



**University Library**

Author/Filing Title ..... SHEIK SAID .....

.....  
Class Mark ..... T .....

**Please note that fines are charged on ALL  
overdue items.**

--	--	--

0403122627





**AN EXPERIMENTAL STUDY TO DEVELOP  
AN ENGAGING MULTIMEDIA DESIGN MODEL  
FOR CHILDREN**


by

**Normahdiah Sheik Said**

Submitted in partial fulfilment of the requirements  
for the award of  
Doctor of Philosophy of Loughborough University

**JULY 2004**

© Normahdiah Sheik Said 2004

 University of London	
Date	SEP'05
Class	T
Acc No.	40312262

## **ABSTRACT**

Multimedia has enormous potential but there is still much to learn about what works and what does not work for children. The aim of this research was to develop a model for multimedia design that gives user engagement for children. A preliminary scoping study showed that children did realise the potential of multimedia but did not like the design of the applications given to them. A search was made for a multimedia application that fitted the 'wish lists' of the children in the scoping study in order to identify a vehicle for these investigations. The Sims, a popular game about Life Management, where players play a major role in the management of everyday family life (providing a place to stay, managing finance, basic needs, moods and desires), fitted this description and was selected for this purpose. Five experiments were conducted with children (9 to 14 years old) varying the use of The Sims to test what really engaged them. An Engagement Scale was created as a rating scale to measure engagement at five-minute intervals. Other data to establish the degree of engagement was gathered through video recordings and interviews.

The experiments obtained high levels of engagement for some conditions, for example, simulation and construct conditions. From this the factors contributing to engagement were identified. As a result a 6-component theory of engagement was formulated as 'An Engaging Multimedia Design Model for Children'. The model proposes that children need to be able to interact with the multimedia at several levels to be engaged to it. The lowest level of interaction needs to give immediate feedback as a result of the child's actions to support physical or motor skills. The higher levels of interaction, however, need to support mental model skills and goal achievement. In some cases goals set by the designer are effective. In others the children need to set their own goals and levels of aspirations. If the design features in the multimedia conform to these principles the multimedia application will be engaging for children.

## Acknowledgements

To name every person to whom I am indebted would require a separate volume for this thesis. There are some groups and individuals that I should express my personal gratitude for without them this thesis would have been impossible.

- The children of Holywell Primary School for their willingness to participate in my research
- The children of my colleagues, friend and neighbours mainly children of the International Students of Loughborough University
- The children of my colleagues, friend and neighbours of my Malaysian Community in Loughborough University and neighbouring universities
- The Human Sciences and Advanced Technology (HUSAT) – usability labs, Elms Grove, Loughborough
- All the academic staff, clerical and technical staff of the Department of Human Sciences for the support and assistance given during the course of my studies in ensuring I get the best of the days of my stay in the UK
- My sponsoring body Universiti Putra Malaysia, in the Government of Malaysia

Above all there are two most important influences beyond compare in the journey of completion of this thesis:

- My supervisor Professor Ken Eason, the most valued personality, for his guidance, on going supervision and professionalism that had made wonders in making sure that I did not lose sight of the final outcome of my thesis

And for everything else... MY FAMILY...

...My loving husband, Mohamad Rashid and my lovely six children, Alina Hasni, Anees Aisyah, Mohamad, Yusuf, and my twins, Eishaque and Eismael who had made lots of sacrifices and endless support to this fulfillment...

# Table of Contents

Page

## Abstract

## Acknowledgements

## Chapter 1

<b>Introduction</b>	<b>1</b>
1.0 The Promise of Multimedia	1
1.1 Definition	1
1.2 History	4
1.3 Multimedia and People	7
1.4 Multimedia and Children	8
1.5 Relating HCI, UCD, Children and Multimedia	9
1.6 The Landscapes of Multimedia	10
1.7 The Failure of Multimedia?	12
1.8 The Problem	13
1.9 The Research	14
1.9.1 Research Background and Aims	15
1.9.2 Why Research?	15
1.10 Theoretical Hypothesis	16
1.11 The Research Questions	16
1.12 The Purpose of Study	17
1.13 Structure of the Research	17
1.14 Thesis Structure	19

## Chapter 2

<b>Research Methods for Studying Children Using Multimedia</b>	<b>21</b>
2.0 Chapter Outline	21
2.1 Introduction	22
2.2 Research Methods Review	22
2.2.1 Ethno methodology	22
2.2.2 Action Research	23
2.2.3 Grounded Theory – Generating a Theory	25
2.2.4 Usability Evaluation Methods	25
2.2.5 The Experimental Research Approach	26
2.3 Research Methods and Issues When Studying Children	27
2.3.1 Usability Evaluation and Children	27
2.3.2 Methods on researching children	28

2.3.3	Where the children are in this research paradigm?	29
2.3.4	Ethical Issues in studying Children	31
2.4	The Approach Adopted	31
2.4.1	Researcher's stand	31
2.4.2	Qualitative and Quantitative Data	33
2.5	The Research Programme and the Method Used	34
2.5.1	The Participants – Children	34
2.5.2	Criteria for Selection	34
2.5.3	Gender	35
2.5.4	Research Instruments	35
2.5.5	An Engagement Scale Score	35
2.6	Other Methodological Considerations	39
2.6.1	Making the Children Comfortable	39
2.6.2	Cultural Barriers	39
2.6.3	Selecting Multimedia Applications for Study	39
2.6.4	How to get Children to Behave Naturally in Video Recordings and in An Experimental Setting	40
2.7	Overall Conclusion	42

## **Chapter 3**

### **An Early Study of Children to Identify Issues**

	<b>–Study 1 (The Pilot Study )</b>	<b>43</b>
3.0	Chapter Outline	44
3.1	Introduction	44
3.2	Selected Children: Age and Gender	44
3.3	The Research Programme	44
3.3.1	Experimental Location	44
3.3.2	Duration of Study	45
3.4	Subject Matter Identification	45
3.4.1	Selecting the Themes	46
3.4.2	Matching Materials with Intended Target Audience (Age – Group)	47
3.5	The Materials	49
3.5.1	The Multimedia CDs	49
3.5.2	Information Books	50
3.6	Investigative Procedure	52
3.7	Findings	53
3.7.1	Session 1 and Session 2	53



3.7.2 Findings	54
3.7.3 Session 1 and Session 2	64
3.7.4 Findings	65
3.7.5 Session 1 and Session 2	76
3.7.6 Findings	77
3.8 Reflections on Methods	84
3.9 Analysis of Findings	84
3.10 Discussion	87
3.11 Conclusions	90

## **Chapter 4**

<b>Engagement &amp; Interactivity in Multimedia</b>	<b>91</b>
4.0 Chapter Outline	91
4.1 Introduction	92
4.2 Theoretical Issues and Concepts	92
4.3 The Psychological Contribution	92
4.3.1 Passivity versus Activity	92
4.3.2 Being in Control or in Charge	95
4.3.3 Psychological Studies of Design Features	96
4.4 The Human Computer Interaction (HCI) Contribution	
– Design Principles, Issues and Concepts	98
4.4.1 The “Gulf of Execution” and The “Gulf of Evaluation”	98
4.4.2 Direct Manipulation	101
4.5 The Educational Contribution	
– Activity and Interactivity	102
4.5.1 Media Debate	102
4.5.2 The Role of Interactivity in Engagement (Educational Technologists Perspective)	104
4.5.2 Other Views	106
4.6 Interactivity and Engagement	108
4.6.1 Interactivity	108
4.6.2 Engagement	112
4.7 Other Related Issues	115
4.7.1 Gender	115
4.7.2 Cognitive Development	115
4.7.3 Individual Differences	117
4.8 Overall Conclusion	118

## **Chapter 5**

### **The Engaging Multimedia Experience**

- Factors that Matters in Multimedia Design for Children (Study 2)	121
5.0 Chapter Outline	121
5.1 Introduction	122
5.2 Summary : Purpose, Method and Experimental Design	123
5.3 Selected Children: Age and Gender	123
5.4 The Methods	124
5.4.1 Experimental Location	124
5.4.2 Research Organisation	124
5.4.3 The Experimental Design of Study 2	124
a. What is The Sims?	125
b. Why The Sims?	126
c. Visual Representation of the 5 factors in The Sims	128
5.5 Experimental Objective and Structure of Study 2 – The Sims	134
5.6 The Materials – Experimental Instruments	134
5.6.1 The Edutainment Multimedia CD- The Sims	134
5.6.2 An Engagement Scale Score	134
5.6.3 Timer	135
5.6.4 Semi - Structured Interview	136
5.6.5 Video Recordings	136
5.7 Study Programme	136
5.7.1 Experimental Organisation	136
5.7.2 A Standard Briefing Session	137
5.7.3 A Free Play Session	137
5.7.4 The Constrained Resources Condition – Condition 1	138
5.7.5 The Unlimited resources Condition – Condition 2	139
5.8 The Data	139
5.9 The Results	140
5.9.1 Overall Engagement Scale Scores for Condition 1 and 2	140
5.9.2 Setting Analysis Standards	142
5.9.3 Average Engagement Scale Score	142
5.8.4 Average of Engagement Pattern at Every 5-minute Interval	143
5.10 Description of Engagement Patterns	144
5.10.1 The lowest Level of Engagement	145
5.10.2 The Starting Levels	147
5.10.3 Dips	147
5.10.4 Gradual Increase and Gradual Decrease	149

5.10.5 Plateau	151
5.10.6 The Highest Level of Engagement	154
5.10.7 The Ending Levels Range	155
5.10.8 Findings from Interviews	156
5.11 Analysis of Findings	157
5.11.1 Overall Analysis of Findings of the Engagement Scale Scores and Averages for Condition 1 and 2	158
5.11.2 Analysis of the Low Levels Engagement Pattern	161
5.11.3 Analysis of the Starting Levels	164
5.11.4 Analysis of Dips	167
5.11.5 Analysis of Findings of Gradual Increase and Gradual Decrease	169
5.11.6 Analysis of Findings of Plateau Category	173
5.11.7 Analysis of Findings of the Highest Level of Engagement Category	174
5.11.8 Analysis of Findings from Interview	175
5.12 Overall Conclusion of Study 2	175
5.12.1 From the Engagement Tables and Other Graphical Representation Perspective	176
5.12.2 Gender and Age Perspective	178
5.12.3 Important Variables Contributing to Engagement	178
5.13 Summary of Findings from Study 2	180
5.14 A Preliminary Engaging Multimedia Design Model	181

## **Chapter 6**

<b>An Engaging Multimedia Design Model for Children</b>	<b>182</b>
6.0 Chapter Outline	182
6.1 Introduction	183
6.2 Models of User Behaviour	183
6.2.1 The TAM Model	183
6.2.2 Mental models and Data Models	184
6.3 The Engaging Multimedia Experience of Study 2	185
6.4 Designing for Children	186
6.3.1 Usability that Matters	186
6.3.2 Design Features that Matter	187
6.4 Initial Hypothesis of What Could Be Engaging	188
6.5 The Five Main factors for An Engaging Multimedia Experience	188
6.5.1 Construct Interactivity	189
6.5.2 Simulation Interactivity	189
6.5.3 Immediacy	189

6.5.4 Feedback	190
6.5.5 Goals	191
6.6 An Engaging Multimedia Design Model – A Preliminary Model	191
6.6.1 Stage One	191
6.6.2 An Analogy	192
6.7 Conclusion	194

## **Chapter 7**

<b>Testing the Engaging Multimedia Design Model</b>	<b>196</b>
7.0 Chapter Outline	196
7.1 Introduction	197
7.2 The Purpose of Study	197
7.3 Testing the Engaging Multimedia Design Model	198
7.3.1 Introduction	198
7.3.2 Selected Children: Age and Gender	198
7.4 The Methods	199
7.4.1 Experimental Location	199
7.4.2 Experimental Scenario and Time Span	199
7.4.3 Overview of Experimental Conditions	199
i. No Interaction – Condition 1	200
ii. Simulation Interaction – Condition 2	201
iii. Construct Interaction – Condition 3	202
7.5 Data Gathering and Data Processing	203
7.6 The Results	203
7.6.1 Overall Engagement Scores for Each Experimental Condition	203
i. Condition 1 (No Interaction)	203
ii. Condition 2 (Simulation Interaction)	204
iii. Condition 3 (Construct Interaction)	205
iv. Overall Average Engagement Scores per Interval	207
7.6.2 Engagement Patterns According to Categorisation as in Study 2	208
i. The Lowest Level of Engagement Category	208
ii. The Starting Levels Range Category	209
iii. Dips	209
iv. Gradual Increase and Gradual Decrease Category	210
v. Plateau	211
vi. Maximum	213
vii. The Ending Levels Range	214
7.7 Data Analysis	215

7.7.1 Analysis of Findings of No Interaction	215
7.7.2 Analysis of Findings of Simulation Interaction	222
7.7.3 Analysis of Findings of Construct Interaction	228
7.8 Discussion	234
7.8.1 Introduction	234
7.8.2 Significant Difference	235
7.8.3 Triangulation Analysis	235
7.8.4 Comparing Engagement Patterns Amongst Conditions	235
7.9 Conclusions	239
7.10 Summary	242

## **Chapter 8**

<b>A Study of Previous Experience- Study 4</b>	<b>244</b>
8.0 Chapter Outline	244
8.1 Introduction	245
8.2 Further Tests – Study 4	245
8.2.1 The Purpose of the Study	245
8.2.2 Selected Children: Age and Gender	245
8.3 The Methods	246
8.3.1 Experimental Location	246
8.3.2 Experimental Scenario and Time Span	246
8.4 Simulation Interaction	247
8.4.1 What the children had to do	247
8.4.2 How was this condition set up?	247
8.5 Construct Interaction	247
8.5.1 What the children had to do	247
8.5.2 How was this condition set up?	248
8.6 Data Gathering and Data Processing	248
8.7 The Results	248
8.8 Overall Engagement Scale Scores According to Experience for Both Experimental Conditions	249
8.8.1 Engagement Scale Scores for Sims (WE) Group	249
8.8.2 Engagement Scale Scores for Sims (WOE) Group	249
8.9 Average Engagement Patterns Simulation Interaction Vs Construct Interaction	250
8.9.1 Simulation Interaction Vs Construct Interaction Sims WE Group	250
8.9.2 Simulation Interaction Vs Construct Interaction Sims WOE Group	251
8.10 Engagement Patterns According to Categorisation as in Study 2 and Study 3 for Both Groups Sims WE and Sims WOE	252

8.10.1	The Lowest Level of Engagement Category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction	252
8.10.2	The Starting Level Range Category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction	253
8.10.3	Dips Category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction	254
8.10.4	Gradual Increase and Gradual Decrease Category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction	255
8.10.5	Plateau Category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction	256
8.10.6	Maximum Category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction	257
8.10.7	The Ending Levels Category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction	258
8.11	Data Analysis	258
8.11.1	Engagement Scale Scores; Simulation Interaction Vs Construct Interaction for Sims WE Group	258
8.11.2	Engagement Scale Scores; Simulation Interaction Vs Construct Interaction for Sims WOE Group	259
8.11.3	Conclusion	260
8.11.4	Significant Difference	261
8.11.5	Triangulation Analysis	261
8.12	Comparing Engagement Patterns According to Categorisation	261
8.12.1	The Lowest Engagement Level Category	261
8.12.2	The Starting Level Range Category	263
8.12.3	Dips Category	263
8.12.4	Gradual Increase and Gradual Decrease Category	264
8.12.5	Plateau Category	264
8.12.6	Maximum Category	265
8.12.7	The Ending Levels Range Category	265
8.13	Discussion	265
8.14	Summary	267

## **Chapter 9**

<b>Study 5 – An Investigation into Prolonged Play</b>	<b>258</b>
9.0 Chapter Outline	258
9.1 Introduction	259
9.2 Study 5	259
9.2.1 Introduction	259
9.2.2 The Purpose of Study 5	259
9.2.3 Selected Children: Age and Gender	260
9.3 The Investigation	260
9.4 Data from Group 1	261
9.4.1 The Findings	262
9.4.2 Analysis of Findings of Group 1	266
9.4.3 Conclusion	268
9.5 Data from Group 2	270
9.5.1 The Questionnaire	270
9.5.2 The Findings	271
9.5.3 Analysis of Findings of the Questionnaire	274
9.5.4 Conclusion	277
9.6 Data from Group 3	278
9.6.1 The Findings	278
9.6.2 The Positive and Negative Views of Prolonged Play of the Early Version	279
9.6.3 Other Comments During Early Version Phase	279
9.6.4 Views about Construct and Simulation Mode of Prolonged Play.	280
9.6.5 Analysis of Findings of Group 3	282
9.7 Overall Discussions and Conclusions	285
9.8 Summary	287

<b>Chapter 10</b>	
<b>Discussion &amp; Conclusions</b>	<b>290</b>
10.0 Chapter Outline	290
10.1 Introduction	291
10.2 Methodological Review – Research Strengths and Limitations	291
10.2.1 Research Method Strengths	291
10.2.2 Limitations	292
10.3 Lessons Learned about Working with Children	295
10.3.1 Researching Children	295
10.3.2 Research Instruments	296
10.3.3 Helping Children to Articulate	296
10.4 Other Issues to Ponder	297
10.4.1 If given another chance	297
10.4.2 Other Future Research Opportunities	297
10.5 The Research Programme	298
10.6 What did the children want?	299
10.7 The Five Design Features	301
10.8 Towards A Model of Engagement	301
10.9 The Model of Engagement	302
10.9.1 Introduction	302
10.9.2 Interaction and Immediate Feedback- Motor Skills Level – Achievement of Goals	303
10.9.3 Simulation – Mental Model Skills Levels – Achievement of Goals	305
10.9.4 Construct – Mental Model Skills Levels – Achievement of Goals	307
10.9.5 Previous Experience and Sustained Engagement	307
10.9.6 The Scope and Limitations of the Model and How it Might be Further Developed	309
10.10 Implications of Designing for or with Children	311
10.10.1 Designing Multimedia for Children	311
10.10.2 Designing Educational Multimedia for Children	313
10.10.3 Designing with Children	315
<b>BIBLIOGRAPHY</b>	<b>318</b>
<b>Appendices</b>	



## List of Tables

Page

### Chapter 1

Table 1.1 Relating Humans, Computers and User Interface

6

### Chapter 4

Table 4.1 The Interactivity Evidence

101

Table 4.2 Levels of Interaction

109

### Chapter 5

Table 5.1 Customer's Reviews Rating in Terms of Preferences

125

Table 5.2 5 Main Factors versus The Sims

126

Table 5.3 Engagement Scale Scores for Condition 1 of Study 2

141

Table 5.4 Engagement Scale Scores for Condition 2 of Study 2

141

Table 5.5 Lowest Level Engagement Category of the Engagement Scale Scores for Condition 1 (LM\$ - 2 Loc -MBuFCFm)

145

Table 5.6 Lowest Level Engagement Category of the Engagement Scale Scores for Condition 2 (ULM\$ - F Loc- FBu/FBy FmG)

146

Table 5.7 The Starting Engagement Scores for the First 5-minute Interval

147

Table 5.8 Dips in Engagement Scale Scores for Condition 1 (LM\$ - 2 Loc -MBuFCFm)

148

Table 5.9 Dips in Engagement Scale Scores for Condition 2 (ULM\$ - F Loc- FBu/FBy FmG)

148

Table 5.10 Gradual Increase Engagement Scores for Condition 1 (LM\$ - 2 Loc -MBuFCFm)

150

Table 5.11 Gradual Increase Engagement Scores for Condition 2 (ULM\$ - F Loc- FBu/FBy FmG)

150

Table 5.12 Gradual Increase Engagement Scores for Condition 1 (LM\$ - 2 Loc -MBuFCFm)

151

Table 5.13 Plateau of the Engagement Scale Scores for Condition 1 (LM\$ - 2 Loc -MBuFCFm)

152

Table 5.14 Plateau of the Engagement Scale Scores for Condition 2 (ULM\$ - F Loc- FBu/FBy FmG)

153

Table 5.15 Maximum Level Engagement Scale Scores for Condition 1 (LM\$ - 2 Loc -MBuFCFm)

154

Table 5.16 Maximum Level Engagement Scale Scores for Condition 2 (ULM\$ - F Loc- FBu/FBy FmG)

155

Table 5.17 The Ending Engagement Scores for the last 40-minute Interval for Condition 1 and 2

156

Table 5.18 Children Preferences from Interview Data

156

### Chapter 7

Table 7.1 Children according to gender and age groups

198

Table 7.2 Children according to experience

198

Table 7.3 Children Participating in Condition 1 (No Interaction)

200

Table 7.4 Children Participating in Condition 2 (Simulation

	Interaction)	201
Table 7.5	Children Participating in Condition 3 (Construct Interaction)	202
Table 7.6	Engagement Scale Scores for Condition 1 (No Interaction)	204
Table 7.7	Engagement Scale Scores for Condition 2 (Simulation Interaction)	205
Table 7.8	Engagement Scale Scores for Condition 3 (Construct Interaction)	206
Table 7.9	Average Engagement Scores Per Interval for 3 Experimental Conditions	207
Table 7.10	Lowest Level of Engagement Score Category Condition 1 (No Interaction)	208
Table 7.11	Lowest Level of Engagement Score Category Condition 2 (Simulation Interaction)	208
Table 7.12	Lowest Level of Engagement Score Category Condition 3 (Construct Interaction)	208
Table 7.13	The Starting Levels Range Category for all 3 conditions	209
Table 7.14	Dips as they occur in Condition 1 (No Interaction)	209
Table 7.15	Dips as they occur in Condition 2 (Simulation Interaction)	210
Table 7.16	Dips as they occur in Condition 3 (Construct Interaction)	210
Table 7.17	Gradual Decrease Engagement Pattern in Condition 1 (No Interaction)	211
Table 7.18	Gradual Increase Engagement Score Pattern in Condition 2 (Simulation Interaction)	211
Table 7.19	Gradual Increase Engagement Score Pattern Condition 3 (Construct Interaction)	211
Table 7.20	Plateaus in Condition 1 (No Interaction)	212
Table 7.21	Plateaus in Condition 2 (Simulation Interaction)	212
Table 7.22	Plateaus in Condition 3 (Construct Interaction)	212
Table 7.23	Maximum Score in Condition 1 (No Interaction)	213
Table 7.24	Maximum Score in Condition 2 (Simulation Interaction)	213
Table 7.25	Maximum Score in Condition 3 (Construct Interaction)	214
Table 7.26	The Ending Levels Range in all 3 Conditions	214

## Chapter 8

Table 8.1	Engagement Scale Scores for Simulation Interaction Sims (WE) Group	249
Table 8.2	Engagement Scale Scores for Construct Interaction Sims (WE) Group	249
Table 8.3	Engagement Scale Scores for Simulation Interaction Sims (WOE) Group	250
Table 8.4	Engagement Scale Scores for Construct Interaction Sims (WOE) Group	250
Table 8.5	The Lowest Level Category Simulation Interaction Vs Construct Interaction for Sims WE Group	252
Table 8.6	The Lowest Level Category Simulation Interaction Vs Construct Interaction for Sims WOE Group	252
Table 8.7	The Starting Engagement levels in Simulation Vs Construct Interaction for Sims WE Group and Sims WOE Groups	253

Table 8.8	Occurrence of Dips in Simulation Interaction Sims (WE) Group	254
Table 8.9	Occurrence of Dips in Construct Interaction Sims (WE) Group	254
Table 8.10	Occurrence of Dips in Simulation Interaction Sims (WOE) Group	254
Table 8.11	Occurrence of Dips in Simulation Interaction Sims (WOE) Group	254
Table 8.12	Occurrence of Gradual Increase in the Sims (WE) Group	255
Table 8.13	Occurrence of Gradual Increase in the Sims (WOE) Group	255
Table 8.14	Occurrence of Plateaus for Simulation Interaction in the Sims (WE) Group	256
Table 8.15	Occurrence of Plateaus for Construct Interaction in the Sims (WE) Group	256
Table 8.16	Occurrence of Plateaus for Simulation Interaction in the Sims (WOE) Group	256
Table 8.17	Occurrence of Plateaus for Construct Interaction in the Sims (WOE) Group	257
Table 8.18	Occurrence of Maximum Scores for Simulation Interaction in the Sims (WE) Group	257
Table 8.19	Occurrence of Maximum Scores for Construct Interaction in the Sims (WE) Group	257
Table 8.20	Occurrence of Maximum Scores for Construct Interaction in the Sims (WOE) Group	257
Table 8.21	Occurrence of Maximum Scores for Construct Interaction in the Sims (WOE) Group	258
Table 8.22	The Ending Engagement Levels Range for both Simulation and Construct Interaction Experimental Conditions for Sims WE Group and Sims WOE Group	258

## Chapter 9

Table 9.1	The Two Selected Prolonged Play Children in Study 2 doing Condition 1 (Simulation)	262
Table 9.2	Another two children in Study 2 with Sims experience doing Condition 1 (Simulation)	262
Table 9.3	The Two Selected Prolonged Play Children in Study 2 doing Condition 2 (Construct)	263
Table 9.4	Another two children in Study 2 with Sims experience doing Condition 2 (Construct)	263
Table 9.5	Average Engagement Scores of Prolonged Play Children and No Experience Children doing Condition 1 (Simulation Condition of Study 2)	263
Table 9.6	Average Engagement Scores of Prolonged Play Children and No Experience Children doing Condition 2 (Construct Condition of Study 2)	264
Table 9.7	Engagement Scores for Other Children Without Experience doing Condition 1 - Simulation Condition of Study 2	265

Table 9.8	Engagement Scale Scores for Other Children Without Experience doing Condition 2 – Construct Condition of Study 2	266
Table 9.9	Classification of Questionnaires	274
Table 9.10	Positive and Negative Views of Boys (B) and Girls (G) About Length of Play	279
Table 9.11	Positive and Negative Statements of Boys and Girls in the Early Version Phase	280
Table 9.12	Views about Construct and Simulation Mode of Early Version Phase	281
Table 9.13	Views About Construct and Simulation Mode of Later / Recent Version Phase	282

# Chapter 1

## Introduction

### 1.0 The Promise of Multimedia

This thesis is about children using multimedia. Multimedia has been said to have enormous potential for leisure and education. But does it work? Do children like it, etc? The thesis focuses on all users but especially on children. This research investigates children's use of publicly available multimedia (CD-ROMs). The chapter starts with a definition, its history and promise. And the reality – where it doesn't work, where it does work and what we know of why the differences – in the form of multimedia and in the way it is designed. It presents the purposes and objectives of the research and ends with a description of the structure of the thesis.

### 1.1 Definition

ISO 14915 (2001) defines multimedia as

... user interfaces that integrate and synchronise different media (static media such as text, graphs and images; and dynamic media such as audio, animation and video)...

This guidance insists on standards that need to be applied to presentation and interaction techniques for computer based multimedia applications in general, including stand-alone and networked applications. It provides recommendations for their design and evaluation, but only covers ergonomic issues. The standard excludes "non-ergonomic" issues such as aesthetics and entertainment.

In a design guide INUSE (European Usability Support Centres) (1997) multimedia is defined as:

...The use of different input devices and different media, both time dependent (sound, music, voice, video) and time independent (graphics, text) in a system or service (Clarke, 1992). A multimedia system or service may therefore include a combination of text, still images, graphics, video animation, sound and speech as output media. To interact with these elements, the user may use a mouse, tracker ball, joystick, touch screen, pen, stylus, keyboard or speech for input..

Both the definitions above are evidence of current multimedia capabilities. In its early and developing stage it had fewer capabilities. Dix (1993) describes early multimedia in terms of two interchangeable concepts multi-modal and multi-media systems. He discusses its development through interactive systems, starting with the traditional keyboard, and a mouse as a pointing device, one-screen display and limited sound output.

As system developments took place more multiple communication channels could be used simultaneously and gradually multi-media systems appeared. They used a number of different media to communicate supplementary, additional and redundant information through input and output devices. These systems use "the multiple sensory channels" of humans and also different "types of visual inputs" like "textual, graphical, iconic, animation, video and CD-I" (Dix, 1993). Since 1993 more functionality has led to an increase in the "bandwidth of human-computer interaction" to include interfaces for users with special needs and virtual reality.

Preece (1994) defines multimedia from a HCI perspective. She emphasises concepts of quality (high quality sounds and video images), aesthetics (appeal), distributiveness (high storage capacity), user-centeredness (effective interaction, easy to use), ...

...Any computer application that employs a videodisk, images from a CD-ROM, uses high quality sound, or uses high quality video images on screen may be termed a multimedia application. Such interfaces are often aesthetically appealing and where high capacity storage devices such as CD-ROM are used, can provide effective interactions for the user, by acting as very large databases or storehouses of information with dense but easy-to use cross referencing and indexing. Preece (1994: p.225)

Barnhart (2002) acknowledges the uncertainty and confusion caused by the emerging concepts of multimedia. In her ergonomics' view she explains the existence of two different camps proposed by England (1994): one that looks at "user's perspective which refers to the different sensory and operating modalities that a user brings to bear in receiving and communicating information to a machine", and another from "a systems-oriented approach ..." Barnhart (2002: p.3) The latter she claims to be most commonly used (Steinmetz & Nahstedt, 1995; Georganas, 1997; Blattner & Dannenberg, 1992) in Barnhart (2002).

Jones (2003) looks at multimedia as

"... The integration of multiple media forms, including text, music, spoken words, video, illustrated graphics, and still photographs, to communicate unified messages that, ideally at least, are also interactive..." (Jones (2003) p.329)

He claims that digital multimedia becomes "hypermedia" due to the hypertext linkages presented when it submerged itself in the Internet.

To Cawkell (1996) multimedia means:

" 'The processing and presentation of information in two or more media', so computers which are capable of handling text and simple graphics, ...could be called 'multi-media computers'...many extra attributes have been developed that the word now usually means the processing and presentation of at least text, graphics, and pictures, if not animation and motion video, usually in colour with sound...many systems and activities...including hypertext, image processing, compression systems, colour electronics, input technologies like scanners, cameras, and picture frame grabbers, output technologies such as displays and reprography, transmission systems, Virtual Reality, and visualization. Compact Disk media and techniques, electronic books and journals, and videoconferencing are multimedia, as are computer games and home shopping." (Cawkell (1996) p.3)

Hence we have different writers defining multimedia differently. Some writers do so by looking at it from a historical perspective, some the form it was at the time the definition was made, whilst others according to the disciplines they hold. Some include the professional jargon of software developers or multimedia technical specialist while others do not. Defining it is just as intricate as discussing the history of its creation. Gonzalez (2000) when expressing the difficulties of getting the right multimedia curricular in the academia arena, has this to say about its definition:

Ask for a definition of "multimedia", and you'll likely never to hear the same description twice. So, how do we go about teaching it?" (Gonzalez (2000) p.89)

For the researcher, metaphorically multimedia behaves like the "mitosis" phenomenon of a human cell; it divides and multiplies but still maintains its genetic characteristics of multi-functionality. The concept was created with the intention of the exploitation of the possibilities of integrating these multifunctional media using text, sound, animation and video imaging, etc. in one application, platform or

environment. The concept has been assimilated into computer technologies through computer desktops as standalone CDs, through on-line systems of the Web and through the digital age of the mobile phones. Its birth and creation has affected many disciplines in and around computer technology symbiotically and therefore contributed a lot to the multidisciplinary nature in building, creating, designing and using it.

## **1.2 History**

Druin (1996a) traces the historical development of multimedia as far back as the 1960s, while Jones (2003) goes even further. But both agree that its popularity begins in the 1960s. This is the time when people started experimenting with different media with the incorporation of music, sculpture, painting and live performance to bring about the "multi" functionality phenomenon. Later they come up with the term "multi-media" with a "dash" in 1970s. This was the time when people started to attempt mixing theatre-based film and slide shows. Sometime between 1970s and the early 1980s the "dash" lost its functionality. This marriage of varying media - text, graphics, video, animation, and sound in combination with computer technology contribute to its name.

Hughes (2000) looked at its history from the time when the tools of creation became accessible to the masses and not just the work of a "sacred few". As the years progressed many experiments took place. More functionality was being built to allow users more opportunities to interact. As the capacity increased the demand for this type of environment increased. People wanted to do more things with it and authoring tools became easier to use.

Both writers, Druin and Hughes, acknowledge that HyperCard, (referred to as WildCard by Bill Atkinson, the creator) was the first authoring tool that allowed users to create interactive multimedia on a desktop computer. From it bloomed other authoring tools that led to the diversity described by Hughes (2000).

HyperCard is really what got "multimedia" started on its present course. A huge "developer community" formed around it that was unlike anything that had happened before. It involved people from all walks of life. Many of them had never used computers before - let alone built anything with them. Diversity flourished. Many of the results were loveable only in the eyes of



their creators – but that’s democracy for you, and without it, some of the most original and inspiring works we have today would never have happened. “HyperCard then was what the Web is today...” (Hughes (2000) p.62.)

Jones (2003), however, mentions Canter, an entrepreneur, who was impressed by the graphical user interface (GUI) and produced the first authoring tools for desktop computers. These systems had hardware and software tools that allowed the development of interactive programmes, hardware that converted information to machine-readable formats and software that enabled non-programmers, especially artists and musicians, to build multimedia programmes. This software could be found on many platforms but its demand on storage space made CD-ROM a very good option, which makes it portable and very distributive. Druin (1996) claims it was in this form that its “dash” was lost for good.

However, the development of multimedia cannot be seen as just an expansion of machine capabilities. It has to be related to what people want to do with it. Otherwise we fall into a “machine-centred orientation to life” (in this research context a “technology-centred orientation to life”). Man is asked to conform to the needs of the “machines” and not the other way round. The trouble is...


“When we take a machine-centred viewpoint, we judge things on artificial mechanical merits. The result is continuing estrangement between humans and machines, continuing and growing frustration with technology and with the pace and stress of a technologically centred life.” (Norman (1993) p. xi)

It then adds concerns to a phrase once said by Churchill...“First we built our buildings then they built us”. Now we are serving the technology instead of having it serve us. It is about time we reversed the machine-centred viewpoint to a person-centred viewpoint. It is about time, says Norman (1993), “Technology should serve us”.

From this, parallel with the development of multimedia, came issues about making systems usable. In the mid 1980s research into the field of User Centred Design (UCD) in computer technology bloomed. As ergonomics and usability studies became an issue in designing for humans, Human Computer Interaction (HCI) became a field specifically for users of computers and computer systems. **Table 1.1** below encapsulated the field of HCI as described by Jones (2003).

The problems that HCI seeks to investigate and address stem essentially from the differences between humans and computers at the place where they meet: the so-called user interface, which includes everything from a lap-top's on-off switch to the choice of icons on its screen, from the angle at which users sit to the shape of the mouse they use. Jones (2003: p. 222)

The place where Humans and Computers meet - HCI investigates

Situation / Conditions	Humans	U S E R  I N T E R F A C E	Computers
Past Experience	<ul style="list-style-type: none"> <li>- Think, reason and behave according to theories and models of the world based on past experience</li> </ul>		<ul style="list-style-type: none"> <li>- Store information</li> </ul>
Memories	<ul style="list-style-type: none"> <li>- Limited memories and attention spans</li> </ul>		<ul style="list-style-type: none"> <li>- Retrieve information consistently</li> </ul>
Task	<ul style="list-style-type: none"> <li>- Ability to concentrate and perform tasks varies, for reasons that are unpredictable and arbitrary</li> </ul>		<ul style="list-style-type: none"> <li>- Better at processing information</li> </ul>
Learn to generalise	<ul style="list-style-type: none"> <li>- Ability to learn one task and make generalisation to help with other tasks</li> </ul>		<ul style="list-style-type: none"> <li>- Worse at recognising patterns, almost completely incapable of generalising their learning to other tasks</li> </ul>
Intelligence	<ul style="list-style-type: none"> <li>- Intelligent</li> </ul>		<ul style="list-style-type: none"> <li>- Not, so far, intelligent enough</li> </ul>

**Table 1.1:** Relating Humans, Computers and User Interface

Changes in the direction of design became prominent in this period. A precise scenario of changes from innovative technological development to technology for human-computer interaction could be seen in Eason (1992). In the advent of the UK Alvey and the CEC ESPRIT programmes of information technology, he had an opportunity to work with systems developers on the processes by which systems were designed and implemented.

The developers of generic hardware and software were going through a major period of change in which technological innovation was no longer sufficient. They had to look carefully at their markets and this 'market pull' meant they had to understand the needs and behaviour of end users (Galer et al 1992). This provided opportunities for rapid developments in the technology of human-computer interaction... (Eason (1992) p.2)

In order to get the 'user's pull' it became essential for the developers to develop "usable" systems. The best possibility is to design one that could allow the user to "simply walk up to the device and use it successfully first time" (Eason in Preece, 1994 p.v).

A definition of HCI in 1987 was:

'[a] Set of processes, dialogues, and actions through which a human user employs and interacts with a computer' (Baëcker and Buxton (1987) p.40 in Preece (1994) p 7)

It is now perceived as a much broader field.

'Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them' (ACMSIGCHI, (1992) p.6 in Preece (1994))

As a result of the aim to satisfy more and more of the user's "wishes, needs and desires" Human Computer Interaction (HCI) has intertwined itself in many fields. At the same time, the potential and power of computing technology has spread and widened. The number of users has increased, the variation of use had widened and the demand of user has led to more challenges for HCI. Amongst the technological developments are speech recognition, multimedia, information visualization, and virtual reality. Therefore, in the design of multimedia, the discipline should tell us how to engage in user-centred design to make sure it is what users' want. It will also tell us what form of multimedia will be usable. Therefore, one of the contributions of this discipline will be to help us address issues of making multimedia easy to use.

### **1.3 Multimedia and People**

Each new medium has different connotations and consequences for the user. When comparing old and new media Jones (2003) noted that:

"Each new impact shifts the ratios among all the senses" (McLuhan, 1964) the visual order of print, for example, structures a sequentially ordered thought. Electronic media, on the other hand, invite a form of thinking that is non-linear, repetitive, discontinuous, and intuitive, proceeding by analogy instead of sequential argument" (Jones (2003) p. 451)

Thus, the challenge in designing, among others, is to satisfy the user. It is not so much about content but about the opportunities the medium could give to the user when using it.

McLuhan's famous aphorism, "the medium is the message," expresses his belief that the effect of a medium is not carried by its content, but rather in its format: every medium transmits a powerful message of its own in its format, above and beyond its content. The idea is easier to comprehend when we compare different media experiences while holding the content constant. For example, given the same piece of music, the experience generated from listening to high quality stereo system is different from that of listening to a Walkman." (Jones (2003) p.451)

Within this statement lies the argument "We shape our tools and afterwards our tools shape us." Yet those that present this argument also believe that the medium is transparent or neutral and it is man who gives direction to its potentialities.

## **1.4 Multimedia and Children**

Like other technological advances the early design of multimedia was to cater for adult users. Children were not considered as users until much later. It is however, the usual practice to retrofit design to fit young adults and sometimes, the technology then fits children better than adults. Take the case of mobile phones. Who could ever imagine that its creation would lead to the present wide market potential for children?

Since most technologies have adult users in mind, child users are usually a second priority or, at times, even left out altogether. Yet many have found that multimedia systems have a good potential in the fields of education and training.

Multimedia for children comes in various formats, e.g. CD-ROMs and on-line systems. For this research, the researcher intends to limit the research to multimedia in compact discs, 'multimedia CDs', computer applications on CD-ROMs, with standard storage for data larger than one could previously imagine. This means that multimedia can be developed for many child audiences. Everyone wants to give children a rich multimedia experience with these multimedia applications and because of that multimedia production for children bloom liked mushrooms after a rainy day.

## **1.5 Relating HCI, UCD, Children and Multimedia**

Human-computer interaction (HCI) is to put it simply the study of people, computer technology and the ways these influence each other. The purpose of studying HCI is to determine how we make this computer technology more usable by people. This therefore requires an understanding of computer technology, the people who interact with it and what is meant by 'more usable' which must include an understanding of the work that people are trying to perform by using the technology.

