message that was not seen.

> *V1-Y5S7: "When the tutor asked me to delete the box I didn't know how to at first, it was taking some time, and noticed that i was sending him a private message to ask how to do it, but I don't think he read my message because he asked again and again,…it was embarrassing but i managed to do it at the end"*

The student's quote reveals the level of disassociation that he sensed. This relates to the theory of transactional distance, which hypothesises that distance is a psychological, not a geographical distance in online learning. It is a distance of understandings and perceptions that can lead to a communication gap or a psychological space of potential misunderstandings between people (Moore and Kearsley, 1996). The students and tutors, who were physically distant but virtually connected, tended to exaggerate their social interactions in order to compensate the absence of direct social cues.

Another student in Virtual Crit (1) indicated in his questionnaire that he thought there was a connection problem due to not having instant response from the tutor's end so he had to repeat until he discovered that the tutor had been away.

> *V1-Y5S3: "I found myself repeating the sentence again but I realised the tutor had previously said 'one moment please', but i didn't see it,...I would have kept going on and on"*

The student's above explanation identifies two reasons for his feeling of disassociation caused by remoteness, the first is that he didn't see the tutor's incoming message that indicates he will be back in a moment, and the other is that he naturally assumed there must have been a technical reason for the delay.

This form of psychological distance is a result of misinterpretation of the student's silence (no response in the chat line), that led the tutor to add a notion of exaggeration to emphasise his words, furthermore the repetition of the sentence created a sensation of shouting. This would not have happened in real life as such, here, remoteness creates the desire for social and communicational compensation which makes the form of exaggeration such as shouting; i.e. text in capital letters, acceptable by some in distant communication, yet may be misinterpreted by others.

8.6.3 Identity Issues

Remoteness has also brought the question of identity to be raised by a number of researchers in virtual worlds and online communication, SecondLife allows users to choose their first names only, but they must choose their last names from the SecondLife name

directory, some users choose similar names to their own, and some do not. The appearance of the Avatar may also be manipulated within a wide range of varieties.

It was also noticed in the Virtual Crits (1) and (2), that not all users used their real first names, some chose similar names and appearances but some did not indicating they simply wanted to avoid appearing as the default Avatar, and thought it would be '*cool*' to explore other characters, see Figure 8-19.

Figure 8-19 Some Avatar Appearances in Virtual Crit (1)

When asked about their preference of using similar/ different names and appearances to their own, one student from Virtual Crit (1) who have used an animal –like appearance answered as following:

> *V1-Y5S9: "I thought it would be cool, but then it made it hard to know who is talking, so i guess it isn't relevant in a formal crit"*

Some of the participating students discussed this from a moral perspective:

> *V2-Y2S1: "There's a bit of an identity issue with this method, like someone else can be doing your crit for you".*

> *V2-Y1S4: "You can prepare it in advance and just paste it in, and make it sound like a scenario".*

Where from a different view, another student considered remote communication advantageous to some students:

> *V2-Y1S6: "In a positive way, some who are not good at remembering can print out a whole manuscript and just type it or read it out to the tutors".*

Remote communication may help students who experience communication difficulties in face-to-face reviews, either for their lack of good communication skills or for difficulty to remember information.

8.7 Findings on Learner-Technology Interaction

The Learner-Technology Interaction was studied in this section based on observations of the two mediated reviews and responses from the participants regarding their opinions and perceptions of the technology. Appropriate utilisation of the affordances offered by the technology in the online learning environment has been found to depend on both, the technology and the users.

By examining the affordances of the remote communication technology, and how participants in Virtual Crits (1) and (2) used and adopted them, it became evident that the under development, complexity or the inappropriateness of certain affordances to the context of the on-going activity, affected the effectiveness of the learner-technology interaction. In addition to that, it may have also related to the unsuccessful employment of these affordances by the users in some occasions as viewed in this chapter; either due to their skills, prior experience, preferences and enthusiasm, etc. So for example, the technology used in the virtual design reviews afforded the Avatar; which is the human representation and is aimed to provide an alternative to human nonverbal actions, however, from the observations, Avatar gestures and expressions were not completely employed as what would be expected. In the same sense, some students tried to make the best of the technology, and managed to overcome its limitations, while other students were reluctant to use the technology in the first place.

Some mediated interactions and virtual perceptions inside the 3D virtual world supported the notion of student engagement such as the ability to orient the conversation using pointing and navigation, but the complexity in attempting to carry out some inevitable nonverbal actions distracted the focus of the participants. This in turn lessened the feeling of embodied presence sensed by the users. In addition to that, the notion of having separate viewpoints isolated each of the communicators in a narrow perception of the virtual environment, at the same time, did not allow to predict where the other users were looking or relating to.

It was shown also from the analysis in this chapter that communicating at a distance was in favour of the majority of the students; however, not facing the tutor was not the

reason, but rather, it was the presence of their peers in face-to-face reviews. This was not an expected result however, but it shows that the open review system used in many schools of architecture may need rethinking. Remoteness was not advantageous for all students however, as in some cases stress was added due to the frustration experienced by inefficient communication. In addition to that, the disassociation experienced in this context caused, as observed, some level of transactional distance.

In conclusion, this chapter examined the students' relation with the technology; i.e 2D interface, 3Dvirtual environment and physical computer. Personalities, performances and perceptions of the users as well as properties and affordances of the technology play significant roles in the effectiveness of this relation. The next and final chapter concludes this thesis by collectively drawing links between the findings of communication efficiency, learning effectiveness and learner-technology interaction where a collective view on the process of mediating design reviews in 3D virtual worlds will take place.

Chapter Nine

Concluding Discussion

"Where is the wisdom we have lost in knowledge? Where is the knowledge we have lost in information?"

T.S. Eliot- The Rock (1934)

Chapter Nine Contents

Chapter Nine **301**

9 Concluding Discussion **304**

9.1 Introduction **304**

9.2 Back to the Research Question **304**

9.3 Key Issues and Related Findings **306**

9.3.1 The 'Unemployed' Avatar 307

9.3.2 The Separation of the Two Worlds 309

9.3.3 Embodied Presence,... or Focus of Attention? 311

9.3.4 Remote Learning, Where is the Group? 313

9.3.5 Situation-Provoked Actions 314

9.4 Validation of the Research Hypotheses **316**

9.5 The Road to Development and Improvement of Learning Interactions of Design Reviews **317**

9.5.1 Developing Technologically-Mediated Design Reviews 318

9.5.2 Improving Traditional Face-to-Face Design Reviews 320

9.6 Lessons Learned: Difficulties and Constraints of the Research **322**

9.6.1 Experimental Risk Assessment 322

9.6.2 Technical/ Media-Related Difficulties 324

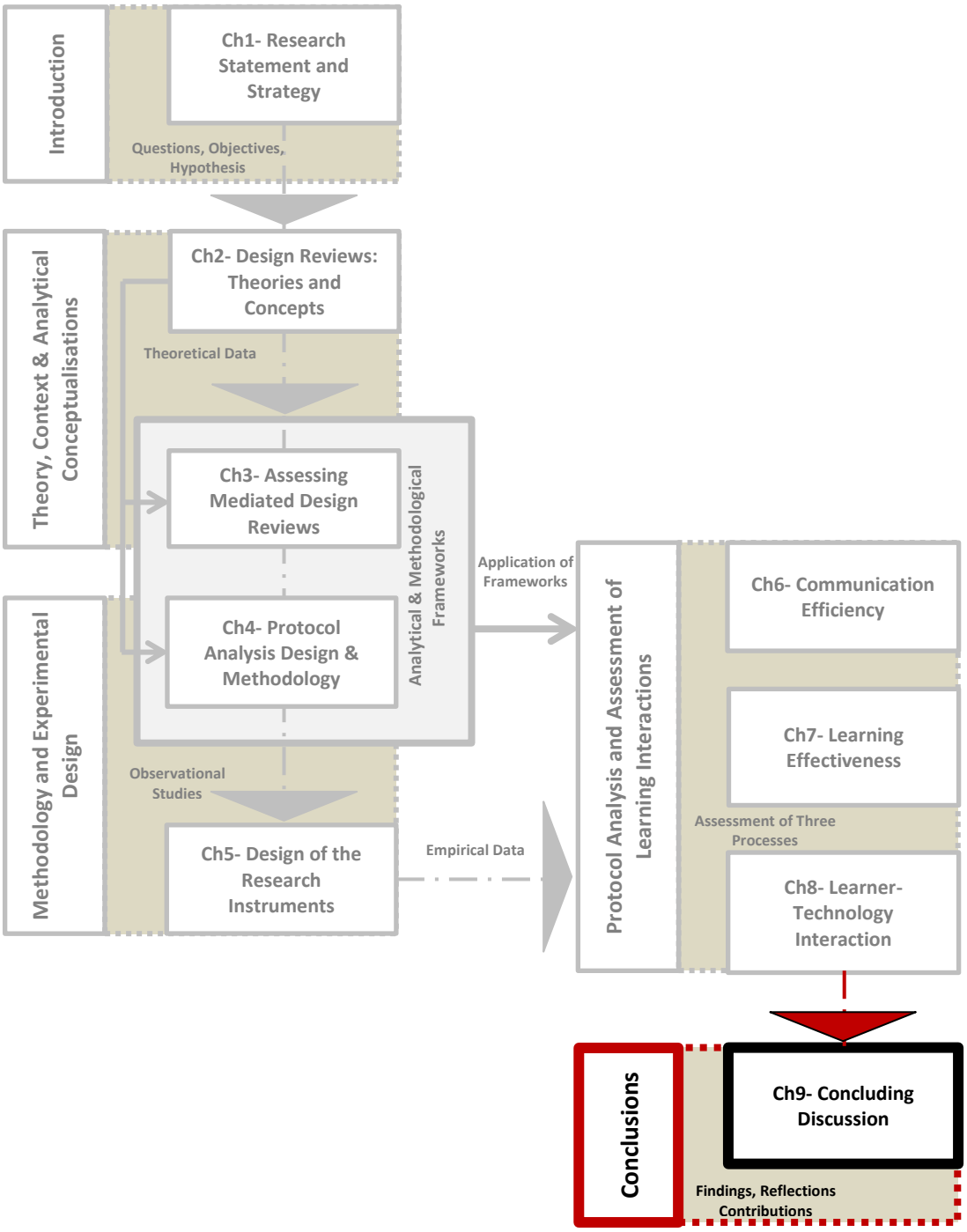
9.7 Contribution and Qualities of the Research **326**

9.7.1 Developing a Specialised Analytical Tool; "The Review Interaction Protocol" 326

9.7.2 Developing a Framework for Assessing the Effectiveness of Mediated Learning Interactions 327

9.7.3 Employing Design Reviews in the Virtual World of SecondLife 328

9.8 Future Research **329**


Introduction
Ch1- Research Statement and Strategy
Questions, Objectives, Hypothesis
Theory, Context & Analytical Conceptualisations
Ch2- Design Reviews: Theories and Concepts
Theoretical Data
Ch3- Assessing Mediated Design Reviews
Analytical & Methodological Frameworks
Ch4- Protocol Analysis Design & Methodology
Methodology and Experimental Design
Observational Studies
Ch5- Design of the Research Instruments
Application of Frameworks
Empirical Data
Protocol Analysis and Assessment of Learning Interactions
Ch6- Communication Efficiency
Ch7- Learning Effectiveness
Assessment of Three Processes
Ch8- Learner-Technology Interaction
Conclusions
Ch9- Concluding Discussion
Findings, Reflections Contributions

9 Concluding Discussion

9.1 Introduction

This final chapter revisits the salient points presented in this thesis with the aim to draw together the various interlinked issues which have been raised throughout the study. These will be discussed in turn, and references will be made to the findings of particular chapters where appropriate. First this chapter starts by returning to the research question and reflects on the aims and objectives which have directed the study. Then it highlights some results that will confirm or deny the research hypotheses, and may also help virtual world developers to be aware of the kinds of interactions, content and patterns that are desirable and occur in the design review to consider them for future technological development. The chapter also presents the difficulties encountered during the preparation of this thesis where lessons learned are summarised for further employment. Then this chapter highlights the main contributions added to the relevant fields of knowledge by stressing on the methodological and empirical qualities of the research. Finally, this last chapter concludes by identifying further analytical dimensions that need to be researched further by educators and researchers to provide more understanding of the interaction outcomes and dynamics of mediated design reviews using different sets of information and media.

9.2 Back to the Research Question

This research has questioned **the role of mediated interactivity in the creation of effective mediated design reviews**. The multi-dimensionality of such question required the construction of a conceptual framework that represents the complex and specific interrelations of the mediated learning process. Therefore the first aim of this study was **to describe and understand the learning interaction process of mediated design reviews**. The key elements of such process were identified in **Chapter Two;** learning interactions and

mediated communication/ interactivity dynamics. Initial descriptions of these elements were presented from the current literature.

At this point, it was possible to draw a conceptual framework that describes the mediated design review in 3D virtual worlds; this was explained in **Chapter Three;** a proposed model of assessment was also presented. The development and design of the **'Review Interaction Protocol'** was introduced in **Chapter Four**; this was formed from a composition of qualitative data collection and analysis methods. The main function of such protocol in to aid the examination, visualisation and analyses of the parallel layers of interactional data needed to assess the process of mediated learning interactions.

Whereas **to examine the effectiveness of the mediated learning interactions in empirical settings** in more detail; as the second aim of this research, three sets of observational studies were conducted in the physical and virtual contexts. These were described in **Chapter Five**. The effectiveness of the mediated interactions was studied by deconstructing this process into three constituting processes which are (1) communication efficiency; (2) design review learning effectiveness and (3) learner-technology interactions. The first two processes; communication efficiency and learning effectiveness were examined in **Chapters; Six**, **Seven**

Whereas **to identify the role of mediated interactivity in the creation of effective design reviews,** the learner-technology interactions were studied in **Chapter Eight.** This, along with the collective view of the research key findings in this final chapter; **Chapter Nine** will conclude our inquiry and produce an informative observation on the subject and relate findings to the initial research hypotheses.