Thus, when we talk about HCI in the context of interaction between children and the computer, we need to consider children's cognitive, behavioural, psychological and physical capabilities and how to incorporate the knowledge of these into the design of technology. In this research it would mean studying the psychological implications of the design features in multimedia applications and how these features affect their preferences.

Considerations are made of the technology itself, both in terms of what is available in the options presented by computer technology as opposed to the printed form and how functionality can be specified on screen interface designs as opposed to printed text. Such studies identify the principles of linearity and interactivity and paradigms embodying usability in computer-mediated materials. Evaluations of user preferences regarding what engages users (in this case, children) will bring to light the evaluation of design models against usability and suitability. It exemplifies the connotations used in User Centred Design (UCD) Systems. Therefore in UCD context it looks at user's activity, both in terms of tasks to be performed and the context in which they occur, to strengthen UCD and HCI needs and requirements.

The usefulness of knowing the right methodological method to assess evaluation models is rightfully illustrated by the importance of HCI itself. Terry Winograd's view of HCI by Preece (1994):

'Human-computer interaction is the kind of discipline which is neither the study of humans, nor the study of technology, but rather the bridging between those two. So you always have to have one eye open to the question: what can the technology do? How you can build it? What are the possibilities? And one eye open to the question: what are people doing and how would this fit it? What would they do with it? If you lose sight of either of those, you fail to design well... I think the challenge is to really keep

knowledge of both the technology and the people playing off against each other in order to develop new things.' (Preece (1994) p.53)

This research intends to study users and their tasks, in particular, children. The study relates this information to design styles and human factor theories, guidelines and standards in order to build an appropriate form of interaction for multimedia applications suitable for children. The study will also develop knowledge of evaluating systems usable by the target user population.

The question that arises when designing multimedia applications for children is that it is highly competitive and highly unpredictable. An application that looks very promising and saleable on the day it is launched turns out a complete flop the very next day. Designing technology is designing a moving target. Technology is history the very next day it is launched. Iterative design is one form of design process that helps to ensure good quality products. But iterative design processes take time and time means money for producers. Most producers want their products to reach the market as soon as possible. Therefore, we find masses of multimedia applications on the market that reach their target date of production but defeat the needs of the target audience.

We all know that, in one way or the other, the success of software and courseware development and design are dependent upon the people using the product. Not only do the producers have to cope with the competitive markets, they also have to face the consequences of the convergence of multiple technologies in the product. The convergence in some way effects effective use of our senses and if the satisfactions of these senses are not met for that particular context, time and space, the material will be discarded by the user. Even though the elements of text, graphic, sounds and animations give a multiple effect to multimedia applications there is always the question of how much, how long, how often, what, when and where. If one does or does not work at its best, the next question to ask is why?

## **1.6 The landscapes of multimedia**

When many different bits of computing come together in multimedia people said it had great potential. They said it had potential for children. So many people built many systems for them. Most multimedia appears to be designed for aesthetics but

is it beneficial? Do users want it? Some multimedia is complex. Is the purpose of making it complex meant to make it more attractive? Do their users value them? What do users actually want? What do children want?

Norman, a man who has made us think twice about the psychology of designing every day thing, has this to say:

“If everyday design were ruled by aesthetics, life might be more pleasing to the eye but less comfortable; if ruled by usability, it might be more comfortable but uglier. If cost or ease of manufacture dominated, products might not be attractive, functional, or durable. Clearly each consideration has its place. Trouble occurs when one dominates all the others.” (Norman, D. (1988) p. 151)

Therefore, if design restricts itself to aesthetics, the product could be pleasing but not necessarily beneficial, for example, to the educationist “educational”, to the economist “marketable”, etc. If the design is usable, it is “operative” but the task could be dead “boring”. If the cost of iterating and redesigning exceeds the cost of not doing so, the design will in most cases be doomed. It is no wonder that Norman says we should consider every requirement carefully because trouble does come when one dominates all others.

Sometimes applications really work but there are always cases of enjoying this part of an application and not that. The aim of this research is to look at what makes the difference. Is it the issue of the quality of interactivity? If so, to what extent does a highly interactive multimedia allow you to treat it or manipulate it like a tool you can play with or something you can work with, as opposed to other tangible things like books, or toys. To what extent does, an interactive multimedia application allow you to be in control of ‘flipping pages’ at a pace most comfortable to you as in books, or allow you to build and rebuild as in building block toys? This research intends to look at the qualities of successful multimedia design in applications for children and how it engages them and in these to answer the question, “DO THEY NEED IT”?

There are successful stories that need to be accounted for. There are multimedia applications that are saleable and continue production up to this very day. Sadly, there are those that stop after the release of the first production. One aspect of the

research is to see ... what works here and what is it that can be so wrong about it that no magic really happens?

Then there is the question of designing for children. Many people have tried to design for children. Designing multimedia for them is more challenging than one might anticipate. Druin (1996b) a designer of new educational multimedia environments and technologies for children has one child's comments about the material designed for them...

"It's too bad they don't let you be a kid. It would be much better than just being around them" (Druin (1996b) in *Interactions*, vol. 111.5, p.12)

Most designers claimed they had children in mind most of the time. If they were as great as they claim to be why are some companies facing serious closure because of it. Why do some multimedia really work but some a complete flop? When discussing these issues writers tend to look at them through the principles and disciplines they follow. However, there is no research that looked at what the children think about applications that had been circulating in the market for a number of years. What are their preferences after the applications have reached them? What are their favourites? What can others do to ensure that what they produce could reach this favourable level and how can they maintain that level?

## **1.7 The failure of multimedia?**

There is published evidence that multimedia applications for children have been failing. Authors like Hughes (2000), a developer himself, put the blame for failures down to the "when ideas become big" phenomenon. He gave his views about the multimedia crisis in the late 1980s and early 1990s, when many major publishers who entered the CD-ROM arena failed to perform both commercially and aesthetically. He said some even began to have doubts about what this technology could do. "Could it be ...that this brave new technology doesn't actually work?" Hughes listed a number of failures in his book:

"In October 1996, Penguin and HarperCollins, and the British Marshall Cavendish, cut their losses and pulled out of multimedia altogether...The Voyager Company was brought to its knees. Dorling Kindersley sacked 50 multimedia staff. Even the Living Books Company ("Just Grandma and Me," "Arthur's Teacher Trouble,") shed staff and had to cancel projects. Bill Gates's



Corbis Corporation ...now cancelled development effort and pulled out of the business..." (Hughes (2000) p.72)

Is his opinion the same as other writers and researchers talking about multimedia design for children? An economist would look at them from the angle of how sellable the products are in the market and may plan for improved marketing and advertising strategies. Others have also pointed to problems, like the cultural psychology research groups who anticipated failures especially of educational CDs. Although these were designed for children they failed due to the children's lack of use of them in their environment (Giacquinta, Bauer and Levin (1993)) in Kerawalla (2002), Livingstone and Bovill's (1999) and Kerawalla (2002)). These groups look at these CDs, besides other media like television, etc., and studied how children used them in their homes and found their preferences. They preferred games to educational CDs. Therefore we would not do justice to multimedia if we exclude games when we talk about successful and non - successful stories. Games have found a more successful format in multimedia.

## **1.8 The Problem**

From the literature we cannot assume that everything is fine and wonderful in the multimedia applications designed for children because there must be a problem for it not to be performing successfully because amidst its potentialities there are failures. The fact that some multimedia applications have high potential and do not fail is promising. This means that there is still something good that is worthwhile for us to exploit. In trying to solve the problem of failures it is useful to look at successful stories and compare them with unsuccessful ones, i.e. listing the set of conditions that leads to success and the set that leads to failure.

There are various research projects being done about successes and failures like this in HCI and they usually point out that what engage people is levels of interaction and the things they can do with the system they interact with. What the human computer interaction community is saying in general probably applies to multimedia as well what these successes and failures means is that there are some things that are engaging to children and some are disengaging. There is something about the good systems that is keeping them involved with something in bad systems that made them bored and not engaged. There is some sort of an engagement phenomenon going on between the child and the system they are interacting with.

The fact that there is success means that a system can work. There are also ideas that the degree of interactivity in the multimedia makes a contribution to whether the children are engaged or not. It looks like there might be a working hypothesis that says engagement is caused by interactivity, the levels of interaction the user encounters while interacting with the system. But there might be other factors that are causing this as well.

This is what this research intends to be concerned with. What are the things about a system that engage children? What design features get them engaged? In other words the research question this thesis seeks to address is what features of a computer-based multimedia application help children to become engaged in the material of the application. Engagement is therefore the most significant dependent variable in this research and its history and meaning is explored in chapter 4. An initial working definition of engagement is the extent to which user's shows intrinsic motivation when using an application, i.e. a desire to keep using it even when there is no external motivation or pressure to continue. The intention is not to study whether children learn but to limit the scope of study to whether they become engaged by the application and, as a result, show a willingness to continue using it. The applications under review might therefore be intended for learning purposes but might also include games because some forms of multimedia used in games seem to have the ability to sustain the interests of children.

We have some ideas about what the factors are that might make a difference but for this research issues of interactivity are the major ones. Interactivity is therefore the most significant independent variable in this research and a working definition is the degree to which the user can manipulate and control the objects in the multimedia application. This research will not look from the technology or even the literature point of view but from the user-centred and child-centred approach in trying to understand what matters to children. The likely methodology to use would be to start by doing a pilot study by giving children some things to work with to find the issues associated with them. Then, it will try to take those factors and study them in a more systematic experimental programme to develop an engaging multimedia design model that will associate key issues like multimedia applications, children, interactivity and engagement.

## **1.9 The Research**

### **1.9.1 Research Background and Aims**

The interest of researching children using multimedia was a follow-up to the researcher's previous interest in children's reaction to the use of illustrations in her master's dissertation in University of Wales Aberystwyth, Said (1995) "The Use of Illustrations in Children's Information Books". While the previous research looked at how illustrations on paper could transform and inspire children, the present interest looks at the design potential of multimedia made for children.

Chronologically, the research begins by looking at children's reaction to information books in comparison to multimedia applications on similar theme. The aim of the initial study is to list the likes and dislikes of children to the features found in the multimedia CD-ROMs as compared to the books.

The aim of the research therefore is to use the 'discovery led by children' method to guide the research. The second aim is to find a multimedia application that has the features the children wanted and to test this application with children. The research will find out what the issues are, try to test them experimentally and try to build a model of what works.

### **1.9.2 Why research?**

Many people have tried to give children rich multimedia experiences. It seems like a good idea. In many cases it does not seem to be working. What works and what does not seem to be the question. The main objective of this research is to find out whether the degree of interactivity relates to the success of multimedia applications.

However, one genuinely good excuse for doing this research is the researcher is a parent herself. Like all parents, the researcher is curious and worried. Should they or should they not buy the multimedia materials on the market for their children and if so, which one is the best for which purpose and occasion? If we do not buy, are the children being deprived of their rights to learn in this way, but if we do, are they going to be used or tucked away with all the other stuff in a cupboard? Even though this research does not look directly at the usefulness of multimedia but more at

design issues pertaining to its production, this research hopes to give useful insights to good multimedia designs for children.

### **1.10 Theoretical Hypothesis**

It has long been the researcher's belief that whatever form of computer application is created for its users it must include design elements that allow the users to interact with the system. Any form of multimedia application that does not allow any form of interaction between the user and the system created for them is doomed to fail. The existence of interactivity is so important, so much so that the initial research hypothesis was that, for children, the level of interaction in multimedia applications (especially educational applications) correlates to level of user engagement. In other words, if the multimedia could produce a high level of interactivity it will increase the level of engagement of children to those applications.

However, being engaged in a multimedia application is not only about the presence of interactivity but has got a lot to do with the type of interactivity the multimedia possesses. It has also got to do with immediacy i.e. how quickly does the system respond when the input devices are used like linking the movement of a pointer with the movement of the mouse. Engagement has also got to do with the feedback received from the actions given during interaction whether immediate or delayed. Most importantly engagement has also got to do with the goals the user pursues whether directed by the designer or adopted by the user. So engagement may be a product of more interactivity.

### **1.11 The Research Questions**

This research seeks to answer a number of research questions:

1. What is multimedia, its history and relation to user-centred design in human computer interaction?
2. What are the methods used to research children using multimedia?
3. What are the children's reaction and preferences to multimedia as compared to other media especially books?
4. What is the children's 'wish list' and factors that matters when designing for them? What criterion do children favour? Is it about designing a system that engages them?
5. Is there a multimedia that conforms to this 'wish list'? If so, is it really engaging?

6. What does engagement mean? How could it be measured?
7. What affects the level of engagement? Is it about the amount of interactivity present? Does more interactivity mean more engaged; less interactivity less engaged and no interactivity non-engagement?
8. Does engaging only mean the ability to interact? Does having many different types made it more engaging than others? Or are there types that are more favoured than others? If so, which ones are they?
9. What other factor matter which will make children engaged and stay engaged?
10. What causes disengagement? Where and how does this occur?
11. How long does engagement last? How does prolonged play affect engagement?
12. Could a model be formed from these factors? How could the model define the engagement phenomenon of interacting with multimedia?
13. What are the implications of the model for design?
14. What other research should be done in the future?

## 1.12 The Purpose of Study

The purpose of this study is:

- To define multimedia, its history and its relation to user-centred design in human computer interaction
- To look at research methods concerning children and multimedia interaction
- To discover children's reaction to multimedia as compared to books
- To gather children's 'wish lists' and factors that matters when designing for children
- To identify and choose one highly rated children multimedia application from an independent source customer's review column of edutainment CDs as a vehicle for investigation
- To determine whether the 'wish lists' factors are present in the application
- To investigate whether the application is really engaging
- To identify what causes disengagement
- To develop An Engaging Multimedia Design Model for Children from the engaging experience
- To test the Preliminary Engaging Multimedia Design Model with a number of experimental conditions: no interaction, simulation and construct interaction
- To do further tests to understand the experience factor
- To investigate how long engagement lasts, what happens after prolonged play
- To finalised the Final Form of An Engaging Multimedia Design Model for Children and define what it means
- To relate the model to implications for design
- To review strengths and limitations of research and suggest ways to go forward

## 1.13 Structure of the Research

The structure of this research as it is reported in this thesis could be seen in **Figure**

**1.1**

## Structure of the Research

### 1. Introduction – Literature Search I

- Background Information about multimedia literature review; definition, history and relation to UCD and HCI
- Specify and justify research
- Build Research Questions
- Structure of Thesis

### 2. Study 1 (The Pilot Study)

- Early study of children to identify issues
- Identify resources and materials (books and multimedia CDs) according to themes
- Set up experimental design comparing reaction to information from media – printed vs. screen; conduct study and analyse data
- Identify 'wish lists' and contributing factors, listing reactions and preferences, likes and dislikes

### 3. Research Methods

- Literature on researching children using multimedia
- Identifying issues and how to measure it
- Develop an evaluation method to measure engagement - An Engagement Scale Scores
- Select Instruments and materials to do research
- Develop research design for data collection

### 4. Engagement & Interactivity in Multimedia

- Further literature of successful and unsuccessful multimedia
- Research on emerging issues, interactivity and engagement
- Matching factors from pilot study and literature search
- Build a conceptual framework of what works and what do not
- Find high ratings edutainment CDs from reputed sources - The Sims
- Identify design features of this popular multimedia application

### 5. Study 2 – An Engaging Multimedia Experience

- Conduct an experimental condition to identify issues
- Is The Sims really engaging? Was it an engaging experience?
- What is engagement?
- What features engages children?
- How, what and where does engagement and disengagement occurs?

### 6. Build A Preliminary Engaging Multimedia Design Model

#### Testing the Model

### 7. Study 3

- 3 Experimental conditions
- No Interaction
- Construct Interaction
- Simulation Interaction

### 8. Study 4

- Sims WE children and Sims WOE children
- 2 experimental conditions
- Construct Interaction Vs Simulation Interaction

### 9. Study 5

- Prolonged Play
- Revisiting Study 2
- Questionnaires to fans and ex-fans
- Customers' review since release 18 Feb 2000 till Oct 2001
- Recent reviews Dec 2003 and Feb 2004

### 10. Discussions and Conclusion

- Review of research findings
- Revising The Model
- What the model means?
- Implications on designing for children
- Recommendation for future research

**Figure 1.1** Structure of the Research

## 1.14 Thesis Structure

This thesis is divided into four main sections with 10 chapters:

- i. Part I deals with background knowledge as the researcher ventures into discovering area of interest about multimedia, and design issues relating to children as end users of multimedia applications. It comprises of:
  - Chapter 1 – Literature Review I which illustrates what was found so far about the study and what was about to be uncovered
  - Chapter 4 – Engagement and Interactivity which refines further literature on the actual issues when relating children use of multimedia application
- ii. Part II describes the methods used to pursue this line of research interest.
  - Chapter 2 - Research Methodology used in this research, as the theoretical model for this research is unfolded.
- iii. Part III describes the experimental studies conducted for this research
  - Chapter 3 – An early study of children to identify issues (Study 1) to uncover factors that matters in multimedia design for children
  - Chapter 5 – Account of Study 2 in analysing an engaging experience of children using multimedia
  - Chapter 6 – Unfolding A Preliminary Engaging Multimedia Design Model
  - Chapter 7 – Testing The Preliminary Engaging Multimedia Design Model using varying experimental conditions: No Interaction; Simulation Interaction and Construct Interaction
  - Chapter 8 – Further Testing of The Engaging Multimedia Design Model with two groups of children with experience and without experience doing simulation versus construct
  - Chapter 9- Further investigation into Prolonged Play
- iv. Part IV a concluding section of the thesis.
  - Chapter 10 – A discussion chapter reviewing findings of studies, the final form of the Engaging Multimedia Design Model, its meanings and implications for designing multimedia design for children and suggestions for future research

A diagrammatic representation of the thesis structure could be seen in **Figure 1.3** below. All discussions in the following chapters will be based on this structure.

## Thesis Structure

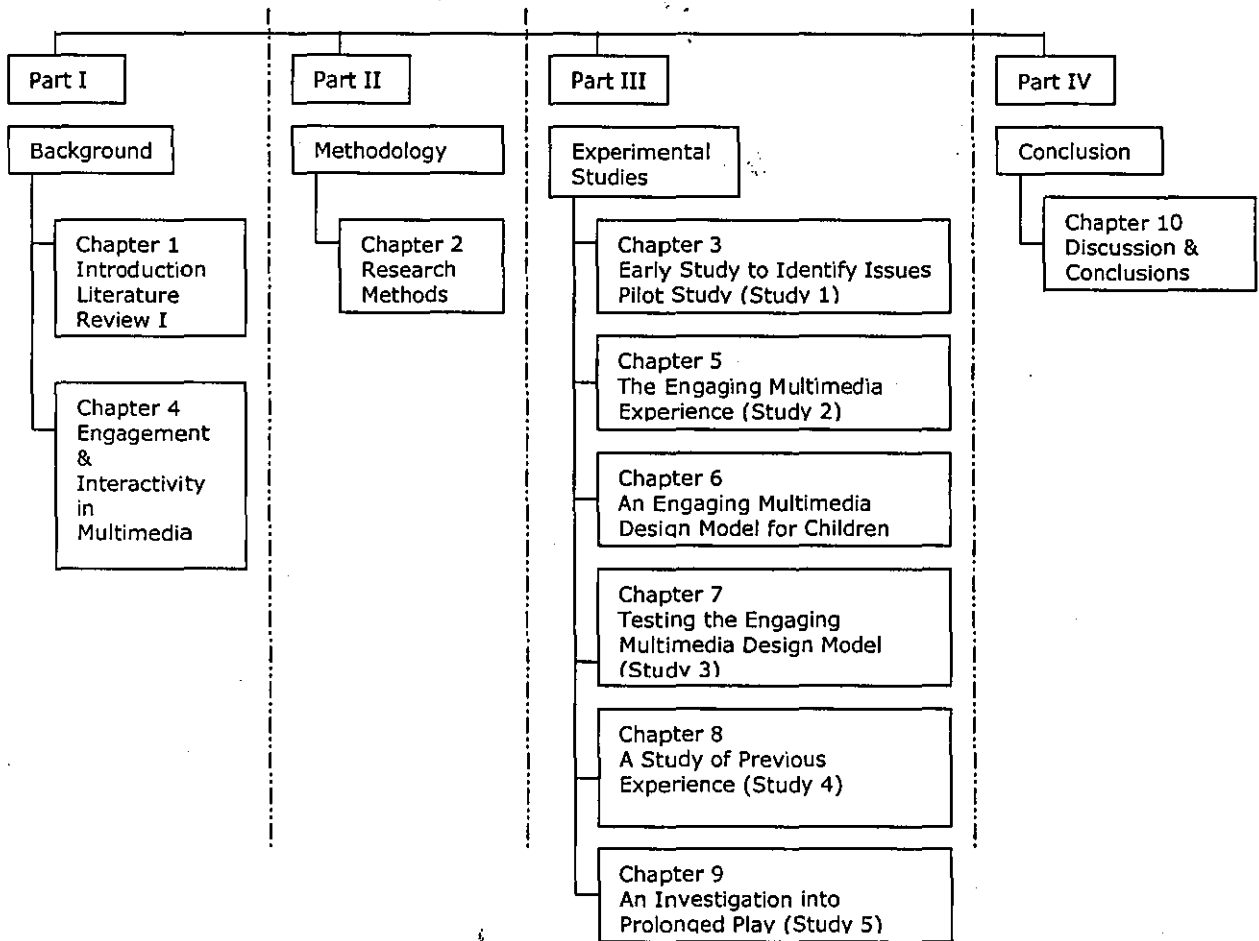


Figure 1.2: Thesis Structure



# Chapter 2

## Research Methods for Studying Children Using Multimedia

### 2.0 Chapter Outline

This chapter deals with the research methodology used in the study on children using multimedia. It outlines some related issues especially regarding usability and of working and designing for and with children. It discusses the best possible ways of overcoming problems when investigating these issues with children.

#### Thesis Structure

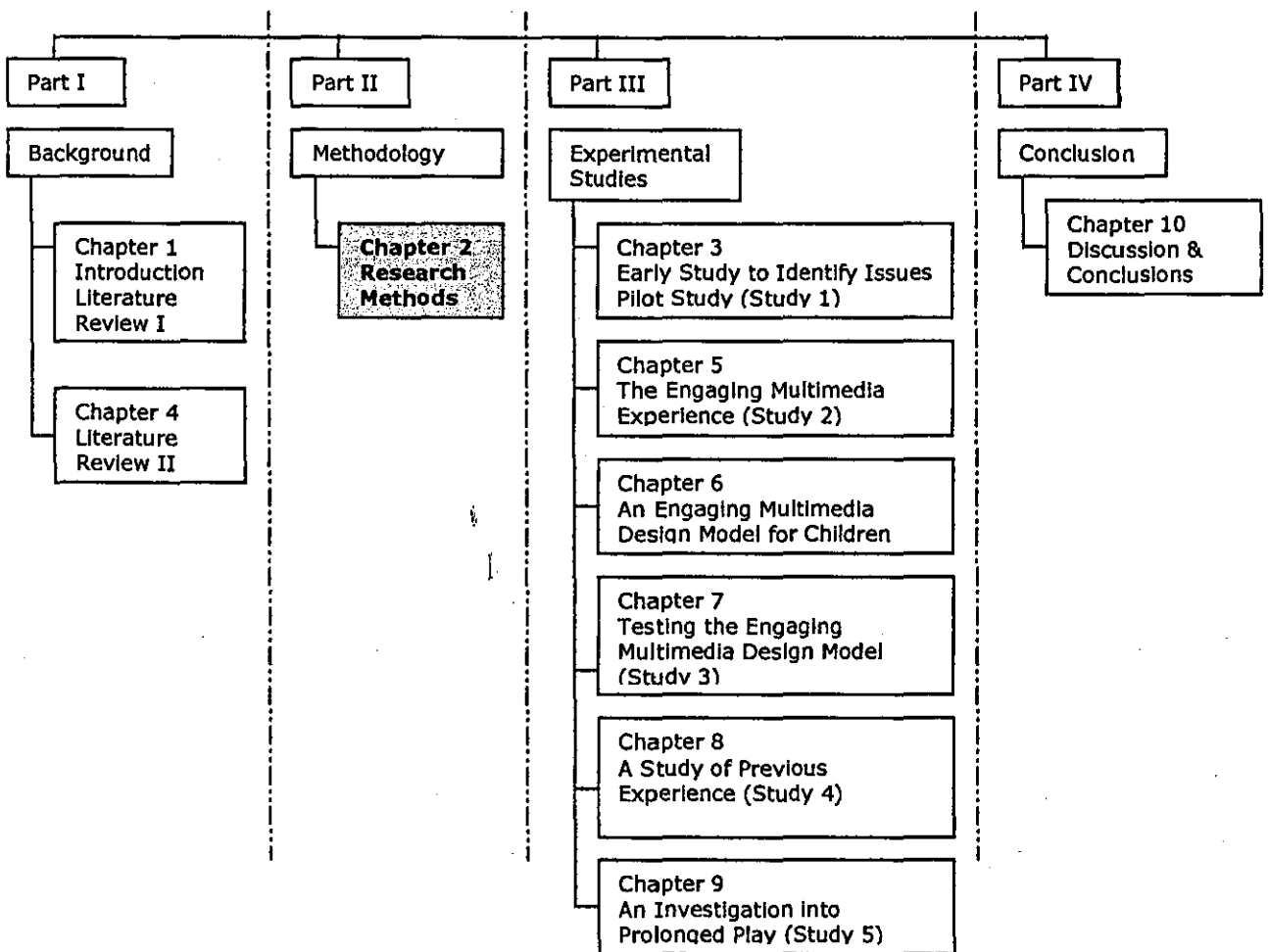


Figure 2.1: Chapter 2 in the Thesis Structure

## **2.1 Introduction**

The anguish and anxiety that comes with the quest for knowledge through research in this area has proved to be overwhelming for the researcher. What that has made this research so interesting and challenging is the subject matter of the research, multimedia, which tends to become obsolete the minute it is reported on paper, and the subjects, children, the most versatile yet manipulative if one hits them at the right time and place.

Therefore there are two entities to examine in discussing the research methodology of this research study; one is the multimedia and all the surrounding research that comes with it (the computer system and technology that goes with it); and the children, the cutting-edge users.

We need methods to enable us to understand the variables that affect children's use of interactive CD-ROMs. We want to build models, which will help designers, so we need to systematically test theoretical propositions as we go. Thus this chapter explores the potential of different research approaches for these purposes. First, in section 2.2, it considers research methods used in studies of human behaviour with computers. Then, in section 2.3 it considers methods that had been used specifically for studies with children. Then, in section 2.4, methods adopted are outlined. Having reformulated the research questions, the specific methods used in the various studies are then presented.

## **2.2 Research Methods Review**

Literature search has revealed that there are many ways to research users of computers. This review will look at some different research approaches as a basis for selecting those which would suit the research aims and objectives of this study.

### **2.2.1 Ethno methodology**

*Ethno methodology* is a technique recently used by the social sciences to study the design and evaluation of systems. This method is used to analyse actions and reactions when people use computer systems as they occur in their natural context by observing them communicating with each other or with their machines.

This method has been claimed to be especially useful in investigating how the introduction of new technologies could support existing working practices in various work settings, and to find mismatches that could arise from its presence. The purpose is to prevent all those involved, e.g. the designers, from relying on assumptions when designing systems (Button, 1991). Amongst companies that have used this method with success is 'the synch-and stabilize process development' used by *Microsoft* (Cusumano and Selby (1995) in Preece (2002)).

This type of methodology is important in user-centred design approaches that would seek to create "useful and easy to use computer systems". They emphasise: an early focus on users and tasks – understanding who the users are and their cognitive, behavioural, and attitudinal characteristics by observing them doing their normal tasks, studying the nature of the tasks, and involving the users in the process. Empirical measurements can be made – in the early stage of development through scenarios, later through simulations and prototypes. Design should be iterative – involving users through the cycles of design in a "design, test, measure, and redesign" approach (Gould and Lewis (1985) Preece (2002)) refers to the concept of studying people in their 'natural' surroundings, that is, in using this ethnographic methodology as a study of naturalistic behaviour.

The method above may not be easy to use in this research because the purpose of this study is different. However, the researcher has tried to do 'naturalistic' studies in her first phase of study to elicit issues. In this research the research paradigm was not to look into how well this new technology fits existing working practices, in this case the learning and teaching practices in the school, and to find out the mismatches that could arise from its presence.

The first stage of this research will be to find out what kinds of existing multimedia educational software catches and sustains children's interest and what do not. This research will not use the ethnographical method not only because it is very time consuming but because the experiments done in the studies that follow after the initial study will be divorced from the natural setting, that is, the school. However, some methods used in ethno methodology, e.g. video recording were adopted to suit this study.

### **2.2.2 Action Research**

Cohen and Manion (1989) define action research "as a small-scale intervention in the functioning of the real world and a close examination of the effects of such

intervention". This is an approach suitable for this research. This researcher wishes to intervene in a child play situation and examine its effects as the child interacts with a multimedia application. The purpose is to find out through close observation the child's reaction to the application. This research could also be described as situational as it is concerned with diagnosing a problem in a specific context (Cohen and Manion (1989), and Charles (1989)).

What has inspired the researcher about action research is its purpose, which is not to make generalised discoveries. This type of research stems from a strong need to find out about matters in a particular situation or setting. In some ways this research is to seek an answer to a question; what makes a multimedia application more successful than others when used by children. Although the results could prove to be useful in other settings, it is particular to this research situation where this concern exists and therefore it is not intended to be generalised beyond children using multimedia.

Much of the approach of action research will be used in this line of research. Though action research is done to resolve matters in their natural settings, this research will not be done wholly in natural settings because the purpose is not to resolve matters of those settings. This study will be done in experimental settings to test different variables but we have to create a natural environment so that the children are comfortable and will respond normally. It will be a major requirement to avoid an artificial environment.

Organising an action research is different to that of a generic research process in other ways. According to Charles:

In generic research, the procedure includes a problem statement, hypothesis or research questions, selection of sample, design for data collection, analysis of data, presentation of findings, and statement of conclusion. In action research, however, a problem is identified, a way is envisioned to resolve it, a solution is planned and implemented, reactions monitored, strengths and weakness identified, revisions made, and an overall effectiveness assessment made. (Charles (1989) p. 284)

When these procedures are compared to this research the following conclusions are drawn. In order to find out what makes a multimedia appealing to children, a pilot study has to be conducted. For this research, the 'problem' is identified as "what makes a multimedia application more successful than others". The aim of the research has to be to explore the nature of the problem in a pilot study.

Thereafter, if possible, a solution needs to be found, i.e. a multimedia application that would be successful for children. Ideally, in an action research process, one could be designed and then tested. This is not likely to be possible. An alternative approach could be to use the findings of the pilot study to determine the properties of a good solution and then examine whether one exists that could be the subject of an experimental programme.

### **2.2.3 Grounded Theory – Generating a theory**

According to the book on *The Discovery of Grounded Theory* (Glaser & Strauss (1968)) the main concern in most writings of sociological research has been on obtaining evidence to test a theory. This has been what the researcher initially thought would be the case when conducting this research, that is, to test and verify a theory. However, the idea of grounded theory has given the researcher a different perspective to look at.

To the people that use a grounded theory approach, the most important fact about a theory is that it should fit empirical situations. This method discovers theory from data that is systematically obtained from the real situation. The basis of generating grounded theory is to let the researcher arrive at theories that fit the phenomenon observed 'on the ground'.

A lot of the aspects discussed in Glaser & Strauss are of great interest to the researcher and suit very well the research intentions. There is no existing theory, which relates directly to the use of multimedia by children. It will be necessary to proceed by grounded methods, i.e. to explore what factors matter to the children in an exploratory study and to use these factors to create a theory that can subsequently be tested.

### **2.2.4 Usability Evaluation Methods**

Another method commonly used in human-computer interaction studies is the usability evaluation method. The International Standards Organisation defines usability as

'... the effectiveness, efficiency and satisfaction with which specified users could achieve specified goals in particular environments' (ISO DIS 9241-11. (1997))

Research in usability tries to answer the question how usable is a human computer interface when particular users use it for particular tasks.

One good example is described by Ravden and Johnson (1989). The method used here is in the form of a checklist. The checklist consisted of a set of questions to assess usability. The usability issues covered were visual clarity, consistency, informative feedback, explicitness, appropriate functionality, flexibility and control, error prevention and correction, user guidance and support, system usability problems, and other general questions on system usability. It is possible that these issues will prove to be important in the use of multimedia by children but this will become apparent in the pilot study.

### **2.2.5 The Experimental Research Approach**

The use of the experimental approach will be important in this research because the intention is to build a model of the factors that contribute to a successful multimedia application. Thus will necessitate the systematic manipulation of variables to test which are important. According to Bryman (1989), there are three significant things to consider when conducting an experiment. One is the form of control the researcher needs to have on the experiment in order to manipulate the circumstances. With it, the researcher would identify significant factors, which he or she would introduce or exclude from the situation so that their effect could be observed.

Another is the identification of causal effects as a result of the introduction or exclusion of factors to or from the situation. With these controls the researcher is able to locate and pinpoint which factor actually contributed to the occurrence of the observed outcome. And then finally, the experimental result outcomes would need to be reported through precise, detailed, intensive observation and close measurement of what is observed. The result of the findings would include changes that occur following the introduction or exclusion of these potentially relevant factors.

There are arguments that laboratory experiments are of little significant because they are artificial settings, so much so that the results of the findings have little validity beyond the confines of the laboratory. Some research groups e.g. the cultural psychological groups are against the experimental method. To this group, the experimental method disturbs the phenomenon of what the researcher wants to understand especially when researching children. This group believes that people cannot be taken out of their natural surroundings. This group are in favour of ethnographic research because this type of research is said to respect the

natural organisation of the system, while experiments tends to break them from the natural surroundings. It would be very difficult to locate situations in which children are naturally using successful multimedia applications and in which the conditions of use can be systematically varied. The experimental method is therefore necessary to this research but the researcher recognises that it will be necessary to make these settings as natural as possible for the children.

## **2.3 Research Methods and Issues when Studying Children**

Many studies have already been undertaken of children using computer systems. This section explores the methodological issues arising from these studies.

### **2.3.1 Usability Evaluation and Children**

Most of the methods used to research children in the context of computer technology especially in the use of multimedia are to assess usability. The trouble is that these measures are of user satisfaction, system effectiveness, and systems efficiency. However, systems or applications that are designed for children do not necessarily fit into this usability paradigm.

According to Read, MacFarlane & Casey (2002a) in proceedings of 'Interaction Design and Children' (2002) children are not the same as adults. Their motivations are different. Their desires and expectations are different. Druin et al (1999) stressed that we need to understand children's own environments. The need is not only essential when we design for children but also important when we use children to evaluate products. "The concept of user satisfaction, which is core to traditional usability, is difficult to place within a child's experience. A better experience to consider for children is fun." Druin et al (1999) in Read et al (2002) p.1

Therefore, Read et al (2002), Draper (1999) and Malone & Lepper (1987) measures usability in children in terms of 'fun'. To them, fun is not a usability metric; fun may be a requirement for a product or a description of a user's experience. When fun is a software requirement, in systems that include games and edutainment products, fun becomes a parallel feature to usability. Therefore when a user finds a product usable he or she will find it to be fun. In other words if a product could be designed to be usable it could be designed to be fun. Druin's account of their usability research at Microsoft indicates, " ... The usability of a product is closely related to children's enjoyment of it. " (Druin (1999) p. 4)

Risen, Hanna, and Kanerva 1997 defined some components of a fun product from literature review, surveys, and responses to questions assessing, liking and usability of computer software as a product of a number of engagement dimensions such as "familiarity," "control," and "challenge". Others like Lepper (1988); Malone (1980); Whalen and Csiksentmihalyi (1991) in Druin (1999) also gave a similar line of definition. In fact most of them including Hanna et al placed 'ease of use' as 'a critical determinant of engagement' and agreed that it is key to the success of every children's product. To this research, all the issues "familiarity," "control," "challenge", "easy of use" and "fun" are non-separable elements of engagement. This research needs to embrace all of these factors.

### **2.3.2 Methods on researching children**

Druin (1999) stated that there are three different ways to collect data with children. *Contextual inquiry* observational techniques adapted from Beuyer and Holtzblatt (1997); Holtzblatt and Jones (1992); Holtzblatt and Jones (1995); Holtzball and Beyer (1997) are used by Druin, Boltman, et al. (1997) to capture children's exploratory activity patterns. The *Technology immersion* method (Boltman et. al. (1998); Druin, et al. (1997)) involves giving children a technology - a rich environment in combination with time and freedom of choice in order to understand what children do and want with technology. *Participatory design* techniques adapted from (Bjerknes, Ehn, and Kyng (1987); Müller (1991); Müller, Wildman, and White (1994)) developed a partnership with children the same way as using adult users as design partners, that is, to find out what they would like to see in the future system.

Scaife and Rogers in Druin (1999), when discussing issues of children in user-centred design (UCD) method, mentioned that there have been problems in positioning children in the UCD approach. There is a need to make the differences between the roles more apparent, either having them as testers, evaluators and informants to test products or as participants to create a design. Most practices place users in the reacting role where designers obtain feedback about their designs whilst others placed them as participants in the design.

The "informant design framework" (IDF) research group, however, involves children as reactive critics. This group is in-between user-centred design and participatory design. The children will tell them about motivational and genre expectations that the design team would not otherwise know about. They pay



attention to input not only from children but also from teachers and educational advisers to maintain the educational domain. They do not treat children as full design partners. Through their research, they believe that when children are design partners, the design team must be able to know when to say yes and when to say no of children's ideas. The involvement of children at different stages of software development would, it is claimed, make it more efficient and reduce the gap between designing something that is learnable and something that is motivating and effective.

There is no doubt that having children in the design process could make a useful contribution to designers as a way to enter their world but the question that is most likely to arise is at which phases of the design process should the children be placed. Treating children as testers and informants does give the design team a chance to stand back and discover what they did not know rather than simply trying to confirm what they already know (Scaife and Rogers in Druin (1999)). So, do having them as design partners. However, in the present research, there is no opportunity to create new software and there is therefore, no development process to engage the children in. It is inevitably, therefore that the children will be in the position as evaluators of existing products beyond the design domain. So where are they placed in this research paradigm? A fuller account of their position will be discussed in the next section.