The findings of this research are the results of multi-method techniques involving direct real-time physical and virtual observations, content and discourse analysis as well as nonverbal interaction analysis, combined in an integrated analysis framework. In addition to that, the experiences and perceptions of the participating students in the virtual environment maximised the quality of the findings and supported the validity of the interpretations.

In order to enable a complete examination, the settings used in this thesis included a wide range of influencing factors; components and properties of both the virtual and the physical contexts, this increased the opportunity to examine a richer set of interactions and test the research hypotheses. In addition to facilitating a holistic examination of effectiveness of mediated learning interactions, the methods used in this research also allowed us to discover interactional experiences specific to design reviews. This opened directions for questioning aspects of the technology which transcend the current state of the art of 3D virtual worlds and call for developmental studies to enable them to effectively host interaction-based learning activities such as mediated design reviews.

So, what is the role of mediated interactivity in the creation of effective mediated design reviews?

It has been proposed, and proven by the key findings in this research that the mediated learning interaction process is a result of input from both the users and the technology. Based on Simpson and Galbo's (1986:37) concepts on interaction;

> *"Learning is a result of something considerably more than external forces brought to bear upon the student, learning is individually constructed from one's interaction with others in context".*

The learner, which was the focus of our inquiry, brings his/her experience, skills, willingness, and abilities, among other possessions, to the mediated learning experience. The technology, however, plays the greater role in hosting the interaction, influencing, directing and to some extent, dictating the resulting learning content and interactions. The influences of the technology come from the attributes and properties it possesses.

9.3 Key Issues and Related Findings

The following sections discuss how some interactional aspects of the mediated design review presented themselves significant to address, and synthesises interrelated links between the findings of this research; showing how the mediated, virtual and remote properties of the technology, shaped the learning interactions accordingly and how the participants dealt with the affordances of the mediated context. Some of these aspects relate to the current status of virtual worlds; represented in the examined environment of

SecondLife. Other aspects relate to how design review interactions are enacted inside, and outside of the virtual worlds. Another set of aspects considers the appropriateness of the remote context to design review learning.

9.3.1 The 'Unemployed' Avatar

The findings of this research have verified the importance of mediating nonverbal means of communication for their significant role to orient verbal narratives. As restricting the access or interrupting the fluency of using specific nonverbal modes of communication in the mediated environment have caused more asking for orientation, which interrupted the lines of thought and sequences of narratives hence wasting time on giving orientation, and depriving the students from saying everything they wanted.

Building upon the characteristics of all media, McLuhan (1964:8) has stated that the message of any medium is always another medium, therefore, the importance of nonverbal modes of communication lies in the fact that they can be considered media in their own sense; they possess different functions and meanings that participate in completing and managing the communication which in turn, affects how meanings are perceived. It was found from the observations of the two mediated design reviews, that pointing and spatial gestures, which refer to size, location and spatial orientation, do not just carry information as media, but they are the message being communicated as well, and therefore they can be considered messages and media at the same time. So for example, the tutor perceives, from facial expressions of the student, that his instructions are understood, and the student gains confidence when capturing nonverbal signals of solitude such as head nodding, or a smile. These interactions must be seen by the tutors and students in context in order to deliver their intended meaning.

In the absence of the video channel, there is great pressure on the Avatar to act as the substitute of human expressions, and embodied gestures. The analyses showed that the level of restriction and/ or affordance of Avatar pointing, and facial expressions, affected the ability to (1) orient the narrative of the verbal content of the review and (2) to show

and predict signs of attentiveness and perception of information. Therefore the delivery of meanings was affected substantially.

It is true that the Avatar is perceived as a representation of the human body, to point and perform a set of embodied gestures and signals, yet these sets of nonverbal communication have been found to be unemployable in the context of design reviews. But when examining, in isolation, the way gestures, pointing and facial expressions of Avatar's were enacted in the Virtual Crits (1) and (2), and correlating this with the students' perceptions and opinions, it could be possible to identify some of the reasons that let users cease to use built-in Avatar gestures in the two virtual crits, except for exploration and fun, before the actual review session began:

(1) The Avatar gestures and nonverbal behaviours available in SecondLife were few and inarticulate, and have no potential to complement the verbal dialogue, except for a few which are only effective when activated such as nodding, laughing,....etc.

(2) Activating these gestures from a pull down menu was inefficient, the users needed to perform a conscious act using the mouse/keyboard to select their choice of gesture comparing to real life; nonverbal gestures occur naturally, spontaneous and unconsciously accumulating the verbal conversation.

(3) Most 'lifelike' behaviours or predefined gestures were not relevant to the design review conversation, but they occurred randomly, such as looking around the environment, or staring in another direction, while this act could have resulted in false prediction of orientation due to the misleading signals.

Antonijevic's (2008:228) has classified nonverbal communication in SecondLife specifically into four classifications, these are (1) user-defined cues, (2) predefined cues, (3) blended cues and (4) missing cues, as previously introduced in Chapter Two. However, we see that Antonijevic's (2008) classification of nonverbal communication in SecondLife are based upon 'availability' where it is more reasonable to classify them upon functionality and usability. As it can be argued from the findings of this research that these cues exist in the virtual world and can be executed, but they fall beyond the stream and flow of

spontaneous communication, and therefore they are 'unoccupied' and 'unemployed' in the communicators' narrative.

Referring specifically to the context of the mediated design review, as an assessment-based, graphically-focused, relatively short discourse, Avatar pointing and other cues that can be performed from a pull down menu or a keyboard shortcut, seem to be imposed on the communication and hence, interrupt the line of thought. This means that they 'get in the way' rather than support the flow and quality of the verbal discourse. When students need to spatially relate to the graphics and point to specific locations during the design reviews, a price must be paid, more thought and more time. Communicational frustration as well accompanied the poor gestural language that was enacted by uncontrollable Avatars, compared to the richness of the physical context of communication. Nonverbal communication used in this way are probably better off not used in the first place, especially when this research has found that users managed to communicate their messages nevertheless, using to some extent Avatar navigation and flying, where using verbal communication was the main method of orienting the discourse.

9.3.2 The Separation of the Two Worlds

The most natural way of linking spoken material with visual imagery is through hand gestures (Camurri and Volpe, 2004). Tang (1991) has concluded in his studies that illustrator gestures are a crucial resource information in design activities. While we do not have explicit evidence that can generalise that a successful design review communication requires certain nonverbal actions to occur; the fact that these actions occur so frequently and naturally as recorded and closely observed in this study, means that they are vital to the effective design review dialogue.

Observing the physical space of the second virtual experiment, a quite interesting simultaneous blend of physical nonverbal actions accompanied voice in the audio stage of Virtual Crit (2). The participants started to use their hands; zooming in and out or controlling the Avatar with the mouse or keyboard controls with one hand, while pointing or gesturing with the other hand, or gesturing with one hand and pointing with the other

to the computer screen. This particular form of interaction came out naturally, moreover, the verbal narrative seemed more structured, the participants claimed back their use of physical pointing and gestures once they freed their hands from typing, yet still, navigating their Avatars was enacted to orient the spoken utterances. This particularly proves the following statement by (Mousavi *et al.*, 1995:321):

> *"When possible, spoken information—rather than text—should accompany images, because the text necessarily takes visual attention away from the imagery. If the same information is given in spoken form, the auditory channel can be devoted to it, whereas the visual channel can be devoted to the imagery".*

Hand gestures which relate to the ideas by expressing certain emphasis or directing ones narrative, occur simultaneously with the verbal explanation of the idea. As timing is important here since gestures that revolve around the graphical representations are closely associated with speech, any technology that conveys gestures should avoid disrupting their relationship in time with the accompanying verbal discourse. Yet, this level of precision to mediate hand gestures in the virtual worlds via the Avatar is near impossible, having experienced and observed the state-of-the-art of current virtual worlds, the processes of coding, abstraction and encoding of these actions creates an unavoidable time-lag. So why not do it the other way around? Referring to Hiroshi Ishii's (2008:xv) statement when describing the separation between the physical and the virtual worlds:

> *"we are now facing the challenge of reconciling our dual citizenships in the physical and digital worlds. Our visual and auditory sense organs are steeped in the sea of digital information, but our bodies remain imprisoned in the physical world"*

The call for this approach in architectural design collaboration and learning to manipulate the digital information directly with human hands is an extension of the physical affordances of the objects into the digital domain, by situating the physically-embodied digital information in physical space, and not the opposite as created through the Avatar in the virtual world.

9.3.3 Embodied Presence,... or Focus of Attention?

Social presence is an important factor in distance learning and one of the four theoretical constructs in distance education (McIsaac and Gunawardena, 1996). The intensity of the sense of the social presence of others depends on the particular media in use, as social presence theory notes the fact that people select media for its degree of social presence and its particular suitability for the task they wish to accomplish (Becker and Mark, 2002). Meaning that we decide whether to meet, speak on the phone, send an email or an instant mobile text message depending on what we want to say and how we want to say it, and probably to whom we want to say it to. Recently, virtual worlds have been added to that list of media options. SecondLife among other 3D Avatar real-time virtual worlds, according to a number of recent publications convey a strong sense of presence (Stein and Wanstreet, 2003), social presence (Wheeler, 2005; Warburton, 2009) and much recently; embodied presence (Mennecke *et al.*, 2011). Researchers also argue that there is a positive relation between the richness of the media, and the feeling of presence, such as Davis *et al.* (2009) who conclude that embodiments via Avatars and visual media in general facilitate more presence than audio/ text based media alone.

The 'VIRTU'vian man, as Boteva (2006:23) calls him, is considered a virtual self of the human user. According to Mennecke *et al.* (2011) this virtual body is a whole representation of the self, complete with affordances that allow users to re-enact existing social scripts while interacting with others. Mennecke *et al.* (2011:435) state that in virtual worlds, the Avatar is used as a tool for communicating through action embedded in a symbolic context, which is how we use physical bodies in physical spaces. However, the fidelity in trying to manipulate the viewpoints and navigate the Avatar interrupted the spontaneity of the conversation, and thus, affecting the feeling of engagement. The Avatar was merely a 'virtual pointer' and not a 'virtual self' to the participants of Virtual Crit (2) who could not enact Avatar pointing.

It was therefore made evident that the main factor that facilitates attention and promotes devotion to the task and thus strengthens the feeling of presence is not the richness of the medium, nor the simulation of the human body, but rather, it is the

appropriateness of the afforded modalities to communicate both verbal and nonverbal interactions to serve particular contexts i.e. design reviews.

Therefore this research proposes that when attempting to raise the feeling of presence and immersion to support online learning interactions, it is important to concentrate on the '*focus of attention*' of the shared learning discourse and not the richness of the affordances. Focussing on serving specific activities requires providing efficient communication delivery, with minimal interruptions. It is necessary therefore to analyse the activity, identify a set of the most used interactions and customise those in the virtual worlds explicitly, to better serve the focus of attention of the design review.

This echoes what Mennecke's *et al.* (2011:435) found;

> *"when users through avatars, are engaged in a substantive activity-based interaction, a deeper level of interaction occurs"*

They concluded that participants experienced a higher level of embodied presence when there was a meaningful shared activity-based interaction process going on, with fewer distractions. In Virtual Crit (1) the participants used the properties of the Avatar for orienting the narrative more efficiently than those in Virtual Crit (2), and this created a more fluent verbal communication where encoding, conveying, and decoding individual and collective communicative acts was carried out more efficiently, thus resulted in a higher order cognitive and critique conversation as well.

The notion of 'co-navigation' which was observed and discussed in Chapter Eight, is also an example of engaged embodied activity that involves two Avatars 'walking together' in the virtual world, the way this activity was enacted suggests that it highly relates to embodied presence. Thus, in an interpretation based on the observations in this thesis, embodied presence in mediated design reviews may be related to three factors; (1) the focus and devotion to discuss the project in the design review and (2) the appropriateness of nonverbal modes that complete the verbal discourse; that does not cause interruption to the narratives or the thoughts (3) the duration of the embodied activity, the longer the embodied activity, the more engagement and sense of presence that could be achieved.

9.3.4 Remote Learning, Where is the Group?

Learning production through reflection and feedback in the design review is significant for future learning. According to Doidge *et al.* (2000), teaching in an ideal design review is supposed to be targeted to the whole group of attending students. However, this may not be the case in practiced face-to-face reviews due to numerous reasons, to mention one, each of the students is worried about his/her own review, they hardly pay attention. Some tutors aim at stressing the qualities of their peer's project or note down common mistakes, and this has been considered by researchers to be central to design review learning (Crysler, 1995).

What could be easily distinguished between the three experiments; Face-to-Face, Virtual Crits (1) and (2), when examining the critique narrative of the participants was that the presence of other students in the Face-to-Face crits provoked an important interaction which is '*summarising of agreements'* by the tutor as a type of reflective discourse to teach gathering students through abstraction. On the other hand, the participants in the two Virtual Crits (1) and (2), did not experience this form of teaching and learning. Despite the fact that other students were 'remotely' attending other students' crit sessions and their Avatars were visibly present to other participants, yet their presence could not be 'physically' sensed and therefore were not addressed as a group in the analysed dialogue.

Praising the lower degree of stressfulness in the virtual crits as an advantage of remote communication, the students have referred to the relief of not feeling their peers looking/staring at them during their formal discussion with their tutor. However tutor-student conversations became isolated, with minimum input from other attending students despite the presence of other Avatars in the virtual learning environment. Almost half of the participating students have stated that they have attended their peers' virtual crit sessions, but none of them have considered them beneficial in terms of learning and feedback; the disappearing sense of 'the group' in fact, affected their participation as listeners, so they may have missed out on some great opportunities for group learning in the remote context.