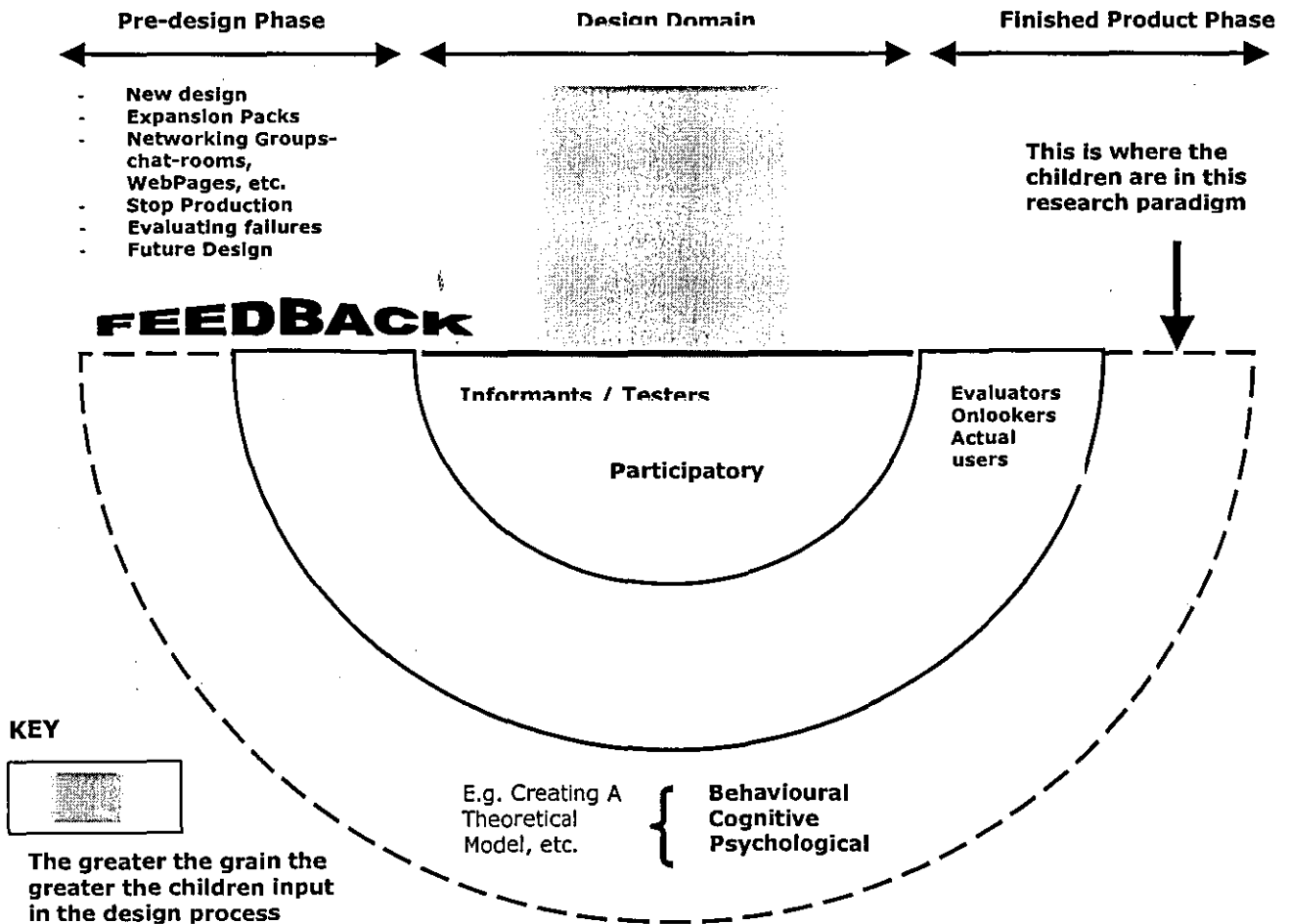
### **2.3.3 Where the children are in this research paradigm?**

From the literature into the design of usable interfaces, a number of processes involve in the design process are based on the users and their tasks. Some of them are user analysis, task analysis, and iterative design (Dumas & Redish, 1993) in Read (2002 b). User centred design approach had been for quite sometime positioned users solely as testers and evaluators of a system (Rubenstein & Hersh, 1984) in Read (2002 b). However, recently, others found that users acting as design partners in a design process could be most useful and could engage them more when they are themselves users of the system they created with the designers (Bjerknes, Ehn, & Kyng, 1987, Greenbaum & Kyng, 1991, Schuker & Namioka, 1993, Papert, 1980) in Read (2002 b).

For the researcher, when researching children in a design domain, the children could be placed anywhere in the design process. To the researcher, when the children act as informants and testers as the design goes through its phases, the children are usually involved in the front line of a design domain. This is the place

where the designer designed and used the children to inform and to test the design phase by phase. However, if the children are as design partners the researcher feels that they could be somewhere in the middle of the design domain. The designer had an idea and throws it to the children to design how they would like it to be like if they were asked to design e.g. A Treasure Hunt, etc. When the children act as evaluators to the researcher they should be somewhere at the end. Here they could be evaluators, onlookers, and actual users.

If a linear model were created to determine where the children were in the design process it could be presented in **Figure 2.2** below "A Model for Researching Children in the Design Process". In this research paradigm, however, the children will not be evaluating a design to contribute to another design but will be contributing to the creation of a theoretical model to understand what matters to children when designing for them. The feedback got from the children in the linear model will result either in the creation of a new design, an expansion pack for the existing ones, a creation of an online networking groups e.g. chat-rooms, WebPages, etc. It could also mean simply an end to a production or an evaluation of why it fails and a basic guideline to future design.



**Figure 2.2:** A Model for Researching Children in the Design Process

Note: Further explanation to the grain of colouration as explained in the key is the greater the grain or concentration of colours the greater contribution from the children in the design process. Therefore from the linear model it could be seen that children as design partners in participatory condition tend to give greater input of ideas as compared to when they are informants or testers and evaluators. This is because in the latter roles, the ideas come from the designers themselves and the children are the testing ground for innovations set by them.

The children are not direct contributors to the design domain. However it is important to note whatever research goes beyond the design domain are as useful and important as the ones in the domain. The findings from this research will inevitably contribute to the literature of children and multimedia.

### **2.3.4 Ethical Issues in Studying Children**

The participants in this research will be children and it is important for the researcher to follow closely the restrictions that comes with that. Not all parents nowadays, for example, allow their children to be subjects in research.

The researcher followed all the necessary procedures set by the university to do this research on children. The University Ethical Board approved the research plans. Each participant will be given the right to withdraw at any time before or during the experiments. The procedures of the experiments will be shown in detail and agreed with the parents of the children. The safety of the children will be assured even to the extent that the researcher applied for insurance to drive the children to and from the experimental locations.

## **2.4 The Approach Adopted**

Below is the approach adopted as a result of the research methods review. Some of the principles of studying children are stated to clarify researcher's stand in carrying out this study.

### **2.4.1 Researcher's stand**

" Man has long been concerned to come to grips with his environment and to understand the nature of the phenomena it presents to his senses. The means by which he sets out to achieve these may be classified into three broad categories: experience, reasoning and research..." in Cohen and Manion (1989) p.1.

This research is investigating the bases of knowledge, the form and nature of it, to discover, find and explore the path and route to acquire it and to know how to communicate it to others. This research will investigate how knowledge when transformed into a multimedia format could best be passed on to others. In this research the purpose is to study the response of children to multimedia computer applications under varying experimental situations and conditions. More precisely, the research looks into how the design features in a number of multimedia applications relate to the children's actions and reactions. To narrow down a broad perspective the researcher limits the search to the issue of preferences, what they like and dislike about the design features in these multimedia. What comes out of this orientation is the issue on engagement. The research is therefore to find out what makes the child engaged or 'glued' to a particular application, wanting to play with it and not wanting to stop when asked to do so.

According to Cohen and Manion (1989) different assumptions demand different research methods: the objectivist approach uses surveys, experiments, etc.; whilst the subjectivist approach uses accounts, participant observations and personal constructs, etc.

With the objectivist approach, the scientific investigation will predominantly be quantitative.

"...The concern is with the identification and definition of these elements and with the ways in which these relationships can be expressed. The methodological issues of importance are thus the concepts themselves, their measurements and the identification of underlying themes. This perspective expresses itself most forcefully in a search for universal laws which explain and govern the reality which is being observed." Burrell and Morgan (Cohen (1989) p.8)

For the subjectivist, the principal concern is with an understanding of the way in which the individual creates, modifies, and interprets the world in which he or she finds himself or herself. The approach takes a qualitative as well as quantitative approach. As Burrell and Morgan in Cohen (1989) observe,

"...the emphasis in extreme cases tends to be placed upon the explanation and understanding of what is unique and particular to the individual rather than of what is general and universal. This approach questions whether there exists an external reality worthy of study. In methodological terms it is an approach which emphasises the realistic nature of the social world..." (Cohen (1989) p. 8)

In this research, the researcher holds a two-fold approach, that is, to use both the objectivist and subjectivist approach in trying to understand what makes a successful multimedia design. The children will be in various experimental

conditions in various settings, a school setting, in usability labs and in some special rooms, to explore what makes a successful multimedia design.

#### **2.4.2 Qualitative and Quantitative Data**

Glaser and Strauss (1968) were positive in their position on both qualitative and quantitative data. The writers believe that "each form of data is useful for both verification and generation of theory". According to them, this will be heavily dependent on the circumstances of the research, which rely on research interest and training experience of the researcher, as well as, the resources available to enable the researcher to formulate the theory.

"In many instances, both forms of data are necessary. These data are not used to test each other, but both as supplements and as mutual verifications. When these different forms of data are on the same subject, the comparison will each generate theory." (Glaser, B.G.& Strauss A.L. (1968) p.18)

In this research the intention will be to obtain some standard, quantifiable evidence of the degree of children's engagement. If similar evidence can be obtained across all experiments it will be possible to compare the degree of engagement under different experimental conditions. However, to enrich understanding of why the children respond as they do and which multimedia factors influence their response, qualitative evidence will also be obtained. This may be in the form of video recordings and interviews after each experimental session.

This approach should enable a theoretical model to be created, tested and restructured in the grounded theory way described by Glaser, B.G.& Strauss A.L. (1968):

... When generating theory, the analyst will first discover two-variable relationships; and then, discovers their elaboration. In the third stage the researcher starts generating possible elaboration of the relationship between the two variables. The researcher then looks through the data to find indicators for the concepts that are related in theoretical ways to the emerging theory. Then, the researcher arranges elaboration tables to test if they bear out the hypotheses for suggestion but not verification. In order to discover what actually happens, the researcher does further runs, filling gaps and answering remaining questions in order to saturate categories. At this stage, the researcher is moving quickly between situations, and this is where an active dialogue of discovery and generation develops between the researcher and the data collected (Glaser, B.G.& Strauss A.L (1968) p.210)

This research used a combination of resources to explore the phenomena surrounding engaging with multimedia. The combination would map out or

explain more fully the fundamentals of human behaviour from more than one angle to justify the model developed from them.

The whole research will start with a grounded, unstructured survey and later move to studies that are more experimental to 'test' what matters to the children.

## **2.5 The Research Programme and the Methods Used**

The plan for the research is to conduct a pilot study in a school initially to ascertain the main factors that affect children's use of multimedia. In this study children will be given a free opportunity to explore a number of multimedia applications and qualitative data will be captured to support a grounded analysis of the factors that may be important.

The initial results will be used to formulate a tentative model and a focused literature review will be conducted to examine what is known about the variables in the model. An experimental programme will then be devised to test and reformulate the model. It is likely that the vehicle for the experimental programme will be a multimedia application that has the potential to create the conditions for a fully engaging experience for the children. This will make it possible to manipulate the variables in the model to test their effects on the experience of the children.

### **2.5.1 The Participants - Children**

The audiences that interest the researcher are children. The aim is to determine what factors about multimedia matter to children in the age range 9 to 14 years old. The researcher has previous experience of researching children and found they were usually very frank at this age. Other researchers have also commented on children as research companions, e.g. Jean Poindexter Colby (1967: p.14) in Said (1995)

Children of this age make wonderful companions. A writer would do well to find a pal of nine, ten or eleven if he wishes to write for this group. He will be fully repaid for his time, and no other experience or study will be so informative or convincing. He will soon see that this is the age of frankness, discernment and rapidly growing intelligence. It is also the age of curiosity and unbounded enthusiasms. It is the reading age.

### **2.5.2 Criteria for selection**

Having obtained clearance from the University Ethical Board, the selection of children for the pilot study was undertaken with the authorities at a local school. The school sent letters to parents for consent in letting their children participate

in the research and consent to photograph or videotape them during the experiment.

The selection of children for the subsequent experiments will be based mostly on the relationship established by the researcher with the parent and the child. The aim will be to ensure that both children and their parents have confidence in the researcher.

### **2.5.3 Gender**

The aim is to have equal representation of the two genders in all of the studies. It is not the aim of this research to formally study gender differences so the aim will be control for any differences.

### **2.5.4 Research Instruments**

A number of research instruments will be used in this research to provide both quantitative and qualitative evidence. They will be described in the context of each study. However, one instrument, formulated after the pilot study, became the major source of standard, quantified data for all the experiments to measure the main dependent variable.

It seemed likely that children's feelings about multimedia application might vary considerably as they used it. Some measure was needed about how positive or negative they were feeling at any point in time if a detailed understanding of the effects of multimedia variables was to be established. Any measure of the children's feelings would have to be quick and easy to complete if it was to be reliably completed by the children in the course of using the multimedia. An attempt was made therefore to create a simple scale for assessing engagement.

### **2.5.5 An Engagement Scale Score**

Observing the children playing the game during the free session has given the researcher an indication of how difficult it is to measure engagement. The researcher created a scale score and did several tests with the children to refine it. The scales were initially developed using a Likert Scale pointer of 1 to 5. The children were asked to place an indication of their feelings when playing the game. An upright scale was designed to give the children a sense of rise and fall. The higher the score on the vertical scale the greater the degree of felt engagement. In a pilot trial the children were more at ease using 10 point scale than a 5 point scale so it was changed.

The children were also observed to hesitate in placing their preferences on the scale. They stopped for a while every time before placing their scores on the scale when the alarm rings. The researcher felt that symbols needed to be added so that the child could easily indicate their feelings at that time.

A smiley face was added to the scale scores and the scale was validated and calibrated by asking four children to use it when playing the game before the main experiment was conducted (see below).

After developing the scale and using it in her experiments the researcher found that there were some similarities with the scale score from *Microsoft* usability test of Hanna et al in Druin (1999) p.8 as shown in **Figure 2.3** below. Most of what has been said and used in Hanna is verified through the experience the researcher had when developing the scale and testing it. The researcher found vertical presentation of a scale (as in that of Likert scales) is better for children when marking preferences than horizontal scales.

Hanna, however, said that children are more comfortable with more or less concepts than exact values. The scale (**Figure 2.3**) in Hanna has no numbers added to the presentation.









**Figure 2.3** A Scale for asking children to rate software attributes of usability and engagement Reproduced from Druin (1999) p. 8

However, the tests in this research found that the children had difficulty in placing their scores while at the same time concentrating on the game. Therefore the researcher placed numbers to the scale as seen in the finalised Engagement Scale Score (**Figure 2.4**).

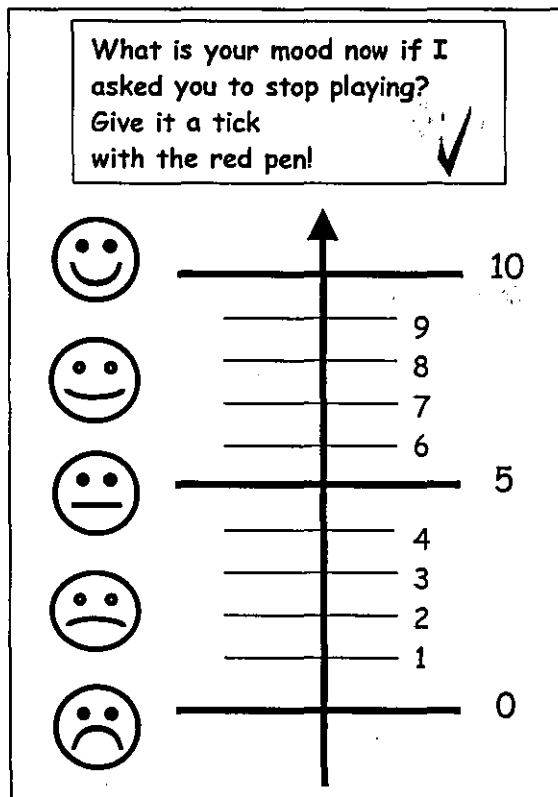


Pictorial representations are useful when using this scale with children. Hanna (Druin, 1999 p. 8.) found that children are able to respond more reliably to pictorial representations that were meaningful anchors like smiling and sad faces. However, the researcher had more smiley faces than Hanna. Through observation and the tests she conducted the researcher felt her scale had given her better accuracy than the ones given by Hanna. She felt that if the instrument above was given to the child, the child might not be able to place their scores properly. This is because, when the numbers are not visible, the children's rating will affect the accuracy in determining where the child scores were in a scale of 1 to 10.

As the purpose of this experimental study was to concentrate more on the game, this scale score used should have indicators with numbers and additional pictorial presentation. Another three symbols were added to make five . Two of the symbols  and  were created personally by the researcher to represent the in-betweens of three commonly used smiley face symbols    to make up a feature similar to Likert score of 1 to 5.

The use of these additional features she felt would help the child to respond to her experimental needs better. The additional pictures and numbers increased the speed in ticking at the time the bell was rung.

The final scale score looks like **Figure 2.4**. A score of 10 at the top of the scale indicates a maximum degree of felt engagement, a zero indicates disengagement, literally a wish to stop. For each 40-minute experimental session, eight of these were placed on an A4 sheet and each child was asked to tick at the appropriate place at every 5 minute interval signaled by a timer.



**Figure 2.4:** An Engagement Scale Score

**a. Validation of the Engagement Scale Score**

To check whether the instrument actually measures what the researcher wanted to measure, that is, the changes in the degree of engagement, the scale was validated by asking four children to use it while playing the game before the main experiment. Validation was undertaken by triangulating findings, i.e. by comparing the marks they made with observations and interviews with them by the researcher. This form of triangulation of data collection (the scale, observation and video analysis, and interview) was also used throughout the experiments to be reported. The validation studies demonstrated that the marks on the scale were correlated with the other data and that, over the time period of a session of usage, the scale marks reflected the rise and fall of the degree to which the child was engrossed in the material of the multimedia application.

### **b. Calibration of the Engagement Scale Score**

In order to check whether the scale is sensitive to the range of responses it needs to pick up, the scale was tested before it was used in the main experiments in Study 2. The scale was given first to two children. They were asked to tick appropriate places on the scale. Their difficulty in placing scores while playing the game resulted in taking its present form. The final form was later tested with another four children. During the test the marks or scores they indicated covered the range of the scale and reflected their moods from being disinterested to being fully engrossed. As a consequence the scale was adopted.

## **2.6 Other Methodological Considerations**

### **2.6.1 Making the children comfortable**

When researching children it is important that the children feel comfortable with the researcher and the place of study. So in an area of study of this kind a number of obstacles should be looked into and overcome so that the results are genuine and valid. The children selected for this research would be likely in some ways know the researcher or a member of her family either her sons or daughters. They will be mainly children from her circle of friends and neighbours. The researcher plans to choose children from her son's class for the pilot study if approved by the school head teacher and staff. They might probably be her son's classmates because she practically sees them everyday. Whilst the other studies will mainly be children of her friend's and neighbours children.

### **2.6.2 Cultural Barriers**

It could be argued that responses to multimedia are culturally specific. As an international student there will be an opportunity to choose children from many different countries. The researcher plans to ask parents who are international students of Loughborough University and neighbouring universities to let their children participate. The multimedia chosen must take into account the cultural barrier factor that might be associated with it.

### **2.6.3 Selecting multimedia applications for study**

#### **a. Language Barriers**

As some of these children are more proficient than others in the English Language, choosing multimedia applications that exemplify these factors would be avoided in the studies that follow. The multimedia and books chosen in the

Pilot Study, however, need not have such barriers because it would be done in the school with local children that are fully versed with the language and conventions.

When choosing the multimedia for the experimental studies, it would be necessary to include within the criteria that it should be universal in nature, non-vocalic or verbose in nature, something that is educational yet entertaining.

### **b. Cultural bound conventions**

Previous research by the researcher herself on the interpretation of pictorial cues and features (Said (1995) p. 24) concluded, "Pictures that are heavily laden with culture-bound conventions must be learned if they are to be understood". Hagen and Jones (1978), Levie (1978), Serpell and Deregowski (1980) in Willows (1987: vol. 1: p.7-8) reported Said (1995) had this to say about this phenomenon. Young children and adults without ample picture-viewing experience will have trouble decoding pictorial information that is abstracted, complex or represented in cultural-bound conventions. The case is especially true when the objects and concepts shown are unfamiliar and uncommon to them. So it is therefore very important that the multimedia application has pictorial cues and features that are universally and commonly known.

### **c. Contents Barriers**

The content of any multimedia application may also be more meaningful to children from some cultures than others. Another criterion for the application chosen will be that its content relates well to every child's experience.

### **d. Conservatives and Non-conservative Ideologies**

There are also differences in the ideologies to which children are exposed by their parental upbringing. Some parents are very strict, for example, in deciding when their children are allowed exposure to certain experiences, what they should and should not do or see, e.g. some parents do not like early exposure to violence, to sex, etc. The selection of the multimedia applications for the research had also to consider their content from this perspective.

## **2.6.4. How to get children to behave naturally in video recordings and in an experimental setting**

The pitfalls in using video to record children had been reported by Hanna et al in Druin (1999). Iversen (2002) in *Interaction Design and Children* has mentioned

that Druin experiences that children when exposed to video camera tend to "perform" if not to "freeze". Druin, Boltman, et al (1997) found them not to be successful in capturing data.

We found that children tended to perform when they saw a video camera in the room. In addition, even with small unobtrusive devices, video was still difficult to use in small private spaces (e.g., bedrooms) because the video image was incomplete: it was difficult to know where to place cameras when it was unknown where the child would sit, stand, or move in their own environment. In large public spaces, the sound was of poor quality and frequently inaudible (Druin (1999) p. 56)

The researcher understands why the authors above expressed the opinion the way they do because they were actually involve in a methodology called contextual inquiry where the researchers were there to collect data in the users' own environment. In this field of research the users are observed performing typical activities and the researchers ask questions when clarification is needed (Beyer and Holtzblatt and Beyer 1997; Holtzblatt and Jones 1992; Holtzblatt and Jones 1995; Holtzblatt and Beyer 1997) in Druin (1999). When the users are children, the researchers observed them in their homes and favourite public places (e.g. children's museums, activity centres, game arcades) (Druin (1999) p.55).

This research however will set up experimental conditions for the children to be involved in. The researcher intends to pretend using the camera for something else when the children do the Pilot Study. She intend to place two cameras in the room as she sits with the children when they interact with the books and the multimedia CDs she plans to give them. The researcher also plans to have standby instruments and devices hidden under the desk and some in between the books in the library. She intends to pretend to do something else when actually reporting what she had observed. All happenings will be audio taped and she plans to use this triangulation method to justify her findings.

She will try the same procedure in all the other experimental settings she plans to conduct. She will try to hide the videos or get them used to it by making the setting like a family home. There will be food and places to laze around watching TV, playing board games, reading magazines and books or listening to music. The children will be allowed to bring along companions friends or siblings. The researcher will in all circumstances try to help the children get used to the place and its surroundings by taking them round the place of experiments or finding places they are familiar with like their week-end extra class classrooms.

## **2.7 Overall Conclusion**

Overall the research methodology chosen for this research is a combination of action research, the grounded theory approach and an experimental programme collecting systematically quantitative evidence to develop and test an "Engaging Multimedia Design Model for Children". An important point to consider in developing this model is to determine the exact role to be played by the children during the process.

For this research, therefore, the children's contribution will be their expressed views and 'wish lists' gathered in an initial study, and after finding a suitable application that suits their 'wish lists' criteria, their observed behaviour as they interact with it. Through the observation this research will be able to find out whether if the application does have the features that they wish for would it really be engaging for them as they claim it should be. If the application with their 'wish lists' does engage them, the next step is to find out what is engagement, what, where and why is it engaging, and for how long could it be engaging so that a tentative model could be developed from it. The model will then be manipulated to test its effects on the children's experience in the hope of building a final model that could be used to explain an engaging experience for a multimedia design for children.

# Chapter 3

## An Early Study of Children to Identify Issues - Study 1 (The Pilot Study)

### 3.0 Chapter Outline

This chapter will give an account of a Pilot Study conducted to identify issues of children using multimedia. The study was an early investigation on children using multimedia CDs. The aim was to identify the issues that lead to a multimedia CD being successful or not successful.

#### Thesis Structure

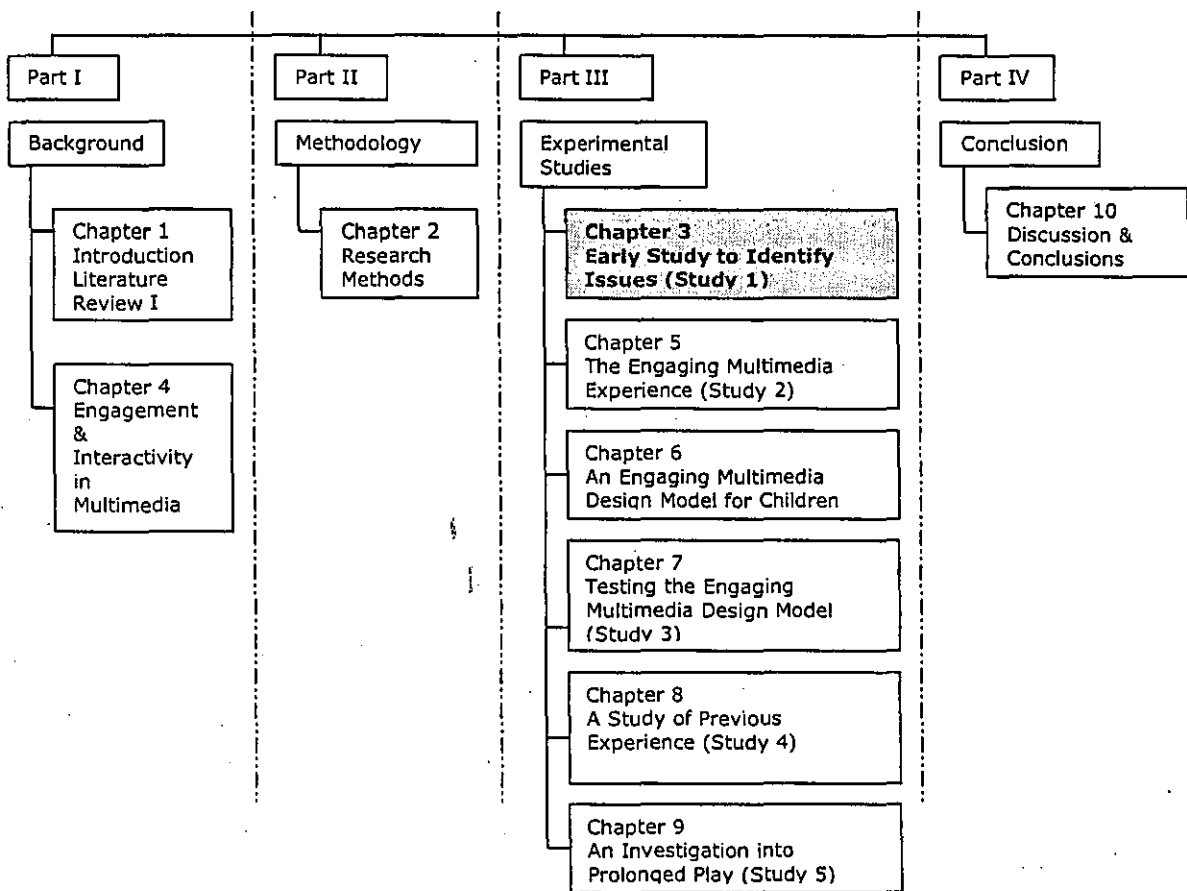


Figure 3.1: Chapter 3 in the Thesis Structure

### **3.1 Introduction**

Issues in multimedia applications are diverse and many. The purpose of this thesis is to find out more about the forms that affect children preferences. The researcher believes that the more the designer knows and understands users' needs and preferences the better will their products be. Children have 'wish lists' just as adults do. The best way to find out what they are is to ask the children. But this is not as easy a task as it sounds. Children are not necessarily articulate. Why should they have to be? The researcher needs to find a way to elicit answers from children. A lot of preparation and effort has to be made before such a 'wish list' can be gathered.

The purpose of this study was to identify children's preferences by using 'a discovery led by children' research approach. The study was done in its natural settings in the school and was slightly structured in nature. The researcher had gone through many phases of search before the study was conducted. This research will look for preferences amongst a collection of multimedia CD-ROMs and equivalent books. The analysis and conclusion from this study will help the researcher determine future research tracks for the rest of the studies of children using multimedia.

### **3.2 Selected Children: age and gender**

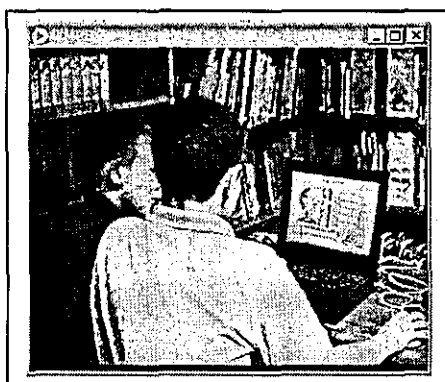
A primary school near the university was chosen for this study. Twelve children from year 5, aged 9-11 years old were involved. No specific instruction was given to the teachers in the school about criteria of choice except that there must be equal numbers of males and females. It was nearing term break so the teacher's chose the children, it was partly a voluntary process and, partly from those not involved with sports practice.

### **3.3 The Research Programme**

#### **3.3.1 Experimental location**

The researcher was given a corner in the school library to conduct the session and make observations. The place was chosen because it was somewhere familiar and comfortable for the children so that they would feel at ease and could respond to the researcher through their hearts and minds and not because of some constraints they felt. **Figure 3.2** below shows an example of where the experiment was held.





**Figure 3.2:** A picture of a session in Study 1 – In a corner of a school library.

### **3.3.2 Duration of Study**

The research involved three school days. A break between the first and second day gave the researcher a chance to reflect on the flow of the research procedure and make amendments where necessarily.

Two different scenarios were conducted each day. Every session took one hour. During the sessions the children were given the time to look at materials both in print and multimedia CDs. There was no particular task or test given. The number of materials varied according to themes and numbers per day. The children were either paired up as mixed couples, a boy and a girl, or both boys and girls. The teacher chose them, whichever combination, at random and whomever she found suited her best on that day.

### **3.4 Subject Matter Identification**

Preferences are better highlighted when materials are compared from amongst the same forms or other forms. The researcher decided to design a research procedure that allowed the children a chance to express their likes and dislikes of one form of material to that of others. The reason for doing so is to enable the researcher to define its parameters of likes and dislikes clearly and precisely so that similarities, differences, and reasons for preferences could be highlighted.

The research design for this study followed the researcher's master's dissertation (Said, 1995) line of thought. Findings from Said (1995) 's about children's reactions

to illustrations in children's information books showed that illustrations in some Dorling Kindersley's (DK) Eyewitness Series were favoured by children. Most preferred simple line drawings to that of shaded detailed drawings or illustrations. These findings could only be highlighted when the children were given books designed by other publishers as well. Since there are many types of information books, designed by many publishers, choosing the ones with similar themes helped a lot in determining which ones children like and dislike and highlighted the reasons for the preferences.

Therefore in the pilot study the researcher gave the children two different forms of material, a set of multimedia CD-ROMs and books from similar themes and a time to study them. The books were chosen as opposed to multimedia CDs on the basis that there are some similarities and differences on how information is being conveyed between them. Looking at both of them, the researcher hoped to find actions and reactions of children as they interact with these materials. Since some children find it difficult to express their likes and dislikes, giving them these two forms of materials will help them to express their experiences, which therefore helps us to understand more of their preferences.

### **3.4.1 Selecting the Themes**

Said (1995) found that there are diverse types of information books for children on one particular theme and the best method to learn about the use of illustrations in them is to choose them according to similar themes and compare them. From the list of choices the children were then asked to choose which ones they liked and to articulate why. From this study it was found that there are also many multimedia CDs to choose from. Just as information books for children, information multimedia CDs tend to have a variety of presentation forms of similar themes from many different publishers. For this study the researcher based the research on 3 main themes: The Human Body, The Way Things Work and Dinosaurs.

#### **a. The Human Body**

The Human Body was chosen because the class was at that time doing this topic and in choosing this theme, the children would be on some familiar ground. The researcher also knew that the children had some experiences of looking at the topic on the Internet. The researcher wanted to find out the children's reactions to book

form, multimedia and the Internet (this form was not formally conducted but referred to in the discussion with some children).

#### **b. The Way Things Work**

The Way Things Work was chosen because during the researcher's previous study (Said, 1995) the illustrations in this book were not liked very much by children particularly because they preferred simple line drawings to shaded detailed drawings. The New Way Things Work was a new edition of the Way Things Work. The illustrations in them were still the same as in the old edition. The researcher choose this book and a multimedia of it to find out if the illustrations done in the multimedia application had a different impact on the children when compared to the illustrations in the books.

#### **c. Dinosaurs**

This theme was chosen because Dinosaurs has been one of the children's favourite topics. There are no real life issues here because most images are "reproduced" whether it is in CDs or book form. Since the topic is interesting to children the researcher wanted to find out their preferences when it is presented in different formats.

This was a pilot study and the method of study was that of "discovery led by children". Using a diversity of materials for children to explore could help us to discover the full story of their preferences.

### **3.4.2 Matching Materials with Intended Target Audience (age-group)**

It is difficult to identify the age group intended in multimedia CDs, just as it is difficult to identify them in information books for children. The age ranges for the target audience for information books are estimates of children's reading age rather than literal age. Clarke (1993) in Said (1995) had this to say about the matter:

"... Most publishers are reluctant to label their children's books as suitable for one specific age." (p.56)

The reason for the difficulty of the attempt was:

"It is impossible to predict what a child's mind will seize on at any stage. Their minds are like houses in a staggered process of building – some rooms complete with furniture, others just bare bricks and girders." Clark (1993) in Said (1995) p.57

The chosen CDs may not exactly fit the intended age range 9 to 11 years old but had to be estimated based on lists stated in some primary education brochures. E.g. Primary ICT Software Catalogue 1998-99 "Resources for the National Grid for Learning" looking at age range from 7 to 16; Primary CD-ROMs and software "The essential guide for ages 3 to 11" which in some cases is stated as suitable for children age 7-14, etc. **Figure 3.3** below is a list of phrases used by publishers to describe their target audience in information books listed by Said (1995) as compared to those found in information multimedia CDs. Some of the multimedia CDs from which these phrases are drawn was chosen for this study.

Phrases used in Information Books for Children	Phrases used in Information Multimedia CDs for Children
<ul style="list-style-type: none"> <li>• Can be used by the entire family</li> <li>• For people of all ages</li> <li>• Entertaining reference book for readers of all ages</li> <li>• An essential addition to every child's bookcase</li> <li>• An essential guide to the working world</li> <li>• A readable scientific introduction to the subject</li> <li>• An excellent starting point for the reader to begin understanding some of the things that surround us</li> <li>• Useful as a source of information, as well as making it a perfect place for anyone to begin learning about the human body</li> <li>• A dramatically illustrated series for young readers</li> </ul> <p style="text-align: right;">Said (1995) p.57</p>	<ul style="list-style-type: none"> <li>• Harnesses the power of technology to give users fantastic information adventure... <i>Dorling Kindersley (1996)</i></li> <li>• The virtual landscape lets kids discover... <i>Dorling Kindersley (2001)</i></li> <li>• ...Consolidate what kids learn in the classroom... <i>Dorling Kindersley (2001)</i></li> <li>• ...Travel back in time ...to search ...explore <i>Microsoft (1996)</i></li> <li>• Featuring live-action video ...and a built-in connection to ...the internet site for young inventors ...the ultimate guide to the world ...for curious young minds <i>Dorling Kindersley (1996)</i></li> <li>• With amazing sights, sounds, and movies, ...brings you face to face ... <i>Microsoft (1994)</i></li> <li>• Utilises colourful three-dimensional graphics to create a 'virtual museum' through which pupils can wander and explore... <i>Granada (2000)</i></li> <li>• Step back through time ...where you can roar into a prehistoric land of fun, excitement, and adventure... <i>Disney Interactive (2000)</i></li> </ul>

**Figure 3.3:** Target Audience for Children

The chosen materials were therefore from an age range of 7 to 14 even though the children in this pilot study were within the range of 9 to 10 years old.

### 3.5 The Materials

There are 10 materials used in this study, 5 books and 5 multimedia CDs. The number of books or multimedia presented in each of the 3 days varies.

- Day 1 – 3 books and 1 multimedia CD
- Day 2 – 1 Book and 1 multimedia CD
- Day 3 - 1 book and 3 multimedia CDs

#### 3.5.1 The Multimedia CDs

Multimedia CDs come in many "shapes and sizes". The problem is that the "shapes and sizes" do not come in physical state but in "virtual form". The only physical form is the floppy circular silver disc commonly named Compact Disc. HyperDictionary.com defines Multimedia Compact Disc (MMCD) as a CD-ROM standard for storing 650 MB of data including video. DVDs now store 4.7 GB.

A survey was undertaken to list the multimedia forms designed for children. Some refer to multimedia forms as platforms whilst others as environments. The researcher was interested to look at children's reaction to publicly available educational multimedia CDs.

Over the years Dorling Kindersley (DK) has ventured into producing information multimedia CDs of its information books. They were very successful with information books and the potential of multimedia is maybe a reason they produce it in this form too. The researcher initially believed this was the case but literature has shown that educational CDs, particularly information or encyclopaedic ones, produced by DK and other publishers have not necessarily been successful in targeting children (Hughes, 2000). It is interesting to know the reactions of children to information or encyclopaedic multimedia produced by DK and other publishers. The researcher gathered lists through the web, from publisher's brochures, and those available in public libraries. Some were also obtained from parents and friends. One CD in a game format was included to see whether it could make a difference. **Figure 3.4** shows the lists chosen for this pilot study.

Theme	Number Used	Format / Textual Design	Title
The Human Body	1 (Day 1)	Multimedia CD (MM1)	1. <i>The Ultimate Human Body</i> (1996) [CD-ROM] London, Dorling Kindersley
The Ways Things Work	1 (Day 2)	Multimedia CD (MM2)	2. <i>The New Way Things Work</i> (1997) [CD-ROM] London, Dorling Kindersley
Dinosaurs	3 (Day 3)	Multimedia CD (Encyclopaedic format) (MM E)	3: <i>Dinosaurs</i> (1994) [CD-ROM] London, Microsoft
		Multimedia CD (Exploratory - simulation format) (MM EX)	4. <i>The Magic School Bus - Dinosaur</i> (1996) [CD-ROM] London, Microsoft
		Multimedia CD (Game format) (MM G)	5. <i>Disney Activity Centre- Dinosaur</i> (2000) [CD-ROM] United Kingdom, Disney Interactive
<b>Total Number Used</b>			<b>5 Multimedia CDs</b>

Figure 3.4 - List of Multimedia CDs Used in Pilot Study

### 3.5.2 Information Books

The potentialities of multimedia could not be defined if there was no benchmark for comparison. From the researcher's previous study, Said (1995), children do like Dorling Kindersley's illustrations in the "Eye Witness Series." The popularity of this publication made the researcher chose some of these information books as a basis or benchmark along with other publications.

The books chosen have a number of different characteristics. Some were chosen for illustration types found in them and some for their textual design layout. There was a set of books that displayed different illustration types: one, Dorling Kindersley's illustrations type named "interactive illustrations"; and another "photographic illustration" type. The other sets are the ones that show different textual design: a pop-up book layout and an overlay type.

#### a. "Interactive Illustration"

These illustrations are found in Dorling Kindersley's information books. Two books were chosen for this study: *The Ultimate Human Body* and *The New Way Things Work*.

**b. Photographic Illustration**

This illustration shows very realistic images. BBC *The Walking Dinosaurs* shows “reproduced” images of dinosaurs as though they are real.

**c. A Pop-up Textual Design Layout**

A pop-up or mock-up or 3D book was chosen in this study to give children an experience of seeing books that could present the theme The Human Body in a different way than the conventional printed form. The purpose was to see whether such a layout got a reaction from children and if so to see whether it affected their preferences.

**d. An Overlay Textual Design Layout**

Another different textual design layout was also given to the children. An overlay is a book design that uses a number of layers of acetates to present a given information. E.g. an overlay of a human body would start off with a frame of skeleton, then the muscle tissues over it, followed by the human skin, etc. This representation gives the children some sort of a build up phenomenon, a slightly different approach to the conventional printed form. The purpose of giving this form of textual design was also to see children’s reaction to it. A list of information books used in this study could be seen in **Figure 3.5 - List of Information Books Used in the Pilot Study.**

Theme	Number Used	Format / Textual Design	Title
The Human Body	3 (Day 1)	Pop-Up Book (PB)	1. <i>The Human Body</i> (1983) London, Jonathan Cape (A three dimensional study).
		Overlay (O)	2. <i>Human Body</i> (Inside Guides Series) (1997) London, Dorling Kindersley
		Interactive Illustrations (I 1)	3. <i>The Ultimate Human Body</i> (1996) London, Dorling Kindersley
The Ways Things Work	1 (Day 2)	Interactive Illustrations (I 2)	4. <i>The Way Things Work</i> (1988) London, Dorling Kindersley
Dinosaurs	1 (Day 3)	Photographic Illustrations (PI)	5. <i>Walking with Dinosaurs</i> (1999) London, BBC Worldwide
<b>Total Number Used</b>			<b>5 Information Books</b>

Figure 3.5 - List of Information Books Used in Pilot Study

## 3.6 Investigative Procedure

### Day 1

In the first session a mixed couple were given one multimedia CD (an encyclopaedic format) (**MM 1**) on a theme "The Human Body" and three information books of different textual design layout: one, a pop-up book (**PB**); two, an overlay (**O**); and three, an interactive illustrative information book (a Dorling Kindersley's Production) (**I 1**). The couple were asked to look at the CD for about 15 to 20 minutes and later to look at the books for 10 minutes each. They were then interviewed for another 10 to 15 minutes about their views on all the materials given to them. The whole session was videotaped and the conversations audiotaped.

To avoid the order effect, the sequence was changed for the second couple. While the first couple looked the multimedia first, the second couple looked at the books first before looking at the CDs. The first couple looked at the printed forms individually while the second couple looked at them together. Both couples, however, looked at the multimedia CDs together.

### Day 2

On this day, in both sessions, the children were given informative material on "The Way Things Work", one in a book form (**I 2**), and one on a multimedia CD (**MM 2**). The same technique of reversing the order was also conducted in this session. They were given 15 to 20 minutes to look at each material and later interviewed for another 10 to 15 minutes. The only difference in each session is that, the first was a couple of girls and the other boys only. All the couples looked at both materials together. Both sessions were videotaped and the conversations audiotaped.

### Day 3

In this session, both couples (first session girls only, second session boys only) were given one information book with photographic illustrations on dinosaurs (**PO**) and three different multimedia CDs about dinosaurs. One CD had an encyclopaedic format (*Dinosaur*) (**MM E**), one an exploratory simulation format (*The Magic School*



*Bus-Dinosaur*) (**MM EX**) and the other a computer interactive game CD (**MM G**) on dinosaurs (*Disney Activity Series- Dinosaur*).

In the first session, both girls looked at the book first for 10 minutes before spending time, about 10 to 15 minutes each on the multimedia CDs. They were then interviewed for another 10 minutes about their views on all the materials given to them.

The second couple of boys were allowed to choose which one of the multimedia they wanted to look at first. They chose to play with the game CD first, and then the exploratory CD, the encyclopaedic CD and the book last. Both couples looked at all the materials together. Both sessions were videotaped and the conversations audiotaped.

### **3.7 Findings**

The findings are presented in detail in this section to provide a rich basis for extracting the factors that are important to the children. The findings are reported for each session. They are structured according to the questions posed to the children at the end of each session. The comments of the children are supplemented with evidence from the video recordings.

#### **Day 1**

##### **3.7.1 :**

**Session 1** (Boy – Girl; 3 Information Books (PB/O/I 1); 1 Multimedia CD (MM 1))

**Session 2** (Boy – Girl; 1 Multimedia CD (MM 1); 3 Information Books (PB/O/I 1))

---

Three information books of different textual designs were given to the children: pop-up book (**PB**), overlay (**O**) and interactive illustration (**I 1**). The interactive design format (**I 1**) is similar to the one in a multimedia format (**MM1**). The intention of giving these variations to the children was to obtain:

- the reactions of the children to the different textual designs in printed form when given along side a multimedia application
- their preferences when they are asked to choose
- opinions on the design features in the multimedia application
- their reaction to games

- other information and issues about learning and teaching from these materials, the Internet, etc.

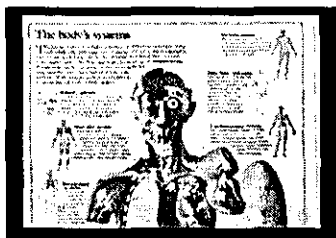
**Figures 3.6, 3.7, and 3.8** are examples of the textual design format in information books given to the children for Session 1 and 2. **Figure 3.9** is a multimedia CD format of the title to the "interactive illustration" information book of **Figure 3.8**



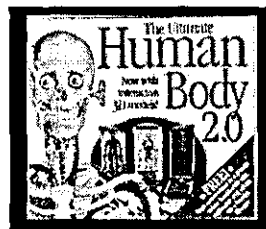
**Figure 3.6:** A Pop-up Book (PB)



**Figure 3.7:** An Overlay (O)



**Figure 3.8:** An interactive illustration information book (I 1)



**Figure 3.9:** A multimedia CD (MM 1)

Some of the data gathered in the two sessions were:

- Observation of children's reactions to the materials given to them.
- A semi-structured interview conducted at the end of each session.
- A videotaped recording of each session.

### **3.7.2 Findings**

The review of findings will be described in the sequence of the objectives listed above including the results from observation, semi-structured interview transcripts and an analysis of the videotape recording of each session.

#### **a. Reactions to the different textual designs and multimedia**

##### **i. Information Books (PB/O/I 1):**

Both couples (boy-girl groups) were observed to be more excited by the textual design of the pop-up book **(PB)** as compared to the other two books, overlay **(O)** and interactive illustration **(I 1)**. Visiting the videotape recordings showed that the couple that saw the books together seemed to be more excited when looking at the materials together than the couples that looked at them individually.

**ii. Multimedia CD (MM 1):**

The videotaped recordings also gave evidence of how a child could dominate the other when looking at the multimedia together. Only when the mixed couple was comfortable with each other's company was there equal participation between them. Because of this, the researcher changed the pairs to single genders in all the other sessions with the children. However, looking at their reactions to the multimedia CD **(MM 1)**, both couples tended to show some excitement when listening to the introductory music **(MM 1)** but after about 10 minutes they tended to look at each other, in other directions and to show signs of being a bit restless.

**b. Preferences when they are asked to choose**

In the interview the children were asked their preferences for the books or CDs.

<p><b>Session 1:</b> <b>Boy-Girl (PB/ O/ I 1 /MM 1)</b></p> <p><b>Researcher:</b> I have shown you different types of materials one in multimedia and the other in these books. What do you think are the differences between these two? How do you feel...which one do you like...do you prefer the books or do you prefer looking at multimedia. What about you Girl 1?</p> <p><b>Girl 1</b> I think the books are better</p> <p><b>Researcher:</b> You prefer the books, why?</p> <p><b>Girl 1</b> Well, I just understand them better than the computer</p> <p><b>Researcher:</b> What about the movie, video, life pictures inside it (multimedia) do you like that?</p> <p><b>Girl 1</b> I do but I prefer books</p> <p><b>Researcher:</b> Why, why do you think?</p> <p>Silence...no one answer</p>
--

<p><b>Session 1:</b> <b>Boy-Girl (PB/ O/ I 1 /MM 1)</b></p>
---

**Researcher:**

What about you Boy 1?

**Boy 1:**

I like them because I'm used to computers...because in my house I have a computer and I like them...

**Researcher:**

So you like because you are comfortable with it...you are used to it already?

**Boy 1:**

Yeah...

**Researcher:**

What about yourself?

**Girl 1**

I just like it, I think, I understand the book better ...

**Researcher:**

What is the difference between the one in multimedia and the book...you can have a video in it...but you still like the book...why is it?

**Girl 1**

If I had to choose, I would prefer the book...

**Researcher:**

Is it because you can flip over, check, etc...?

What is the difference between the one in multimedia and the book...you can have a video in it...but you still like the book...why is it?

No answer...

**Researcher:**

Do you think having a multimedia alone to learn about the human body is better than having books only or you prefer learning it by using both multimedia and computer?

Nodding...

**Researcher:**

What about yourself Girl 1?

**Girl 1:**

I think both

**Researcher:**

You want both?

**Girl 1:**

If I had to choose I would prefer the book...

**Researcher:**

Is it because you can feel the book...you can open the pages and look at it

**Girl 1:**

Yes, like you can do it at your own time...

With the computer, a man talks to you and if, like, you don't have enough time, if you can't understand it quickly you won't understand it...

**Researcher:**

Why?

**Girl 1**

I like reading books and I understand it better then when I read it...then when somebody says it to me. I like to read rather than be read.

**Researcher:**

What about yourself Boy 1, what do you think?

**Boy 1:**

I am used to computers because when it asks you a question you've got more time to answer it...as when, if my dad gives me a quiz you've got not enough time to answer that question

**Session 1:**

**Boy-Girl (PB/ O/ I 1 /MM 1)**

**Researcher:**

If it is done in class which one do you think you like the teacher to use? When teaching you all about the

human body...do you like pop-up ones or that one...why?

**Boy 1:**

That one (pointing to DK) got more details looking at it...whilst this one (pop-up) you can see what's there and get things to move and see how they work

**Researcher:**

You can do that in a computer as well isn't it...in multimedia...

**Girl 1:**

Yeah...but you can't really see inside of it...

**Researcher:**

How do you like it the one in multimedia compare to this book (pop-up book)...you think this (pop-up book) is better?

Nodding...

**Researcher:**

What about yourself Boy 1? You prefer the computer?

**Boy 1:**

I prefer the pop-up...you see it moving like that (holding the handle of one of the pop-up diagrams)...you can move it...

**Researcher:**

What about the overlay...

No answer.

**Session 2:**

**Boy-Girl (MM 1/PB/ O/ I 1)**

**Researcher:**

You have looked at the books and the multimedia. If you are given a choice which one would you prefer?

**Girl 2**

Books

**Researcher:**

Why?

**Girl 2**

It (books) gives you a bit more information

**Researcher:**

But the multimedia...

**Girl 2**

The multimedia gives...but the problem is it gives you a bit too much information you can't fit it all in...

**Researcher:**

Is it because it is the manipulation of the mouse or is it because it is on the screen or what do you think?

**Girl 2:**

I think it is because it is on the screen ...it is because everything is there and you can't focus

**Researcher:**

What about the book, I mean, which books do you like?

**Girl 2:**

I think that one is fine (pop-up) (**PO**) but if you like a little bit more information that one (DK)

(**I 1**) is good

**Stuart:**

That one (Overlay Book) (**O**) is good for beginners but I think it is too young for us

**Researcher:**

What about the one in multimedia (**MM 1**)?

**Girl 2:**

That was fine because it is just that you get into it and you don't take any information in...you just sort of just keeping everything just looking in...

### c. Design features in the multimedia as compared to books

In the interview the children were asked questions that highlighted design features in multimedia like animation, movie, video, life pictures etc. Some children gave opinions whilst others did not. These exchanges might be repeated later but for this section the design features are highlighted.

<b>Session 2:</b> <b>Boy-Girl (MM 1/PB/ O/ I 1)</b>
<b>Researcher:</b> Do you like the <b>animated</b> part of it <b>(MM 1)</b> ?
<b>Girl 2</b> Oh right...that was good
<b>Boy 2</b> You can't take it all in. It becomes a bit complex.

<b>Session 1:</b> <b>Boy-Girl (PB/ O/ I 1 /MM 1)</b>
<b>Researcher:</b> What about <b>the movie, video, life pictures</b> inside it (multimedia) <b>(MM 1)</b> do you like that?
<b>Girl 1</b> I do but I prefer books
<b>Researcher:</b> Is it because you can flip over, check, etc...? What is the difference between the one in multimedia and the book...you can have a video in it...but you still like the book...why is it?
No answer

The researcher also tried to explore whether the children were able to see similarities or differences between the multimedia **(MM 1)** and the book **(1 2)** of the same title presented in two different formats by the same publisher. The question is more direct to one couple but put in a slightly different way for the other couple. The purpose was to elicit what they knew about design similarities and differences.

<b>Session 1:</b> <b>Boy-Girl (PB/ O/ I 1 /MM 1)</b>
<b>Researcher:</b> What are the similarities between the two <b>((I 1) and (MM 1))</b> ?
<b>Both (Girl 1 and Boy 1)</b> Almost show the same things...
<b>Session 2:</b> <b>Boy-Girl (MM 1/PB/ O/ I 1)</b>

**Researcher:**

The way you interact with a computer and the way you interact with a book; what are the similarities or what are the differences

**Girl 2**

Well, when you are reading from a book you are **thinking what are on a page** ...when you are like looking on a screen you are not, you just sort of it's there and I'm **just sort of looking at it**.

**Boy 2**

When a book you've **got still pictures** you can like looking at it, sort of revise on it, but in that (multimedia) **(MM 1) the pictures are moving** and you're like **have to look quickly** at it.

**Girl 2**

That (multimedia) **(MM 1)** has **got pictures and diagrams** just like a book but this (book-DK) **(I 1)** gives you **more information**

**d. Reactions about learning and teaching from these materials**

When asked which materials they prefer their teacher to use when teaching one couple had this to say about their preferences and reasons for them.

**Session 2:**

**Boy-Girl (MM 1/PB/ O/ I 1)**

**Researcher:**

If a teacher has, lets say, a choice to use multimedia or a book which one would you prefer to get information from

**Girl 2**

I think I learn a lot more if I look at a book

**Boy 2**

Yeah ...nodding with agreement

**Researcher:**

Is it because you don't like computers?

**Boy 2**

I like computers it is just that you think computer is a bit more ...giving you more than needed but it doesn't like giving you a name and you just like it is being known but still when you get on it it has got too much on it and you've just have got to find out what you are looking for...

**Researcher:**

So, so much information is there, everything to look at ...so does it confuse you or something?

**Girl 2**

Yeah, it confuse me

**Researcher:**

Sometimes you feel a bit fed-up, a bit worried, phobia or something?

**Girl 2**

You tend to be a bit worried because you just like...oh no what is the name of that thing...I don't know what is the name of that thing again...I know that it looks like but its funny... you can't remember what it is called and that thing (name) is really with the little ones...

**Researcher:**

What about if it is in a book?

**Girl 2**

You can always go back to it...it is much easier from a book you can learn a bit more and you can like look back at it again till you know sort of familiar with it

**Researcher:**

Lets say a teacher comes to teach about the Human Body with you ...do you like a mix variety of it, you prefer from books, you think it is enough from books...

**Both Girl 2 and Boy 2**

Mix variety ...not solely in one form

**e. Reaction to games, and learning from them**

There were mixed views about games. Most agree that in some way or the other they could learn from games as well. The two girls gave rather different reactions to this question than the boys. One girl was slightly unsure and changed her opinion after some time while the other girl liked game quizzes. The boys talked more and seemed to favour games and had different ways of presenting their opinions.

<p><b>Session 1:</b>  <b>Boy-Girl (PB/ O/ I 1 /MM 1)</b></p> <p><b>Researcher:</b>          If you are given a game sort of multimedia, do you like it?  <b>Both (Girl 1 and Boy 1):</b>          Yeah (nodding)  <b>Researcher:</b>          Even if it is about the human body...  <b>Both (Girl 1 and Boy 1):</b>          Yeah  <b>Researcher:</b>          Can you study with games?  <b>Both (Girl 1 and Boy 1):</b>          Long nods...  <b>Researcher:</b>          Do you like it when it is with information or do you like it when it is games?  <b>Girl 1</b>          If I want to find out information I like books, if I want to play games I prefer the computers.  <b>Boy 1</b>          Games and information in computers</p>
<p><b>Session 2:</b>  <b>Boy-Girl (MM 1/PB/ O/ I 1)</b></p> <p><b>Boy 2</b>          If it is a game with a computer level in it and tells you a bit information about it then it is good  <b>Girl 2</b>          Yeah...that will be good. If it is like a quiz or something ...I thought the quizzes are good because even if you don't know the answer you'll be able to find out what the answers are ...if you are reading the information you don't actually get what the answer is...</p>

#### **f. Other issues**

There are some other issues discussed in this interview that highlighted some features children find useful or less useful about multimedia, computers and the Internet

#### **i. Quizzes or Tests**

From the exchanges about features, surprisingly a quiz feature got some interest from children of both groups.



**Session 1:**  
**Boy-Girl (PB/ O/ I 1 /MM 1)**

**Researcher:**

By the way about the way a test is being tested...if it is a test you prefer in the book or the computer

**Boy 1**

Computer...we've got two computers in the class and we've got the website (on the human body) and books as well...

**Boy 1**

I like the quizzes in the computer because it tells you answers at the end of the page whilst in a book you get your answers at the end of the book.

**Session 2:**  
**Boy-Girl (MM 1/PB/ O/ I 1)**

**Researcher:**

So if it is written on a piece of paper and asked questions as in a quiz you prefer it to be in multimedia then...

**Girl 2**

Because it gives you some answers as well and sort of guide you through...if it is in a piece of paper ...it is either right or wrong...if you don't know the answer unless you've got the books all in front of you...it is still not very good

**Researcher:**

Which is better? Having the books as well, you've got the questions and you've got to answer...what do you think? You are given books to look at the answers from and a quiz ...and you are given a multimedia and a quiz in the multimedia

**Girl 2**

I think you can find out the information from a multimedia quite easily ...rather than looking at something else (looking it up in a book) you forget what was the answer in the group or something...you get carried away...

**Researcher:**

What about in the multimedia?

**Boy 2:**

When you look at one thing (in the multimedia) it is really very specific about what it is...you really know what to get the answers right, then if it is from books and you have a question you have to search from it and you don't know where it is or something like that...you'll have a problem there yeah...

## ii. Using Multimedia in Class

The children gave some interesting answers to using multimedia in the classroom. As a result the researcher posed questions about when to use it in a class lesson: at the beginning, middle or end.

**Session 1:**  
**Boy-Girl (PB/ O/ I 1 /MM 1)**

**Researcher:**

If you mixed all these materials (multimedia and books) in your class do you like it?

**Boy 2**

Having it together at different times

**Session 2:**  
**Boy-Girl (MM 1/PB/ O/ I 1)**

**Researcher:**

So when do you think is the best time to have the multimedia? Is it at the beginning of the lesson or at

the end of the lesson?

**Boy 2**

At the end of the lesson when you know everything ...yeah at the end of the lesson when you can understand it a little bit better...

**Researcher:**

You think once you have understood everything then the multimedia is something you can understand?

**Boy 2**

Yeah...nodding

**Researcher:**

If you don't understand about it you get confused?

**Boy 2**

Yeah...nodding again

### iii. Getting information from multimedia

Some of the exchanges demonstrated how children perceived getting information from multimedia as compared to books.

**Session 2:**

**Boy-Girl (MM 1/PB/ O/ I 1)**

**Girl 2**

I think books give good information...but I think if you are doing a research it is best in a computer.

**Researcher:**

Why do you say that?

**Girl 2**

Because if you are researching you are going slower and you sort of going a little bit about it and like adding more details. If you want information then a book will be a useful one and a computer will sort of just give you diagrams and keep coming into one. You can explore more in a computer and in a book all information.

**Researcher:**

You think, what about the thing in a computer where you've got lots of information, while in a book you've got fewer information, lets be more specific...what do you think about that computer

**Girl 2**

It certainly gives you lots more information than a book. It gives you points like it sort of set up in a way you can understand it while in a computer it will be like diagrams, films going on and it will be like...

**Boy 2**

Here if the computer is at home... You've got more time to look at it...in the class you have to stick to the time teacher give you...not enough time...if you have it at home you can revise it look at it again...

**Session 2:**

**Boy-Girl (MM 1/PB/ O/ I 1)**

**Researcher:**

You think in a multimedia you need to look at it many times ...you think?

**Both Girl 2 and Boy 2:**

No...shaking their heads

**Boy 2**

It is just if a person is used to using a computer they'll be able to get more of it...

**Girl 2**

I think books gives good information...but I think if you are doing a research it is best in a computer.

Technical problems with the computer could affect children's preferences in getting information from multimedia. There was a problem faced by the second couple when the multimedia took quite some time to load.

**Session 2:**

**Boy-Girl (MM 1/PB/ O/ I 1)**

**Researcher:**

At the moment you got stuck how do you feel?

**Girl 2**

I was sort of like, what was the matter with it. I was like I felt what have I done wrong...

**Boy 2**

...If it is not working you are thinking I've done something wrong...you always have that feeling...yeah...tension

**Researcher:**

There is tension there? So in a book ...

**Girl 2**

It doesn't happen ...so you just sort of ease your way through the information

**Researcher:**

So even if it is an impact in computer you think a book is still a wonderful thing?

**Both Girl 2 and Boy 2:**

Yeah...nodding...

#### iv. Getting information from the Internet

When asked about their experience using the Internet in the classroom the children expressed their problem in getting access to the site.

**Session 1:**

**Boy-Girl (PB/ O/ I 1 /MM 1)**

**Researcher:**

So how do you like the web site?

**Girl 1**

It is ok...

**Researcher:**

Is it only facts or something like the multimedia?

**Boy 1**

It has got games as well

**Girl 1**

There are 4 different things on the website -skeleton, nervous system, body parts, digestive systems

**Session 1:**

**Boy-Girl (PB/ O/ I 1 /MM 1)**

**Researcher:**

What about the internet? What do you like about the Internet?

**Girl 1:**

I like emailing

**Boy 1:**

I like playing games in the Internet

**Session 2:**  
**Boy-Girl (MM 1/PB/ O/ I 1)**

**Researcher:**  
I have heard that you've done on-line stuff in class so how do you like studying on line than...is it the same as the ones in multimedia?

**Boy 2:**  
It has some websites ...that is not much on it...it is sort of you have diagrams ...not much interaction

#### v. Gender issues

The researcher also wanted to know what the children think and know about other genders using computers and their likes and dislikes.

**Session 1:**  
**Boy-Girl (PB/ O/ I 1 /MM 1)**

**Researcher:**  
What about the idea that boys prefer computers more than girls...Have you heard of that?

**Girl 1**  
No idea...

**Boy 1**  
I heard about boys playing with play stations more than girls...

**Researcher:**  
Why? Why do you think boys like computers more than girls?

**Girl 1**  
Because there are more games

**Boy 1**  
I think it is an equal amount...girls like computers too...I like the Internet.

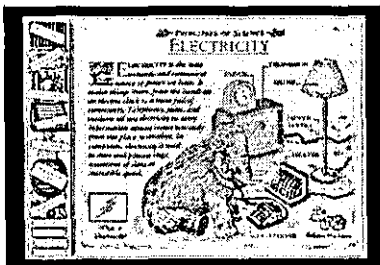
#### Day 2

##### 3.7.3 :

**Session 1** (Girl - Girl; 1 Information Book (I 2); 1 Multimedia CD (MM 2))

**Session 2** (Boy - Boy; 1 Multimedia CD (MM 2); 1 Information Book (I 2))

**Figure 3.10** is a multimedia CD format and **Figure 3.11** the title of the "Interactive Illustration" in the printed form of an information book.



**Figure 3.10** An extraction of a page in multimedia CD "The New Way Things Work" (I 2)

**Figure 3.11** The Information Book "The New Way Things Work" (MM 2)

### **3.7.4 Findings**

#### **a. Reaction to the different textual designs and multimedia**

##### **i. Information Book (I 2):**

There was not much of a reaction from the children when looking at the books. One couple, the boys, looked at the index first and started to select the topics they wanted to look at before opening the pages to look at the content. The girls began by looking from the beginning to the end of the book.

##### **ii. Multimedia CD (MM 2):**

The girls spent quite some time on the initial page before clicking on the icons to get into the topics they wanted to find. They seemed excited to see the movements of the mammoth and started clicking on it several times before proceeding to look at other things. They were restless after some time and started to look at the corridor instead.

The boys were quite excited about the multimedia. The first feature they clicked on was the game. They then ventured into other things. After sometime they too looked as though they had enough so the researcher began the interview sessions earlier with the boys than with the girls.

#### **b. Preferences when they are asked to choose**

When talking about preferences the girls revealed a lot about the illustrations and the content in the book (I 2) comparing it to the multimedia of the same topic (MM 2).

**Session 1:**

**Girl -Girl (I 2 /MM 2)**

**Researcher:**

Between these 2 materials ((I 2) and (MM 2)) about the working stuffs which one do you like?

**Girl 3:**

I think I like the computer better because you don't have to read a lot. You can hear sounds and stuff. I like very much about how the structure of the ship is being made

**Researcher:**

What about the book ((I 2))?

**Girl 4:**

The illustrations are very good. Information is really helpful.

**Researcher:**

How's the content ((I 2))? Is it too much?

**Girl 3:**

When we were looking at the X-Ray parts, because I'm quite young I don't understand the way they put it in the book. They kind of put a lot of new words in...When it is in a book, you find that it is ...new words in here I haven't looked at before, haven't seen one before at any time...

**Researcher:**

What about the one in the computer (MM 2), when you look at X-Rays in the computer?

**Girl 3:**

I could understand that a lot more.

**Researcher:**

When you have it in a book (I 2) you have to read out and it takes sometime and in this computer what happens (MM 2)?

**Girl 4:**

We were watching this film about how X-ray is done, and it read a paragraph out to you and explained it in simpler words and explains some of what the hard words were...

**Researcher:**

And you think if this book is a bit simplified, it is better the book or the multimedia?

**Girl 3:**

The book if it is easy to read

**Researcher:**

You prefer the book if it is easier to read?

**Girl 4:**

Yeah...

**Researcher:**

Why?

**Girl 3:**

I don't really know really...I just think it would be...and ehmm...I don't know how to really to explain it ...but it just seems a lot easier in a book.

**Researcher:**

Is it because you can flip it open or something?

**Girl 3:**

Yeah, you can find things quite easily ..

**Researcher:**

But when it is difficult to understand you prefer it to be in a multimedia...

**Girl 3:**

Yeah...

The book form is wordier than the multimedia. The first child found the high vocabulary standards in the book (I 2) more difficult to comprehend than the multimedia. She liked the way it is presented in the computer because the computer seemed to make complex information much easier to understand and she did not have to read a lot. She could hear sounds and see movements. The narration in the multimedia seemed to impress one of the children because she found being read to helped her to understand better because it was explained in much simpler words.

They too found the drawings in the multimedia much finer than the printed form and therefore much easier to comprehend.

When asked if the book was much more simplified, which one would they prefer then they both preferred the book if it is easier to read. One of them said she would feel more relaxed in a book form. They too mentioned that they could get into the topic more easily in the book than the multimedia. However, since the multimedia shown to them looks much more simplified than the books, they found information in the multimedia more easily accessible than the book form.

<p><b>Session 1:</b> <b>Girl-Girl (I 2 /MM 2)</b></p> <p><b>Researcher:</b> And yourself <b>Girl 4</b>, how do you feel with these two materials (<b>I 2</b>) and (<b>MM 2</b>)?</p> <p><b>Girl 4:</b> It would be lovely...It is very relaxing to look at a book (<b>I 2</b>) because you could look at it anywhere...ehmn but the computer (<b>MM 2</b>) is also good because you could look at it when you want to find some information</p> <p><b>Researcher:</b> And if there were lots of information like that one (in the book) (<b>I 2</b>) which one would you prefer?</p> <p><b>Girl 4:</b> If there are lots of information in the book ehmn I don't know...I will probably use the multimedia</p> <p><b>Researcher:</b> Why do you think?</p> <p><b>Girl 4:</b> I think because some of the writings seems a bit bigger on the screen while the writing here (<b>I 2</b>) is a bit smaller</p> <p><b>Researcher:</b> What about when selecting a topic?</p> <p><b>Girl 3:</b> It is easier to go directly to the topic in a multimedia (<b>MM 2</b>)</p> <p><b>Researcher:</b> What about you <b>Girl 4</b>?</p> <p><b>Girl 4:</b> Probably the computer (<b>MM 2</b>) again because you can go into the kind of stuff ... I think it is a bit better</p>
--

The boys in the second session differed in their preferences when talked about storage capability of the multimedia as compared to books. Their preference was based more on the amount of information conveyed by one form as compared to that of the other. One of them said the multimedia stores more information whilst the other said the book. However, when the researcher made them explain further what they meant, their preferences then tended to merge for multimedia rather than the book form. A fuller account of their exchanges could be seen in the sections that follow.

**Session 2:**  
**Boy - Boy (MM 2/I 2)**

**Researcher:**

When you look at both the materials ((I 2) and (MM 2)) which one you prefer?

**Boy 3:**

I say the multimedia (MM 2) ...

**Boy 4:**

I say the book (I 2) ...it stores more information

**Researcher:**

You feel the book (I 2) has got more information?

**Boy 4:**

Yeah ...it has got more in it

**Researcher:**

What do you mean by having more?

**Boy 4:**

The book has more information than a multimedia...

**Boy 3:**

I say the multimedia because in the multimedia they kept on explaining about how it works

**Session 2:**  
**Boy - Boy (MM 2 /I 2)**

**Researcher:**

Could you give an example?

**Boy 3**

In the topic on burglar alarm the multimedia explains it more. Multimedia tells you all about it. You just have to click on the burglar alarm and you will know how it works ...you don't have to read it

**Researcher:**

You think that by just looking at the multimedia you can understand stuff?

**Boy 3**

Yeah you can understand it quite easily

**Session 2:**  
**Boy - Boy (MM 2/I 2)**

**Researcher:**

What about a book, if you are given a book what do you think?

**Boy 3:**

The book you will be able to learn more and slightly you might have to read it. You just might have part of it to understand a teny weenee bit that is difficult to understand but not much just a teny weenee bit. It explains in detail stuffs so you have to put it all together to see what it is like...

**Researcher:**

What about you **Boy 4**?

**Boy 4:**

The same as **Boy 3** when you look at the book you have to look at everything in order to understand and when you look at the multimedia you get the facts there and then

**Boy 3:**

With the book you've to read the whole lot to understand it, but the multimedia you just have to read the topic to understand it.

**Researcher:**

Which one will you remember better?

**Boy 3:**

Probably the multimedia ...it is easier to remember because you've got like the pointed hand to read and you just have to click on the things you want to read ...it has a little box there...

**Researcher:**

If I give you the Human Body in multimedia and books which one do you thing you like better?

**Boy 3:**

I prefer the multimedia because you can go through all of them and I probably prefer the same about the Human Body on the computer disc because you can pick on which one you like.



### **c. Design features in the multimedia as compared to books**

In the following the comments about design features have been highlighted.

<b>Session 1 and 2:</b> <b>Girl - Girl (I 2 /MM 2)</b>
<b>Researcher:</b> Between these 2 materials ((I 2) and (MM 2)) about the working stuffs which one do you like? <b>Girl 3:</b> I think I like the computer better because you don't have to read a lot. You can <b>hear sounds</b> and stuff. I like very much about how the structure of the ship is being made <b>Researcher:</b> What about the book ((I 2))? <b>Girl 4:</b> The <b>illustrations are very good</b> . Information is really helpful. <b>Researcher:</b> How's the content ((I 2))? Is it too much? <b>Girl 3:</b> When we were looking at the X-Ray parts, because <b>I'm quite young I don't understand the way they put it in the book</b> . They kind of put <b>a lot of new words</b> in...When it is in a book, you find that it is ...new words in here I haven't looked at before, haven't seen one before at any time... <b>Researcher:</b> What about the one in the computer (MM 2), when you look at X-Rays in the computer? <b>Girl 3:</b> I could understand that a lot more. <b>Researcher:</b> When you have it in a book (I 2) you have to read out and it takes sometime and in this computer what happens (MM 2)? <b>Girl 4:</b> We were watching this film about how X-ray is done, and <b>it read a paragraph out to you</b> and explained it in <b>simpler words</b> and <b>explains some of what the hard words were</b> ...

The boys had these to say:

<b>Session 2:</b> <b>Boy - Boy (MM 2/I 2)</b>
<b>Researcher:</b> Which one will you remember better? <b>Boy 3:</b> Probably the multimedia (MM 2) ...it is easier to remember because you've got like <b>the pointed hand to read</b> and you just have to <b>click on</b> the things you want to read ...it has <b>a little box</b> there... <b>Researcher:</b> When you were looking at the topic on laser just now, comparing it with the book (I 2) how do you feel about it? <b>James:</b> In the book(I 2) it says that laser can be reflected...a bit more boring than the multimedia (MM 2) because in the multimedia it shows you how it works.

The girls in this session explained in detail their experiences going through the topic on electricity in multimedia (MM 2) and expressed how the application made them understand things better than the book (I 2).

**Session 1 and 2:**

**Girl - Girl (I 2 /MM 2)**

**Researcher:**

What about the animation, the cartoons...?

**Girl 3**

Really good

**Researcher:**

How do you like that compared to the mammoth in the book?

**Girl 3**

On the computer the mammoth flies and you've got movements

**Researcher:**

How do you like it?

**Girl 4**

In the computer they move and in the computer you see clearly exactly what happened.

**Researcher:**

When you compare this with the computer which one would you prefer?

**Girl 3**

Computer probably...

**Girl 4**

Yeah computer as well because you can see movements and got sound as well

**Girl 3**

When we were on the circuit there we pressed the button and it showed us how the circuit works and you can see the circuit.

**Researcher:**

In the book?

**Girl 4**

In the book it would be good...when it talks about electricity on the computer it has sound effects.

**Girl 3**

The last thing we were looking at was the hair dryer with the mammoth and showed you how the electricity kind of got struck by lightning ...showed you it can attract ...

**Researcher:**

And when you see it on paper like this?

**Girl 3:**

I find this really good ...in the computer this bit actually moved and it showed you that these bits actually protected the hair and still made them stick to the comb. When I see it like this (in the book) (I 2) I am not sure what these things are but in the computer (MM 2) I could see it better because it is kind of lighter in the computer.

**d. Reactions about learning and teaching from these materials**

When asked about their preferences for learning using multimedia they had this to say...

**Session 2:**

**Boy - Boy (MM 2/I 2)**

**Researcher:**

When you talk about learning which one do you prefer?

**Boy 3**

I don't mind. I like reading and learning from a computer and a book.

**Researcher:**

You mean you like both?

**Boy 3**

Yeah...

**Boy 4**

It doesn't matter really...It is more fun to do on a computer.

**Session 1:**  
**Girl-Girl (I 2 /MM 2)**

**Researcher:**

What about when selecting a topic?

**Girl 3**

It is easier to go directly to the topic in a multimedia

**Researcher:**

What about you **Girl 4**?

**Girl 4**

Probably the computer again because you can go into the kind of stuff ... I think it is a bit better

However, the children said something different when a question was asked about their reactions to a teacher teaching using either of these or both.

**Session 1:**  
**Girl-Girl (I 2 /MM 2)**

**Researcher:**

Now, if a teacher is going to teach the topic on machines and all that...you prefer your teacher to start teaching the topic using a book or a multimedia?

**Girl 4**

Ehmn, I prefer her to start off with a book and then go in pairs in a computer

**Researcher:**

Why do you think like that?

**Girl 4**

In the book you can check with the whole class and they can see it and for yourself you can understand it better to start off because it starts off with the basics... In the computer there might be different topics and you might not make much of it.

**Researcher:**

You might get confused or something?

**Girl 4**

Only if you just started on the project but if we were kind of in the middle of it I would go on to the multimedia.

**Session 1:**  
**Girl-Girl (I 2 /MM 2)**

**Researcher:**

If there are a mixed variety of things in the classroom both a book and a multimedia, book alone or a computer alone which one would you prefer?

**Girl 3**

I'll take a bit of each

**Girl 4**

Yeah me too...

The boys have a lot more to say about using multimedia in teaching. The exchanges show how it could be used and their perceptions of methods.

**Session 2:**

**Boy - Boy (MM 2/I 2)**

**Researcher:**

If a teacher gives you a topic on the Way Things Work which do you think do you like the multimedia at the beginning, at the end or in the middle? Where do you think the multimedia should be?

**Boy 4**

At the end of the lesson when you want to go a little bit more detail you would want to do the book last. You have the multimedia at the beginning and the book at the end. The book explains a bit more therefore it becomes a bit more complex. To know the basics you should have the computer first. When you want to know a bit of detail you refer to the book.

**Researcher:**

What about yourself, **Boy 3?**

**Boy 3**

I put the computer at the end because you read it and you go on to the next on laser in the computer you can watch it simpler.

**Researcher:**

You think you like to read everything first and then look at the multimedia...why?

**Boy 3**

Books a bit boring but if you put a computer it will be a bit more exciting because it explains to you how it works and stuff.

**Researcher:**

So you want it to be at the end, why?

**Boy 3**

Well if you leave this first and there is a question on the multimedia you don't know it saves you going into this book and reading it again.

**Researcher:**

Now if a teacher uses a book, a multimedia only or both, when introducing a lesson, at different times of day, in a week or so, what do you think of that?

**Boy 4**

If you have a lot of time to study you will do the book...you will get more done but if you have a short time that will be the multimedia because you can get to it quicker

**Researcher:**

What about you **Boy 3?**

**Boy 3**

It is the same as **Boy 4** because if you read a book it is longer to read than if you get it on the computer.

**Researcher:**

Do you like a teacher using a variety of materials or one kind of material?

**Boy 3**

If depends on what you are doing really...depends on what kind of lesson, long term, short term, test...

**e. Reaction to games and learning from them**

Since the boys were very keen to start off with the game when they first interacted with the multimedia the researcher posed most questions about games to the boys.

**Session 2:**

**Boy - Boy (MM 2/I 2)**

**Researcher:**

If you are learning something from a game...one in facts only and one in a game which one do you prefer?

**Boy 4:**

I prefer the games because it is more fun to do and encourages you to do it.

**Researcher:**

Do you think you can really learn from a game or do you think it will put you off using it? What do you think?

**Boy 4:**

You still have to think in the game ... It still makes you think about it.

**Researcher:**

So you think it is much more fun if facts are in a game form

**Boy 4:**

Yeah...

**Boy 3:**

I say book because you can read all that, in the games all you have to do is just clicking-clicking and clicking. Depends on the game really...On the game if you get it wrong it tells you the answer. From it you can learn anyway even when you win or you lose. When studying, I prefer the book.

**Researcher:**

Is it because you can flip it again and again so that you can remember better? People say that when you look at the screen you tend to forget...?

**Boy 4:**

Might have to read it once or twice in the book...had to understand teeny weenie bits...usually explains it all in detail and you have to put it together ...in the computer the facts are at the side for you to understand but you tend to forget game things whatever...

**Researcher:**

If facts you would remember than game form?

**Boy 4:**

Yeah

**Researcher:**

If it ask you a question like ...What is? Who is?

**Boy 3:**

Usually, multimedia or game thing it tells you simple questions that is not too confusing...something, which is quite well known, or something quite important that happens so it will be easier to remember.

**f. Other issues**

Their reactions to some of other issues discussed in the interview were as follows:

**i. Quizzes or Tests**

There was no chance for the children to look at quizzes in these session because the multimedia was not exploited to the fullest and the area on quizzes were left out for some children.

**Session 2:**

**Boy – Boy (MM 2/I 2)**

**Researcher:**

What about a test, how do you like it in a multimedia or a book?

**Boy 3**

I give the book. You learn more and you should be able to answer questions if you learn more.

**Researcher:**

If I have got many books and I give you a quiz and you can find out the answers in the book or I give you a multimedia and down there if you make a mistake you just click and you get the answer which want would you prefer?

**Boy 3**

I'll use the multimedia I'll get the answers quicker...well, books you have to go to the index and if you have got something that you need to know it is a bit longer because you have to go to the index. This will be quicker.

**Researcher:**

You are talking about speed ...what about your liking?

**Boy 3**

Well, I will go for the multimedia more fun.

**Boy 4**

Ehmn...I'll go for the multimedia as well because it is more fun to do probably...

ii. Best time to use multimedia:

The children's answers indicate their preferences

**Session 1:**

**Girl-Girl (I 2 /MM 2)**

**Girl 3**

In the book you can check with the whole class and they can see it and for yourself you can understand it better to start off because it starts off with the basics... In the computer there might be different topics and you might not make much of it.