Moreover, it has been found that this notion of 'not feeling the presence of the group' contradicts the feeling of co-presence which is one of the promoted potentials of the use of embodiments in the 3D virtual world. In our view, giving priority to separate communication threads in separate windows in the virtual world, with encouragement from the tutor, might help reinforce the active participation and presence of other students in the mediated design review.

The issue of identity in the virtual world presents itself relevant here as well; it was shown from the analysis in Chapters Seven and Eight, that the hidden identities of the Avatars caused the persistent need to call each student at the beginning of each session to present his identity. Despite the relatively small all-known group of students and tutors participating in the crits, the Avatars' identities remained unknown; first by the name choice, and second by the appearance of the Avatar which may not relate to the real person's name or appearance in many cases.

Many researchers have approached the issue of hidden identity in 3D virtual worlds such as (Conklin, 2006; Boon and Sinclair, 2009), where they have criticised this notion especially in learning; urging for the caution to use in online education. In the context of design reviews, despite the advantages of not facing the tutor or the audience for its proven effect of decreasing the level of stressfulness, the design review is an exam after all, where the students' identities are important to be known.

9.3.5 Situation-Provoked Actions

It is recognised that user behaviour accommodates to different interfaces and technologies with different communicative features (Bekker *et al.*, 1995), for example; on the telephone, people learnt to describe ideas at greater length because gestures cannot be seen by conversation partners. Simple interactions are artificialised to overcome the distance, signals such as eye gaze, head turn or gestures are translated in symbols and emoticons, which are well known to online communicators and text messaging users.

From the analysis of interactions in the observed mediated design reviews, it was found that participants accommodated their behaviours to the medium of communication, either

by engaging with the available features, or by substituting the limitations and compensating for the remoteness they felt. Thus adapted to the situation, but with a cost; more thought and more words. So for example, in Virtual Crit (1), the participants made full use of textual punctuation to overcome the absence of vocal expressions. They had also been observed regularly asking for and giving online acknowledgements to confirm both, attentiveness and perception of learning. Yet this, it was observed, created instances of repetition and interruption, having to write more words out of the review-discourse context.

Another issue relevant to remote communication should also be noted here, the remote context provoked more instances of showing tutor-immediacy, and friendliness, to compensate the feeling of distance. However, the conversation was not without instances of abstract exaggerations represented in social symbols, or using capitalisation for emphasis, these extreme instances were often observed to cause misinterpretations of meanings.

In Virtual Crit (2), as the participants could not point with their Avatars' arms, they used flying as an alternative; they flew their Avatars and pointed with its feet or head. As they found orienting the narrative quite difficult using the Avatar, the tutor created a system for managing the communication by instructing the student at the beginning of the sessions to start by giving verbal orientation by describing the whereabouts of the drawings, 'guiding the way' through the drawings first, then explaining the designs.

The tutor also suggested how to enter text in short statements followed by acknowledgement to avoid prolonged silent periods waiting for continuing text to be entered in the chat line. These interactions were adopted by the users and it can be claimed that these were quite successful situation-provoked behaviours to deal with the media's shortcomings.

The interactional experiences recorded in this research, may open the way to developing some aspects of 3D virtual worlds to create better learning experiences for tutors and students in the remote context. Some of these would be; a simple hit of a key to trigger 'giving online acknowledgment' through Avatar head nodding for instance. The

prolonged wait for responses in the chat box can be avoided with indicators of 'incoming message' on the screen instead of the 'typing Avatar' animation which gets less attention from users focusing on the chat box or their displayed images.

9.4 Validation of the Research Hypotheses

After summarising the key findings of the research in the above discussion, what can be said about the potentiality of 3D virtual worlds to effectively mediate the design review? These virtual systems are often thought to simulate the real environment as well as to support learning interactions due to the significant interactional potentials they afford and claimed by many researchers such as (Avisthi, 2006; Kieran, 2007; Ryan, 2008; Warburton, 2009; Erickson *et al.*, 2011; Tang *et al.*, 2011). This research has made three hypotheses in Chapter One, based upon initial research anticipation and readings. Given the results of analysis reached in this thesis, the following paragraphs may confirm or deny these hypotheses.

This research has hypothesised that the affordances and limitations of the interactional aspects in the virtual worlds may affect the flow and sequences of the synchronous communication, but not the quality and content of mutually communicated learning content.

The observed mediated design reviews showed that the learning content was not at all times supported by the medium. This was clear in the separation of narratives of the verbal discourse, the inefficiency in mediating nonverbal interactions that led to some disorientation, as well as technical problems that affected the uploading and/or quality of the drawings which resulted in the users' misperception of information and lower cognitive levels of discourses.

The second hypothesis made in this thesis was that certain properties of the technology, specifically those which aim to support different forms of interaction, such as embodiment, presence and remoteness will play a positive role in the effectiveness of the learning interaction process.

This research, focusing on design review interaction has found that 3D Virtual Worlds in educational studies are not exploited as they should be, communication does not go beyond the chat box and voice tool when interacting in a mediated design review. The potentials of Avatar body, gestures, and facial expressions do not serve the formal educational experience; we believe this underdevelopment of features pulls virtual worlds away from the 'hot' zone proposed by. Although the remote context lessened the feeling of stressfulness, it caused a sense of separation and disassociation between the tutors and the students who were physically distant. A level of transactional distance was a result.

This thesis hypothesised as well that students and tutors will continue to interact effectively and create a shared language of understanding despite the communicational challenges.

This hypothesis may be confirmed true to some extent, based on what was witnessed from the users' adaptation to the available tools of interaction they have, conveying their messages and working around limitations of the medium. However, more effort to orient the narratives and to show all possible information resulted in the feeling of frustration as expressed by some of the participants.

9.5 The Road to Development and Improvement of Learning Interactions of Design Reviews

Both the process and outcomes of conducting this research and development of the methodological framework have made it possible to understand and come closer to the strengths and weaknesses of both face-to-face and mediated design reviews. This in turn has opened ways of development and improvement for both learning interventions. So, for example, employing the Design Review Protocol on several traditional face-to-face design reviews makes it possible to visualise different patterns of interactions that may give different readings of different design review scenarios. With the aid of ethnographic studies, and participants' perceptions and their projects' marks, correlations may be made between pedagogical, personal factors and patterns of interaction for the purpose of understanding how to create a best case scenario for design reviews, and thus improve the traditional design review learning interactions.

On another bases, the rigorous analysis of face-to-face communicational interactions carried out in this thesis highlighted the significance of specific nonverbal modes of communication which are crucial to the design review learning interaction process, however these were found to be underdeveloped or missing in the virtual environment hence suggesting recommendations for technological development. Whereas on the other hand, the educational potentials of virtual worlds lead us to realise how we can solve existing problems of face-to-face reviews.

9.5.1 Developing Technologically-Mediated Design Reviews

In order to develop and fully exploit the educational potentials of virtual worlds in design learning contexts, to be able to carry out distant synchronous communication, more rigorous research that employs interaction analysis of face-to-face design reviews must be carried out. A set of the most used interactions can be customised explicitly to better serve the focus of attention of the activity. Thus establishing which features of interaction are to be highlighted, or augmented and select an array of computational tools that address the desired human interactions appropriately.

Table 9-1 highlights the significance of some of the analysed face-to-face interactions that are missing or underdeveloped in virtual worlds from the experience of this research, yet very important in the delivery of learning interactions of the design review, and thus are required in a good online communication system. The following table also suggests a number of technological recommendations to aid interaction in the distant design learning context, either by suggesting implementation and utility of new technologies that carry out much sophisticated mediated interactions, or by development of the current properties of newer versions of 3D virtual worlds.

Table 9-1 Significance of some Missing or Underdeveloped Nonverbal Interactions in 3D Virtual Worlds and Developmental Recommendations

Nonverbal Interactions Found in Face-to-Face Reviews but Unavailable or Underdeveloped in 3D Virtual Worlds	**Importance/ Significance to the Context of Design Reviews**	**Technological Developmental Recommendations for better Online Communication in Design Reviews**
1- Pointing and Spatial Hand Gestures	- Determines Orientation, Location and Spatial Reference	- Development of Avatar Pointing Properties - Gesture Detection Technology via Motion Sensors or Webcam
2- Facial and Emotional Expressions	- Determines Acknowledgement of perceived learning - Shows Solidarity/ Appreciation and Tutor Immediacy - Gives Handover	- Facial Detection/ Recognition via Webcam and Enacted by the Avatar. - Word-Triggered Avatar Gesturing to show solidarity or give Handover.
3- Body Language	-Shows Student Confidence, Anxiety, Stressfulness	- Development of Avatar body language, to be triggered by text or voice.
4- Head Movements	-Shows Agreement/ Disagreement -Gives Positive/Negative Evaluation	- Motion Detection via Webcam and Enacted by the Avatar.

As shown in the above table, this research has found that pointing and spatial gestures in relation to the design graphics are vital nonverbal modes of communication, which have an essential role in determining orientation, location and spatial reference; they must be communicated thoroughly to reach a full understanding of the communicated information. Facial and emotional expressions are active factors in acknowledging understanding and perception of knowledge in the design review as a learning context as well.

Technologically mediated environments that fall under modality constrains for communicating those nonverbal interactions, require considerable adjustments to be fully usable for distant design reviews. Focusing on these interactions specifically for Avatar design development should be a priority for 3D real time virtual world's systems developers and distant educators in graphical based disciplines in order to facilitate and achieve multi-modal communication.

This can be done by designing an Avatar capable of performing accurate body language which supports social interaction suitable for learning activities. A considerable range of facial expressions can be coded and recognised by a web cam to be enacted by the Avatar;

these may include facial expressions which serve the learning communication; by showing solidarity, showing appreciation, giving acknowledgement,..etc.

So instead of enacting Avatar gestures by selecting an option from a pull-down menu, or keyboard shortcuts, a suggestion here would be to develop word-triggered gestures that can activate specific actions that integrate with verbal discourse in a meaningful way, and save both effort and time. Alternatively, immersive motion detection technology can track the user's hands in relation to the object he/she is referring to, and capture human pointing and spatial illustrator gestures which can be mimicked by the Avatar.

9.5.2 Improving Traditional Face-to-Face Design Reviews

On the other hand, as it has been proven in this research that interactional aspects of mediated reviews are not successful compared to face-to-face interaction, thus still far from being fully useful, yet this study has found that distant communication in the design review has provided some useful educational properties that may help solve communication and organisational problems of the face-to-face design review. Reflecting upon this, and inducting back to face-to-face reviews, it is possible to suggest ways to improve the traditional methods of teaching and leaning in design reviews, Table 9-2 summarises these recommendations.

Table 9-2 The Significance of some Educational Strengths found in Distant/Mediated Reviews and the Recommendations needed for Improving Traditional Face-to-Face Reviews

Educational Strengths found in Distant/Mediated Reviews	Importance/ Significance to the Context of Design Reviews	Recommendations for Interactional Improvement of Design Reviews
1- Not Faced by Peers in Reviews	- Lower levels of Stressfulness	- Avoid Public Defences
2- Elimination of Front-Row Advantage	- Equal Access to Projects by all Participants	- Integrating Laptops within the Review Sessions while having access to Digital Projects
3- Diminishing Time and Space Restrictions	- Facilitating Learning by Solving Schedule/ Organisational Problems	-Supplementing Learning by Integrating Distant Reviews in the Time Schedule
4- The Constant Need to show Solidarity, Agreement, Acceptance and Acknowledgement	- Communicating Meaningful Messages that Facilitate Educational Interaction and Feedback	- Tutors should make effort to reveal these interactions in the Face-to-Face Context

So for example, it was found in this research that students were most likely to feel more stressed when faced by their peers, and not as much, as we had anticipated, when faced by their tutors, therefore a suggestion may be to avoid public crits for those students who are shy or have communicational problems.

Another point of strength of the distant communication was the elimination of the front-row advantage of traditional reviews while having the opportunity to save the whole review dialogue as a word document. All students in the virtual crits had equal access to the reviewed design project. This may be implemented in face-to-face crits by sending all the projects to the students, and using laptops in the review session to have access to the projects being reviewed. Peers can easily join in the discussion, and participate with their comments anonymously.

The diminishing of time and space remains the most significant strength of technology and distant communication, despite the many interactional problems associated with the employment of distant design reviews as shown previously in this study, the utilisation of this technology is necessary to solve some organisational problems of face-to-face reviews as a supplement to facilitate learning. For instance, due to the large numbers of students with no corresponding numbers of tutors, the duration of the class -in desk crits for example- may not be enough for all students to have their work reviewed, here implementation of after-hour's virtual crits may be a good solution to overcome the time limitation of classes. Virtual reviews may also be implemented in the schools' time schedule for students who may not be able to be physically present in the school, thus have the benefit of distant communication.

Furthermore, the results of analysing mediated activity in this research have highlighted the importance of 'showing' some communicational acts that are significant to the context of design reviews, yet were difficult to show or enact in the distant reviews. For example, showing solidarity/antagonism, approval/disapproval, agreement/ disagreement in addition to showing acknowledgement of receipt of information from the tutor and the student either by using nonverbal cues or simple one-word utterances, play an educational role of criticism and feedback and carry meaningful messages. Looking at face-to-face

reviews, we may notice that some academics conceal these interactions, and therefore, miscommunication, separation and thus transactional distance may occur in face-to-face reviews. Revealing the importance of these interactions from the undertaken distant reviews leads us to recommend that tutors make effort to 'show' these acts while communicating during the presentation and discussion phases of the design reviews.