**Researcher:**

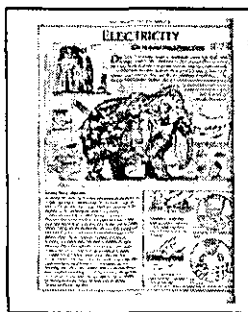
You might get confused or something?

**Girl 3**

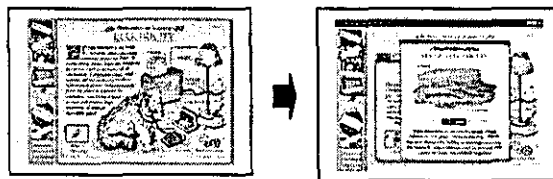
Only if you just started on the project but if we were kind of in the middle of it I would go on to the multimedia.

iii. Getting information from multimedia

A number of issues about getting information from multimedia were discussed in this session. A better understanding of what the children mean would be to look at **Figure 3.12** and **3.13** below.



**Figure 3.12** Electricity in Printed Form (I 2)



**Figure 3.13:** Electricity in Multimedia (MM 2)

**Session 1:**

**Girl-Girl (I 2 /MM 2)**

**Girl 3**

When we were on the circuit there (**Figure 3.13**) we pressed the button and it showed us how the circuit works and you can see the circuit.

**Researcher:**

In the book?

**Girl 4**

In the book (**Figure 3.12**) it would be good...when it talks about electricity on the computer it has sound effects.

**Girl 3**

The last thing we were looking at (**Figure 3.13**) was the hair dryer with the mammoth and showed you how the electricity kind of got struck by lightning ...showed you it can attract ...

**Researcher:**

And when you see it on paper like this?

**Girl 3**

I find this really good ...in the computer this bit actually moved and it showed you that these bits actually protected the hair and still made them stick to the comb (**Figure 3.12**). When I see it like this (**Figure 3.12**) I am not sure what these things are but in the computer I could see it better because it is kind of lighter in the computer.

**Session 2:**

**Boy - Boy (MM 2/I 2)**

**Researcher:**

You think that by just looking at the multimedia you can understand stuff?

**Boy 3**

Yeah you can understand it quite easily

**Researcher:**

What about a book, if you are given a book what do you think?

**Boy 3**

The book you will be able to learn more and slightly you might have to read it. You just might have part of it to understand a teeny weenie bit that is difficult to understand but not much just a teeny weenie bit. It explains in detail stuffs so you have to put it all together to see what it is like...

**Researcher:**

What about you **Boy 4**?

**Boy 4**

The same as James when you look at the book you have to look at everything in order to understand and when you look at the multimedia you get the facts there and then

**Boy 3**

With the book you've to read the whole lot to understand it, but the multimedia you just have to read the topic to understand it.

**Researcher:**

Which one will you remember better?

**Boy 3**

Probably the multimedia ...it is easier to remember because you've got like the pointed hand to read and you just have to click on the things you want to read ...it has a little box there...

**Researcher:**

If I give you the Human Body in multimedia and books which one do you thing you like better?

**Boy 3**

I prefer the multimedia because you can go through all of them and I probably prefer the same about the Human Body on the computer disc because you can pick on which one you like

When information concepts were complex and abstract like electric flow and electric circuit, etc. presentation in multimedia has made it a preferred option than the one in the book. The children find comprehending facts in multimedia much easier than books when the explanation given in a book form became too wordy and too much for them to comprehend.

#### iv. Getting information from the Internet

<b>Session 1:</b> <b>Girl-Girl (I 2 /MM 2)</b>
<b>Researcher:</b> You have learned about the Human Body and I heard that you even have it on line on the website. How do you like learning through the website.
<b>Child 5</b> Yeah it could be interesting but it takes a long time into the actual article.
<b>Child 6</b> It takes about 5 minutes to get into the complete article
<b>Researcher:</b> And when you do get in do you like it?
<b>Child 5</b> It was hard ...when we were looking at arteries and veins they could find the complete subject...
<b>Researcher:</b> Were you frustrated?
<b>Child 6</b> Yeah...I prefer the body book to that on line

#### iv. Gender issues

<b>Session 2:</b> <b>Boy - Boy (MM 2/I 2)</b>
<b>Researcher:</b> There is an opinion that people say boys like computers compared to girls ...have you heard of that...
<b>Boy 4</b> I have heard about boys with toys but not computers...
<b>Boy 3</b> No
<b>Researcher:</b> What is your opinion about that?
<b>Boy 3</b> Well boys are not like girls just studying for ages. They want to be out playing football and want to get it all done so they prefer doing it on a computer.
<b>Researcher:</b> What about you <b>Boy 4</b> ?
<b>Boy 4</b> Well I think that girls like to take a bit longer in answering their questions right but boys want to go out and play-getting facts from a computer is faster.

#### **Day 3**

##### **3.7.5 :**

**Session 1** (Girl – Girl; 1 Information Book (P I); 3 Multimedia CDs (MM E / MM EX / MM G))

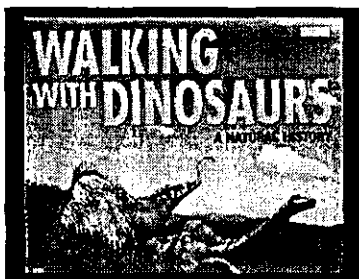
**Session 2** (Boy – Boy; 3 Multimedia CDS (MM E / MM EX / MM G)); 1Information Book (P I))

---

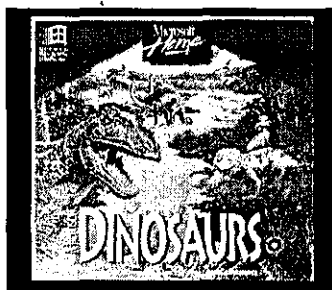
One information book with a photographic illustration (**P I**) and three multimedia CDs (**MM E / MM EX / MM G**) were given to the children.



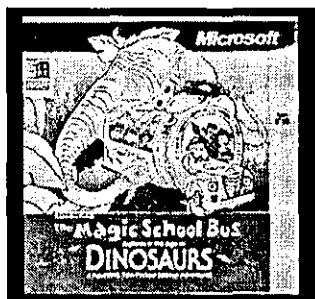
**Figure 3.14** is the information book chosen for this session. **Figure 3.16** a multimedia exploratory and simulation CD "The Magic School Bus" (**MM EX**) – Dinosaur; **Figure 3.15** an encyclopaedic multimedia CD (**MM E**) "Dinosaur" and **Figure 3.17** an interactive game CD (**MM G**) "Dinosaur"



**Figure 3.14** The Walking Dinosaur Book - Photographic Illustration (**P I**) Textual Design



**Figure 3.15** Dinosaur CD The Encyclopaedic format (**MM E**)



**Figure 3.16** The Magic School Bus- Exploratory Simulation Format (**MM EX**)



**Figure 3.17** Disney – Activity Series Interactive Game CD (**MM G**)

### 3.7.6 Findings

#### a. Reactions to different textual designs and multimedia

##### i. Information Book (P I):

The photographic illustration (**P I**) in this book seemed to attract the children especially the girls. But when this book is placed with the multimedia CDs (**MM E / MM EX / MM G**), and the boys were left to choose, they chose the CDs.

ii. Multimedia CDs (MM E / MM EX / MM G):

From the three multimedia CDs (MM E / MM EX / MM G) the girls took first of the CDs on top of the table. The boys however chose the game CDs. One very obvious reaction of the girls when using the CDs was reading aloud. One of them read out loud everything that was on the screen of the encyclopaedic format while the other girl just read the titles aloud.

**b. Preferences when asked to choose**

This is what the girls had to say.

<p><b>Session 1</b> <b>Girl - Girl (MM E / MM EX / MM G / P I)</b></p> <p><b>Researcher:</b> You have looked at different versions of multimedia (MM E / MM EX / MM G) and book (P I), if I were to ask you, which one you preferred which one would you like?</p> <p><b>Girl 5</b> The first one...the book (P I) ...it tells you more about Dinosaurs</p> <p><b>Girl 6</b> The book (P I), yeah ...tells a lot more about Dinosaur</p> <p><b>Researcher:</b> Any particular reason why you think that way?</p> <p><b>Girl 5</b> I think it just that it tells more information ...</p> <p><b>Researcher:</b> What about the one that you have seen in the first multimedia on Facts about Dinosaur (MM E)...?</p> <p><b>Girl 5</b> Yeah...that one is good as well ...</p> <p><b>Girl 6</b> I think it is quite good</p>
--

the boys did not precisely state their preferences.

<p><b>Session 2</b> <b>Boy- Boy (MM G / MM E / MM EX / P I)</b></p> <p><b>Researcher:</b> You have looked at all forms of materials just now, three different CD's (MM G / MM E / MM EX) and one book (P I). If you were given a choice to choose of all the materials which one would your choice be?</p> <p><b>Boy 5</b> Probably I choose that one ...the Magic School Bus (MM EX)</p> <p><b>Boy 6</b> Well, they are all good, I like them all, and I thought the computer is very interesting and the book as well</p> <p><b>Researcher:</b> Which one?</p> <p><b>Boy 6</b> The one with the facts, labels and stuff (Facts on Dinosaurs) (MM E), which I think kids will like. The book (P I) is very interesting as well</p>
---

**Session 2**

**Boy- Boy (MM G / MM E / MM EX / P I)**

**Researcher:**

How do you feel learning from the screen as compared to learning from the book?

**Boy 6**

On the screen it's a bit lazier. It doesn't involve much reading. It has sound effects that can talk to you.

**Researcher:**

So...how do you feel with such an environment?

**Boy 6**

Learning with a computer is good because there is a lot more that you can do than a book...but with a book it is very good because when you are reading it you're able to learn from it

**Researcher:**

Which is better or the best as compared?

**Boy 5**

Both are good

**Boy 6**

Better at different levels

**Researcher:**

What about when you are reading facts from the computers ...the one on a screen compare to the book which one makes you understand better.

**Boy 5**

I think I understand the books better ... the computer are set up for little kids and it doesn't make any sense to me...like "The dinosaur eat meat..."but if you are reading a book it gives you more difficult words which have more meaning...Computer more simplified. When you are on a computer when you must click a button you don't really know where you are going but in a book ...not generally interesting but you can get on to chapters and things.

**c. Design features in the multimedia as compared to books**

When comparing the design features in the multimedia to the books the children has this to say:

**Session 1**

**Girl - Girl (MM E / MM EX / MM G / P I)**

**Researcher:**

I heard you were reading aloud in that one (Facts about Dinosaur) (MM E), why?

**Girl 5**

Because it involves concentration

**Researcher:**

What about yourself **Girl 6?**

**Girl 6**

I read only the titles aloud.

**Session 1**

**Girl - Girl (MM E / MM EX / MM G / P I)**

**Researcher:**

How do you find reading from the screen and reading from the book?

**Girl 5**

From the screen ...I can go round it ...the sentences are a bit simpler so I prefer it from the screen

**Girl 6**

I prefer reading from the book. From the screen it is a bit express and it gets annoying...you can't actually read it. You get a bit mixed up.

**Session 1**

**Girl - Girl (MM E / MM EX / MM G / P I)**

**Researcher:**

When you are learning something do you prefer to read from the multimedia or learning from the book...

**Both Girl 5 and Girl 6:**

Ehmm...from the book

**Researcher:**

Why?

**Girl 5**

I don't really know why really...ehmm...but you know...**I can see the words better**

**Researcher:**

If it is from the screen how do you feel?

**Girl 6**

Well, it is **a bit bright** ...glaring...a bit annoying

**Girl 5**

In the book (**P I**) it is quite good...got **more information with many words on the page**. In the computer (**MM E / MM EX**)... **pictures in computer**

**Researcher:**

When you look at the movie itself...how do you find the **animation**? Do you like **the moving pictures compared to still picture in the book**...which one do you prefer?

**Girl 5**

I prefer **the video** ...it is **more realistic**

**Girl 6**

I prefer **the book (P I)** ...it feels like **the dinosaurs are going to come out**

**Researcher:**

When you look at the movie itself...?

**Girl 6**

Ehmm...it doesn't really...it is moving and stuff but I like the book (**P I**) better because it is **slower** ...not fast ...because it tends to get rather noisy...book is quiet and quite good (**P I**)

**Researcher:**

What about the one in the Magic School Bus (**MM EX**)?

**Girl 5**

I thought it (**MM EX**) was rather fun because you can click on things...it is good for introduction ones like for 7 years old and stuff

**Girl 6**

I like the magic school bus (**MM EX**) because it is kind of making your own life in...I like in one way you have to drive a car...I mean a bus...

**d. Reactions to learning and teaching from these materials**

When asked about learning using multimedia the girls had this to say...

**Session 1**

**Girl - Girl (MM E / MM EX / MM G / P I)**

**Researcher:**

If you were to learn about something would you like to explore it like the Magic School Bus (**MM EX**) or as you read it in a book (**P I**). Which one do you like?

**Girl 5**

About the book (**P I**) ...it is like one person...you don't really get to do things together and get the time...That one (Magic School Bus) (**MM EX**) you get to share and discuss them things and to understand.

The boys have this to say:

<b>Session 2</b> <b>Boy- Boy (MM G / MM E / MM EX / P I)</b>
<b>Researcher:</b> If you are thinking of learning something...?
<b>Boy 6</b> For learning I take the one with Facts on Dinosaurs (MM E) because that one is more educational as well
<b>Researcher:</b> What about the book (P I)?
<b>Boy 6</b> The book (P I) is very good...
<b>Researcher:</b> If you are given a choice which one do you prefer?
<b>Boy 5</b> I choose the book (P I) ...
<b>Boy 6</b> I think this one (P I) too
<b>Researcher:</b> Why?
<b>Boy 6</b> Well, in the book (P I) you've got all of them in one. You don't have to look at many things...you've got the content, you can look at the content and it is more fixed then you just have to look at the content. While in a computer (MM E) you are just looking at something and it takes ages to load up.
<b>Boy 5</b> If it doesn't take long to load up then I think I would like it.

### e. Reaction to games, and learning from them

These children were given a game CD (MM G) together with other educational (MM E / MM EX) CDs.

<b>Session 2</b> <b>Girl-Girl (MM G / MM E / MM EX / P I)</b>
<b>Researcher:</b> What about playing games...do you like the games?
<b>Girl 5</b> Yeah...I like...the Disney (MM G) ...coming out with the puzzle and creating our own dinosaur. The waterhole game was quite hard but after awhile you get the hang of it...
<b>Researcher:</b> How do you find the board game (MM G)?
<b>Girl 6</b> A little bit like bowling...
<b>Researcher:</b> What do you feel of a real game...if you have a dice and you have the one in the computer (MM G) which one do you like?
<b>Girl 6</b> Probably real life because you will really get into the game...
<b>Girl 5</b> You know that you are holding something

**Session 1**

**Girl – Girl (MM E / MM EX / MM G / P I)**

**Researcher:**

When you look at games do you think you could learn something from it?

**Girl 5**

It depends on what sort of game...if it is a question game you can get quite a lot of information but if it is like...it doesn't give information

**Researcher:**

What about the game you look into...is there much information you get from it...

**Girl 5**

No, not really ...it is more puzzles and games.

**Researcher:**

What about yourself **Girl 6?**

**Girl 6**

The monkey just tell you how to play the game...doesn't tell you about dinosaurs and things...

**Session 2**

**Boy- Boy (MM G / MM E / MM EX / P I)**

**Researcher:**

What about having educational materials in games form?

**Boy 6**

Yes, that is good ...when you are learning it on games it make things more familiar, can teach better and a bit more up to date

**f. Other issues**

The children gave their reactions to questions about other issues even though not all of the questions asked in the earlier sessions were asked because of time constraints. Looking at 3 multimedia CDs took much longer then looking at one as was done in the earlier sessions.

**i. Quizzes or Tests**

This section was not being questioned in this session because most of the features found in the CD did not have such features.

**ii. Best time to use multimedia**

**Session 2**

**Boy- Boy (MM G / MM E / MM EX / P I)**

**Researcher:**

If a teacher uses a multimedia and a book, both or either one, beginning, middle or end, which one you prefer

**Boy 6**

I don't know...I don't mind

**Boy 5**

Yeah ...I don't mind too

### iii. Getting information from multimedia

#### **Session 1**

**Girl - Girl (MM E / MM EX / MM G / P I)**

**Researcher:**

If you want to get information you prefer getting it from the multimedia with facts or from books?

**Girl 5**

From multimedia with facts...it would be if you want to research some more because you can get more information from it...from the book it tells you everything on a page

**Researcher:**

What about you **Girl 6**?

**Girl 6**

I think the facts (Facts Multimedia) (MM E) are good...if you click on one of the red words or bolder words you can go on to different things about that kind of things.

#### **Session 2**

**Boy- Boy (MM G / MM E / MM EX / P I)**

**Researcher:**

Do you feel tired reading from the screen?

**Boy 6**

Reading from the screen it has bright colours...it makes your eyes water a bit

**Boy 5**

I don't really feel like that...it doesn't affect me unless I am quite tired at night. When I am looking at a computer, the man talked too fast when you are reading a book it is a bit slower and that is what I feel

**Boy 6**

If you get things that stimulates a bit in a computer it makes it not as fast...if I am given a choice to study, a multimedia is good and detailed as well...

### iv. Getting information from the Internet

#### **Session 1**

**Girl - Girl (MM E / MM EX / MM G / P I)**

**Researcher:**

If you are given a mixed variety...books and multimedia...or books solely...or a multimedia solely which one do you prefer...

**Girl 5**

I like the computer as well...I think it is because you don't usually get on to the computer at school and you're well...

**Girl 6**

...We normally go on the Internet ...on the TV it is more interesting...on the website you don't get things moving...

#### **Session 2**

**Boy- Boy (MM G / MM E / MM EX / P I)**

**Researcher:**

What about reading from the website? How do you like studying from the website?

**Boy 6**

I don't think that was very good...you can't tell whom they are aiming at.

**Boy 5**

Yeah, multimedia is better ...more specific ...you know whether it is for average or good

v. Gender issues

<p><b>Session 2</b>  <b>Boy- Boy (MM G /MM E / MM EX / P I)</b>  <b>Researcher:</b>          Let me ask you something a bit different...Have you heard of boys being better at computers than girls. Have you heard about that?  <b>Boy 6</b>          No...I think it depends If you have a computer at home you will like it better.</p>
--

**3.8 Reflections on Methods**

Reflecting on the methods used in this study it is very important to note that children are not necessarily articulate. The researcher had to find ways of helping children to articulate their reactions. The researcher used a laddering technique to overcome this limitation. The technique uses answers to questions with another question and will stop when the researcher feels that they have given enough to express what they mean.

**3.9 Analysis of Findings**

In order to summarise the reactions of the children positive and negative reactions in the tape transcripts of interviews were counted. The total positive and negative statements given by the children about their preferences to books and multimedia are presented in **Figure 3.18** below.

Day -Session		BOOKS		MULTIMEDIA	
Day 1 (Session 1)		B +	B -	MM+	MM-
	Total for Girl 1	17	0	7	9
	Total for Boy 1	12	2	18	0
	<b>Total Positive and Negative Statements</b>	<b>29</b>	<b>2</b>	<b>25</b>	<b>9</b>
Day 1 (Session 2)		B +	B -	MM+	MM-
	Total for Girl 2	16	7	14	22
	Total for Boy 2	14	5	10	14
	<b>Total Positive and Negative Statements</b>	<b>30</b>	<b>12</b>	<b>24</b>	<b>36</b>
Day 2 (Session 1)		B +	B -	MM+	MM-
	Total for Girls	14	7	36	2
	<b>Total Positive and Negative Statements</b>	<b>14</b>	<b>7</b>	<b>36</b>	<b>2</b>
Day 2 (Session 2)		B +	B -	MM+	MM-
	Total for Boys	15	9	35	6
	<b>Total Positive and Negative Statements</b>	<b>15</b>	<b>9</b>	<b>35</b>	<b>6</b>
Day 3 (Session 1)		B +	B -	MM+	MM-
	Total for Girls	20	3	17	9
	<b>Total Positive and Negative Statements</b>	<b>20</b>	<b>3</b>	<b>17</b>	<b>9</b>
Day 3 (Session 2)		B +	B -	MM+	MM-
	Total for Boys	22	1	11	11
	<b>Total Positive and Negative Statements</b>	<b>22</b>	<b>1</b>	<b>11</b>	<b>11</b>
<b>TOTAL SCORE</b>		<b>+130</b>	<b>-34</b>	<b>+148</b>	<b>-72</b>
<b>PREFERENCES - BOOKS VERSUS MULTIMEDIA</b>		<b>96</b>		<b>76</b>	

**Figure 3.18:** Total Positive and Negative Statements about Preferences to Books and Multimedia CDs for the 3 Day Sessions.



The results in **Figure 3.18** show that the children have many positive views about multimedia. However, even though the scores for multimedia are higher than for books, there are many more negative statements about multimedia. In other words, children do realise the potential of multimedia especially when they are given very abstract and difficult information or content. Multimedia in some ways helps them to understand things like "electricity" better than in books. However, when the content and features are about the same the children felt that they are more comfortable if it is presented in books.

An analysis was also made of the video recordings to identify positive and negative gestures and statements expressed when the children looked at the materials. The reactions portrayed seemed to demonstrate the children's sense of engagement or disengagement to the materials presented to them.

Some of the positive reactions when they interacted with the multimedia gave evidence of being engaged particularly when looking at an event that seemed to attract the child at the moment. The reactions were:

- Smiles, amazement and amusement gestures e.g. hearing the introductory music, etc.
- Laughing and giggling together e.g. when looking at the dinosaurs they created
- Body Language – facial expressions, put hands over the face, moving heads with the rhythm, etc. e.g. when creating a driving license certificate, etc.
- Expressing positive statements like:
  - "Cool!" e.g. when looking at the introductory clip of the dinosaur multimedia game CD
  - "I like that" e.g. when choosing the characters for the driving license certificate of The Magic School Bus.
  - "That's good!" e.g. when looking at the video clips of the encyclopaedic multimedia CD
  - "Interesting" e.g. when looking at how the arteries work in the Human Body CD
  - "Wow, you can really see how it looks like here" e.g. when looking at the electric circuit animation
  - "Much simpler in here than the book..." e.g. when looking at the electric circuit animation

- "The lines are finer too, you can see better here" e.g. when looking at the illustrations in the CD compared to book
- "Looks like fun, lets try it" e.g. when trying to create a dinosaur in one of the section in the game CD

The children were also observed to show some negative reactions, which in some ways tended to be more towards a sign of disengagement. Amongst the negative reactions were:

- Looking restless and bored e.g. after clicking on a number of parts of the Human Body
- Looking at other places instead of the multimedia after sometime into it e.g. clicking at the bold words to get meanings or words, clicking on other words, etc.
- Looks confused. Kept on clicking to get the information faster e.g. information slow to download from the Magic School Bus CD
- Twisting and turning the chair around, playing with a pen, etc. e.g. after sometime interacting with the Human Body CD
- Expressing negative statements like:
  - "Too much information" e.g. when looking at the Human Body CD
  - "Can't see the picture really...what was that? ...Too fast! " e.g. when looking at the video clip in the encyclopaedic multimedia format
  - "Too fast ...did you hear that? Could not make out what they are saying ...what actually happens..." e.g. hearing the narration of the history of dinosaur
  - " Can't you control it and make it a bit slower..." E.g. the speed of the movie clip of the dinosaur CD
  - "Too noisy..." e.g. the narration and sound effects in the dinosaur CD was too loud for the child

The overall conclusion appears to be that, whilst they like the idea of the multimedia, there are many features of these particular applications that they did not like.

The books also had positive features and were familiar to children so there were fewer negative comments. Some reasons they liked the books were:

- they preferred to read rather than be read to
- they could flip through the pages and feel the books
- they were more in control of what they wanted to see
- they could look at the information at their own pace

They felt it was much easier for them to engage with books and to manipulate them than it was with the multimedia. If they had to find information in multimedia CDs, they often felt overloaded "too much there" or "too constraining".

### **3.10 Discussion**

What conclusion does this lead to about the use of multimedia applications by children? Should we continue designing multimedia applications for children or is it too early to tell? The evolution of multimedia is still in its early stages. It has existed for about 10 years, which is very short compared to the evolution of the printing press.

However, the news of companies closing down their production of multimedia applications does make this question important - should we stop designing them? Do they add nothing for children compared with books? Alternatively, should we analyse which features of multimedia designs they responded positively to and which ones they did not? The children do have many positive views of multimedia and it may be a question of designing for these aspects and avoiding the features the children were negative about.

The children were positive if the CDs were "Game-like things" and when they had more control of it. The findings also show that there is evidence of differences in reactions between genders. E.g. boys find getting information from multimedia much more fun and faster as compared to reading it from books whilst girls preferred to read it from a book because they could be more in control. There are also differences in reactions between the novice and expert users - the ones who are familiar with computers and the ones who are not. E.g., the expert users tended to get impatient much faster when the information takes a long time to download.

Some of the reasons why they do not like the multimedia CDs were that there is often too much information that was given on a page. E.g., when the children were looking at The Ultimate Human Body CD, the design feature gave the children too many options to look at; the x-rays form, the skeletal form, and the muscles and flesh form, etc. The children looked confused and seemed lost and did not know

where to start. Their comments were "Too much information in one page...sort of confuse you...Don't know where to look at first".

The children liked "game-like things". Children found this feature fun. The children were engrossed playing the jigsaw puzzle of the dinosaur even though both the boys and the girls preferred more challenging games than the CD given to them. Children believed that if well designed, they too could learn from games. They expressed that learning from games would be more up-to-date than learning from conventional methods.

The children liked animations in multimedia. Seeing the electric circuit at work helped them understand the concepts more easily. Even though they do like the movie in the CDs, cartoons were still the preferred option.

They also expressed their liking for multimedia that allows them to create and be in control. The children seemed very engrossed when they were creating their "looks" on a driving license certificate to ride "The Magic School Bus". They liked the fact that they could personalise things that they could create despising the Internet because the Web sites seemed to "not know where they are aiming at".

One of them expressed his liking of the idea of "allowing you to choose and be in control of the trip you want to explore" as in "The Magic School Bus". The child was allowed to be the driver of the bus. The simulation effect was good because the children felt that they were more in control of the situation than the multimedia. Having a role to play gave the power the child needed to decide what suited them best. Having it all laid out on the screen and being narrated to actually restricted their control of the situation.

The children also expressed their liking for immediate feedback. Surprisingly these children were positive about quizzes in the multimedia. They especially liked the instant answers to quizzes. Some of their comments were that they could get the correct answer right away and the multimedia could explain if they got it wrong right away. Therefore, it is much easier to look up the answers from a multimedia than from books. The boys found this feature saves time whilst the girls found them useful because searching for answers from a pile of books could be tedious and sometimes distracting.

When CDs were considered better than books, their comments were:

- The words used were simpler words
- The illustrations have finer lines, therefore could be seen more clearly
- The multimedia gave more information because more information could be got from words in bold
- The multimedia showed how things work step by step and therefore helped them to understand much better

The examination of other issues also demonstrated some important features and uses for multimedia. When asked about its use in teaching, some children said a teacher should place multimedia at the beginning in order to introduce, others said at the end after we have understood and want to know more, while some others do not mind for according to them it all depends on how much time is available. Most of the children however agree that a teacher should use a variety of materials. Some of their comments were:

"That would be interesting...but depends on how much time we have really...if there is no time the multimedia is much faster..."

When asked about the Internet they expressed their dislike (even though this sample is too small) because they feel they were not in control. They do not know whom the Internet is aiming at. They felt that they could not interact with it and therefore felt a bit bored. A boy said games are interesting on the Internet, while one of the girls said she liked emailing. It is however important for us to recognize that the Internet nowadays do offer multimedia experiences similar to CDs if the child is directed to the appropriate websites.

When asked about gender issues on what do they think of the opinion that boys like computers more than girls they said they have not heard of it but have heard that boys love to play computer games more than girls? When an opinion was asked one of the boys had this to say:

"I guess because boys want to get information faster so that they can get to play football...computer gives information faster than reading..."

"Girls tend to be more serious...look at details...wants to get things right... so girls might prefer to read books"

"We just want to get the information and want it fast...so computer is a good idea"

### **3.11 Conclusions**

Multimedia has great promise. The diversity of multimedia applications in the market shows that there are many ways of approaching the design of multimedia applications. But at the moment nobody is quite sure what works and what does not. It is just like producing a book; some people are producing it in a number of pages while others are approaching it entirely differently. The few examples that were found so far have led us to see such vast differences of characteristics from one to another. It looks as though there are promises of doing things better but the issues are not very clearly defined. This research intends to look at these issues systematically and to define what is actually meant by successful multimedia.

The children were not given any task to do in this pilot study. The researcher wanted to see whether the design features in the multimedia could give some kind of force or drive to influence the children's behaviour with the application. From the findings in the pilot study, the researcher hypothesises that, for children, the level of interaction and control in multimedia applications (especially educational applications) is very important. These factors tended to be the driving force that influenced the children's behaviour with the multimedia applications given to them. Some children tended to be engrossed by some features and distracted by others. The findings in this study seemed to exemplify the fact that this behaviour is about the issue of engagement and being engaged.

Basically a multimedia has to be interactive to engage children. Children must be able to do something with it to make them engaged by it. Passive design, like just looking at the information on a screen, bores children. The children were bored looking at the movie clips. Therefore, the multimedia must have a feature that allows some form of interactive activity. However, the pilot also demonstrated that it is not enough just having interactive features to make children engaged. Children do not like the idea of not being able to interact with it at all but also do not like having too many varieties of interactive features in the application which overloaded and confused them. There was something more about interactivity and interactive design features that needed to be explored. Studies that follow this pilot study based on issues of interactivity and the children's response to it.

# Chapter 4

## Engagement & Interactivity in Multimedia

### 4.0 Chapter Outline

This chapter examines the issues that have been identified in the pilot study by reviewing the literature relevant to the emerging concepts. This chapter locates theoretical issues and concepts especially of engagement and interactivity that will help us understand the way the children reacted to the multimedia applications given in the cases in the pilot study.

#### Thesis Structure

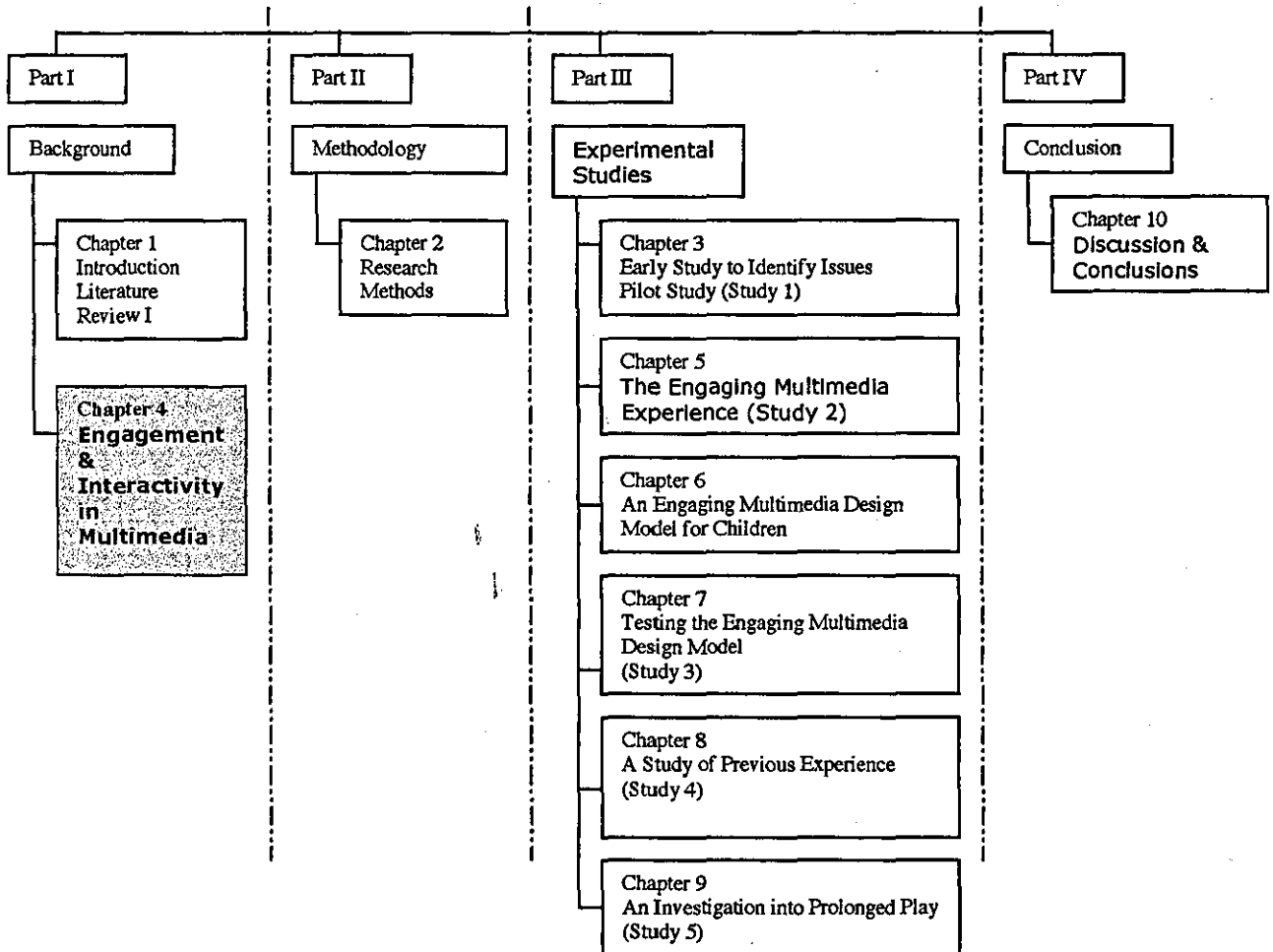


Figure 4.1: Chapter 4 in the Thesis Structure

## **4.1 Introduction**

Findings from the pilot study have demonstrated that there are two major issues that needed to be addressed when designing for these children: one the interactivity issue and another user engagement issue. Children liked to be able to interact with the multimedia application given to them but how long they want to interact depended a lot on the specific design features of the application.

There are many issues about interactivity and user engagement (maybe not expressed by this exact term) being discussed in the literature. In reviewing it the focus will be on the issues that are relevant and related to the results of the pilot study.

## **4.2 Theoretical Issues and Concepts**

There are three major areas of literature to look into for relevant theoretical issues and concepts:

1. The Psychological Literature
2. The Human Computer Interaction (HCI) Literature
3. The Educational Literature

## **4.3 The Psychological Contribution**

The pilot study demonstrated that the most important factor about children's preferences for the multimedia CDs had to do with the ability to interact with the system so that the multimedia could promote a sense of "engagement" or "being engaged". In other words the design features created in the CDs have got to have very powerful elements to draw the user's attention so that he or she would not want to stop when asked if they wanted to do so. Therefore if a multimedia application is to be engaging for children the design features in them must be able to make the user fully immersed. Seeking some relevant psychological contributions to help understand being engaged or not being engaged by an activity may be helpful.

### **4.3.1 Passivity versus Activity**

The concern about the issues of not being engaged, disinterested and boredom is about passivity versus activity. Schank (1993) studied two forms of software that could encourage learning via multimedia computers: simulation software and multimedia software. He found educational software tended to promote



passiveness. He commented on the designs he found in educational software as follows:

"Computer programs that were intended to be educational have invariably asked students to do little more than "press button for next page"" (Shank (1993) p.54)

Kerawalla (2002), a cultural psychologist, found educational CDs bought by parents were not fully exploited and favoured by their children. She found that entertainment games are much more popular than educational titles. In her 30 day study of naturalistic, uninterrupted computer use she demonstrated that the children still opted for entertainment games even when 6 brand new, well-received, market leading, educational titles were made available to them. The findings showed that educational software is relatively unpopular and children find entertainment games far more attractive.

The children in the pilot study reported in Chapter 3 only played a passive role in the multimedia applications given to them. Similarly the children in Kerawalla (2002) reacted in the way they did because they were placed in a passive role. Educational CDs designed for children, in most cases, lacked the ability to encourage the viewer to play an active role when interacting with them.

Schank (1993) found that for a child to appreciate and like a multimedia application there must be some kind of activity occurring between the user and the computer application. Schank (1993) suggested that students learn well when they are engaged in active exploration, interpretation, and construction of ideas and products with multiple resources.

The findings from the pilot study suggested that passivity led to disinterest and boredom. The multimedia did not engage the children.

"...You just sort of look at the screen. You sort of not do anything. Everything is there on the page looking in..."

Engagement is only possible if there is some kind of force or drive to encourage children to interact. Maybe if the children had been given a task, for example, to find certain information to answer a given question, their reactions to the multimedia would have been different. When the purpose was to see whether the design features in the application encourage them to want to interact with it, the lack of a specific task seemed to be an important disincentive.

According to psychologists to be able to do something or to want to do something has to come from some form of drive or motivation or energy. Haber (1966) divided drive or motivation into two forms; primary and secondary drives. Miller (1961) in Haber, describes the importance of drives in the performance of learned behaviour, individually or socially, normal or abnormal. Corsini (1984) referred to motivation as directing and steering goal-directed behaviour. These are descriptions in general terms.

Describing motivation in this research context would mean trying to understand why the children acted the way they did. Specifically, this would be, what made children wanted to continue doing something and what made them disinterested and bored. Therefore the question to ask is how to get them motivated to use the software given to them. Sometimes in the pilot study the children seemed engrossed, interested and engaged but not very often. There must be a reason for the children to react in this way. To be motivated is to have drive, energy and direction. It could come from rewards that you get after the task. Rewards could be extrinsic, for example, that you get marks for doing it. This was not possible in the pilot study. Another possibility is that if the children are active and can do things with the multimedia that enable them to set and achieve their own goals. This is described as 'intrinsic motivation'; the drive comes from doing the task and getting to the end point.

On the occasions when the children behaved in this way, i.e. not wanting to stop or looking very engrossed, the children seemed to be intrigued by what they were doing at that moment in time. In psychology there is a language for that. This is more of an intrinsic engagement. Lewin's (1952) referred to such a phenomenon as the matter of task completion. The person is intrigued by the task he or she is undertaking because of the drive to complete it. So when we talk about the design issues as opposed to the psychological issues, the fact that the design rendered the child passive meant they could not pursue task completion and they got disinterested and bored. This could occur even if the multimedia had some interesting features in it. However, if the design could be made active, the intrinsic drive could be stimulated and the children could be engaged.

In this research it may be necessary to look at the effects of extrinsic and intrinsic motivation and how they relate to giving the children an active role in using the multimedia.

### 4.3.2 Being in Control or in Charge

From the pilot study there was evidence that children found books more appealing because the books allowed them to be in control or in charge. The children preferred the book, because they could look at it at their own pace in their own time.

"If I had to choose I prefer the book...like you can do it in your own time"

"When it is a book you've got still pictures you can like looking at, sort of revise on them, but in multimedia the pictures are moving and you're like have to look quickly at them"

Some children felt that they could be more engaged with books than multimedia because it is much easier to manipulate them and therefore be in control.

Selvidge and Phillips (2000), when examining reading comprehension and usability of a paper book and an electronic book found that there were no differences between the two mediums for both reading speed and reading comprehension. They also found that users rated the reading task difficulty about the same for both the paper and the e-book but differed in their preferences. The ones who preferred the paper commented that they preferred it because they were familiar with it and were wary of the e-book technology. Other reasons for preferences for paper were that paper caused less eyestrain and had fewer glares. Users also stated that they felt more in control with paper than the e-book.

The users who preferred the e-book liked the page up/down buttons, felt the e-book was easier to manipulate than shuffling sheets of paper, and preferred them if the resolutions are low to avoid glare. The main complaints about the e-book were that it was too heavy and it caused eyestrain.

In the pilot study the children too found the glare looking at computers disturbing. One of them found multimedia movies noisy whilst books were much quieter. Another did not appreciate the speed of the movie clips in the multimedia complaining that it was too fast and she could not actually grasp what was shown. She preferred the book because she could "make it slower". Another child did not like to be read to when the narrator in the multimedia narrated the information. She liked reading on her own because she could understand it better. All these issues in some ways exemplify the elements of being in control or in charge.

### **4.3.3 Psychological Studies of Design Features**

What were the design features in multimedia that mattered to the children? Designers have tried many ways to impress users but according to psychological studies they have not always been successful.

Some of the important factors are as follows:

#### **a. The Overloading Phenomena**

In the pilot study children found the information given in the multimedia overloaded them. This was both because there was too much there and it was hard to find what they were looking for.

McKnight (et. al) (1993), when discussing how learners navigate around for information, note that learners can get lost or disorientated in large hypertext structures. This is especially true when there is a lot of information and the structure presented on the screen is unfamiliar to the children who are more familiar with the conventions of reading from a printed page. Their views are supported in some of the children's comments in the pilot study.

"I think it is because it is on the screen ...it is everything is there and you can't focus"

Linkages in hypertext sometimes make things even worse because the learner tends to experience an uncertainty, being unsure where the link will lead or what type or what amount of information will be shown. Jones (1987) in McKnight et al. (1993) pointed out that being given lots of alternative choices in design often makes appropriate selections difficult. The user may feel uncertain about what can be selected and what will happen next.

#### **b. Look, Feel and Manipulate**

Studies have suggested that there are ways one could take objects in the real world and represent them in the computer world. Clements and McMullen (1996) review a research study that showed that ideas could be presented symbolically and found computer representations more manageable, flexible, and extensible than real objects. Char (1989) in Clements and McMullen (1996) found that when one group of young children were made to learn number concepts with a computer felt-board environment using "bean-stick pictures" to select and arrange beans, sticks, and number symbols, as compared to a real bean-stick environment, the computer environment offered greater control to students. Therefore, from the study, it could be suggested that computer manipulative

capability if carefully presented by using appropriate symbols could be just as meaningful and easy to use for learning as real life objects. However some things are difficult to represent symbolically. Whilst some people would find it natural and easy to work with symbols in this form others often find it difficult.

In the pilot study the children reported that multimedia tended to lack a sense of look and feel (the lack of tactile feel) and a chance to manipulate. When the children were given the "pop-up" book of the human body where they were able to look at the "mock-up" or mobile function of the heart or kidney by moving some of the dangling paper parts the children seemed to be engrossed. When looking at the video clip of the function of the heart in the multimedia they were not engrossed. When they were asked about their reactions to the "pop-up" book as compared to the multimedia some of their comments were:

"That one (pointing at book form) got more details looking at it...whilst this one (pop-up) you can see what is there and get things to move and see how they work."

Nevertheless, when told that they could get to see movements too in multimedia, one of them had this to say:

"Yeah...but you can't really see inside of it"

Why did these children react in this way? What made the ability to look, feel and manipulate in paper form engross the children more than the multimedia version. How do we design the 'look and feel' of a concept and manipulate something on the screen with the mouse? Giving a tactile feel in this situation would be to give the mouse some sort of sense that you can feel the texture, e.g. fluffiness, on the surface but not the screen.

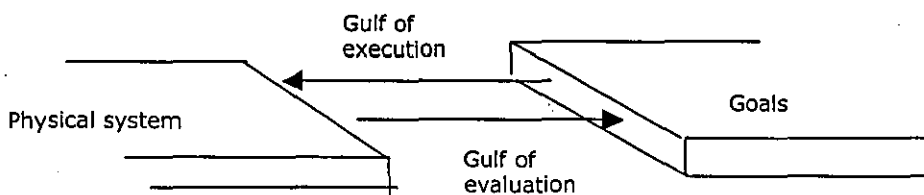
The children's responses seemed to suggest there is a weakness in presenting a physical object in an abstract form on a screen. A physical presence will enable a child to see the size, feel it and even see what it is made of. However, when it is on the screen it is an abstraction. Even though there may be a chance to manipulate the mouse to see its effect on the screen, the fact that it is on the screen made the experience different to that of the physical object.

## 4.4 The Human Computer Interaction (HCI) Contribution - Design Principles, Issues and Concepts

The question that this section tries to answer is what designers should do to make interaction between users and computer system effective. Some of the HCI User Centred Design (UCD) Principles may be relevant to the design of HCI for the children. Basically, HCI specialists refer to exchanges that occur between users and computers as interaction and the ways in which they do so as interaction styles.

In the history of HCI the styles have evolved from command entry to menu navigation systems to dialogues to form-filling to natural language dialogue and, the most relevant in this study, the direct manipulation interaction style. This interaction is so far the most favoured form in the design of interaction for children.

### 4.4.1 The "Gulf of Execution" and the "Gulf of Evaluation"



**Figure 4.2:** The gulfs of execution and evaluation (Norman and Draper (1986) in Preece, (1994) p. 273))

One of the main issues about directness is bridging the gap between the gulf of execution and the gulf of evaluation. According to the design principles set out by Norman (1988) in his User Centered Design (UCD) perspective, successful design needs to bridge the gap between these two gulfs. The Gulf of Execution refers to the distance between user's goals and means of achieving them through the system while the Gulf of Evaluation refers to the distance between the system's behaviour and the user's goal. Even though children may not have "goals" in the way that Norman means some of the issues Norman mentions about bridging the gaps could be considered when designing for children.

There are two ways in which gulfs can be bridged. This can be done by either fitting the man to the design (fitting the man to the job (FMJ)) or fitting the

design to the man (fitting the job to the man (FJM)). So when a system that has been designed leaves gulfs they are forcing the man (child) to do things the way the design requires. If this approach were used when designing for children it would not work because the child would not follow the rules. The next alternative would be to design a system to fit the man (child), i.e. fitting the technology to the way the children work. In other words designing for children would mean we have got to try to find out how children wish to use the system to operate things.

Relating Norman's description of this concept to the pilot study is to raise the question "Does the multimedia application provide actions that corresponds to the children's intentions or ways of thinking, making it easy for the children to carry out their task?" In addition, if so, "Does the presence of these actions make children engaged by it?" According to the design principles therefore, multimedia designs that minimise the differences between the gulfs should be the ones that have good design features in them.

Some designers do address the gulf of execution by consulting users (children) before designing either having users as participants in design or as informants or testers. Such designers use iterative methods to make sure that at the end of the day the application or system they design conforms to the users' needs and wishes. Microsoft's "The Magic School Bus" series practised this method of design and in the pilot study children did find this series interesting and fun.

**Researcher:**

What about the one in the Magic School Bus?

**Child 10:**

I thought it was rather fun because you can click on things...it is good for introduction ones like for 7 years old and stuff

As for the gulf of evaluation, Norman suggests that users could change their interpretation of the system image and evaluate it with respect to their goals or the designers could change the output characteristics of the system. Trouble starts when users are children. Whatever images are designed for them have to suit, at least, to some extent their cultural conventions and some of these need to be learned before they can be understood. On the other hand, when we look at the designer's perspective one example of the way the designer could bridge the gulf of evaluation is to try to design an application that hides the mechanical part of the system. In this way the designer will be able to put the task on the machine and not the user (Norman, 1988).

It is very important, however, that the user should be able to interpret the image the system shows. The system may, for example, hide from the user all the unfamiliar, unrecognisable configurations happening "behind the scenes" but instead just present a graphical representation of an hourglass to indicate something is happening.

Nevertheless not knowing what is going on in the system does not mean that children would be saved from the phobia of knowing the unknown. Children still feel frightened especially when machines take a long time to download or they experience error messages along the way. The trouble becomes worse if the designer overlooks inserting a recognisable feature or image that helps the user to understand what is going on.

During the pilot study a couple of children did face some problems with the multimedia. Some of their comments were:

**Researcher:**

At the moment you got stuck how did you feel?

**Child 4:**

I was sort of like, what was the matter with it. I was like I felt what I have done wrong...

**Child 3:**

...If it is not working you are thinking I've done something wrong...you always have that feeling...sort of tension

**Researcher:**

There is tension there? So in a book ...

**Child 3:**

It doesn't happen ...so you just sort of ease your way through the information

Therefore the designers must find ways to bridge the gap of the two gulfs, the gulf of execution and the gulf of evaluation, because users tend to blame themselves and this might put them off the system. Some of the children's comments about the Internet used in the classroom were:

**Researcher:**

You have learned about the Human Body and I heard that you even have it on line on the website. How do you like learning through the website.

**Child 5**

Yeah it could be interesting but it takes a long time into the actual article.

**Child 6**

It takes about 5 minutes to get into the complete article

**Researcher:**

And when you do get in do you like it?

**Child 5**

It was hard ...when we were looking at arteries and veins we could not find the complete subject...

**Researcher:**

Were you frustrated?

**Child 6**

Yeah...I prefer the body book to that on line



#### **4.4.2 Direct Manipulation**

Ben Shneiderman in Preece (1994) describes direct manipulation as having features of visibility, e.g. icons that represent objects, which could be moved around a screen, and a cursor manipulated by controlling a mouse that could show rapid, reversible, and incremental actions, etc. Well-designed direct manipulation systems should engender enthusiasm and elicit enjoyment from users, and should have the following properties:

##### **a. Affordances and Constraints**

Every object or image of an object gives perceived affordances or constraints that help the user to take proper actions or made proper judgements of the steps they are about to take. Perceived affordances of the image "door" either mean to go out or to come in: therefore a "door" icon could be used to resemble an exit or entrance point while having it "ajar" or "closed" constrains the use of it to only one action.

Affordances and constraints are other HCI factors to consider when designing for children. A lot of the multimedia applications encountered during the selection process to be used in the pilot study did not work very well because the icons used were very foreign to the children. They lacked affordances and constraints to help understand the nature of the CD. On the other hand the "bean-stick" image in the study reviewed by Clements and McMullen (1996) made it easy to understand how to manipulate them. The bean stick is a very good image affording us to know about what it is and what we can do with it. Children do not need a lot of teaching to know this and therefore this feature worked very well in the experiment. Icons with poor affordances and constraints could lead the user to take inappropriate action.

##### **b. Feedback**

Feedback is a well-known concept in the science of control and information theory especially in HCI design principles. The importance of feedback could be exemplified by the following example from Norman (1988) in Baecker (et al) 1995.

"Imagine trying to talk to someone when you cannot even hear your own voice, or trying to draw a picture with a pencil that leaves no mark: there would be no feedback." (Norman, 1988, p. 18)

In HCI a lot of the feedback is done at the direct manipulation level, i.e. at the physical skill level. When a mouse is moved in a certain direction, the cursor will move on the screen as well. We can see the effect on the screen. It is important to note that for users feedback is not just about getting the results of the immediate action. Users too tend to appreciate feedback that tells them whether they have achieved their goal even if the results are delayed rather than immediate. This phenomenon suggests that feedback is needed at a number of levels. In other words besides wanting feedback at the keystroke level, users also want higher hierarchy feedback.

Children in the pilot study appreciated feedback, for examples in multimedia quizzes. Amongst their exchanges were:

**Child 2**

I like the quizzes in the computer because it tells you answers at the end of the page whilst in a book you get your answers at the end of the book.

The immediacy of feedback in quizzes seemed to work really well for children.

Children wanted immediate feedback rather than delayed feedback. The quizzes in the multimedia gave the children immediate feedback to answers while in books the search for answer might lead to prolonged feedback. In other words children seemed to need full and continuous feedback at all levels on the results of the actions taken by them.

Not only is an immediacy feedback at the keystroke level very important to children but they also wanted a higher level of feedback just as adults do. There are always questions needing feedback when we keep asking ourselves "Am I getting to my goal? Am I getting this right, etc.?" We always want that loop back at every single level of the task we are engaged in. For children this seemed to be an important factor to help them focus or stay engaged.

## **4.5 The Educational Contribution** - Activity and Interactivity

### **4.5.1 Media Debate**

There has been a long lasting 'media debate' about whether different forms of media, including multimedia, actually influence learning. Although this research is not primarily about learning, it is instructive to examine the nature of this debate. Clark (2004) says that there is no evidence from comparative studies that multimedia influences learning. He maintains that

"All current reviews of media comparison studies suggest that no learning differences will be found that can be ambiguously attributed to any medium of instruction"

(<http://www.educom.edu/program/nlii/articles/clark.html>)

Croft in Clark (2004) supports Clark's viewpoint by saying that many people have stopped paying attention to user's choice and wants when designing for them:

"Our choice of instructional medium should not be made based on how flashy (or expensive) we can make the package, but on whether that medium is an effective means of communicating the important aspects of the material to the learner's we are trying to reach"

To some writers the medium itself does not influence learning but the designing of effective and efficient instruction of using it does play a major role in achievement (Kobus, Uden) in Clark (2004). Morrison in Clark (2004) sees media as sign vehicle carriers conveying an arrangement of signs known as representation. According to Chakrabati in Clark (2004) the medium does not guarantee anything. It is how we use the medium that is important.

Jean Ann Derco, in Clark (2004) when bring theory and reality together, said that

"As instructional technologists, we need to know what the research says about various methodology / media so that we can educate our clients. If a client insist on using a media that the instructional technologist believes is a bad choice, then he /she needs to know how to use that media in the best way possible for the task at hand"

For the purposes of this research the essential point is that we have to find the correct way to use multimedia to give children the possibility of a learning experience. For the researcher, although agreeing that media are only sign vehicles, it seems likely that different forms of media do transmit a different kind of experience to different users in different situations or environment. It depends a lot on purpose of use.

Listening to audio music from a Walkman is a different experience to listening to it in an acoustic music studio, but for the user the portability of the Walkman (the media in use) is a major criterion in his or her choices. There are two parties involved here. One is the designer of the system and the other the materials to be used in the system. It is the task of the designer of the portable media to design the media as close to the system of an acoustic music studio as possible. Thus, we have buttons for e.g. jazz in audio CD players. It is the task of the designers of materials, when designing materials for use in the media, to be aware of the intention of use of potential users and to accommodate the needs of

the users in various situations so that the users can get maximum satisfaction when using it.

As for designing a multimedia application for education this would mean designing instructions that allow users not only to interact with the system but to be engaged while doing it.

#### 4.5.1 The Role of Interactivity in Engagement (Educational Technologists Perspective)

Most of the chosen multimedia applications given to children in the pilot study were educational CDs. Some of these CDs have gone through a design process in which children were used as testers or informants in an iterative design procedure. These CDs were the Microsoft Magic School Bus "Dinosaur", an exploratory format and Microsoft "Dinosaur", an encyclopaedic format.

In the pilot study the children valued being able to interact with the multimedia. By and large most of the comments of the children about preferences are about the issue of interactivity (**Table 4.1**). Therefore it is important for the researcher to look into the issues of interactivity and its role in engagement in this educational paradigm.

Lists of Exchanges	Interactivity Evidence
"Bold words – Could tell us more information when we click on it"	A child refers to hypertext in "The New Way Things Work" Multimedia CD where she could click on the bold words to find out the meaning of a word.
"Sort of giving you step by step"	A child refers to "The New Way Things Work" Multimedia CD where she could see the way things are done clearly through a small video clip as compared to the book form
"Sort of you are not in control"	A child refers to the multimedia of "The Ultimate Human Body" where she finds that she could not have control over the information that was being read to her instead of her reading it at her own pace. (This is an example of a lack in interactivity experience)

**Table 4.1:** The Interactivity Evidence

It cannot be denied that educationalists have also contributed to the debate about designing multimedia for children and most of their contribution has

concerned interactivity and its role in engagement (though not explicitly mentioned).

Most of the argument in the field of education in the design of multimedia has been and still is about this issue of interactivity – an area of interaction between the learner and the material given to them. Achieving good interactivity which supposedly could engage the user in the learning process has been the aim of the study of educational technologists, which is now increasingly referred to as Interactive Multimedia (IMM) (Sims, 1994).

To many educational technologists, interactivity leads to learning. Barker (1994) emphasizes its importance in learning as:

“A necessary and fundamental mechanism for knowledge acquisition and the development of both cognitive and physical skills” (Barker (1994) p.1)

However, interactivity according to Sims (1994) is not limited to the basic “point and click” level, menu selection or linear sequencing but should also be able to promote intrinsic drive or motivation – a successful, effective instructional practice - to encourage individual discovery. Sims (1994) criticises HCI for limiting interactivity to just the physical skills level:

“A user who has access to a range of input devices (keyboard, drawing, pointing, touch screen, or speech) which can activate the technology being used; the results of this action is some form of visual or audio output (text, graphics, printing, or speech), and the sequence of actions form an interaction” (Sims (1994) p.2)

For him interactivity should mean active user participation not only in the navigational components but also at the cognitive level when the user is creating new learning opportunities. When such a situation occurs the user should supposedly be engaged by it. In other words interactivity is declared to be important as described in Sims (1994) because it suggests “constructive” approach of Vygotsky Activity Theory.

A wider scope definition of interactivity is also seen in the contribution of other writers. Damarin (1982), when looking at a user’s perspective, identifies interactivity as a series of interactive options like watching, finding, doing, using, constructing, and creating while Ambron & Hooper (1988) describe it as a state in which users are able to browse, annotate, link and elaborate from and within a rich and non-linear database. Combining these with what Sims (1995) says leads

to the conclusion that making interactions meaningful and engaging to the user is the most fundamental aspect in any design for instructional technology.

Jonassen (1988) refers to interactivity as the activity that goes on between two elements, the learner and the computer:

"Generally, the quality of the interaction in microcomputer courseware is a function of the nature of the learner's response and the computer's feedback. If the response is consistent with the learner's information processing needs, then it is meaningful." (Jonassen (1988) p.101)

Crawford (1990) in line with Jonassen (1988), has this to say about good quality interactivity:

"...A good program establishes an interaction circuit through which the user and computer are apparently in continuous communication" (Crawford (1990) p. 104)

According to Sims (1995) criticisms about interactive products still continue in the 1990s. Nelson (1990) had this to say about interactive products in Sims (1994)

"... Compared to what it should and will be, today's interactive software is wooden, obtuse, clumsy, and confused. The pervasive lack of imagination and good design is appalling" (Nelson (1990) p. 235 in Sims (1995) p. 2)

Therefore according to Dickson (1995)

"Interactive multimedia has to be more than just software that you click on to bring up a different pop-up or text-menu. "Interactive" has to mean more than point and click—it should be involving and personal" (Dickson p. 145 in Sims (1995) p.9)

Thus the issues discussed above show clearly what they are striving for, that is, to bring about the importance of interactivity in the design of multimedia and how it effects user engagement. However there is nothing in the issues to tell a designer how to design it. In the present research context the issue is not only the importance of interactivity and its role in engagement and how to design it but what types and levels of interaction attract and engaged children most.

#### **4.5.2 Other Views**

Heeter (2000) has addressed issues of activity and interactivity in his study of museums by looking at people in the 'designed experience', i.e., creating something to experience a situation. He found meaningful patterns of interaction from participants who visited a museum as opposed to browsing a web site or a TV show and used this to understand what interaction and interactivity mean.

Basically, everything a human does to or with another human could be called interaction. However when humans interact with media the interaction becomes mediated human interaction (Heeter, 2000). Traditionally media experience had been passive but now we are getting active media experience.

Heeter (2000) mentions there are various ways of interacting with computers. Some interactions a human does with a computer have obvious one to one interaction of actions and reactions. Heeter refers to navigation through menu structures as depicting this type of interaction.

Some interactions could be hidden where a single interaction could lead to many behind the scenes processes in the computer the participant never sees. Some interaction activities are determined by personality characteristics as in Screven (1999) in Heeter (2000) studies of museum designs created for "freely moving, voluntary, leisure-oriented people in public environments".

Czikszentmihalyi (1990) in Heeter (2000) refers to interactivity as the participant's goal. He describes well-designed interactivity as "flow". To him optimal experiences for an individual are when the participant goes through interactivity experiences that support learning of skills, have concrete goals, provide feedback, allow people to be in control, facilitate concentration and involvement, and are distinct from the everyday world.

The findings of the pilot study support Czikszentmihalyi's suggestion that interactivity should be about the participant's goal. The experiences they gained would have been optimal if the media enabled them to learn certain skills, entitled them to be goal directed, provided them with feedback, allowed them to be in control, facilitated concentration and involvement and gave them a different experience to that of the real world.

But that did not happen in some of the educational multimedia applications given to the children in the pilot study. There was no challenge to learn a skill (no extrinsic force or drive to encourage them do so). They were not in control; for example, some movie clips were too fast for them to grasp. Some children read information aloud to help them concentrate. Others felt that being read to by a narrator distracted them from direct involvement. Others referred to this factor as making them "a bit lazier."

However, some aspects of the CDs did appeal to them. Answers to quizzes gave immediate feedback. The simulation role-play technique in the Magic School Bus gave an exploratory experience different to that of the real world. Thus if some of the participant's goals are met, the experience could be meaningful and engaging, if not it would be boring and disengaging.

## **4.6 Interactivity and Engagement**

Interactivity and engagement have been recurrent issues that seem to have great effect on the findings in the pilot study. The following section will discuss what affected these factors directly in the pilot study.

### **4.6.1 Interactivity**

The previous discussions of interactivity were mostly about its importance. In this section however the aim is to look at specific design concepts of interactivity that will help a designer or evaluator of multimedia CDs determine which ones might really work for children. A classification developed by Sims (1995) is chosen to explain the characteristics of the design features found in the multimedia media application in the pilot study and reactions of the children to them.

Sims (1994) refers to interactivity according to levels. The higher the level or number or ways of interacting with the multimedia application the better the product should be. From his list of seven levels of interaction Sims (1994) has classified ten interactivities as a developer's classification list. Schwier & Misanchuk (1993) in Sims (1995) developed taxonomy of them. A summary of what these and other writers say about interactivity is given in **Table 4.2**



**Table 4.2: Levels of Interactivity**

<b>LEVELS OF INTERACTION</b>				
<b>Writers</b>	<b>Rhodes &amp; Azbell (1985)</b>	<b>Jonassen, D (1988)</b>	<b>Schwieer &amp; Misanchuk (1993)</b>	<b>Rod Sims (1994)</b>
<b>No. of levels of Interactivity Identified</b>	<b>3 Levels of Interactivity</b> <b>NB:</b> Control refers to navigation than to instruction	<b>5 Levels of Interactivity</b> <b>NB:</b> User's involvement with the application and the subsequent effect on learning	<b>Taxonomy of Interactivity based on three dimensions</b> <b>NB:</b> Levels of interaction based on the quality of the instructional interaction - the higher the level the better the instruction	<b>7 Levels of Interactivity</b> <b>NB:</b> The extent to which the learner becomes involved with or identifies with the content being studied
<b>Name of Levels and Examples</b>	<p><b>1. Reactive</b></p> <ul style="list-style-type: none"> <li>• Little learner control of content structure</li> <li>• Programmes are directed options</li> <li>• Feedback needed</li> </ul> <p><b>2. Coactive</b></p> <ul style="list-style-type: none"> <li>• Provide learner control for sequence</li> <li>• Learner control for pace</li> <li>• Learner control for style</li> </ul> <p><b>3. Proactive</b></p> <ul style="list-style-type: none"> <li>• Learner controls both structure and content</li> </ul>	<p><b>1. The modality of the learner's response</b></p> <p><b>2. The nature of the task</b></p> <p><b>3. The level of processing</b></p> <p><b>4. The type of programme</b></p> <p><b>5. The level of intelligence in design</b></p>	<p><b>1. Levels</b></p> <ul style="list-style-type: none"> <li>• Reactive</li> <li>• Proactive</li> <li>• Mutual</li> </ul> <p><b>2. Functions</b></p> <ul style="list-style-type: none"> <li>• Confirmation</li> <li>• Pacing</li> <li>• Navigation</li> <li>• Inquiry</li> <li>• Elaboration</li> </ul> <p><b>3. Transactions</b></p> <ul style="list-style-type: none"> <li>• Keyboard</li> <li>• Touch screen</li> <li>• Mouse</li> <li>• Voice</li> </ul>	<p><b>1. Passive Interactivity</b> (Electronic turning page)</p> <ul style="list-style-type: none"> <li>• Learner control restricted</li> <li>• Learner initiated path not provided</li> </ul> <p><b>2. Hierarchical Interactivity</b> (Menu selection)</p> <ul style="list-style-type: none"> <li>• Predetermined course of action</li> <li>• Learners directed to passive interaction after selection</li> </ul> <p><b>3. Update Interactivity</b></p> <ul style="list-style-type: none"> <li>• Dialogue -learner and computer-generated content</li> <li>• Form of interaction ranges - simple question-answer to complex conditional response</li> <li>• More current more individualised</li> </ul> <p><b>4. Construct Interactivity.</b></p> <ul style="list-style-type: none"> <li>• Learner manipulate component to achieve goal or indicate response</li> <li>• More design and strategic effort needed</li> <li>• Enhance learning</li> <li>• Detailed feedbacks determine success of manipulation</li> </ul> <p><b>5. Simulation Interactivity</b></p> <ul style="list-style-type: none"> <li>• Extends role of learner to controller or operator</li> <li>• Requires learner to complete specific sequence of tasks before update generated</li> <li>• Multimedia elements enhance reality in simulation</li> </ul> <p><b>6. Free Interactivity</b></p> <ul style="list-style-type: none"> <li>• Common in encyclopaedic form</li> <li>• Provide wealth of information</li> <li>• Designers effort- define, maintain and integrate hyperlinks</li> <li>• Possible venture into undefined path will dissociate learner</li> </ul> <p><b>7. Situate Interactivity</b></p> <ul style="list-style-type: none"> <li>• Virtual training environment</li> <li>• Popular in adventure and educational games</li> <li>• Mode of interaction generate full multimedia environment - learner or user interact with concepts, objects and people as if in the real world.</li> </ul>

Sims (1995)'s lists seem to conform closely to what the children in the pilot study experienced and what they wanted or did not want the multimedia applications to have. Rather than comment on all the ten listed by Sims (1995) or those list in **Table 4.2** five types of interactivity, which were important in the pilot study are discussed below.

It is also important to note that some of the elements of interactivity listed are integrated. Comprehensive and engaging instructions depend a lot on the skills of the designer or developer of the system. It also depends on the extent to which the interaction is independent (where every encounter will receive similar performance every time) or consequential (where every function will depend upon previous or present actions).

#### **a. Object Interactivity**

Sims refers to this type of interactivity as a proactive inquiry. Objects (buttons, people or things) are activated by a mouse or pointing device. A click will produce some form of audio-visual response. This form of interactivity is often referred to as immediacy; a situation when a user sees immediate responses to the task performed appear on the screen, e.g. clicking a mouse causes something to happen, moving it causes a cursor to move in a certain direction, etc. By and large this is a feature present in all the selected multimedia in the pilot study. In one session of the pilot study the children tended to click on every image on the scene ignoring the instructions of the support agent. The Magic School Bus gives this opportunity on every interface. From observations some children keep on clicking at the little objects instead of "going on the bus" to travel in time.

#### **b. Linear Interactivity**

Sims refers to this type of interactivity as a reactive form of pacing through a linear sequence of instruction. The user is able to move forwards and backwards like turning an electronic page. It does not give a user an opportunity to respond to a specific action. It simply displays the next or previous content in sequence. Instructionalists do not recommend overuse of this type in a learning environment because it restricts learners' control and inhibits learners' diverse capabilities.

This feature is also the ones children in the study did not like. Interaction with these features led to the children showing signs of boredom like looking outside or elsewhere.

### **c. Support Interactivity**

This type of interactivity, which the researcher refers to as "support agent" is a facility for the user to receive help ranging from simple help messages to complex tutorial systems. Some multimedia give this type of support to an extent that it becomes rather annoying to the user because the "character" keeps on popping on the screen every time the user goes back to undo a mistake. Giving the option of using or not using the "support agent" would make a difference to novice and expert users.

### **d. Simulation Interactivity**

This type of interactivity provides the learner with the opportunity to play a role as controller or operator. There is only one multimedia in the pilot study that demonstrates this type of interaction, that is, to role-play as a tour bus driver and be in control of the exploratory journey of the Magic School Bus Adventure of the Dinosaur. Discussions about this feature in the context of the pilot study will mostly refer to this multimedia application.

Simulation interactivity tends to give the learner an opportunity to manipulate objects or components to achieve specific goals. This type of interactivity allows them to make selections. Usually, the learner in simulation interaction is required to complete a sequence of tasks. The designer usually determines the tasks.

There are two ways the designer controls the interaction activity in simulation. One way is by determining the learner's progress after the learner has made a correct choice. In the Magic School Bus, for example, the bus journey experience could only be made if the child chooses the correct entrance icon.

Designer's control can also be consequential. In this situation the actions of the learner generate an update response to the process being simulated. For example, the popping-up of "dialogue boxes" or "support agent" to instruct the child to proceed with the next step, "Where do you want to go now...?" is a way in which the designer controls a consequential action.

Even though in this type of interaction the designer may be in control, the feature allows the learner to do a certain amount of proactive performance. In some sense this type of interactivity does allow a child to be in control of the situation they are in. The fact that they can role-play made them feel that they are in control and was one feature that children liked which the multimedia applications did not provide except perhaps The Magic School Bus.

#### **e. Construct Interactivity**

Construct interactivity is closely linked to simulation interactivity. This type of interactivity, through the creation of an instructional environment, also gives an opportunity for the learner to manipulate objects or components to achieve specific goals. In this feature the designer provides the learner with sets of tools to enable them to achieve goals either set for them or set by them. Therefore, the nature of the feature tends to allow the learner to engage in more elaborate proactive performance.

Sims (1995) mentions that this type of interactivity encourages creativity. In the pilot study this was a factor that the children expressed they liked and was also evident in the video recordings of the children interacting with the multimedia application, the Magic School Bus. This application gave the children the opportunity to create their own driving license. This was seen to be the longest time the children spent when interacting with this multimedia. They were more engrossed in creating the driving license than going on the journey in the Magic School Bus.

#### **4.5.2 Engagement**

Being engaged and staying engaged seemed to be a phenomenon of importance when analysing the children's reactions and behaviour with the multimedia applications. There were moments when a child looked engrossed and engaged in a design feature while they seemed bored and disengaged at other moments. A greater understanding of what is happening may be obtained by looking at literature that addresses this issue of engagement.

Engagement can be looked at from two different viewpoints: the HCI perspective and the Psychological Perspective. In the HCI's perspective in the User-Centred Design context Preece (2002) refers to engagement (though not specifically stated as this term) as affective aspects of a designed system that causes a certain kind of positive response by users. The positive responses by users would

include feeling at ease, being comfortable, and enjoying the experience of using them.

A better understanding of this phenomenon may come from studying the reverse, what Preece describes as 'user frustration'. According to Preece this can range from feeling mildly amused to extremely angry. She lists seven reasons why this emotional response occurs:

- i. when an application doesn't work properly or crashes
- ii. when the system doesn't do what the user wants it to do
- iii. when a user's expectation is not met
- iv. when a system does not provide sufficient information to let the user know what to do
- v. when error messages pop up that are vague, obtuse or condemning
- vi. when the appearance of the interface is too noisy, garish, gimmicky, or patronizing
- vii. when a system requires users to carry out many steps to perform a task, only to discover a mistake was made somewhere along the line and they need to start all over again (Preece (2002) p.147)

She claims that the impact on users of this type of consequence would be that they would abandon the system altogether. Some of the issues mentioned in this list relate very closely to the responses given by the children about the multimedia applications. The fact that the design had these problems made them disinterested and disengaged.

Preece (2002) mentioned that part of understanding user's needs is to be clear of the design objective:

Is it to design a very efficient system that will allow users to be highly productive in their work or is it to design a system that will be challenging and motivating so that it supports effective learning, or is it something else? (Preece (2002) p. 13)

She refers to these purposes of design as goals: usability goals and user experience goals. They differ in terms of how they can be met and through what means.

Usability goals are concerned with meeting specific usability criteria (e.g. efficiency) and user experience goals are largely concerned with explicating the quality of the user experience (e.g. to be aesthetically pleasing) (Preece (2002) p.14)

For Shneiderman (1998) engagement is affected by human factors considerations in design. "Ease of learning, low error rates and subjective satisfaction" are

paramount when designing systems because "use is frequently discretionary" and "competition is fierce".

"If the users cannot succeed quickly, they will abandon the use of a computer or try a competing package." (Shneiderman (1998) p.17)

This factor is also pointed out by the Nielsen Norman Group (2001-2002) [CD-ROM] *Usability of Websites for Children*. To Shneiderman, choosing the right functionality is difficult. He suggested a layered design "one approach to graceful evolution from novice to expert usage" having a constrained simple set of actions for the former and more extensive functionality and rapid performance for the latter.

The above discussion was based to some extent more on an adult's perspective. There are a number of other literatures specifically looked at this issue with the children in mind. Draper (1999) refers to engagement as fun and made it a software requirement for systems designed for children that included games and edutainment products. He equates usable products to fun and therefore regards fun as a parallel feature to usability.

Druin et al (1999), however, stressed that children have their own environment that is different from adult. Fun is an affect, that is, what makes something 'fun' to do? Fun to her is a concept that belongs to a child's environment. Even though fun may be a product requirement, it may also be a useful description of user's experience (Druin et al (1999) in Read et al (2002)).

In this research context designing applications that are engaging would mean designing systems that would be fun, enjoyable, pleasurable and aesthetically pleasing. Therefore this would be about looking at the design from a children's perspective rather than from a design perspective and eliciting what the interaction with the system feels like to the children, a term referred to as user engagement.

To the researcher engagement would be about how the system could intrigue the user so much so that they become so engrossed and engaged that they seem to be 'lost' in the 'space' they are interacting with. There are a number of reasons why these things happen.

The psychologist will relate this phenomenon to achieving goals. Corsini (1984) considers levels of aspiration as a driving motivational force that keeps people going on for more goals. He says that:

Human's needs are insatiable: they are like rubber balloons that never break: the more we have the more we want. (Corsini (1984) p. 304)

In this research context this would mean that engagement would be about how the user stays engaged with the multimedia in order to achieve a goal that he or she had set to achieve but not yet achieved. The children were so engrossed doing the puzzle in the game CD that they hesitated when the researcher asked them to stop and move on to other multimedia CDs during the pilot study.

## **4.6 Other Related Issues**

There are some related issues that affected how the children responded in the pilot study that are important to take note of for the later studies, some in the psychological field and some in the educational field. These issues are discussed here because although they are not central to the hypothesis, they could be important to experimental design.

### **4.7.1 Gender**

Much has been written of differences between girls and boys in their attitudes to the use of computers. Boys reputedly like computers and especially fighting games; girls reputedly do not. In the pilot study there was some evidence that the boys had more experience of computers and liked the CD-ROMs more than girls. However, the features that engaged them or bored them seemed very similar. In the studies that follow an attempt will be made to study equal numbers of girls and boys in the hope of demonstrating that the same suggested model works for both genders.

### **4.7.2 Cognitive Development**

Cognitive development theory could give one way of looking at individual differences when children process information or learn. Since the selected children in the experimental studies might be across a certain age range this theory could be useful. One of them is that of Piaget.

Piaget's theory of cognitive development (Meadows, 1986, 1993; Piaget, 1983) in Colman (1994) suggested that children's actions and reactions to information and learning differ across age. Colman (1994) expands this theory further in saying

that learning and constant practice could improve a child's information processing rather than relying on age-related cognitive development.

"...It seems clear that young children less often show deliberate strategic approaches to problems and have smaller and less flexible repertoires of strategies than older ones. This improvement, though age-related may be connected with practice and the growth of expertise rather than with age per se." (Colman (1994)) p. 703)

This theory suggests cognitive activity is a case of adaptive processes, assimilating and accommodating to information, "assimilation" as a means to relate new information to pre-existing structures of understanding and "accommodation" as a means of developing old structures into new ones. The two will together give rise to a series of structures of cognition from organised systems of rules, categories, and procedures to more complex, comprehensive, coherent, flexible and logical ways of understanding the world.

Vygotskian theory (Kozulin, 1990; Meadows, 1993; Tharp & Gallimore, 1988; Vygotsky, 1978, 1986) in Colman (1994) however, challenges both the Piagetian theory and the information – processing model.

"Cognitive abilities are not internal and individualistic, but formed and built up in interaction with the social environment, inter-psychological before they become internalised and intra-psychological." (Colman (1994) p. 704)

Therefore children can develop sophisticated cognitive competencies with the help of an adult. This "scaffolding" role will help children to act as though they were competent in solving a problem. As the task becomes more familiar and within the children's competence, the adult can let the child do it themselves gradually and leaving the whole task to be done by them successfully on their own.

"The child undergoes apprenticeship in the skills of the culture, and by practising these skills and reflecting on them internalises the cognitive tools that earlier members of the culture have developed. The developing thinker does not have to create cognition out of an unpeopled vacuum, but will first imitate and then internalize some of the cognitive content and processes provided by others, and may in turn develop and pass on these skills". (Colman (1994) p. 704)

The importance of scaffolding in a child's learning process could be important in the use of multimedia. If the child is given some external motivation and direction like giving the child a task and helping them to complete the task step by step till they finally could do it themselves they may get more from the multimedia. The issue here is whether the 'scaffolding' is external, i.e. 'the teacher', 'the parent' or is contained in the multimedia as in levels of engagement or difficulty.



### 4.7.3 Individual Differences

Individual differences between children may come from age or they could come from the experience children gained through their process of development either through formal learning as in schools or informal learning from parents, peers and the environment. Perhaps this is the reason why children in Kerawalla (2002) did not favour the educational CDs because they lacked parental coaxing.

Cognitive styles in individuals are another way of identifying individual differences. Cognitive styles are ways of exploiting people's intellectual capabilities linking cognition with personality. In relating them to learning, Renzulli and Smith (1978) in Colman (1994) suggested that individuals have various learning styles. Each type corresponds to particular teaching methods according to Colman (1994).

Reflectivity is a style extensively studied by Kagan (1966) in Colman (1994) and others.

"The reflective individual thinks before acting and is thoughtful, in general, about what he or she does. In contrast, an impulsive individual tends to act without thinking, and to have poor control of impulses." (Colman (1994) p. 599)

A number of differences between individuals could also be seen in the form of locus of control they conform to. There are two types of locus of control that determine one's personality traits, one internal control and another external control. In an account of the Rotter's (1966) Internal-External (I-E) scales measures; Levenson's (1973) describes internally controlled individuals as people who believe they are the ones that could exercise control over their lives. However, externally controlled individuals believe and feel that their destinies are beyond their own control and are determined by fate, chance, or powerful others.

Gardner's Multiple Intelligences Theory, approaches individual differences differently. This theory states that every individual is allocated intelligences that actually are made up of autonomous faculties that can work individually or in concert with other faculties. Initially Gardner has identified seven: musical intelligence, bodily-kinaesthetic intelligence, logical-mathematical intelligence, linguistic intelligence, spatial intelligence, interpersonal intelligence and intra-personal intelligence (Gardner, 1993).

Knowing these theories of individual differences makes us aware that when designing for children the multimedia application must have qualities to fit all or else the application will satisfy some children more than others.

#### **4.8 Overall Conclusion**

There are many issues to consider when designing multimedia for children. Findings from the pilot study have demonstrated that there are lots of emerging theories and concepts that should be considered when designing for children. There are possibilities that designers overlooked these factors and that this made the applications not as pleasing and interesting to the children as they should be.

Three disciplinary contributions: psychological, HCI and educational have been looked at to find out the underlying reasons why some features in the multimedia application worked and some did not. Through the literature the researcher found that the whole issue about determining children's likes and dislikes for an application has got to do with what the design feature can offer the child to attract and interest them and help them to be engaged and stay engaged.