9.6 Lessons Learned: Difficulties and Constraints of the Research

When talking about difficulties and constrains that affected the collection and examination of data, a number of issues that emerged from the working experience of this research, as well as from the participants' responses and feedback after the two virtual experiments are addressed hereby. The aim is to assess the experience encountered in this research, and set rules for enhancing future experiences. The empirical research showed a range of constraints which can be divided into:

(1) Experimental issues that can be to some extent managed with more time, practice and preparations.

(2) Technical and media-related issues, which refer to the current state and connectivity capacity of the technology and the used media.

9.6.1 Experimental Risk Assessment

With the aim to explore the ground by introducing new methods or innovations, exploratory research yields a number of risks. In general, this risk is mitigated by the experience of the researcher and the ability to change elements of the activity in response to the users' needs (Thackray *et al.*, 2010). Both Virtual Crits (1) and (2) had a number of potential risks, some of which could apply to any innovation, while some were anticipated in advance, others could only be encountered with experimenting.

- Duration of the Virtual Reviews: there was uncertainty about how downtime might affect the students' design reviews. The average duration for a review session is from fifteen to twenty minutes, however online communication was

anticipated to require more time, but it was not by any means possible to predict, prior to the experiments, exactly how much longer the virtual reviews would last. After Virtual Crit (1) was conducted, it was found that time should be added when preparing the sessions of the second review; Virtual Crit (2), so these were made longer. However some sessions needed up to ten more minutes of duration due to some technical problems that occurred unexpectedly in Virtual Crit (2).

- Experimental Control: specifically talking about Virtual Crit (2),this set of design reviews was designed to mimic the remote situation, only the users had to be present in the same space to allow for the recording of the human-computer physical interaction. However, we think that this caused a slight sense of playfulness in some occasions, which affected 'showing solidarity' and 'transactional distance' as shown in chapters Seven and Eight. In addition, although the placement of the communicating tutor and student were made to avoid facing each other, looking at each other was not entirely avoided; this allowed the users to see each other's interactions, for example, 'handover' in the virtual context was to some extent affected as the students could see when the tutor stopped typing and then started their own input as shown in Chapter Six and highlighted by the students who gave feedback.

- The Virtual Learning Space: despite collecting information about the sizes and scales of the students' design projects prior to the experiments via pre-test questionnaires, not all students answered the questions accurately, thus a small number of students gave noticeably low rating to the placement and sizes of the display boards inside the virtual environment. The negative feedback referred to some projects having different orientation and proportions to the prepared display boards in the virtual world, this affected the visual properties of a small number of projects. When asked, some students suggested that they should be given the opportunity to design the boards according to the orientation and proportions they prefer to use.

- Objective Comparison: the experimental research aimed to compare face-to-face interactions with mediated interactions; however theses two sets of interactions happened completely differently between the two environments, thus preventing objective comparisons in some aspects such as facial and vocal expressions. Having said that, the comparison in this case was based on the richness of the on-going interactions in both environments, and resulted in understanding more about mediated interaction and human-computer relations. In addition, the number of participating tutors in the face-to-face reviews could not be replicated in the virtual crits.

9.6.2 Technical/ Media-Related Difficulties

Technology seems to be the factor that, both, enables and constrains learning in online environments; as Soo and Bonk (1998) concluded, educators and researchers are faced to whether accept running a programme with limited interaction capabilities, or postponing distance education until the technology supports the kind of interaction desired. The virtual environment presented its own risks, which are addressed in order to avoid any potential communicational frustrations, difficulty in usability of tools and unwanted interruptions to the learning conversation.

- Accessibility; from a technical perspective, there was a need to ensure that access to the used software would be available on the University private network and it would run in any of the university's computer clusters to set up a physical setting for video recording, and that software updates would be installed as needed in the time of the crit. It was also necessary to ensure that it was not subject to periodic software upgrades when the two Virtual Crits took place. This meant several corresponding with the university technicians to upgrade the software and with the owners of the Newcastle University island in SecondLife to ensure permissions and land ownerships.

- The lack of Detailed Information; no published specifications on the size and resolution of drawings that need to be uploaded in the used medium

(SecondLife) could be found, and therefore it was a matter of trial and error in the preparation phases of the experimental design. During the experiments, uploading large sizes of images (design projects) caused a bit of delay for a few cases caused the software to crash.

- Testing, and more testing; the continuous updating and changing in the platform and tools resulted in amendments in these tools and the way they are used. As Jabi (2003) concluded in his work, testing every aspect of the experiment is highly recommended, it may be worth adding to Jabi's recommendation, that testing may require using different computers with different settings to identify which computer settings i.e. resolution, screen size, etc. work best.

- Familiarity and Usability; neither staff nor students were fully conversant to the medium of communication, even with some practice prior to the sessions; many participants for example were clearly not mastering navigation and the use of other tools at the beginning of the sessions. Training and practice of the media tools and orienting one's self in the virtual environment leads to more focused discussions, and fewer distractions caused by the usability of the tools.

- Time and economics; these present a very real challenge to many educators considering engaging in teaching activities in a virtual world (Thackray *et al.*, 2010). An alternative to purchasing land in the virtual environment can be renting or borrowing a piece of land from another institution. Although a basic account is free but anything beyond simply being present in-world costs money for the individual educator or researcher, i.e. buying items to create teaching spaces; uploading images and textures; and purchasing useful in-world tools such as cameras, employing building and scripting expertise. Learning the use of the tools especially basic building activities in the virtual world is also time consuming to a great extent.

9.7 Contribution and Qualities of the Research

The multi-faceted and complex nature of the design review as an on-going process of communication, interaction and cognitive development, presents a challenge to the examination and assessment of such process, let alone when mediated. Yet, much of the existing literature has not presented a full description of this process.

This study, therefore, proposed to identify and conceptualise interactivity of mediated design reviews in 3D virtual worlds. By this, it is hoped to contribute to the growing body of literature in the fields of design education, distance education and computer-mediated communication. The contributions and qualities of this research have been made in a number of ways in this thesis, these can be summarised in the following.

9.7.1 Developing a Specialised Analytical Tool; "The Review Interaction Protocol"

A number of researchers have carried out interaction analysis in general (Bales, 1950) and some have analysed design activity specifically such as (Salomon, 1981a; Dutton, 1987; Feigenberg, 1991). Others have looked at learning activity in 2D online learning environments such as (Garrison, 1993; Gunawardena *et al.*, 1997; Bender and Vredevoogd, 2006). While others have analysed learning activity in 3D virtual worlds specifically, (Henri and Pudelko, 2003; Thackray *et al.*, 2010). A wide range of studies have also examined design collaboration in virtual design studios such as (Maher and Saad, 1995; Gabriel, 2000; Kvan, 2001; Iordanova *et al.*, 2006; Tang *et al.*, 2011). While a number of researchers focused on analysing activity in online design reviews using computer-supported tools such as (Daily *et al.*, 2000; Weidong, 2005; Bassanino *et al.*, 2010), which is closest to the inquiry of this research, however, no published literature could be located that qualitatively analyses design learning activity in both face-to-face and mediated design reviews using 3D virtual worlds.

The unavailability of an adequate analysis coding scheme prompted us to develop a specialised protocol; see the diagram presented previously in Figure 4-6, page 118. This has contributed to increasing the level of understanding of interactions in the pedagogical context of design reviews specifically, which may enable researchers, in the future, to build

on in order to further investigate verbal and nonverbal interactions in design disciplines or similar.

The development of the "Review Interaction Protocol" allowed the identification of the different dimensions of verbal data and nonverbal interactions and allowed to qualitatively study interrelated categories from different data sources such as functions of verbal discourse, communication management and levels of cognitive and critique discourse that occur in three different communicational formats of design reviews. The rigorous analyses of verbal and nonverbal interactions in this study enabled the visualisation of patterns of activities as they are carried out in parallel, while having the ability to assess the cognitive and critique level of discussions and other communicational instances at the same time. This in turn allowed clear and direct comparisons of different learning contexts (both virtual and physical) relating them to the different actors (tutors and students).

9.7.2 Developing a Framework for Assessing the Effectiveness of Mediated Learning Interactions

This study aimed to contribute to the debate on the effects of the mediated context on learning interactions by going beyond simple acceptance or rejection discourses associated with studies that compare online to traditional learning in architectural design. It is proposed, in this thesis that such researches on online learning focus on assessing some aspects of the learning process, i.e. learning perceptions, but neglect others, i.e. interactional aspects; failing to provide a holistic criterion of assessment of the online learning interactivity process. This study demonstrates the importance of considering every aspect of the mediated learning interaction process before rejecting or accepting mediating design learning.

The assessment framework developed in this thesis makes use of a greater range of interactional aspects and communicational conditions. By initially conceptualising the mediated learning process of design reviews in virtual worlds (see Figure 3-8, page 91), the research has presented an assessment framework (see Figure 3-10, page 96) that is based

on the deconstruction of the mediated learning interaction process into three constituting processes;

(1) Communication efficiency

(2) Learning effectiveness

(3) Learner-technology interaction

The study dealt with each one in detail in three consecutive chapters, six, seven and eight, then made collective observations on the interactional experiences of the whole process relating to the effects of mediation, virtuality and remoteness on the resulting content and interactions of the design review learning process. Although this framework is developed to assess design review communication and interaction, it may be customised to suit other forms of small group interaction in 3D virtual worlds.

9.7.3 Employing Design Reviews in the Virtual World of SecondLife

SecondLife among other virtual worlds has been recommended by a number of studies to be used for its graphical, social, multi-modal communicative features that can serve architectural education. However, no research in architectural education has focused on how exactly virtual worlds can be employable in mediated design reviews. This thesis has explored the potentials of SecondLife as an example of highly reputable 3D real-time virtual words and tested its environment by studying the virtual effects it has as a potential medium of communication on design reviews. By highlighting the technical, and media related problems the researcher has faced in the course of designing a virtual learning environment in SecondLife in a previous section of this chapter; 'Lessons Learned', a road map is presented for further researchers in this platform. It is hoped that the recommendations of this research will aid virtual world designers to develop the interactional aspects of the virtual context to support a wider range of more complicated interaction processes such as the design review settings.

The examined interactional aspects of virtual worlds represented by the virtual world are still underdeveloped, the findings suggested that there are potential affordances of

Avatars and the 3D graphical based environment of SecondLife but are not exactly aimed to support distant design reviews at their current state-of-the-art. In the field of distance design education, the research is significant to innovative design education that allows faculty staff members and students to be geographically distributed, yet be fully connected; with further technological development in the way interactions are mediated, the design review in 3D virtual worlds may be efficiently employed.

9.8 Future Research

The inquiry of this thesis examined verbal and nonverbal interactions in a mediated/ remote context where the subject of inquiry was a specific learning model which is the design review. The following suggestions are made for both modest and large scale future research projects that would take the work described in this thesis forward. These directions are of interest not only to those working in the field of architectural education, but also researchers in design activities, game/3D virtual world developers and educators in general.

On a modest scale, the design review interaction protocol coding scheme developed in this thesis is considered both a research method and an outcome in its own right, a way to move forward is to refine this method and further develop and employ it in order to gain more understanding about the learning interactions of face-to-face design reviews to solve associated communicational problems. Reducing the time scale of the observation unit for example, will lead to more precise analysis of interactions. Developing different forms of visualisation such as adding a screen capture of the nonverbal interactions side-by-side with the verbal communication is an on-going line of thinking as well. Another function of this developed tool is to test more interrelations between verbal and nonverbal communication that were beyond the scope of this research. In addition, exploiting this method to be used more generally in other design learning activities such as desk tutorials and interims will help us understand more about student- tutor interaction for different protocols in the design studio.

This research has been focused on simulating the physical instances of communication and interaction to be exported in the virtual realm; the results of this research have

demonstrated that the media needs to be designed in a way to facilitate that kind of interaction. Now, as the interactional potentials; strengths and weaknesses of the media (3D virtual worlds, represented in SecondLife) have been identified and clearly pointed out in this research, the technology may not be in a position to catch up with the richness of human interactions yet. Having witnessed the successful attempts of the participants to communicate despite the media limitations leads us to consider the other way round; designing the educational system to be suitable for the available technology. Designing a project for remote learning students where interim reviews may be the points of student-tutor contact. The idea would be to change the way of teaching to exploit the potentials of the media. Although this is not discussed in this thesis, the awareness of such issue has been considered for further research endeavours. With the continuing development and availability to import 3D CAD and Sketch-up objects in SecondLife and other 3D virtual environments much recently, extension of the empirical research carried out in this thesis will be examining the three dimensional properties of virtual worlds to afford manipulating 3D objects of the design projects. The students will be able to walk-through with their tutors in immersive experiences of their scale buildings rather than review 3D objects and images of buildings. Here, the difficulties associated with orienting the narrative will be minimised as Avatar co-navigation will be exploited in the virtual project in a very engaging way. This may change the nature of the student-tutor relationship and improve ways of presentation and communication skills away from the hierarchal orders that lead to tension, and defensiveness in traditional reviews.

Large scale more subtle research would be moving from static design to adoptive design. In John Rheinfrank's words as cited in (Evenson *et al.*, 2010):

> *"A new order of systems is emerging, that adapt to the worlds in which they play a part. We start to build worlds that collaboratively participate in the (co-evolution) of our individual and collective abilities. At the simplest level, we no longer are forced to adapt to the worlds in which we live, play, learn, or work. The worlds now shift to meet our abilities, to anticipate whatever they are or what we want them to be"*

This will involve going beyond the computer screen, and interfaces, moving from the 'see, point and click' to the 'grab and move' style of interaction. Studying interactions with

the digital products directly through tangible user interfaces, and examining the 'remoteness' of such manipulation at a distance. Technological development is growing rapidly in that direction, from mobile phones, to touch screen table tops, the direct manipulation of graphical representations that allow a 360 degree view of a 3D model is the way forward for distance learning in design education.