When designing or choosing multimedia applications for children, in order to ensure that they are really something that the children like, the question is does the design follow the design principles and rules that each discipline claimed they

should? The expected answer is they should or else the design will fail. Initially that was what the researcher thought the reason for failure was. Through the literature it was found that there is no one correct answers as to how an application should be designed.

For the psychologists this would mean to design something that could instigate some form of drive or motivation to keep the children interested and to stay engaged to it. Or else the activity will be a very passive one and not liked by children. The drive could be external or internal depending on the goals to be achieved either set for the children or set by the children.

From the HCI perspectives this would mean following suggested conventions that allow children to interact with the application given to them. When the right design affordances and constraints are met, the next step for the designer is to design the application to fit the user (children) and not to fit the user (children) to

the application. If the latter step is chosen the gulfs of execution and evaluation will not be solved and children will not like the application designed for them

Another important issue in HCI is feedback. The design must allow feedback to be appreciated and liked by children. Through the literature it was found that feedback is needed at a number of levels. Initial feedback is immediate in nature. This is the keystroke kind of feedback that basically an application must have. Findings from the pilot study demonstrated that this kind of feedback involving the dynamic outcomes like 'press the bold words' to get meanings to words, might interest a child for a while but not that long. Children tend to want other levels of feedback that are much higher than the keystroke level. These higher levels help children set and achieve higher goals.

The educationalists, however, discuss more of the design issues not only about the ability to allow the user to interact but also about the kind of activity that should be associated with the interaction. The interaction must be purposeful and meaningful for children to learn and acquire knowledge. Having design features that merely allow the child to interact will not necessarily help them learn.

These views are useful to take note of but in this research context the whole purpose is to look at what children really want. A possible solution is to collect many possibilities from varying angles, and to compare and match them with the results of studying children using multimedia.

There are two major issues that needed to be addressed when designing for these children. One, the multimedia application must allow them to do something. Therefore the issue of interactivity is about those interaction designs that allows some form of goal setting activities or tasks that the child could be involved in when interacting with the application, either set for them or set by them, having the child as "active" or "constructive" recipient.

Another is about giving the multimedia application properties that cause the children to be 'glued' to it. In psychological terms this would mean engagement. In HCI this would mean user engagement and in education this would mean setting tasks that are meaningful and goals directed and help to 'scaffold' the child in learning. 'Scaffolding' could be either externally done or contained in the multimedia application. The main purpose, no matter in what form it is, is to

achieve a goal or reward. The degree of engagement could be affected if the reward is external, for example, about getting marks or internal, for example, to complete a task (task closure or task completion). Either way, the children could be engaged. However, the degree of engagement could be different.

An awareness of these issues will help to design an experimental programme to explore which factors in a multimedia application cause children to become engaged.

# Chapter 5

## The Engaging Multimedia Experience

Factors that Matters in Multimedia Design for Children (Study 2)

### 5.0 Chapter Outline

This chapter reports the first systematic analysis of engagement with multimedia. Study 2 was developed based on five features that were suspected to engage children when interacting with multimedia. This chapter will describe the purpose, methods used to conduct this study, characteristics of respondents, results and discussion of findings. The results from this study are used to develop a preliminary Engaging Multimedia Design Model for Children.

#### Thesis Structure

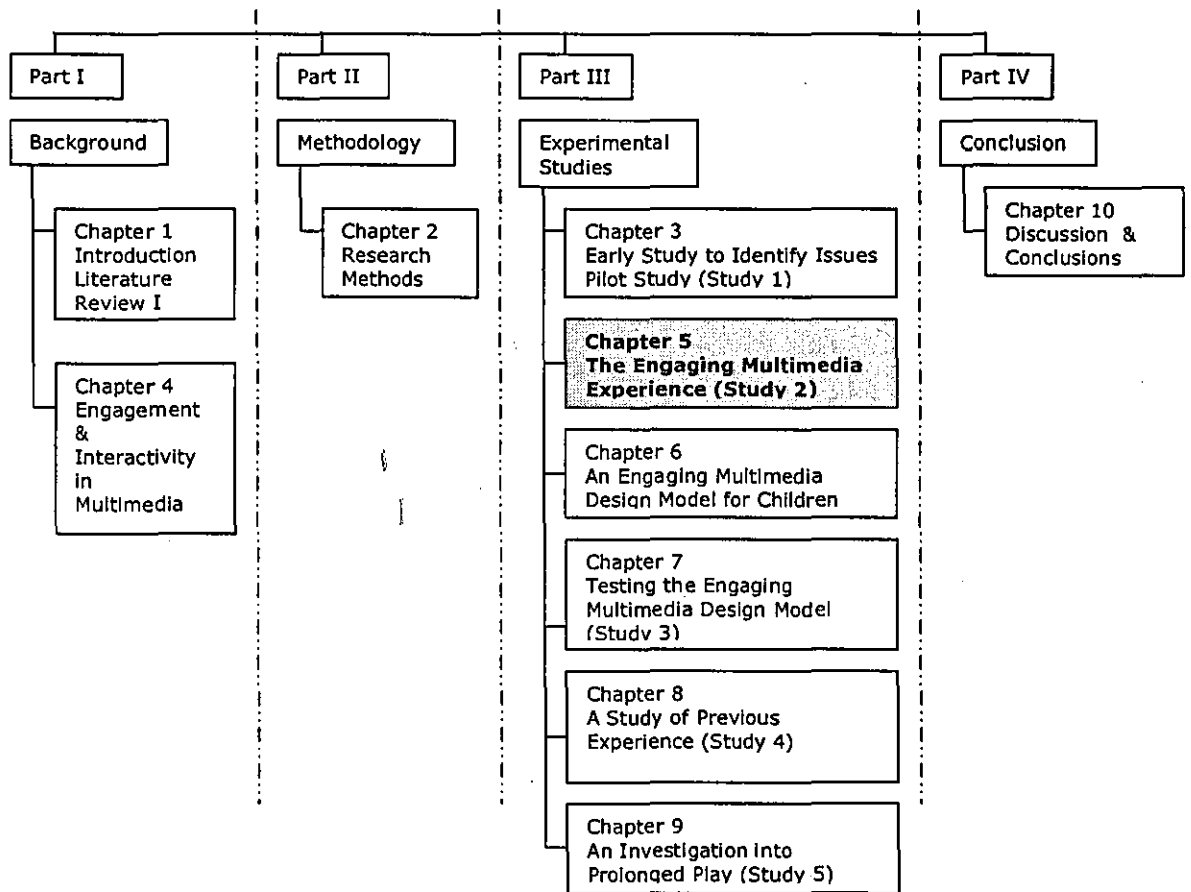


Figure 5.1: Chapter 5 in the Thesis Structure

## 5.1 Introduction

After a further literature search on multimedia applications and environments and relating the conclusions with the findings from the Pilot Study, the researcher found some prominent features that seemed to contribute to the issue of engagement. Many of the successful and unsuccessful stories of multimedia application are related to the issues of interactivity and related concepts.

Basically there are four main features that seemed to be present in any discussion of children interacting with computer applications, that is:

- Does the application allow them to interact with it? If so, what type of interactive design is it?
- What is the way it is being operated (the operating tools)?
- How immediate is the feedback when using it?
- What are the goals expected of them or could be set by them when interacting with the multimedia environment?

Through the literature search and the findings from the Pilot Study it was found that children like it when they could interact with the system. But not all interactive design is appealing to children. It was found that children tend to like two types of interactive design, one that allows the child to act out a role through movement and animation (**simulation** interaction); and another that brings in the elements of creation (**construct** interaction).

The children too tend to like using operating tools that give them an ability to see every move they make when interacting with the system, e.g. the changing position of the pointer when a mouse is moved forward or backward, or what happens when the arrow keys on the keyboard are pressed to the left or right. Since this feature involves the dynamics of interacting activity we will refer to this as a form of **immediacy**.

The children too like any form of **feedback**, the outcomes from inputs given by children during interaction, which is immediate rather than delayed, to some kind of response when an action is taken, and not those that they have to wait till it is completed before they could get the result. And last and not least, in most circumstances, the child is comfortable when the multimedia has **goals** that are

crystal clear either set for them by the designer or intrinsically set by them as they interact with the multimedia application.

From these it could be seen that there are features that should be present in an application that allows a child to stay engaged: **simulation, construct, immediacy, feedbacks and goals**. The following research design is therefore conducted to find out more about these features and its connection to engagement.

## **5.2 Summary: Purpose, Method and Experimental Design**

The purpose of this study is to assess the degree of engagement achieved by children when using a multimedia application under a number of different conditions. A multimedia application is selected that, on the evidence available, has the five properties identified in the previous chapter that could lead to engagement. Children are given 40 minutes to use the application and record their levels of engagement every 5 minutes. In addition, in order to triangulate the findings, a video record of the interaction is made and the children are interviewed after the session. Children are allocated to one of two conditions; in the first condition they have constrained resources to use in the application and this limits the kind of interaction that is possible. In the second condition they are given unlimited resources and this gives them a greater interactive opportunities. The hypotheses under test are first that the children will experience engagement in both conditions because they have interactive opportunities in each of the five features identified above and second that the unconstrained condition will give the highest level of engagement because it provides the richer form of interaction.

## **5.3 Selected Children: age and gender**

Sixteen children, 8 boys and 8 girls were chosen to participate in Study 2. The children were from 3 age groups 9-10, 11-12, 13-14 with equal representation from each gender. All children knew each other in some way. They were classmates, friends or neighbours. The researcher gave them ample time to interact with each other during their stay in the usability lab.

## **5.4 The Methods**

### **5.4.1 Experimental Location**

The study was conducted in a usability lab at HUSATS, Research School in Ergonomics and Human Factors during Easter vacation. The Research School is now part of a new institute, The Ergonomics and Safety Research Institute (ESRI).

### **5.4.2 Research Organisation**

The study was undertaken in a span of two weeks. One week was allocated to get the children familiarised with the place, the computer and the game and another week to do the experimental work. In most cases there are separate sessions for the boys and girls.

The researcher provided them with as comfortable a situation as possible. Most came with parents or siblings. They were given a tour guide of the whole building the first day they came. There was a room for them to play other computer games and board games, read magazines, newspapers or watch TV or a video. There was an eating-place with food to be eaten at anytime during the day. The experimental room had one computer in the middle of it fitted with cameras and a one-way mirror. All doors are open at all times and all rooms are accessible to everyone except the experimental room with cameras during solitary experimental sessions.

### **5.4.3 The Experimental Design of Study 2**

In trying to find a multimedia application that exemplified user engagement the researcher looked for a multimedia application that has been proven to be very popular with children and yet educational. To fit the criteria the researcher looked at an area beyond educational, an area known as edutainment. The purpose of this study was to find out whether the five design features identified in the Pilot Study were present in the application and if so whether the features do contribute to the degree of engagement experienced by children.

The researcher found a website from an independent and reputed source that sells all kinds of edutainment and games CDs for children. It was found that the game The



Sims got very high ratings (higher upper end ranging from 8/10 to 10/10) in terms of preferences from lists of 96 customer reviews about it collected by the source from 18 Feb 2000 to 23 October 2001 (Woolworths, 2002) since its release 11 Feb 2000. **Table 5.1** below illustrate the rating scores gathered from these customers' reviews.

No of Customers	Date of Customer's Review Woolworths (Information from An Independent Source – Selling Edutainment and Games CDs) Available at: <a href="http://www.woolworths.co.uk">http://www.woolworths.co.uk</a> Accessed date: 29/01/2002	Score Ratings									
		1	2	3	4	5	6	7	8	9	10
The Sims Date Released: 11 Feb 2000											
5	Range 23 Oct 2001 – 2 April 2001	-	-	-	1	-	-	1	-	1	2
5	Range 26 Mar 2001 – 1 Dec 2000	-	-	-	-	-	-	1	-	-	4
5	Range 1 Dec 2000 – 16 Oct 2000	-	1	-	-	-	-	-	-	1	3
5	Range 9 Oct 2000 – 18 Sep 2000	-	-	-	-	-	-	-	6	1	3
5	Range 18 Sep 2000 – 22 Aug 2000	-	-	-	-	-	1	1	1	2	-
5	Range 3 Aug 2000 – 25 Jul 2000	-	-	1	-	1	-	1	1	1	-
5	Range 20 Jul 2000 – 10 Jul 2000	-	-	-	2	1	-	1	-	1	-
5	Range 10 Jul 2000 – 16 Jun 2000	-	-	-	-	-	-	2	1	2	-
5	Range 16 Jun 2000 – 8 Jun 2000	-	-	-	-	-	-	1	4	-	-
5	Range 7 Jun 2000 – 30 May 2000	-	-	-	-	-	-	1	1	2	1
5	Range 30 May 2000 – 25 May 2000	-	-	-	-	-	-	-	2	1	2
5	Range 24 May 2000 – 12 May 2000	-	-	-	-	-	1	1	-	1	2
5	Range 9 May 2000 – 3 May 2000	-	-	-	-	-	-	-	2	-	3
5	Range 3 May 2000 – 13 Apr 2000	-	-	-	-	-	-	1	-	1	3
5	Range 12 Apr 2000 – 10 Apr 2000	-	-	-	-	-	1	-	1	2	1
5	Range 31 Mar 2000 – 22 Mar 2000	-	-	-	-	-	-	-	2	2	1
5	Range 20 Mar 2000 – 15 Mar 2000	-	-	-	-	-	-	-	1	-	4
5	Range 15 Mar 2000 – 8 Mar 2000	-	-	-	-	-	-	-	3	1	1
5	Range 8 Mar 2000 – 21 Feb 2000	-	-	-	-	-	-	-	2	1	2
1	18 Feb 2000	-	-	-	-	-	-	-	-	1	-
96	<b>Total Scores According to Ratings</b>	-	1	1	3	2	3	11	27	21	32

**Table 5.1:** Customer's Reviews Rating in Terms of Preferences

A close observation of the application revealed that this multimedia has all the five elements mentioned above. (A detailed description is given below.) The researcher decided to use this multimedia application as a vehicle in this research study.

### **a.What is The Sims?**

The Sims is a popular game about Life Management. The players play a major role in the management of every day family life - providing a place to stay, managing finance, basic needs, moods and desires

## b. Why The Sims?

The Sims had got all the five main factors that children liked. Most importantly:

- They wanted something where they could build or create
- They wanted something that has a simulation which enables them to role play and see what the impacts would be if they took various actions
- They wanted to do it quickly and to get immediate responses- what happens when you press this button, move this mouse to a certain direction, etc?
- They wanted feedback in the results of their actions preferably immediately and not too delayed e.g. taking care of a cyber pet and watch them grow is an example of delayed feedback. Not many children have the patience to watch them grow if the interactive actions are pretty mundane and repetitive.
- They wanted clear goals to pursue either the ones they could set themselves or goals that they are asked to go for.

The Sims provided ways of meeting these requirements as listed in **Table 5.2** below

<b>5 Main Factors</b>	<b>The Sims</b>
Construct Interactivity	Create a family mode Build a house mode
Simulation Interactivity	Live mode
Immediacy	Drag and Drop Scroll bar
Feedback	Immediate and delayed
Goals	Directed and undirected

**Table 5.2:** 5 Main Factors versus The Sims

1. In **construct interactivity** The Sims allows them to create their own family or choose from the ones listed. They can design their own house or buy a ready made one and decorate.
2. In the **simulation mode** they could see the characters in action. The act of interacting using tools to control the characters in this application is referred to as simulation interactivity. They can instruct them to do things and see the impacts of these actions.
3. **Immediacy** is another feature that involves the dynamics that allows the child to see their actions on the screen. Every mouse click or drag and drop movement in The Sims could be seen immediately on the screen
4. Feedback from . There are two kinds of feedback in The Sims, delayed and immediate. Examples of **immediate** feedback is when seeing the house as we

are designing it, and of **delayed** is when we see the consequences of the actions we took in trying to solve a problem. E.g. not letting the characters rest will make them, after a time, resent any other commands given by the player like to go to work to gain more money. When the characters refused, money does not come in and disasters result.

5. The Sims has **goals**. The goals in The Sims could be directed or non - directed. In the manual the child is given a broad set of instructions and goals.

...your Sims can be a lot like you. Or your parents. Or the President's parents. You get to design them that way... But once you've set it up, a Sim household will make some demands upon you... Like our everyday world, the world of the Sims requires judgement and decision making from the trivial to the life threatening... (The Sims (2000) pdf. file)

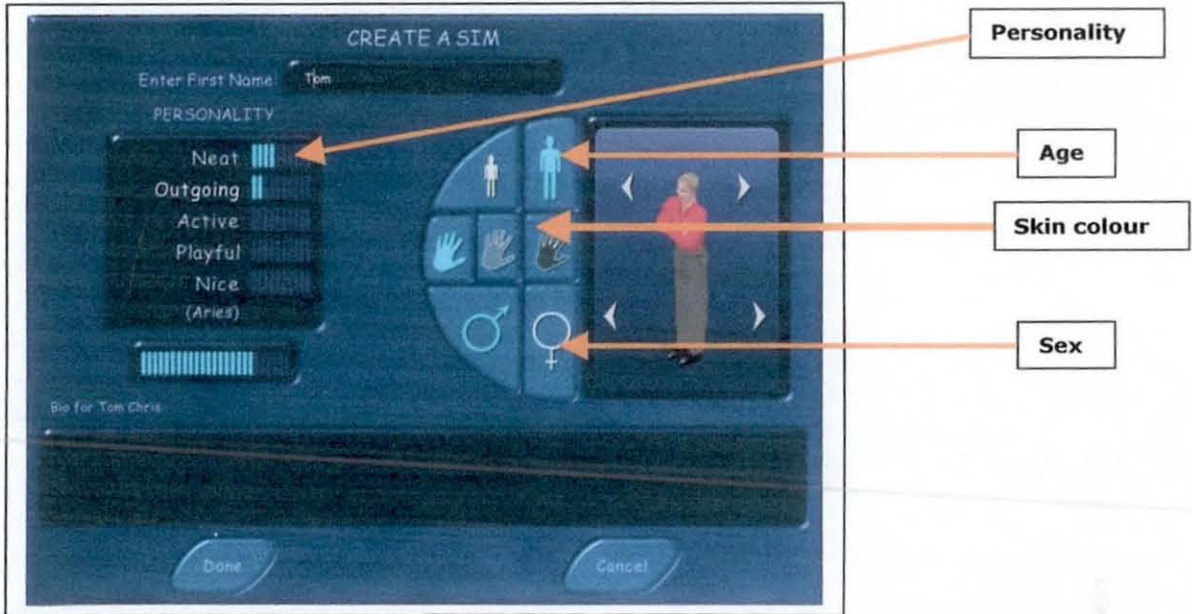
**Directed goals** are tasks the player has to accomplish first as set by the designer before they could play the game. Goals became directed when the children were specifically instructed to do things e.g. they must choose a family or create a family before they can enter the neighbourhood to build their own house or play in the ready-made ones.

**Undirected goals** are possible when the players has a desire to fulfill a target or goal to put a closure to whatever they were doing in trying to solve the 'mass' they created, etc. E.g. When a player created family members with negative personalities like less neat, less nice, playful, too outgoing, etc. they will not know the consequences of their action but only after they are sometime into the game. The characters in the game will behave badly. Trying to solve problems associated with these actions while at the same time trying to maintain a harmonious family life will be a task closure drive that the player tends to possess in their effort to strive hard to solve it. This is the time the goals became undirected. This type of non-directed goal is intrinsic in nature set by the child in trying to solve the problems they created. It is this factor that could contribute to some form of engagement and made them stay engaged when the child interacts with the application.

### 5.4.3 Visual Representation of the 5 factors in The Sims

#### i. Construct Interactivity.

Examples in **Figure 5.2** (Create a character) and **5.3** (Create a house)



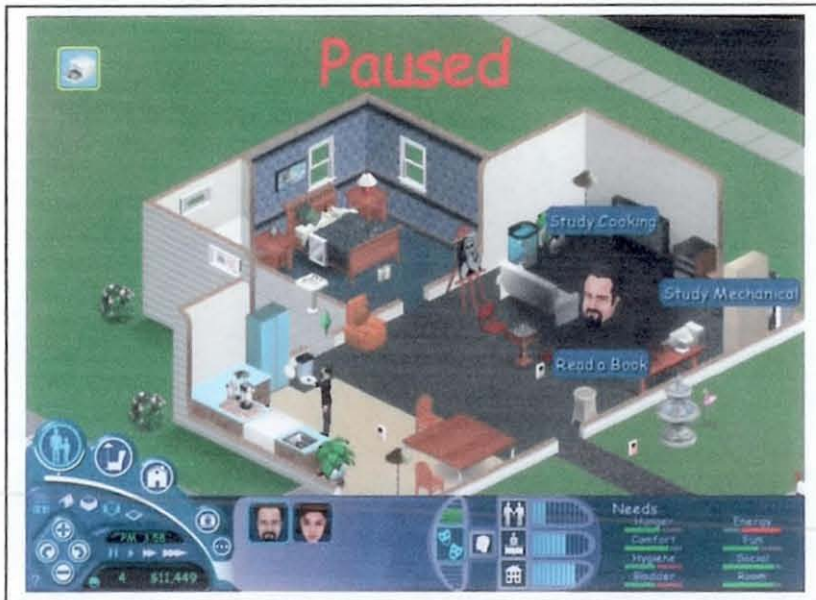
**Figure 5.2:** A set of keys to create a Sims Family



**Figure 5.3:** Keys to design build and decorate

ii. The Simulation Interactivity

Examples in **Figure 5.4** (controlling the characters), **5.5** (live mode keys) and **5.6** (in live mode)



**Figure 5.4:** Character Simulation. Interacting by controlling and instructing actions



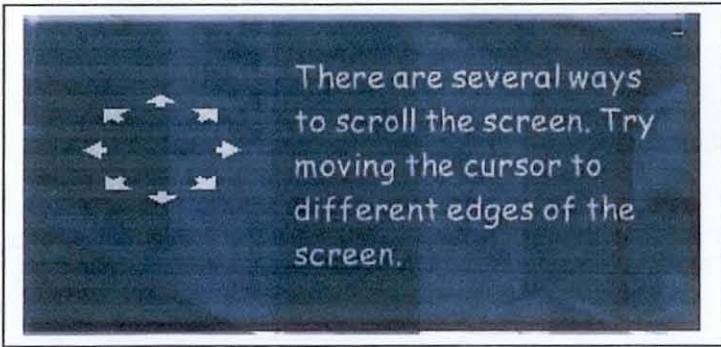
**Figure 5.5** Activating the Live Mode Keys for Simulation Interactivity



**Figure 5.6** Character is in a live mode

iii. Immediacy

Figure 5.7 shows examples of immediacy – immediate feedback caused by movements made on input devices on icons on the screen



**A Mouse Movement and Mouse Click**

- Get an immediate response if a mouse is moved
- Click to position a character from one place to another
- Rotate according to arrow to get a better viewing position



**Live Mode**

**Buy Mode**

**Build Mode**

**Zoom in and Zoom out**

**Clicking on in these keys gives immediate responses**

- Live Mode gets into simulation
- Build and Buy into lists of tools to design, build and decorate

**Drag and drop technique**

- Positioning a chair
- Drag from keys to position in house



**Scrolling technique**

- Position 1 to Position 2



#### iv. Feedback

There are two types of feedback in The Sims.

##### a. Immediate Feedback

**Figure 5.8** shows examples of **Immediate Feedback** that is, the ability to see the shape of the house as we are designing it or the effect of decorating it.



**Figure 5.8:** Examples of **Immediate Feedback** - the **Build** and **Buy Mode**

##### b. Delayed feedback

Delayed feedback however is about seeing consequences of action. **Figure 5.9a**, **5.9b** and **5.9c** shows examples of delayed feedback. Taking one example would be about fulfilling the basic needs of the characters in the simulation (**Figure 5.9a**). When a character has gone through a certain period of time, a colour coded indicator template becomes a central key point in the play session because the colour starts to move from positive green to negative red if left unattended. Something will happen to the characters in the game if this is not taken care of. The consequences are an example of delayed feedback. Other examples are that in relationships (**Figure 5.9b**) and personality traits (**Figure 5.9c**).



**Figure 5.9a:** **Mood** or **Basic Needs** Indicator moving from green to red like hunger, comfort, hygiene, bladder, energy, fun, social, room



**Figure 5.9b: Relationships** ranges from love to friends only



**Figure 5.9c: Personality traits** based on neat, outgoing, active, playful, and nice.

#### v. Goals

Goals could be of directed task or undirected task, either set by the designers or intrinsically motivated. **Figure 5.10a**, **5.10b** and **5.10c** are some examples of the game goals. **Directed goals** are tasks the player has to accomplish as set by the designer, for example, before a player could play and move in the neighbourhood the player must first do the following: create a family or choose from a given list. However, whatever the player creates they will have to deal with the consequences of it. For example, if the player creates an unfriendly character, by placing very little character pointers in the 'nice' column of the personality trait, the character during simulation playtime will behave badly and the children at this point will have to set their own goals to solve this problem. This is the **undirected goal**, a desire to put a closure to whatever they were doing. Initially, most goals are task directed by designers but when the child wants to continue playing the goals are set by the child

**Figure 5.10a** shows game goals during the initial phase of the game, that is, before the children could start playing the simulation. The goals are directed by the designer, i.e. what the child had to do first before they can play the game. Sometime into the game the goals become undirected. Thus living in harmony and building relationships amongst family members and with neighbours are examples of undirected goals.



**Figure 5.10a:**

Game Goal Examples

i. Directed Task:

- Create a family or choose from the list
- Moved it into a community

ii. Undirected Task:

- Live in harmony in the neighbourhood
- Build relationships amongst family members and with neighbours.



**Figure 5.10b:**

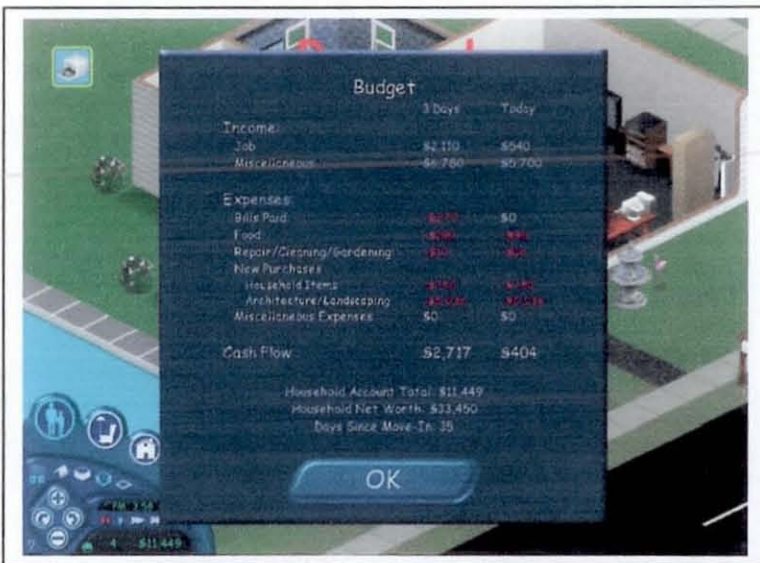
Game Goal Examples

i. Directed Tasks:

- Financial management
- Build a house within allocated budget
- Get a job to secure finance

ii. Undirected Tasks:

- Must have enough money to spend on food
- Must have enough money to spend on buying furniture, basic utilities, kitchen utensils, etc.



**Figure 5.10c:**

Game Goal Examples

i. Directed Goals

- A goal to comply with basic needs: hunger, bladder, energy- sleep, mood - happy
- Relationships
- Room Cleanliness
- Personal Hygiene
- Personal development

ii. Undirected Goals of consequences not taking the necessary actions to accomplish the directed goals above



## **5.5 Experimental Objective and Structure of Study 2 –The Sims**

The primary purpose of this study was to find out if this multimedia application, The Sims, that has all five features that theoretically contribute to engagement: (construct interaction, simulation interaction, immediacy, feedback and goals), is really engaging. A second objective, if the game is engaging, is to start testing which of the factors contribute to the sense of engagement.

Since not every feature can be examined at once, two experimental conditions were chosen for this study:

- **Constrained creation:** an example of construct interaction with fixed goals: create a family with restricted resources (build a house within limited budget and in specific locations) and maintain family lives.
- **Unconstrained creation:** an example of construct interaction with no fixed goals: given a family with unrestricted resources (build or buy a house with unlimited budget of any location) and maintain family lives.

The study used a repeated measure design, that is, each child did both conditions. The order of conditions was alternated to counter any learning effects.

## **5.6 The Materials – Experimental Instruments**

There are a number of experimental instruments used in this study.

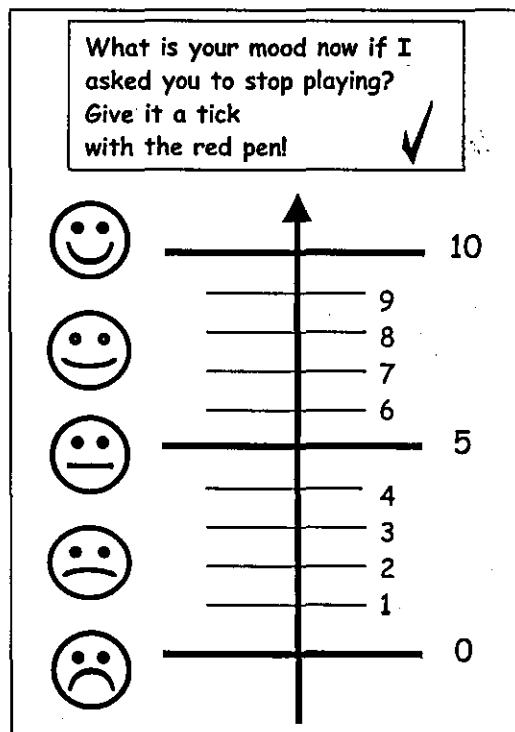
### **5.6.1 The Edutainment Multimedia CD – The Sims**

One multimedia CD - The Sims<sup>3</sup> was set up in a computer in the middle of a usability room. The CD was installed and reinstalled whenever necessary so that each child will get it as new each time. None of the game sessions played by a child was saved. Each child faced fresh new conditions every time they interacted with the computer. Other files were erased before the next session began. A simple set of instructions was given for each experimental condition.

### **5.6.2 An Engagement Scale Score**

An engagement scale score of 0 to 10 with a 5-point scale smiley face was created for this session. The children were asked to place their feelings at the moment if they were asked to stop. If they would not mind stopping when asked to do so they could

place their feelings at 5 or lower than 5. If they feel bored they could even place it at 0 or leave the game. If they did not want to stop and wanted to continue playing they could place their feelings higher than 5 up to a highest score of 10. **Figure 5.11** shows the engagement scale scores used:



**Figure 5.11:** The Engagement Scale Score

The scale score had been tested before it was used in this experiment. A full account of this scale score has been given in Chapter 2. The scale was only used during the experimental sessions. No scale scores were collected during the trial and free play sessions.

### 5.6.3 Timer

A time was set only for the experimental conditions. There was no time limit for the trial and free play but the researcher did stop the sessions if they got out of hand. Roughly the estimates for the free sessions were about one to one and a half-hours. The experimental sessions were restricted to 40 minutes only. A bell rang at every 5-minute interval and the child was asked to record an engagement scale score.

#### **5.6.4 Semi -Structured Interview**

A semi-structured interview was conducted at the end of the whole session. Lists of standard questions were covered with the child as informally as possible so that the children could express how they felt. Some of the answers were elicited while eating with the child at the end of the experimental sessions.

#### **5.6.5 Video Recordings**

Three video cameras were placed in the experimental room. One camera was on the ceiling looking down at the keyboard and the mouse as the children used them. This part of the recording was not specifically exploited because it was not the intention of the experiment to look at the events of children interacting with the input devices.

A recorded version of the actual playing experience, with picture inserts of the children's facial expressions as they interacted with the computer was obtained from two other cameras. One camera was placed facing the children to see their facial expressions and another behind to look at the screen as the children interacted with the interfaces. The recordings of these cameras were synchronised. The children's facial expressions were recorded as picture inserts in the recording of the screen. Therefore the researcher was able to see every move they took when interacting with the interfaces and their facial expressions at the time.

### **5.7 Study Programme**

All sixteen children have to be in the usability lab three times. All of them went through four sessions each:

- i. A Standard Briefing Session
- ii. A Free Play Session
- iii. Condition 1
- iv. Condition 2

#### **5.7.1 Experimental Organisation**

A pair was called during every briefing session. Then one of the children was asked to play alone at any one time. The child was given a choice to have his or her peers play with them when they were in the free play session. However, the child must be alone when playing in each of the experimental conditions.

The standard briefing and free play session took up one day, the first day they were in the lab. They were then called again the following week to do the semi-controlled Condition 1 and 2. In one experimental condition the child was given the constraining situation, i.e., a set of instructions with restricted resources, while in the next experimental condition the child was given a partially free condition with unrestricted resources.

### **5.7.2 A Standard Briefing Session**

A standard briefing session about The Sims was given to the children on the first day of their visit to the lab. This first briefing about the game was done in a pair. Then one of the children was asked to leave and wait for his or her turn. The one that remained was taught how to use the operating tools either by the researcher or by one of his or her peers who knew how to play the game. The child was later left to try to use the tools for about 5 to 10 minutes.

The purpose of this session was to give the child an early exposure to the game, get them comfortable with the computer and the place before the other sessions were conducted. The child was given a chance to familiarise him or herself with the operating tools. They are free to get help from researcher or their peers if they had any difficulty.

### **5.7.3 A Free Play Session**

After familiarisation with the tools and the interfaces the child was left to go through a free play session. They started from the very beginning of the game. They could choose to create a family if they wished (any number, any character, any age group, any gender) or choose from the ones listed in the package. They could choose a place (cheap or expensive) to live in the neighbourhood, buy a ready-made house or build their own. Each game had an initial \$20,000 budget. All these decisions were left to them. They were to play the game as they would with any other computer game. No instructions were given. No time was set. There was no requirement to mark Engagement Scale Scores.

In this session his or her peers could join the child. He or she was allowed to choose to play together with them or to play alone. They were free to ask for help either from the researcher or their friends whenever they faced any problems. It was

during these sessions that they got tips from experienced players. At some point some even played as a group. They were allowed to play for about one to one and a half-hours before another child took over.

The purpose of this free play session was to give the child a chance to explore the game the way they chose. This session was to observe children in their actual play environment. The researcher often left if the child looked uncomfortable, shy or restless with her presence. Most observations were either made through the one-way mirror or the video recordings of the session afterwards.

It is important to note, however, that this session was not done to gauge the children's engagement pattern and therefore their engagement in this session was not measured formally. Some questions in the final interview did refer to this session. Since some skills in this game take some time to acquire, especially for those with less prior experience, this session was necessary to accelerate the phase for the two experimental conditions.

#### **5.7.4 The Constrained Resources Condition – Condition 1**

The child was given a set of simple instructions to follow.

- The child was given limited money to spend (\$20,000)
- The child was allowed to choose from two specified locations in the neighbourhood – some land to build on, an expensive site (Sims Lane 1) and a cheaper option (Sims Lane 2)
- The child must build his or her own house but is free to create the family members

A bell was rung at every 5-minute interval and the child was asked to place his or her engagement score (the feelings they felt if asked to stop) on an engagement scale of 0 to 10.

The purpose of bringing in these constraining conditions into the game was to enable the researcher to identify factors that affect engagement. This experimental condition maintains some elements set by the package, like having limited money to spend. The child experiences the challenge of maintaining the family life within this limited constrains: under the 'build and create' factor to build a house within the

budget; and the 'role play or simulation' factor to keep the family going, maintain relationships, look after basic needs, moods and desires within the family and its neighbourhood. On top of this constraint the child was given a time limit of 40 minutes to complete the game.

### **5.7.5 The Unlimited Resources Condition – Condition 2**

The child in this experiment too was given a set of simple instructions to follow. The instructions helped them to fulfil a set of conditions as follows:

- Money was unlimited (up to \$1 million and more)
- The child was free to choose a location in the neighbourhood
- The child was free to build his or her own house or buy a ready made one but the family members were created for them

During this experiment the child was given an engagement scale score to complete as in Condition 1. The purpose of this condition was to see whether giving greater freedom led to greater engagement. The children had more room for freedom of choice in the conditions set for this experiment. Money was unlimited and they were free to choose a location in the neighbourhood; free to build a house or buy a ready made one. They could choose any place, anywhere because money was unlimited.

The researcher modified the game structure to create this experimental condition. The researcher set a 'special' cheat from the designer's website to enable the child to get lots of money (a million dollars or more). In order to do this the family had to be created for them. Even though they were not able to create their own family the children faced no money constraints to maintain the family life in the simulation mood. The child in this experiment was also, however, given a time limit of 40 minutes to complete the game.

## **5.8 The Data**

The data for this study comprised of data collected:

- An engagement scale score marked by every child at every 5-minute interval when playing Condition 1 and 2
- Semi-structured data from the interviews conducted at the end of both the conditions.

- Video recordings of each child as the child goes through the three sessions, free play, Condition 1 and 2 to validate some points raised from close observations of the engagement scores and the interview.

This "triangulated approach" (video observation of computer interfaces and facial expressions; semi-structured interview answers; and the plotted graph of the engagement pattern of Condition 1 and 2) was used to crosscheck and validate the issues of what engages children most.

## 5.9 The Results

The core findings in this study were from data collected in Condition 1 and Condition 2: the engagement scale scores of each child as they go through the conditions; and the graphs plotted of them. This section reports overall scores and patterns, averages, and some individual cases to emphasise issues.

### 5.9.1 Overall Engagement Scale Scores for Condition 1 and 2

The overall engagement scale scores for Condition 1 and 2 were tabulated from a collection of data of children interacting with the multimedia at every 5-minute interval in the two tables illustrated.

The codes used for Condition 1 are **(LM\$ - 2 Loc - MBuFCFm)**:

- Limited money to spend (\$20,000) - Limited (L) Money (M) \$ = **(LM\$)**
- Choose only two locations in the neighbourhood - Two Locations = **(2 Loc)**
- Must build his or her own house but is free to create the family members - Must Build (MBu) Free (F) Create (C) Family (Fm) = **(MBuFCFm)**

The codes used for Condition 2 are **(ULM\$ - F Loc - FBu/By FmG)**:

- Money was unlimited - Unlimited Money \$ = **(ULM\$)**
- The child was free to choose a location in the neighbourhood - Free Location = **(F Loc)**
- The child was free to build his or her own house or buy a ready made one but the family member is created for them - Free Build (FBu) or Buy (By) Family (Fm) Given = **(FBu/By FmG)**

**Table 5.3** shows the engagement scales scores per child per interval, the averages and total sum of scores for Condition 1 and **Table 5.4** shows: the engagement scales scores per child per interval, the averages and total sum of scores for Condition 2.