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10 References

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Appendices

Appendices Contents

11 Appendices 353

Appendix (A): Subject Consent Forms 354

Appendix (B): Instruction Sheet emailed to Participants of Virtual Crit (1) 355

Appendix (C): Pre-Test Questionnaire 357

Appendix (D): Participants Completion Status and Raw Data Sources in Virtual Crits (1) and (2) 360

Appendix (E): Post-Test Questionnaire 362

Appendix (F): A Sample Transcript from a Face-to-Face Crit Session 369

Appendix (G): A Sample Transcript from a Virtual Crit (1) Session 371

Appendix (H): A Sample Transcript from a Virtual Crit (2) Session 373

Appendix (I): Timeline Grids with Selective Analysis for one of the Face-to-Face Design Reviews 376

Appendix (J): An Abstract of a Published Paper 381

Appendix (A): Subject Consent Forms

University of Newcastle
School of Architecture,
Planning and Landscape

Reham Abdellatif
PhD Candidate
Email: reham.abdellatif@ncl.ac.uk

Disclaimer Form

I am a PhD candidate in the School of Architecture, Planning and Landscape, Newcastle University. My research looks at the different modes and channels of communication in design crits when applied in a computer-mediated environment, and how it differs from face-to-face crits. Capturing different aspects of the nature of this interaction is necessary; therefore I will carry out an experiment in the virtual world of SecondLife. Chat logs, and video recordings of the crit sessions in both, the 'virtual' and 'real' environments will guide in the collection of data on verbal and non-verbal modes of communication.

Thank you for taking part in this study, and as by signing below, you agree that your 'virtual crit' in SecondLife and chat log will be saved, you will be video recorded and photographed. You also agree to take part in the Focus Group to share your opinions afterwards. This will be used for research purposes ONLY and in the dissemination of research related to the study introduced above.
You should also understand that participation is entirely voluntary and you can withdraw from participating at any time without any consequences.

All participants in this experiment will be anonymous. The research will not by any means, assess your design project and will NOT be used in the event of dispute or discipline by either the researcher or the participants.
If you would like to see the results of this research, please contact me on the email provided.

I hereby agree to participate in this experimental research study, which is conducted by Reham Abdellatif (PhD candidate) under the supervision of Martyn Dade-Robertson (Lecturer, School of Architecture, Planning and Landscape), at the University of Newcastle upon Tyne.

I agree to be recorded and photographed and such material being used for the purposes of research as long as my anonymity is preserved. I have been offered a copy of this disclaimer form.

Name (please print): _____

Signature: _____ Date: / / /

Appendix (B): Instruction Sheet emailed to Participants of Virtual Crit (1)

1- Getting started with Second Life:
-Go to: www.secondlife.com
-Make sure that your PC system has the minimum requirements:
Internet Connection*: Cable or DSL
Operating System: Windows XP (Service Pack 2)
OR Windows 2000 (Service Pack 4)

NOTE: Second Life does NOT currently support Windows Vista (March 2007)

Computer Processor: 800MHz Pentium III or Athlon, or better
Computer Memory: 256MB or better
Video/Graphics Card:
nVidia GeForce 2, GeForce 4mx, or better
OR ATI Radeon 8500, 9250, or better

NOTE: Second Life is not compatible with dial-up internet, satellite internet, and some wireless internet services

NOTE: For system requirements and recommendations go to:
http://secondlife.com/corporate/sysreqs.php

2- Download SecondLife:
Go to: http://secondlife.com/community/downloads.php

3-Regester in SecondLife and create an Avatar:
Go to: https://secure-web11.secondlife.com/join/

4- Log onto SecondLife using your Avatar's first and last names and password.

5- Teleport to the School of Architecture Island:

-Press on the Map button in the lower menu of the screen.

-Type (Aelius) in the Search box then press Search.

- Type 202 – 32 – 23 in the location boxes, then press the Teleport button.

- Get permission from the group leader to join the group: Advanced Visualisation Techniques, this will allow you to display your work.

Welcome to class!

6- Preparing your deliverables for criticism:
To display your work in SecondLife you should convert all documents into images, either using a converting program such as one of these two (or any other):
http://www.pdf-convert.com/convert/DOC-to-JPG.html
http://www.aaapdf.com/doc2img/bmp-convert-doc.html
OR,

If your document is a PDF file, use the snapshot tool to convert the selection to JPG or JPEG or TGA or BMP formats (These are the image formats accepted by SecondLife among other formats: for sounds: WAV and for animations: BVH).
NOTE: The limit of images for each student is 10 images.

7- Getting Virtual Money:

First you need credit for uploading files:
The Avatar of the group leader (Ramnat Planer) will give you virtual money in SecondLife.

8- Upload your files:

File > Upload image > Browse
Now your images have been uploaded in your inventory as 'textures'.
Press Inventory button in the lower menu in SecondLife, open My Inventory > Textures> your file.
Drag and Drop the texture to the object of display i.e. Screen.

9- Use the Chat option in the lower menu to chat with other Avatars.

Appendix (C): Pre-Test Questionnaire

University of Newcastle
School of Architecture,
Planning and Landscape

Reham Abdellatif
PhD Candidate
Email: reham.abdellatif@ncl.ac.uk

Purpose of Questionnaire:

Second Life is a massively multiplayer online role-playing game (MMORPG) that offers a virtual environment where people as Avatars -who represent the residents of SecondLife can interact in real time.

Applying Second Life in higher education has been the interest of a growing number of educators around the world. Using this environment for remote connection between tutors and students for giving feedback on assignments is one of the various education potentials of SecondLife.

The purpose of this questionnaire is to collect initial data to help in creating a learning environment for a crit in SL. The data will indicate the students' interest and experience with the online game and their computers requirements to run SecondLife, also information about the format of their final deliverables of their assignments.

General Information:

1-Name:	2-Gender:
3-School:	4-Year:
5-Email Address:	

Interests & Experience:

6-Do you ever play online-games?

Yes	No

7-If yes, Give examples:

8-How many days/ week do you play?

0-1 days	2-3 days	4-5 days	6-7 days

9-Why do you like to engage in online games, if applicable?

It's fun		To make money	
To meet people		To learn	
Other (please specify):			

10-Have you logged into SecondLife before?

Yes	No

11- Have you socialised with other Avatars in SecondLife?

Yes	No

Connection and Hardware:

12-Where do you connect to the internet?

Home		University	
Net Café		Friend's Home	
Other (please specify):			

13-What kind of internet connection do you use?

Dial-up		DSL	
Satellite		Cable	
Wireless			
Other (please specify):			

14-What are you computer's hardware and software specifications?

For PC:

a)Operating System:			
Windows 2000		Windows XP	
Other (please specify):			
b)Processor:			
800MHz Pentium3		1.6 GHz Pentium4	
Athlon		Athlon2000	
Other (please specify):			
c)Memory:			
256 Mb		512 Mb	
Other (please specify):			
d)Video/Graphics Card:			
Nvidia GeForce 2		GeForce 4mx	
GeForce Fx 5600		GeForce 6600	
Or: ATI Radeon 8500		ATI Radeon 9250	
ATI Radeon 9600		ATI Radeon x600	
Other (please specify):			

For Macintosh:

a)Operating System:			
Mac OS X 10.3.9		Mac OS X 10.4.3	
Other (please specify):			
b)Processor:			
1GHz G4		1.25 GHz G4	
Other (please specify):			
c)Memory:			
512 Mb		768 Mb	
Other (please specify):			
d)Video/Graphics Card:			
Nvidia GeForce 2		GeForce 4mx	
GeForce Fx 5600		GeForce 6600	
Or: ATI Radeon 8500		ATI Radeon 9250	
ATI Radeon 9600		ATI Radeon x600	
Other (please specify):			

About your Design Crit:

15-What are the final formats of the deliverables of your project?

16- How many images have you prepared for your digital arch crit?

Using SecondLife environment for feedback:

17-Have you considered SecondLife as a learning environment before?

Yes	No	I don't know

18-If you have used SecondLife before, Have you uploaded any images, videos, sound clips, etc. in it?

Yes	No

19-What do you think about presenting your deliverables for your project in SecondLife for feedback and criticism?

I strongly agree	I agree	I disagree	I strongly disagree

20- Why?

Please give other comments or opinions:

Thank you for your cooperation.

Appendix (D): Participants Completion Status and Raw Data Sources in Virtual Crits (1) and (2)

Experiment: Virtual Crit (1)

Participants and their Completion Status

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Student Initials	AL	TQ	JM	MS	MG	VA	NH	MQ	PL	CS	CY	AB	OL	HB	LY
Student ID	V1-Y5S1	V1-Y6S2	V1-Y6S3	V1-Y5S4	V1-Y5S5	V1-Y6S6	V1-Y5S7	V1-Y5S8	V1-Y5S9	V1-Y5S10	V1-Y5S11	V1-Y5S12	V1-Y5S13	V1-Y5S14	V1-Y5S15
Completed Virtual Crit															
Questionnaire															
Participated in Experiment															
Volunteered															

Data from Virtual Sources

Data Outcome	Number of Files	Format
1- Full Chat Logs	11	Word documents
2- Second Life Video Captures	28	(Avi) videos
3- Second Life Screen Shots	22	(Jpeg) images

Data from Real Sources

Data Outcome	Number of Files	Format
1- Pre-test Questionnaire	13	Word documents/ Handwriting
2- Observation Notes	13	Word documents/ Handwriting
3- Post-test Questionnaire	13	Word documents/ Handwriting

Experiment: Virtual Crit (2)

Participants and their Completion Status

	1	2	3	4	5	6	7	8	9	10	11
Student Initials	**JW**	**EK**	**MT**	**KG**	**JW**	**OG**	**DZ**	**MO**	**PW**	**JM**	**RD**
Student ID	**V2-Y2S1**	**V2-Y1S2**	**V2-Y2S3**	**V2-Y1S4**	**V2-Y2S5**	**V2-Y2S6**	**V2-Y2S7**	**V2-Y2S8**	**V2-Y2S9**	**V2-Y2S10**	**V2-Y2S11**
Completed Virtual Crit											
Focus Group/ Questionnaire											
Participated in Experiment											
Volunteered											

Data from Virtual Sources

Data Outcome	Number	Format
1- Full Chat Logs	5	Word documents
2- Second Life Video Captures	12	(Avi) videos
3- Second Life Screen Shots	15	(Jpeg) images

Data from Real Sources

Data Outcome	Number	Format
1- Pre-test Questionnaire	8	Word documents/ Handwriting
2- Full Crit Video Recordings	5	Word documents
3-Photos of Physical Settings	14	(Jpeg) images
4- Observation Notes	8	Word documents/ Handwriting
5- Audio Recordings (Focus Group)	2	(Wav) sound clips
6- Post-test Questionnaire	7	Word documents/ Handwriting

Appendix (E): Post-Test Questionnaire

University of Newcastle
School of Architecture,
Planning and Landscape

Reham Abdellatif
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Email: reham.abdellatif@ncl.ac.uk

Purpose of the Questionnaire:

This questionnaire contains post-experiment questions about the crit you have recently participated in, using SecondLife; the purpose of the questionnaire is to collect data that will indicate both positive and negative aspects of the experience. The first part will allocate why some students could not attend the crit or could not complete it, and for who did complete it, the questionnaire will ask about their opinions and perceptions about: usability of the tools in SecondLife, the learning space, communication, interactions with others, sense of presence, as well as asking about your ideas on how to improve this virtual learning tool in the future.
Note: The data collected in this questionnaire will be used only for research purposes.

Section (I) For all students:

Place an (x) in the proper answer box, add comments where relevant.

General Information:

1-Name:	2-Gender:
3- Avatar's Name:	
4-School:	5-Year:
6-Email Address:	

7- Have you taken place in the SecondLife crit?

Yes		No	

8- If No, Why?

a) PC specifications do not match the requirements to run SecondLife.	
b) Internet connection does not match the requirements to run SecondLife.	
c) Difficulties downloading the program or creating an account.	
d) Unfamiliar with the program.	
e) Not interested in using new environment.	
f) Time slot not suitable for you.	
If other, Please specify:	

9- If Yes, Did you complete your crit session?

Yes		No	

10-If you have not completed your session, please specify Why?

Section (II) Only for students who completed their crit session:

Usability of tools in SecondLife:

11- Were you able to find and teleport to the crit location easily?

Yes		No	

12- Did you find uploading images and displaying them difficult?

Yes		No	

13- Did you experience difficulties in?

a) Moving your Avatar around	Yes		No	
b) Using the different tools chat/ map/ search	Yes		No	
Other difficulties:				

14- Was the instruction sheet given to you enough for learning to use these tools?

Yes		No	

15- Did you have the chance to practice before your time slot?

Yes		No	

16- How would you rate on a scale from 1 to 10, your satisfaction with regards to the use of SecondLife tools in your crit? (Knowing 1 is lowest and 10 is highest):

Avatars appearance and identity:

17- How did you feel about using a different name and appearance than your own?

a) Prefer using your real name	
b) Prefer using a different name	
c) Prefer using similar appearance to yourself	
d) Prefer using a different appearance	
Why?	

18- Did using Avatars give you feelings of human -like communication, not experienced through e-mail or instant messaging programs?

Yes		No	
Comments:			

19- Did the use Avatars give you feelings of presence, i.e. feel of engagement and 'being there' which is not experienced through e-mail or instant messaging programs?

Yes		No	

20-How would you rate this feeling of engagement and presence on a scale from 1 to 10 (knowing 1 is lowest and 10 is highest):

Comments:

The Learning Space:

21- How suitable in your opinion was the area of the space of the criticism?

Not suitable	Suitable	Very suitable	N/A

22- How suitable was the size of the displaying screens?

Not suitable	Suitable	Very suitable	N/A

23- How suitable was the location of the displaying screens?

Not suitable	Suitable	Very suitable	N/A

24- Were you able to see the images clearly on the displaying screens?

Yes		No	
Comments:			

25- How would you rate on a scale from 1 to 10, your satisfaction with regards to the virtual learning space? (Knowing 1 is lowest and 10 is highest):

Comments:

Communication:

26- Did you find using the chat tool suitable for communication with your tutor?

Yes		No	

27- If Not, Why?

a) You type slowly.	
b) The previous chat text fades away too fast.	
c) You have difficulty reading off the PC monitor.	
d) Other, Please specify:	

28- Was the chat tool enough for you to describe your project to your tutor?

Yes		No	

29- Did you at any point feel that you could not describe your project to your tutor using the chat only tool?

Yes		No	

30- How did you find describing your project without the ability to physically point at the images?

Very difficult	Difficult at some point	Not difficult	Did not face this problem

31- How would you rate on a scale from 1 to 10, the use of Avatar pointing as an alternative to physical pointing? (Knowing 1 is lowest and 10 is highest):

32- How would you rate on a scale from 1 to 10, your overall ability to present your crit in SecondLife? (Knowing 1 is lowest and 10 is highest):

Comments:

33- Did you have to open the Chat History Box, to catch up with the conversation at any point?

Yes		No	

34- Was there any information you wanted to present but couldn't because of the interface?

Yes		No	
Please Specify:			

35- Did your tutor show signs of misunderstanding of your presentation at any point?

Yes		No	
Comments:			

36- Did you fully understand your tutor's remarks and instructions for your project using the chat option only?

Yes		No	
Comments:			

37- How would you rate on a scale from 1 to 10, your perception of information in the virtual design crit? (Knowing 1 is lowest and 10 is highest):

Comments:

38- How would you rate on a scale from 1 to 10, your overall enjoyment of the virtual design crit? (Knowing 1 is lowest and 10 is highest):

Comments:

Remote Communication:

39- Where did you connect to SecondLife for the crit?

Home.		University.	
Net Café.		Friend's Home.	
Other (please specify):			

40- How formal was your conversation with your tutor in the criticism?

Very formal.	Formal.	Casual.	Very casual.

41- How did you feel about not being in the same place (face-to-face) with your educator in the criticism (remote communication)?

a) Less stressed than real life criticism (more casual).	
b) Same as real life criticism.	
c) More stressed than real life criticism.	
Comments:	

42- How did you feel about having the crit away from the classroom where other students are observing?

a) Less stressed than real life criticism (more casual).	
b) Same as real life criticism.	
c) More stressed than real life criticism.	
Comments:	

Interactions with Others:

43- Did you attend any of the other students' crit sessions?

Yes		No	

44- If Yes, how many sessions (other than yours) did you attend?

45-Did you benefit from attending other sessions?

Yes		No	
Comments:			

46- Were you aware of the presence of any of the other students during your crit?

Yes		No	

47- Did you chat with other students/ people in SecondLife?

Yes		No	
Comments:			

Opinions about Further Use:

48-Do you think you needed more time before the crit sessions to gain experience about SecondLife tools?

Yes		No	
Comments:			

49- Would you have preferred using a voice/ video chat option for the crit?

Yes		No	
Why?			

50- What other features or objects do you prefer added/extracted/modified to the crit space?

51- How would you rate on a scale from 1 to 10, the relevance of graphical features of SecondLife that aided the virtual crit? (Knowing 1 is lowest and 10 is highest):

52-What do you think about using SecondLife as a learning environment for:

a) Casual discussion and interactions.	Yes		No		N/A	
b) Formal university lessons.	Yes		No		N/A	
c) Tutorials.	Yes		No		N/A	
d) Presenting work for others to see.	Yes		No		N/A	
e) Give other ideas.						

53- What do you think about having another crit in SecondLife?

Strongly agree	Agree	Disagree	Strongly Disagree	N/A
Why?				

54- Have you developed any new experiences/ideas from attending the crit in SecondLife?

Yes		No	
Examples:			

55- How would you rate on a scale from 1 to 10, your overall learning satisfaction in the virtual crit? (Knowing 1 is lowest and 10 is highest):

Please give other Comments or Opinions:

Thank you for your patience and cooperation.

Appendix (F): A Sample Transcript from a Face-to-Face Crit Session

Crit Number:		8	
Student ID:		F-Y1-S8	
Stage:		Y1	
Date:		Friday 11/12/2009	
Duration:		12:00 - 12:15	15min
Video File Name/Location:		Y1S8.avi (MyPassport Hard Drive)	

T1: We're ready
S: First of all I would like to point out that I know that the North arrow is missing i took it out with the intension to draw it again however it was late and

T1 It is there then?

S: so with your permission I -would just draw it back.

T1: It wouldn't make a difference. Technically at this stage you cannot change anything, you know it's not there that is good for me.

S: When I was little my family rented a house in the Swedish countryside in the forest virtually in the middle of nowhere, one winter we had a power blackout and it got all dark so my mother lit candle all over the kitchen and we all sat down....
And I remember feeling very, mm anticipation the world outside which I can barely see because of the reflection in the window glass because of the candle light, I could barely see it but it was mysterious and I was imagining anything that would be out there.
When I chose my keyword which is Mystery and Earthly I wanted to show that contrast between the known and the unknown.
I think I struggled a bit with the keyword at the beginning and somehow on directly on the development models and it wasn't until we had this lecture on materiality and colour, that I began to really abstract in a way and take it away because before that I had made 2 literal interpretation about a hut or a little house but now I tried to see it in terms of colour and reflection instead and I chose to use the,... I will show you the memory book.
My keywords are Earthly and mysterious, and this part represents the Earthly, and it chose to represent this particular space in stone which has a sense of maternity which is dependable and ..It is also very tough and also wood oak because it has a warm solid feeling. And as you come here you see the wall it catches your eye and the reflection of copper in the sunlight also depending of course on how the sun is directed, if it is east the rays will create a intriguing pattern (laugh) which make the visitor want to explore further and go around the corner and find out what is more to excite.
And form this part you get into this area which basically, as the site is created, there is water around, so I brought water into the site which enhanced the reflection also I wanted a tree inside to bring nature inside.
A change I made from an earlier model was to elevate this area like to distinguish one space from another more clearly and also to cut off this wall to make it possible to have flow around the side and not just shut you off and create a dead space here.

I also worked with a lot with reflections that's why i brought water and the copper to give a distorted reflection of reality. And also I wanted to use around this copper wall, when you lay the stone you mix in small pieces of metal which will also enhance the reflection.
Yes this is it.

T1: (to T2) do you know the answer to this...can you treat copper in a way that it won't end up going green?

T2: That was something I wanted to ask about.

S: Yes you can.

T1: You can?

S: You can but it will likely be less reflective.

T2: Kind of dull, less shimmering.

S: Yeah it won't be this shiny, but it will still be reflective, that's also why i chose this colour because, this will be a concrete wall that you could plaster to get this almost vibrant warm texture to it, and then these copper titles, I chose the colour green because if I chose to not treat the copper wall then it will by time turn green and it would be a nice way of showing the space as well and the colour will echo the colour of the wall. (Smile)

T1: So what is your decision, do you do want to treat it? Or?

S: Probably I would want to treat it because the reflection itself is so important to the concept, so yes.

T1: Good, the continuity of the two materials was a good decision as so is the reflection concept.

T2: Your site, you can actually go around all the way so it is like a circular route, but where do you think in your site that there is a place where you can say I have arrived now...and is there such a space?

S: How do you mean I've arrived? Like a final destination?

T2: Yeah kind of like a destination space.

S: Of course it depends on where you come from, say that you come from this part side, you come from the inside to the obvious place where u feel less comfortable the rests is not nurturing in a way they will lead you outdoors but this part is more static place where you can rest.

Appendix (G): A Sample Transcript from a Virtual Crit (1) Session

Crit Number:		6	
ID/ Avatar:		V1-Y6S6	Vivek Carfagno
Stage:		Y2	
Date:		Wednesday 21March 2007	
Duration:	Chat	12:00-12:35	35 min
Video File: Name/Location:		Vivek.mp4 (MyPassport Hard Drive)	

[5:02] Vivek Carfagno: hi
[5:02] Mil Karas: hello everyone
[5:03] Mil Karas: where is Vivek?
[5:03] Vivek Carfagno: hi carlos i m here...
[5:03] Mil Karas: ok
[5:04] Mil Karas: do u have 10 images?
[5:04] Vivek Carfagno: i have around 6 images
[5:04] Mil Karas: only 60 dolars..then
[5:04] Vivek Carfagno: ok
[5:04] Mil Karas: done
[5:04] Vivek Carfagno: i have recieved 60$
[5:05] Mil Karas: ok show me ur work
[5:05] Mil Karas: helllo
[5:05] Vivek Carfagno: hi
[5:05] Vivek Carfagno: i m uploading
[5:05] Mil Karas: ok
[5:06] Mil Karas: Reham, i could not get into my office today.. i have misplaced my Harvard ID card...
[5:06] Mil Karas: so I am on my batery
[5:06] You: ok,well
[5:06] Mil Karas: which might run out..
[5:07] Mil Karas: so we need to be quick
[5:07] Vivek Carfagno: i have uploaded one
[5:07] You: sure
[5:07] Vivek Carfagno: how do i show it to u .
[5:07] Mil Karas: well just drag and drop the textures on these screens..
[5:08] You: follow instructions, open ur inventory from the bottom menu
[5:08] Vivek Carfagno: k
[5:08] You: then open MYInventory, then Textures
[5:08] You: u will find the files there
[5:08] Vivek Carfagno: thats my site plan
[5:09] Mil Karas: both images?
[5:09] Vivek Carfagno: thats the new dwevelopment marked
[5:09] Vivek Carfagno: and i have used sketup and google earth to incorporate
[5:09] Mil Karas: ok
[5:09] Mil Karas: so it is the one in red...
[5:09] Vivek Carfagno: yes
[5:10] Vivek Carfagno: i want the lanscape to be developed using google earth map
[5:10] Vivek Carfagno: to have a surrounding
[5:10] Vivek Carfagno: and add 3D elements on top of it

[5:11] Mil Karas: this is the project u show me last...tiime
[5:11] Mil Karas: it is fine..
[5:11] Mil Karas: a very flat terrain though..
[5:12] Vivek Carfagno: ya
[5:12] Mil Karas: and how much r u going to model?
[5:12] Vivek Carfagno: there is leve difference of 5 meter from front to the back of the site
[5:12] Mil Karas: or the outdoors..
[5:12] Mil Karas: difficult to see from here..
[5:12] Vivek Carfagno: sir how can i c ur earlier message I missed
[5:13] You: hit on History
[5:13] Mil Karas: ok...how much ar u going to model of the landscape?
[5:13] You: next to the chat box
[5:13] Vivek Carfagno: got it
[5:13] Vivek Carfagno: u can c the sketchup model which i have done
[5:14] Vivek Carfagno: thats the area i will be modelling
[5:14] Mil Karas: yeap noel
[5:14] Mil Karas: but what about teh outdoors..
[5:14] Vivek Carfagno: i will model the site...
[5:14] Vivek Carfagno: and some surrounding building as blocks
[5:14] Mil Karas: well WHAT ARE the surrounding blocks?
[5:15] Vivek Carfagno: there is a school at the back
[5:15] Vivek Carfagno: on the plan its on the top
[5:15] Mil Karas: can u point that out on the map?
[5:15] Vivek Carfagno: how do i do that here
[5:15] You: click on the part you want to show on the screen.
[5:16] Mil Karas: ok
[5:16] Mil Karas: so sourround the area then u want to model..
[5:16] Vivek Carfagno: and this is the existing CSC pool comples
[5:16] Mil Karas: ok
[5:16] Vivek Carfagno: yup
[5:17] Vivek Carfagno: but that will be all block model
[5:17] Vivek Carfagno: as interaction i wanted to add a site map
[5:17] There is no suitable surface to sit on, try another spot.
[5:17] Vivek Carfagno: at places so the the client can be teleported at diffetent places if he wants to
[5:17] Mil Karas: ok that's fine...
[5:17] Vivek Carfagno: thats the site map
[5:18] Vivek Carfagno: and u can also enter the lift and go to upper level
[5:18] Mil Karas: which lift?
[5:18] this one, in the hashed area
[5:18] Is this a close-up, I thought those were rooms
[5:18] Mil Karas: and not sure i understand what the site map is.
[5:18] Mil Karas: and what's for?
[5:18] Mil Karas: but let's recap.
[5:18] Vivek Carfagno: sure

Appendix (H): A Sample Transcript from a Virtual Crit (2) Session

Crit Number:		1	
ID/ Avatar:		V2-Y2S1	Jonas Szentmartony
Stage:		Y2	
Date:		Thursday 01/06/2010	
Duration:	Chat	11:41-11:53	12 min
	Voice	11:53 12:17	24 min
Video File Name/Location:		Jake-Emma.asf (MyPassport Hard Drive)	

[03:35] Martyn Bloobury: Ok let's start
[03:37] Jonas Szentmartony: shall i start? Full on crit?
[03:37] Martyn Bloobury: go for it
[03:37] Jonas Szentmartony: ok
[03:38] Jonas Szentmartony: ok these are the plans for the sculpture park on hunters moor
[03:38] Jonas Szentmartony: the park is based around a central open field
[03:39] Jonas Szentmartony: that is surrounded by ash planting and Ha-has to enclose the cows that currently inhabit the space
[03:40] Jonas Szentmartony: the building (which won't upload) is an inverted barn roof structure that houses the cows and a Milkshake Cafe/steak restaurant
[03:40] Martyn Bloobury: could you take me through the sequence of images
[03:40] Jonas Szentmartony: yep
[03:40] Martyn Bloobury: its tough to see without refereing to the graphics
[03:40] Jonas Szentmartony: on our left
[03:41] Jonas Szentmartony: is the basic development of the ideas that always focuses around visual connections between cows and people,
[03:41] Jonas Szentmartony: yet a physical separation
[03:41] Jonas Szentmartony: the park's doughnut shape gives people a prescribed route through the sculpture park for people to follow
[03:42] Jonas Szentmartony: at intervals there are little hidden path ways into the main cow field in the centre
[03:42] Martyn Bloobury: can you fly to the drawing you are referring to?
[03:43] Jonas Szentmartony: this one here
[03:43] Jonas Szentmartony: beside my feet
[03:43] Martyn Bloobury: I get the idea
[03:43] Jonas Szentmartony: unfortunately the drawing that would really help hasn't uploaded
[03:43] Martyn Bloobury: thats no excuse
[03:44] Martyn Bloobury: you should be better prepared for a crit!!
[03:44] Jonas Szentmartony: in the real world, tru
[03:44] Martyn Bloobury: can we focus on the main drawing in the middle
[03:45] Jonas Szentmartony: let's try that
[03:45] Jonas Szentmartony: the first render is where you enter the main building
[03:45] Jonas Szentmartony: you are immediately welcomed by the presence of the cows
[03:46] Jonas Szentmartony: the aromas, the sounds, the visuals
[03:46] Martyn Bloobury: and cow dung
[03:46] Olga Daysleeper: aromas...? lol (all laugh)
[03:46] Jonas Szentmartony: the reason for the vast height of the barn is to keep the building well ventilated

[03:47] Jonas Szentmartony: oh no, the aromas, would be fairly minimal, on hot days they would increase in intensity ☺
[03:48] Jonas Szentmartony: as you leave the cowshed, you walk down a beech hedge avenue
[03:48] Martyn Bloobury: Take me through the sequence of the journey
[03:48] Martyn Bloobury: whats Dayle doing?
[03:49] Jonas Szentmartony: with frames that constrain your vision to the horizontal
[03:49] Dayle Biscuit: was getting a closer look at the renders, sorry ☺
[03:49] Jonas Szentmartony: this should be clear if you look at the centre drawing
[03:49] Jonas Szentmartony: focusing your attention on the sculpture
[03:50] Martyn Bloobury: The strategy seems fairly light touch.
[03:50] Martyn Bloobury: More farm than garden?
[03:51] Jonas Szentmartony: the moors are protected in ancient local law to the freeman of newcastle and their cattle
[03:51] Jonas Szentmartony: the north of the site is slightly more farm
[03:51] Jonas Szentmartony: and yes, i agree
[03:52] Jonas Szentmartony: as you progress south, this connection becomes gentler
[03:52] Jonas Szentmartony: the cows become small visual pieces of eye candy to view
[03:52] Martyn Bloobury: connection?
[03:52] Martyn Bloobury: Cos - Eye candy?
[03:52] Martyn Bloobury: You hang out at the wring bars!
[03:53] Martyn Bloobury: wrong I mean - in every sense.
[03:53] Jonas Szentmartony: this is tough to type fast enough

[04:17] Jonas Szentmartony: thanks very much

Voice Communication Starts:

T: Can we simulate life chat now, (all laugh) coz I think jake is having difficulty typing , i mean we do have the voice chat option, Is that alright now..?

O: Yes no problem

S: It is tough to type all the words (laughs)

S: I keep losing my trail

T : yes, i ended up getting that, so would you like go first to that image and take us through that sequence

S: cool, basically the sculpture park is based around this huge centre field, which is going to be for a guest sculpture, the sculptures change every year or six month. There will still be a huge field that the cows will be left as they are. And as we leave the site driving up north, if you look at the left image, just at the top right hand corner there is a little exit. There is this path way that goes around the field, and when you walk in you see the view from a distance. Along the pathway you can see far small view points across the hall, just from top the hill, then you see the cows in the middle.

T: just to check here, I think I'm missing a context, is the plan uploaded?

S: it is too big, had to give it up.

T: Right

S: yeah, well the main pathway leads to the main centre field, the sculptures based around the corners, and all the time you walk in, you can see a small view of the sculptures along the distance and you can see the middle view where you can see the cows, mmm.
The building which is the black thing in the centre picture, looks straight down across the entrance view. Which has the services, and that kinda looks, when you get in this sort of, I can't explain how it looks like,... it's a big ceiling that has space...

T: which image are we looking at?

S: The centre screen,

T: Centre screen, ok...ok, I need you to talk me through as you go in the sequence of the layout, and be specific about the parts you're talking about, because you are doing a lot of pointing that i can't see.

S: (tries to fly to point to the image with the avatar's feet) (laughs)

T: jumping is obviously not working (laughs)

(some laughing from other students)

S: beside my head on the centre picture is the glass box and frame, that is the cafe... which is extended above the cow's area, and if you look down to the side you can see the view and the restaurant.

T: so this is the box on the left basically, the top rendering is the cafe suspended on the span frames structure

S: yeah, and there are some steps just behind where the cafe is. Mmm the sequence as you walk through is (moves around with avatar) here is the lake, mmm, as you walk through the pathway of the park around the sculptures, there is a little sitting area to the south of the lake, which you could see on the far right screen –i hope- (walking with avatar to the image)
There is a big willow tree planted at the side, which is a fast growing species, they are on the north east, they create a buffer to the wind, the idea is that they trap the afternoon sunlight to create a warm area across the water, and these little black and green spots represent other areas of trees.
Mmm, from behind the seating area where the willow trees, is the access to the farm to get to the cow field, and this is through the cafe where they keep...

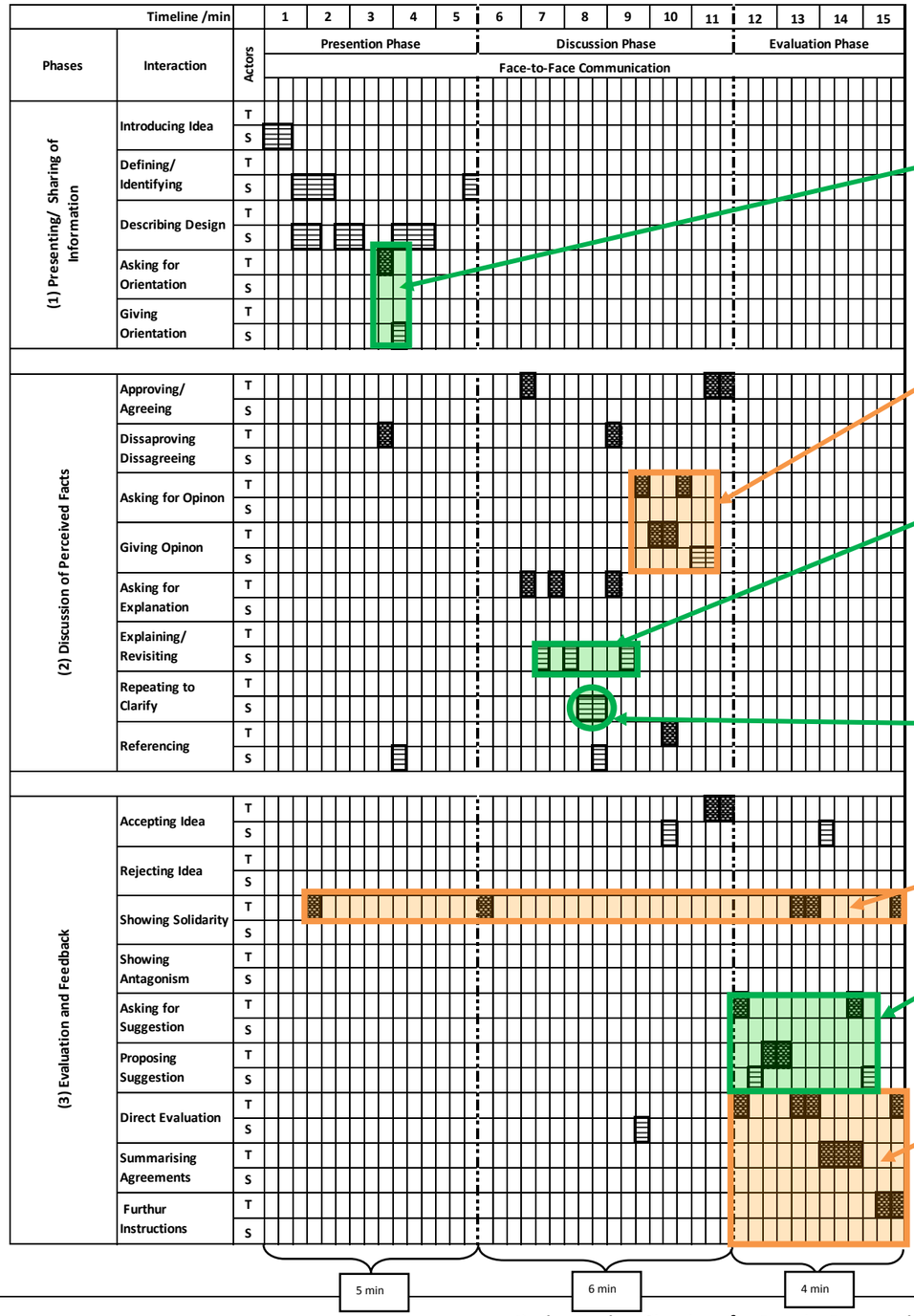
T: You're going to have to direct me again, because I'm not sure which plan.

S: (Flies avatar to point) just above my head there.

T: Right i'm set.

Appendix (I): Timeline Grids with Selective Analysis for one of the Face-to-Face Design Reviews

Design Review Structure: F-Y1S8



1- This crit session followed the normal sequence of the review structure as suggested by the Review Interaction Protocol. The patterns of the interaction suggest reasonable timing, as each phase consumed nearly one third of the overall duration.

2- It can be noticed that there is minimum 'Asking for and Giving Clarification and Orientation'.

3- Verbal communication in this crit focused on design related utterances; for the Discussion phase was rich in utterance focusing on a number of 'functions', as it consists of:

- Asking for and Giving 'Opinions' e.g.:

T: *"So what is your decision, do you want to treat it? Or?"*

S: *"Probably I would want to treat it because the reflection itself is so important from the concept, so yes".*

- Also 'Revisiting and Defending while Explaining',

T: "*... but I'm not sure about the different materials and the number of them because every wall is treated differently and because one uses this material in a smaller scale, I'm just not sure here, so convince me*".

S: "*Ok, My concept of using materials that the earthly part would be natural easy to mould and shape with my hand, and the other part would be manmade, more artificial, not colder I would say but definitely more artificial. And it should be a big break between these two spaces, so that's why I made these two in relation to each other and these two in relation to each other*".

- On the other hand there were very few instances of 'Repetition'.

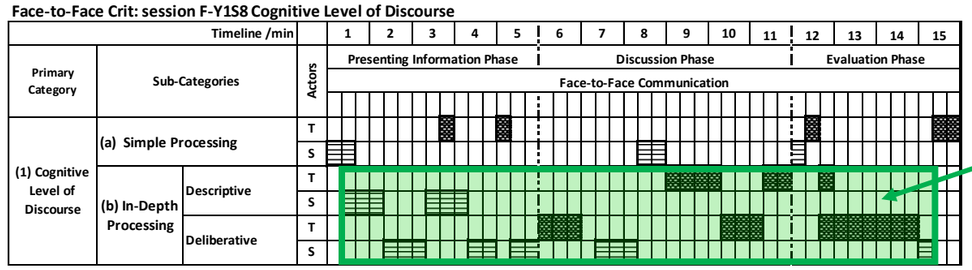
4- The area of Evaluation and Feedback consisted of direct and indirect forms of evaluation, by showing solidarity, acceptance. After asking and giving suggestions by the tutor, he indicates that the discussion has to come to an end, and gave a quick summary of the positive and negative issues of the presentation and design.

e.g.: *"We are spending a long time in this bit of detail because this is the most critical part of the architecture, Ok, to conclude,....most of the tree is going to be read from behind this wall, which I think that is very successful indeed...and the choice of these materials served your concept.*

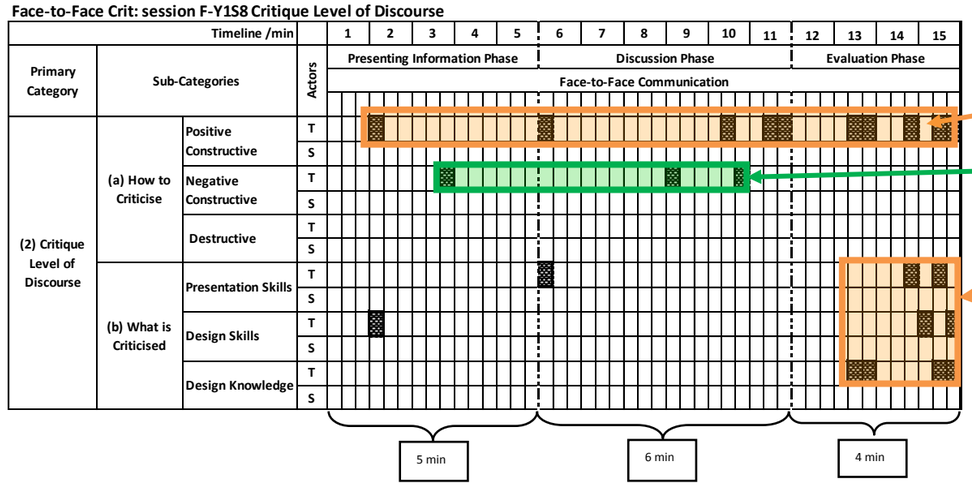
I've noticed in your presentation, you've actually stood in front of your A1 sheet most of the time, but the drawings are very well conceived, the focus is on the model, but just try not to do that next time".

Design Review Structure for Face-to-Face session: F-Y1S8

Face-to-Face Crit: session F-Y1S8 Cognitive Level of Discourse



Face-to-Face Crit: session F-Y1S8 Critique Level of Discourse

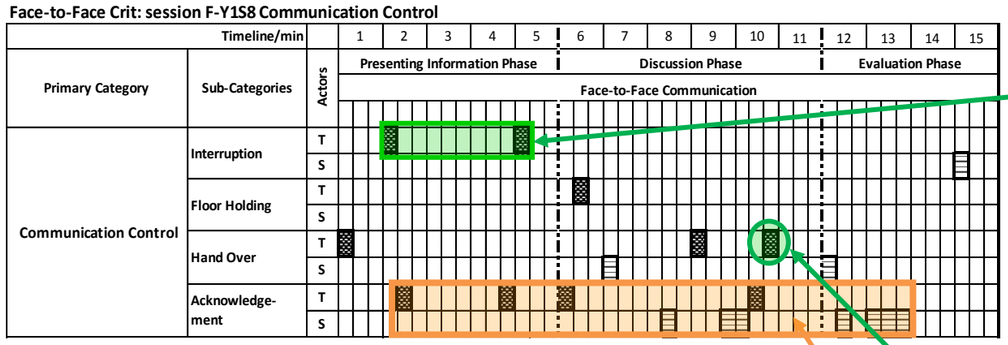


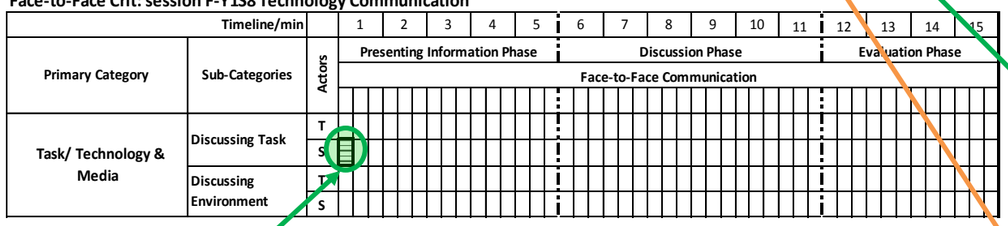
5- The cognitive and critique level of the review appeared to fall mostly in the two In-Depth Processing categories, Descriptive and Deliberative..
As observed, statements were long and deliberate, focusing on details throughout the crit session. e.g.: *"I think I struggled a bit with the keyword at the beginning and somehow directly on the development models and it wasn't until we had this lecture on materiality and colour, that I began to really abstract in a way and take it away because before that I had made two literal interpretations about a hut or a little house but now I tried to see it in terms of colour and reflection instead, so I chose..."*

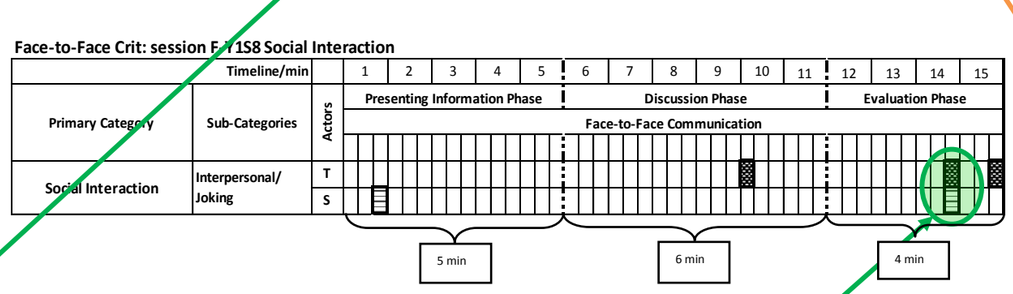
6- Evaluation has started early on the crit, as constructive positive remarks giving encouraging feedback.
e.g.
T: "Good, the continuity of the two materials was a good decision."
And a constructive but negative evaluation was through directly giving one's opinion about designing:
T: "...so you get the shape of the stone but in copper...but it kind of confuses people and blurs the line between the natural and artificial, I would not take that approach in that way"

7- All areas of constructive criticism according to the coding scheme have been covered in this crit session,
e.g.: Presentation *"...the overall oral presentation is also very good"*
e.g.: Design Skills *"...it feels absolutely right, you are organising the drawings well in order to tell the story"*
e.g.: Design Knowledge *"...there is a real sense now that this has some very clearly thought through structure and preparations,* having made decisions of the tectonic material level, it seems to me to be a very successful way of approaching the project*"*

Cognitive and Critiques Level for Face-to-Face session: F-Y1S8







8- A low number of interruptions in the face-to-face crit session were observed; the participants had control and management over the communication and established to hand over the communication smoothly, with only one attempt to hold the floor in the discussion phase.
e.g.:
T: "I think the relationship between these two worked, it's beginning to read because you've got the wooden frame going out and you've decided to take it over the back passed the couple of..."
S: "Yes I was thinking of it to be more like a threshold to mark the different spaces.. but...".
T: "Yeah, absolutely, and I think that that does start to rationalise out these different elements a bit".

9-Hand over was determined in this session using nonverbal communication in most times; using vocal expression and eye signals. The direct verbal utterance for handing over occurred in the form of questions or direct invitation to talk, e.g:
T: *We are ready now.*

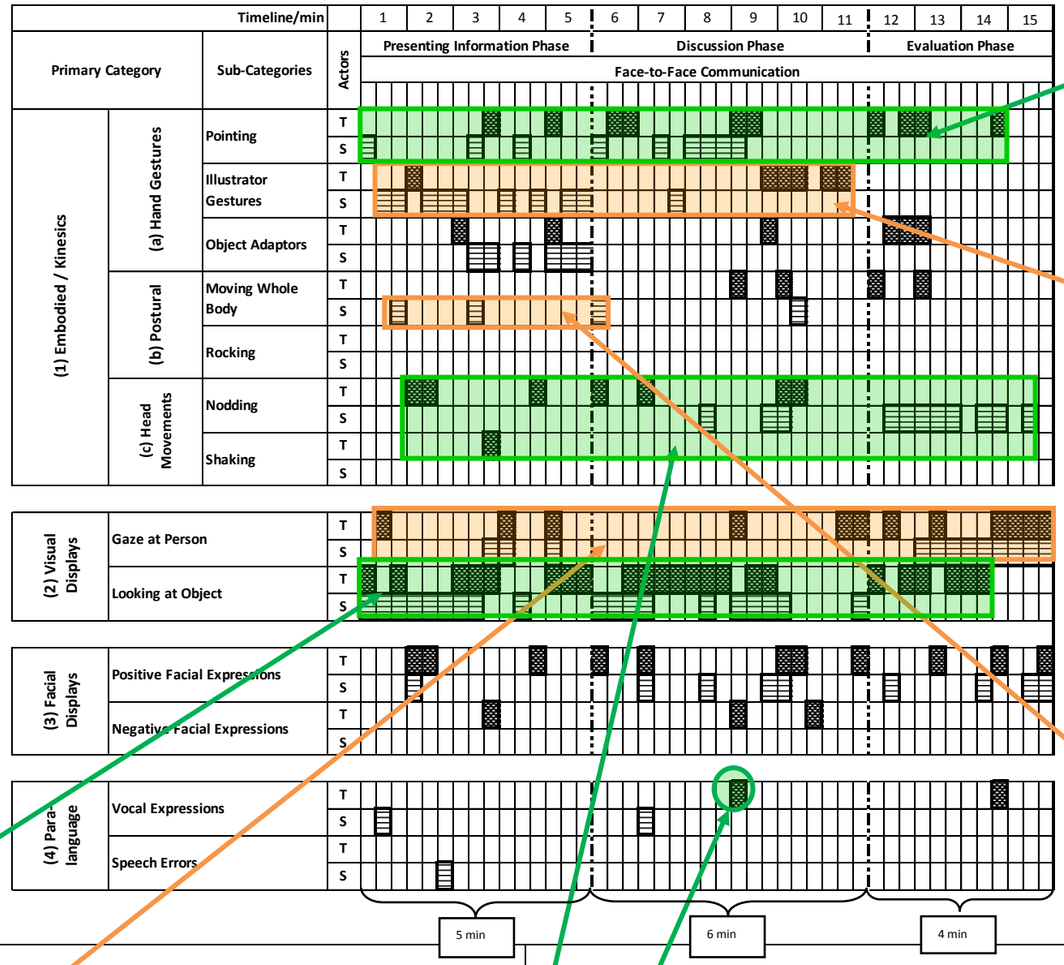
10- Acknowledgement was highly enacted, users would constantly use utterances such as "mm", "aha" and "yeah" among others to indicate their attentiveness to their partner.

13- Participants' utterance about tools and media in this session were nearly non-existent, nevertheless, some utterances discussed the tools, and 'technology' at hand. e.g:
S: *First of all I would like to point out that I know that the North arrow is missing I took it out with the intension to draw it back however it was late and...*
T: *It is there then?*
S: *No but with your permission I would just draw it back.*
T: *Technically at this stage you cannot change anything.*

12- Social interaction included light humour within the context and was accompanied with smiles or laughs in a few occasions.. e.g.: T: So that works really well...the tree..oops.., I'm gonna put this down now, I tend to break stuff... (laughs).

11- Facial expressions and nodding in a spontaneous manner gave acknowledgement throughout the crit as well as shown later in the Nonverbal Communication Visual Sheet for this crit session.

Communication Management and Facilitation for Face-to-Face session: F-Y1S8



13- Pointing as a primary function of hand gestures was observed to be specific and in relation mainly to the model, in this project, the scale was big and the model was centric to the design, so object adopters with in-between pointing and continuous illustrator gestures occupied most of the speaking time.

14- Illustrator gestures included those that 'imitate' the user or other objects in spatial reference; e.g.(left image): *"...depending on how the sun is directed, if it is East the rays will create..."* and (right image): *"...there is water around, so I brought water into the site to enhance reflection..."*. Sizes and Distances were also mimicked occasionally.

18- During Presentation and Discussion phases, the student would look at the drawings or model while describe her idea, and look at the tutor for acknowledgement or reaction, she would also look at her hands when attempting to illustrate a movement, and sometimes stare at the void while talking. The tutor would be looking at the sketch book, model or board during the description, and occasionally look at the student when she introduced a new concept, or to hand over the conversation when he asked her a question.

17-- It was also noticed that participants had few engagements in eye contact, and that happened mainly due to a strange concept or word that grabbed attention, or a joke that got them laughing. E.g.: *"I chose the colour green because if I chose to not treat the copper wall then it will by time turn green and it would be a nice way of showing the space as well and the colour will echo the colour of the wall. (Smile)"* During the last phase of the crit, exchange of evaluation and feedback implied attention and therefore mutual gaze accompanied by constant nodding from the student were observed.

15- Nodding and shaking were not only indicators of agreement and disagreement in this session, but also forms of expressing attention and presence; as a spontaneous way of communicating in face-to-face discussions, even without direct gaze, another function is the acknowledgement of receipt and perception of information, which is very effective in the learning conversation, it gives a sense that the other party is following and understanding or not. As shown in the visual sheet, these two nonverbal interactions are almost co-related with positive and negative facial expressions and signals that either encourage or hinder the flow of the utterance, and sometimes, the flow of thoughts.

16- Verbal expressions in this session were expressed using voice tone to emphasis an opinion, but this was observed on only a few occasions asociated with a mistake or a joke.

14- The tutor would stand up to get a closer look at the drawings, or moves to pick up the model.
S: *"I wanted it to be that the people see the tree from behind this wall. Even though this is not a very a good representative of a tree".*
T: *"Let me see the model".*

Nonverbal Communication for Face-to-Face session: F-Y1S8

Appendix (J): An Abstract of a Published Paper

Citation:

Abdellatif, R. and Calderon, C. (2007) 'SecondLife: A Computer-Mediated Tool for Distance-Learning in Architecture Education?', 3rd International ASCAAD Conference on Em'body'ing Virtual Architecture ASCAAD-07. Alexandria, Egypt, 28-30 November 2007. ASCAAD, pp. 17-34.

SECONDLIFE: A Computer-Mediated Tool for Distance-Learning in Architecture Education?

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Abstract

Despite the importance of distance learning for its ability to reach a wide audience, easiness to access materials, and its lower cost compared to traditional learning, architecture education has not been well served by distance education. This is because it has a higher level of learning objectives, it is taught by coaching methodologies, and involves nonverbal forms of communication. One of the most common learning methods used in the design studio is the Criticism/Critique, which is a graphic and oral type of communication between the tutor and the students. In this investigation, Second Life, a massive multi-user online virtual environment that offers three-dimensional spatial capabilities via Avatars impersonation, is used as a computer-mediated tool for text and graphic-based communication in a distance learning situation. The study describes a demonstration experiment where students had to communicate with their tutor, display and describe their projects at a distance, in a purposely designed criticism space in SecondLife.

The main objective of this paper is to observe and document the effects and the use of SecondLife virtual environment as an online 3D graphical-based tool of computer-mediated communication in distance learning in architecture education. The study also answers some questions: How well did the students use the tools of the medium provide? Was there a sense of personal communication and realism gained through using Avatars in the virtual environment? Did SecondLife provide a successful means of communication for a graphic-based context? And what are the students' opinions about the learning environment? Using multiple methods of data collection, mainly based on an electronic observation of the experiment, questioning the participants before and after the experiment, and the analysis of the chat transcripts, the study presents descriptive results of the experiment, and discusses its main features. Proposals for modifications are made for future replications.

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