Engagement Scale Scores for Condition 1 (LM\$ -2 Loc - MBuFCFm) of Study 2									
Cases	5- mins	10- mins	15- mins	20- mins	25- mins	30- mins	35- mins	40- mins	Average
Girl 1 (14)	7	6	8	8	9	9	10	10	8.4
Girl 3 (9)	8	9	10	9	8	9	9	10	9
Girl 4 (10)	10	8	10	10	5	7	9	10	8.1
Girl 5 (12)	7	7	5	8	10	9	10	9	8.1
Girl 6 (11)	8	10	10	8	10	10	10	10	9.5
Boy 2 (10)	7	8	9	7	9	6	9	8	7.9
Boy 3 (14)	5	6	7	7	8	7	9	10	7.4
Boy 4 (14)	6	8	8	7	9	10	8	10	8.3
Boy 5 (12)	8	8	8	8	5	6	7	10	7.5
Boy 6 (10)	8	7	10	9	7	9	9	10	8.6
Boy 7 (11)	6	6	7	8	8	7	8	8	7.3
Boy 8 (11)	7	7	6	8	7	8	8	9	7.5
Girl 7 (11)	5	5	6	7	6	8	8	9	6.8
Girl 8 (11)	6	6	5	7	6	7	9	9	6.9
Girl 2 (14)	6	7	7	8	7	7	6	8	7
Boy 1 (12)	5	6	7	9	10	8	6	6	7.1
<b>Average</b>	<b>6.8</b>	<b>7.1</b>	<b>7.7</b>	<b>8</b>	<b>7.8</b>	<b>7.9</b>	<b>8.4</b>	<b>9.1</b>	<b>7.8</b>
<b>Sum</b>	<b>109</b>	<b>114</b>	<b>123</b>	<b>128</b>	<b>124</b>	<b>127</b>	<b>135</b>	<b>146</b>	<b>125</b>

Table 5. 3: Engagement Scale Scores for Condition 1 of Study 2

Engagement Scale Scores for Condition 2 (ULM\$ - F Loc-FBu /By Fm G) of Study 2									
Cases	5- mins	10- mins	15- mins	20- mins	25- mins	30- mins	35- mins	40- mins	Average
Girl 1 (14)	9	8	8	10	8	9	9	10	8.9
Girl 3 (9)	7	7	9	9	10	10	10	10	9
Girl 4 (10)	8	8	10	10	10	10	10	10	9.5
Girl 5 (12)	9	8	10	10	10	10	10	10	9.6
Girl 6 (11)	10	10	10	10	10	10	10	10	10
Boy 2 (10)	6	7	8	10	10	10	10	10	8.9
Boy 3 (14)	4	5	6	9	10	10	10	10	8
Boy 4 (14)	9	8	9	10	10	10	10	10	9.5
Boy 5 (12)	6	7	7	8	8	8	10	10	8
Boy 6 (10)	8	9	10	10	10	10	10	10	9.6
Boy 7 (11)	8	9	8	10	10	10	10	10	9.4
Boy 8 (11)	8	8	6	9	10	10	10	10	8.9
Girl 7 (11)	8	8	8	9	10	10	10	10	9.1
Girl 8 (11)	7	7	8	8	8	10	10	10	8.5
Girl 2 (14)	10	10	10	9	9	10	10	10	9.8
Boy 1 (12)	8	10	10	8	10	10	9	10	9.4
<b>Average</b>	<b>7.8</b>	<b>8.1</b>	<b>8.6</b>	<b>9.3</b>	<b>9.6</b>	<b>9.8</b>	<b>9.9</b>	<b>10</b>	<b>9.1</b>
<b>Sum</b>	<b>125</b>	<b>129</b>	<b>137</b>	<b>149</b>	<b>153</b>	<b>157</b>	<b>158</b>	<b>160</b>	<b>146</b>

Table 5. 4: Engagement Scale Scores for Condition 2 of Study 2

### 5.9.2 Setting Analysis Standards

In order to assess the engagement levels of each condition and of each child a set of standards were established as follows:

- The maximum level of engagement is a score of = 10/10
- The lowest level of disengagement is 0/10.
- High Scores = 5/10 and above
- Low scores = 4/10 and below

Therefore, for engagement to occur a score from 5/10 to 10/10 will have to be achieved. Anything below is a sign of disengagement.

### 5.9.3 Average Engagement Scale Scores

Graphical representations of the overall engagement scores for the two conditions are presented in **Figure 5.12** and **5.13**.

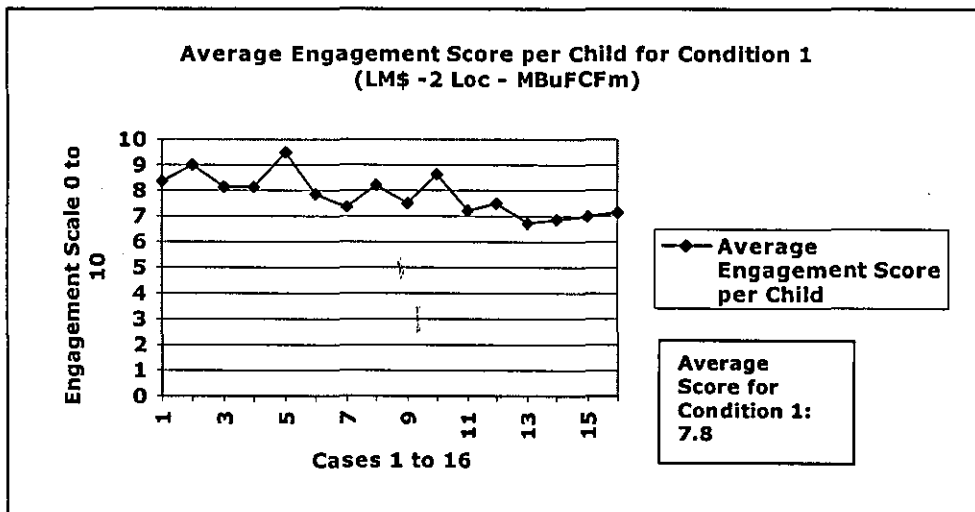
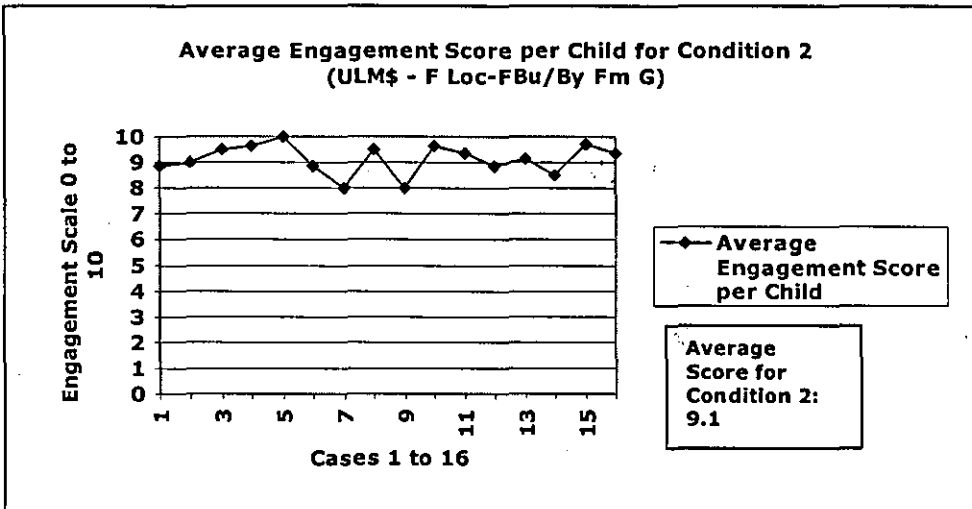


Figure 5.12: Average Engagement Score per Child for Condition1

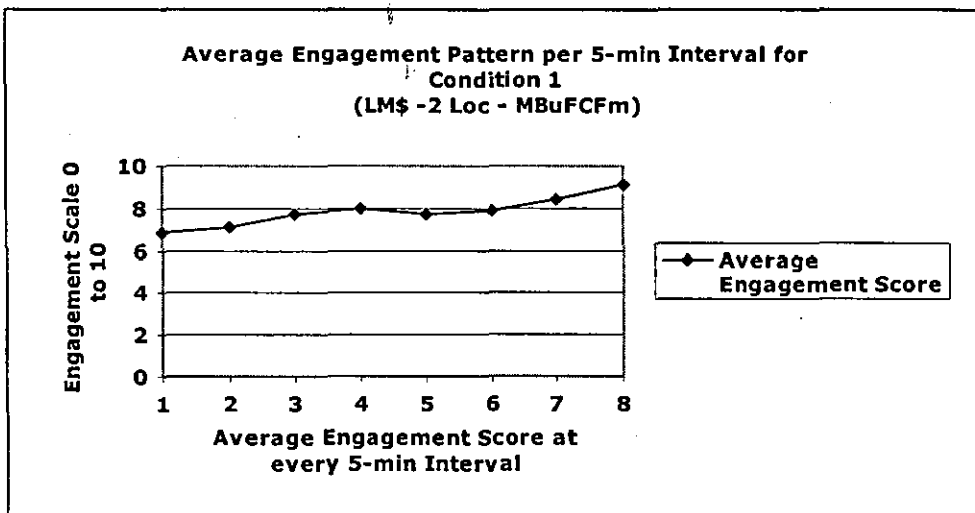


**Figure 5.13:** Average Engagement Score per Child for Condition 2

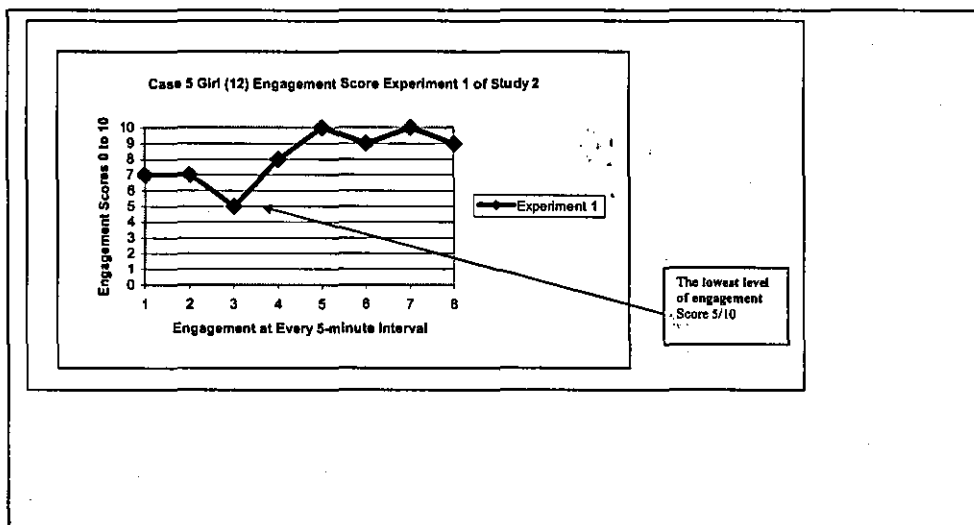
From **Figure 5.12** and **5.13** it could be seen that the average engagement scale scores are above 5/10 for all children for both experimental conditions. This is evidence that the children had an engaging multimedia experience in this study and that The Sims does indeed contain features that provide children with an engaging experience. The analysis section will reveal issues of being engaged, staying engaged and any disengagement experiences.

**5.9.4 Average of Engagement Pattern at Every 5-minute Interval**

The average of Engagement Pattern at every 5-minute interval is presented graphically in **Figure 5.14** for Condition 1 and **Figure 5.15** for Condition 2.



**Figure 5.14:** Average Engagement Pattern per Interval for Condition 1



**Figure 5.15:** Average Engagement Pattern per Interval for Condition 2

When comparing the average engagement pattern for Condition 1 in **Figure 5.14** above and **Figure 5.15** in Condition 2, it can be seen that the pattern for Condition 1 is much more turbulent before reaching a maximum score at the end of the session than the engagement pattern for Condition 2. The next section will describe the emerging pattern of engagement when the scores were plotted individually.

### 5.10 Description of Engagement Patterns

Engagement patterns can be seen by giving case examples of individuals as they go through the engaging experience. The graphs for individuals displayed a number of patterns that were placed in the following seven categories:

- Low levels of engagement
- The starting level range
- Dips
- Gradual increase and gradual decrease
- Plateaus
- Maximum
- The ending level range

The description of these categories in the following section will be based on three sources:

- a. Comparing data from **Table 5.3** and **5.4**
- b. Scores of Engagement that fit the discussed category

c. Individual Cases Examples.

Whilst most categories take into account all the three sources above, some categories are described by one or two sources only.

**5.10.1 The Lowest Level of Engagement**

From the engagement scores in **Table 5.3** and **5.4** it can be seen that the gaps between the highest and lowest level of engagement are very small. The average engagement scores for Condition 1 is 7.8 while Condition 2 is 9.1. Each score is above the minimum level of higher scorers (5/10) and therefore is within the level of engagement. This means that everybody was engaged by these experimental situations. The average lowest level of engagement of all the 16 children in Condition 1 is 7/10 while Condition 2 is 8/10. Therefore the term **lowest level of engagement** in this area of discussion is a score from 7/10 and below. The range 7/10 and below is therefore the new indicator for the lowest scores of engagement for this particular experiment. Any score within this range is the nearest to a form of disengagement or disinterest in this study.

Engagement Category	Engagement Scores at Every 5-minute Interval for Condition 1 (LM\$ - 2 Loc -MBuFCFm)								Total Score for Each Range
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
<b>Lowest Level of Engagement Scale Score Range: 7/10 and below</b>									
7/10	4	4	4	5	3	4	-	-	24
6/10	4	5	2	-	2	2	2	1	18
5/10	3	1	2	-	2	-	-	-	8
<b>Total Score per Interval</b>	<b>11</b>	<b>10</b>	<b>8</b>	<b>5</b>	<b>7</b>	<b>6</b>	<b>2</b>	<b>1</b>	<b>50</b>

**Table 5.5:** Lowest Level Engagement Category of the Engagement Scale scores for Condition 1 (LM\$ - 2 Loc -MBuFCFm)

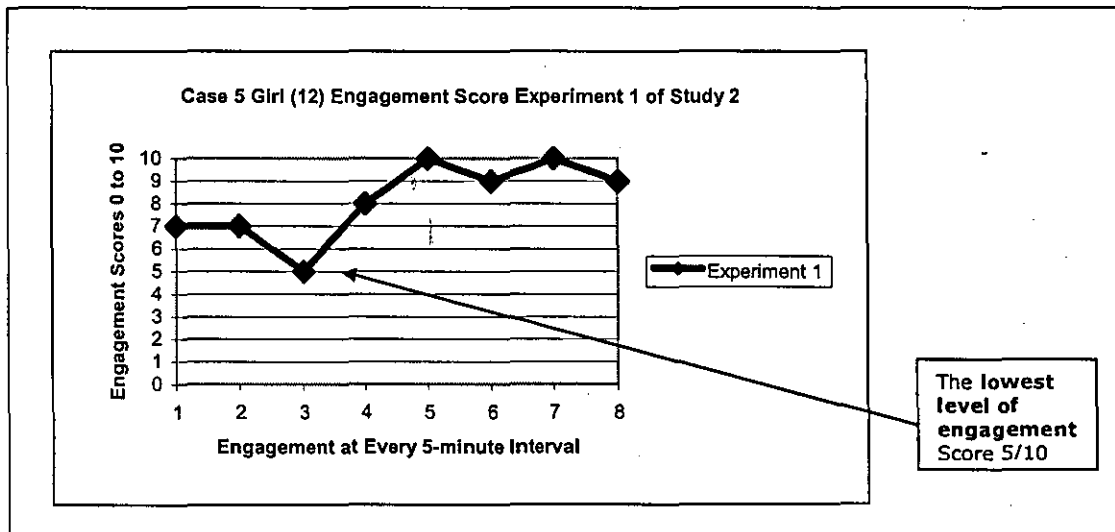
From **Table 5.5** it can be seen that most of the lowest level engagement scores in Condition 1 were at the beginning of game (first 5-minutes) decreasing steadily as the children get deeper into the game. The number of children that had this range of scores of 7/10 and below became less and less for most intervals as the children played on till 40 minutes into the game.

Engagement Category	Engagement Scores at Every 5-minute Interval for Condition 2 (ULM\$ - F Loc- FBu/Fby FmG)								Total Score for Each Range
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Lowest Level of Engagement Scale Score Range = 7/10 and below									
7/10	2	4	1	-	-	-	-	-	7
6/10	2	-	2	-	-	-	-	-	4
5/10	-	1	-	-	-	-	-	-	1
4/10	1	-	-	-	-	-	-	-	1
<b>Total Score per Interval</b>	<b>5</b>	<b>5</b>	<b>3</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>13</b>

**Table 5.6:** Lowest Level Engagement Category of the Engagement Scale scores for Condition 2 (ULM\$ - F Loc- FBu/Fby FmG)

From **Table 5.6** the lowest level engagement scores for Condition 2 were still at the beginning of game (first 5, 10 and 15 minutes). After 20 minutes none of the children had scores of 7/10 and below.

When looking at the engagement pattern of individual cases, the lowest level of engagement was at the beginning, after the first or second interval, or occasionally in the middle of the game session. This is true for both Condition 1 and 2. **Figure 5.16** below is an example of the engagement pattern of Case 5 doing Condition 1 where the child starts off quite high (7/10) then drops to its lowest point (5/10) at the third interval before rising to the maximum.



**Figure 5.16** The Engagement Pattern of Case 5 plotted while doing Condition 1 in a 40 – minute session

This pattern of occurrence, starting at a higher-level score and dropping to a lower score after the next 5 or 10-minutes could also be seen in a number of other individual cases, 6 cases in Condition 1 and 3 in Condition 2.

### 5.10.2 The Starting Levels

Most children for most sessions begin their scores at 5/10 and above. There is only one exception, a child in Condition 2 that started with a score of 4/10 at the first interval of the game. **Table 5.7** below shows the starting level range scores for both conditions.

The Starting Engagement Scores for First 5-minute Interval	Total number for each score for Condition 1 (LM\$ - 2 Loc - MBuFCFm)	Total number for each score for Condition 2 (ULM\$ - F Loc- FBu/FBy FmG)	Total number of scores
4/10	-	1	1
5/10	3	-	3
6/10	4	2	6
7/10	4	2	6
8/10	4	6	10
9/10	-	3	3
10/10	1	2	3
<b>Total Scores</b>	<b>16</b>	<b>16</b>	<b>32</b>

**Table 5.7:** The Starting Engagement Scores for the First 5-minute Interval

From the table it can be seen that, with one exception, all the other scores marked at the first 5-minute interval were within the range of 5/10 and above, having 8/10 as the most popular score. Note that higher starting scores are in Condition 2 than Condition 1. Average scores for Condition 1 is 6.9 whilst for Condition 2 is 7.8.

### 5.10.3 Dips

**Table 5.8** and **Table 5.9** shows the points where dips occur in Condition 1 and Condition 2 respectively. Some individuals have more than one dip, whilst there are others which show a much smoother ride to reach the maximum score.

Engagement Category	Engagement Scores at Every 5-minute Interval for Condition 1 (LM\$ - 2 Loc -MBuFCFm)								Total Score For Each Child
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Girl 1 (14)	7	6	8	8	9	9	10	10	1
Girl 3 (9)	8	9	10	9	8	9	9	10	1
Girl 4 (10)	10	8	10	10	5	7	9	10	2
Girl 5 (12)	7	7	5	8	10	9	10	9	3
Girl 6 (11)	8	10	10	8	10	10	10	10	1
Boy 2 (10)	7	8	9	7	9	8	9	8	3
Boy 3 (14)	5	6	7	7	8	7	9	10	1
Boy 4 (14)	6	8	8	7	9	10	8	10	2
Boy 5 (12)	8	8	8	8	5	6	7	10	1
Boy 6 (10)	8	7	10	9	7	9	9	10	2
Boy 7 (11)	6	6	7	8	8	7	8	8	1
Boy 8 (11)	7	7	6	8	7	8	8	9	2
Girl 7 (11)	5	5	6	7	6	8	8	9	1
Girl 8 (11)	6	6	5	7	6	7	9	9	2
Girl 2 (14)	6	7	7	8	7	7	6	8	1
Boy 1 (12)	5	6	7	9	10	8	6	6	2
<b>Total No. of Dips</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>4</b>	<b>6</b>	<b>5</b>	<b>3</b>	<b>2</b>	<b>26</b>

Table 5.8: Dips in Engagement Scale Scores for Condition 1 (LM\$ - 2 Loc -MBuFCFm)

Engagement Category	Engagement Scores at Every 5-minute Interval for Condition 2 (ULM\$ - F Loc- FBU/FBy FmG)								Total Score For Each Child
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Girl 1 (14)	9	8	8	10	8	9	9	10	1
Girl 3 (9)	7	7	9	9	10	10	10	10	-
Girl 4 (10)	8	8	10	10	10	10	10	10	-
Girl 5 (12)	9	8	10	10	10	10	10	10	-
Girl 6 (11)	10	10	10	10	10	10	10	10	-
Boy 2 (10)	6	7	8	10	10	10	10	10	-
Boy 3 (14)	4	5	6	9	10	10	10	10	-
Boy 4 (14)	9	8	9	10	10	10	10	10	1
Boy 5 (12)	6	7	7	8	8	8	10	10	-
Boy 6 (10)	8	9	10	10	10	10	10	10	-
Boy 7 (11)	8	9	8	10	10	10	10	10	1
Boy 8 (11)	8	8	6	9	10	10	10	10	1
Girl 7 (11)	8	8	8	9	10	10	10	10	-
Girl 8 (11)	7	7	8	8	8	10	10	10	-
Girl 2 (14)	10	10	10	9	9	10	10	10	-
Boy 1 (12)	8	10	10	8	10	10	9	10	2
<b>Total Number of Dips</b>									<b>6</b>

Table 5.9: Dips in Engagement Scale Scores for Condition 2 (ULM\$ - F Loc- FBU/FBy FmG)



There are more dips occurring when the individuals do Condition 1 (Table 5.8) as compared to when they were doing Condition 2 (Table 5.9), 26 in Condition 1 and 6 in Condition 2. Most individuals experience only one dip before rising to a maximum. Note that a lot occur at 25 minutes in Condition 1.

For those that experiences more that one dip, the results are giving signs or signals of a "troubled" or "unstable" performance that affect their pattern of engagement when interacting with the multimedia. There are 8 case examples in Condition 1 of 2 or more dips. These children are displaying quite a lot of difficulty staying engaged under these conditions. Figure 5.17 below is an example of an engagement pattern plotted from a Boy (Case 6) (10) doing Condition 1.

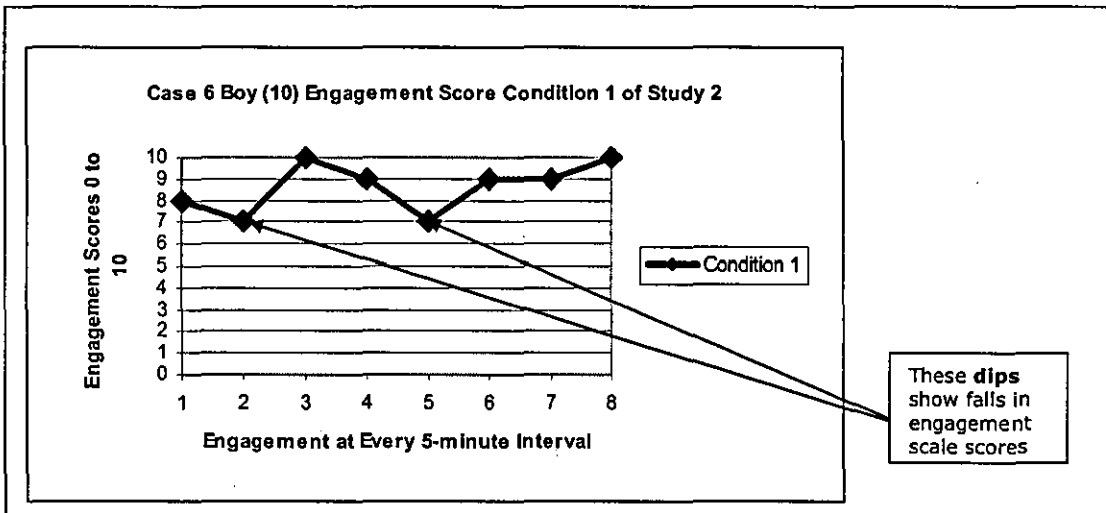


Figure 5.17 The Engagement Pattern of Case 6 plotted while doing Condition 1 in a 40 – minute session

#### 5.10.4 Gradual Increase and Gradual Decrease

From Table 5.3 and 5.4 it can be said that there are two types of gradual patterns, one that increases and the other that decreases. There are other ways of determining indicators for this category. The research categories gradual patterns as clusters of 3 scores in succession either increasing or decreasing. Therefore, **gradual increase** in this area of discussion is when scores move up from **lower to higher**, one point up for the next two to three consecutive intervals. For example, from 5/10 at a second interval of 10 minutes into the game, to a higher score of 6/10, than 7/10 or whatever combinations till it reaches a maximum of 10/10. **Gradual**

**decrease**, however, is about decreasing scores from **high to lower** in three consecutive intervals. There are 6 out of 16 children that had this kind of gradual increase experience in Condition 1, and 3 out of 16 in Condition 2. For the gradual decrease feature, there is only one case (Girl 3) (9) that experienced this pattern in Condition 1.

**Tables 5.10** and **5.11** below show the gradual increase and gradual decrease scores of individuals that were doing Condition 1 or 2. **Tables 5.10** and **5.11** shows that the majority (8 out of 9 children: 5 out of 6 in Experiment 1 and 3 in Experiment 2), show gradual engagement increases at the beginning of the game, while only 1 (in Condition 1) is midway into the game. For the **gradual decrease** pattern, however, there is only one case (**Table 5.12**). All participants reached the maximum range score (9/10 to 10/10) at the end of game.

Engagement Category	Engagement Scores at Every 5-minute Interval for Condition 1 (LM\$ - 2 Loc -MBuFCFm)								Position of gradual increase
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Gradual Increase Pattern									
Girl (Case 3) (9)	8	9	10	9	8	9	9	10	Beginning: Gradual - High - Low
Boy (Case 2) (10)	7	8	9	7	9	6	9	8	Beginning: Gradual - High -Low
Boy (Case 3) (14)	5	6	7	7	8	7	9	10	Beginning: Gradual - High - Low
Boy (Case 1) (12)	5	6	7	7	8	7	9	10	Beginning: Gradual - High -Low
Boy (Case 5) (12)	8	8	8	8	5	6	7	10	Midway: High - Low - Gradual -Max
Girl (Case 7) (11)	5	5	6	7	6	8	8	9	Beginning: Plateau-Gradual-Low-High

**Table 5.10:** Gradual Increase Engagement Scores for Condition 1 (LM\$ - 2 Loc -MBuFCFm)

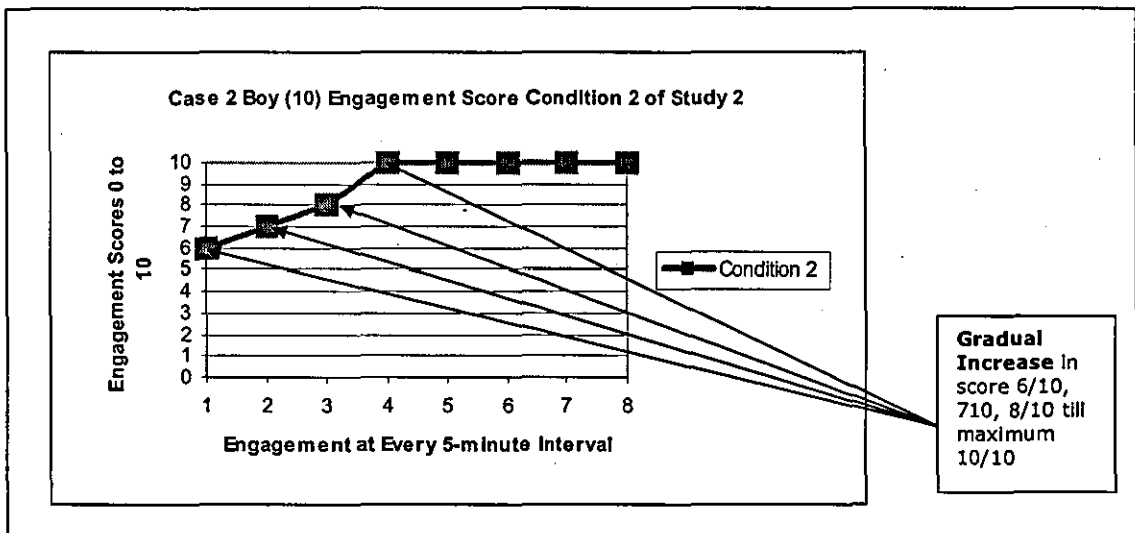
Engagement Category	Engagement Scores at Every 5-minute Interval for Condition 2 (ULM\$ - F Loc- FBu/FBy FmG)								Position of gradual increase
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Gradual Increase Pattern									
Boy (Case 2) (10)	6	7	8	10	10	10	10	10	Beginning: Gradual - Max
Boy (Case 3) (10)	4	5	6	9	10	10	10	10	Beginning: Gradual - High- Max
Boy (Case 6) (10)	8	9	10	10	10	10	10	10	Beginning: Gradual - Max

**Table 5.11:** Gradual Increase Engagement Scores for Condition 2 (ULM\$ - F Loc- FBu/FBy FmG)

Engagement Category	Engagement Scores at Every 5-minute Interval for Condition 1 (LM\$ - 2 Loc -MBuFCFm)								Position of gradual Increase
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Gradual Decease Pattern									
Girl (Case 3) (9)	8	9	10	9	8	9	9	10	Midway: High - Max - Gradual Decrease -High - Max

**Table 5.12:** Gradual Increase Engagement Scores for Condition 1 (LM\$ - 2 Loc -MBuFCFm)

The most frequent pattern from the list of cases was to show some increase in the level of engagement at the beginning, remain consistent for two to three points, drops a point or two, then show a gradual and steady increase to the maximum level of engagement.



**Figure 5.18:** The Engagement Pattern of Case 2 plotted for Condition 2

**Figure 5.18** is an example of an engagement pattern plotted for a Boy (Case 2) 9, doing Condition 2 where the child starts off quite low (6/10) then rises steadily (7/10 and 8/10) before reaching a maximum score of 10/10.

### 5.10.5 Plateau

The term **plateau** is used when the pattern of engagement scores remains consistent for a number of interval points. Children at most times reached a **plateau** when they reached the maximum range score. While some do not regress after this

stage, others do. **Table 5.13** and **5.14** highlight the results for condition 1 and 2 respectively.

There are a number of places where plateaus occur. Below it can be seen that there was no specific pattern of occurrence of plateaus as a whole for Condition 1 (**Table 5.13**).

Engagement Category	Engagement Scores at Every 5-minute Interval for Condition 1 (LM\$ - 2 Loc -MBuFCFm)								Total Score for Each Child
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Girl 1 (14)	7	6	8	8	9	9	10	10	3 Plateaus
Girl 3 (9)	8	9	10	9	8	9	9	10	1 Plateau
Girl 4 (10)	10	8	10	10	5	7	9	10	1 Plateau
Girl 5 (12)	7	7	5	8	10	9	10	9	1 Plateau
Girl 6 (11)	8	10	10	8	10	10	10	10	2 Plateaus
Boy 2 (10)	7	8	9	7	9	6	9	8	-
Boy 3 (14)	5	6	7	7	8	7	9	10	1 Plateau
Boy 4 (14)	6	8	8	7	9	10	8	10	1 Plateau
Boy 5 (12)	8	8	8	8	5	6	7	10	1 Plateau
Boy 6 (10)	8	7	10	9	7	9	9	10	1 Plateau
Boy 7 (11)	6	6	7	8	8	7	8	8	3 Plateaus
Boy 8 (11)	7	7	6	8	7	8	8	9	2 Plateaus
Girl 7 (11)	5	5	6	7	6	8	8	9	2 Plateaus
Girl 8 (11)	6	6	5	7	6	7	9	9	2 Plateaus
Girl 2 (14)	6	7	7	8	7	7	6	8	2 Plateaus
Boy 1 (12)	5	6	7	9	10	8	6	6	1 Plateau
<b>Total Scores for Plateaus</b>									<b>24 Plateaus</b>

**Table 5.13:** Plateau of the Engagement Scale Scores for Condition1 (LM\$ - 2 Loc -MBuFCFm)

However, a certain pattern did emerge in Condition 2. **Table 5.14** shows that they mostly occur at the time when the individuals reached maximum score and rarely seem to regress after that.

Engagement Category	Engagement Scores at Every 5-minute Interval For Condition 2 (ULM\$ - F Loc- FBU/FBy FmG)								Total Score for Each Child
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Girl 1 (14)	9	8	8	10	8	9	9	10	2 Plateaus
Girl 3 (9)	7	7	9	9	10	10	10	10	3 Plateaus
Girl 4 (10)	8	8	10	10	10	10	10	10	2 Plateaus
Girl 5 (12)	9	8	10	10	10	10	10	10	1 Plateau
Girl 6 (11)	10	10	10	10	10	10	10	10	1 Plateau
Boy 2 (10)	6	7	8	10	10	10	10	10	1 Plateau
Boy 3 (14)	4	5	6	9	10	10	10	10	1 Plateau
Boy 4 (14)	9	8	9	10	10	10	10	10	1 Plateau
Boy 5 (12)	6	7	7	8	8	8	10	10	3 Plateaus
Boy 6 (10)	8	9	10	10	10	10	10	10	1 Plateau
Boy 7 (11)	8	9	8	10	10	10	10	10	1 Plateau
Boy 8 (11)	8	8	6	9	10	10	10	10	1 Plateau
Girl 7 (11)	8	8	8	9	10	10	10	10	2 Plateaus
Girl 8 (11)	7	7	8	8	8	10	10	10	3 Plateaus
Girl 2 (14)	10	10	10	9	9	10	10	10	3 Plateaus
Boy 1 (12)	8	10	10	8	10	10	9	10	2 Plateaus
<b>Total Scores of Plateaus</b>									<b>28 Plateaus</b>

Table 5.14: Plateau of the Engagement Scale Scores for Condition 2 (ULM\$ - F Loc- FBU/FBy FmG)

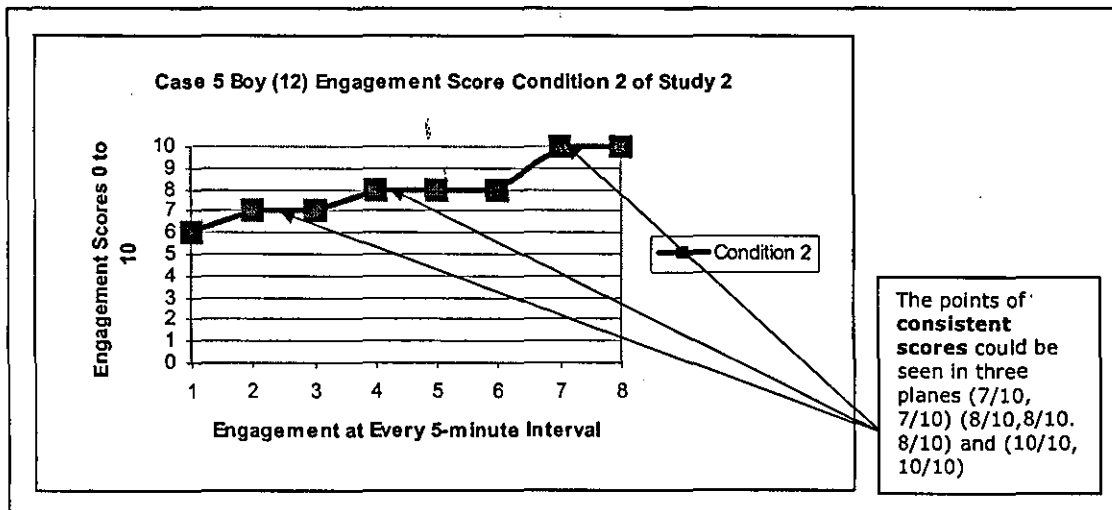


Figure 5.19 The Engagement Pattern of Case 5 plotted for Condition 2

**Figure 5.19** is an example of an engagement pattern plotted for a Boy (Case 5) (12) doing Condition 2. The child's engagement patterns revealed three plateaus. One plateau was at 7/10 for the second and third interval (10 to 15 minutes). Another at 8/10 remained consistent from the fourth Interval to the sixth interval (20 to 30 minutes). And lastly, whenever the maximum plateau is reached 10/10 at the seventh and the final interval (35 to 40 minutes).

### 5.10.6 The highest level of engagement

**Tables 5.15** and **5.16** highlight the maximum scores for each child in Condition 1 and 2 respectively.

Engagement Category	Engagement Scores at Every 5-minute Interval for Condition1 (LM\$ - 2 Loc -MBuFCFm)								Total Score for Each Child	
	Maximum Engagement Scale Score	5 min	10 min	15 min	20 min	25 min	30 min	35 min		40 min
Girl 1 (14)		7	6	8	8	9	9	<b>10</b>	<b>10</b>	2
Girl 3 (9)		8	9	<b>10</b>	9	8	9	9	<b>10</b>	2
Girl 4 (10)		<b>10</b>	8	<b>10</b>	<b>10</b>	5	7	9	<b>10</b>	4
Girl 5 (12)		7	7	5	8	<b>10</b>	9	<b>10</b>	9	2
Girl 6 (11)		8	<b>10</b>	<b>10</b>	8	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	6
Boy 2 (10)		7	8	9	7	9	6	9	8	-
Boy 3 (14)		5	6	7	7	8	7	9	<b>10</b>	1
Boy 4 (14)		6	8	8	7	9	<b>10</b>	8	<b>10</b>	2
Boy 5 (12)		8	8	8	8	5	6	7	<b>10</b>	1
Boy 6 (10)		8	7	<b>10</b>	9	7	9	9	<b>10</b>	2
Boy 7 (11)		6	6	7	8	8	7	8	8	-
Boy 8 (11)		7	7	6	8	7	8	8	9	-
Girl 7 (11)		5	5	6	7	6	8	8	9	-
Girl 8 (11)		6	6	5	7	6	7	9	9	-
Girl 2 (14)		6	7	7	8	7	7	6	8	-
Boy 1 (12)		5	6	7	9	<b>10</b>	8	6	6	1
<b>Total Scores per interval</b>		<b>1</b>	<b>1</b>	<b>4</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>8</b>	<b>23</b>

**Table 5.15:** Maximum Level Engagement Scale Scores for Condition 1 (LM\$ - 2 Loc -MBuFCFm)

From the table above it can be seen that the maximum level scores occur in most cases at the end of the session. There seem to be other occurrences as well worth further investigation but overall, only half (8 out of 16) of these children placed their

maximum at 10/10 at the last interval for Condition 1. The same phenomenon however does not occur for Condition 2.

The maximum scores for Condition 2 in **Table 5.16** below seem to suggest that the children are more engaged towards the end of the session when doing Condition 2 than when doing Condition 1. Whilst there are some children who place their maximum score at the start of the game (2 out of 16), everyone (all 16) reached the maximum at the end. Some indicated maximum engagement as early as 15 minutes into the game (2 out of 16), whilst 14 out of 16 reached the maximum 30 minutes into the game.

Engagement Category	Engagement Scores at Every 5-minute Interval for Condition 2 (ULM\$ - F Loc- FBu/FBy FmG)								Total Score for Each Child
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Girl 1 (14)	9	8	8	<b>10</b>	8	9	9	<b>10</b>	2
Girl 3 (9)	7	7	9	9	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	4
Girl 4 (10)	8	8	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	6
Girl 5 (12)	9	8	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	6
Girl 6 (11)	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	8
Boy 2 (10)	6	7	8	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	5
Boy 3 (14)	4	5	6	9	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	4
Boy 4 (14)	9	8	9	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	5
Boy 5 (12)	6	7	7	8	8	8	<b>10</b>	<b>10</b>	2
Boy 6 (10)	8	9	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	6
Boy 7 (11)	8	9	8	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	5
Boy 8 (11)	8	8	6	9	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	4
Girl 7 (11)	8	8	8	9	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	4
Girl 8 (11)	7	7	8	8	8	<b>10</b>	<b>10</b>	<b>10</b>	3
Girl 2 (14)	<b>10</b>	<b>10</b>	<b>10</b>	9	9	<b>10</b>	<b>10</b>	<b>10</b>	6
Boy 1 (12)	8	<b>10</b>	<b>10</b>	8	<b>10</b>	<b>10</b>	9	<b>10</b>	5
<b>Total Scores per Interval</b>	<b>2</b>	<b>3</b>	<b>6</b>	<b>8</b>	<b>12</b>	<b>14</b>	<b>14</b>	<b>16</b>	<b>75</b>

**Table 5.16:** Maximum Level Engagement Scale Scores for Condition 2 (ULM\$ - F Loc- FBu/FBy FmG)

### 5.10.7 The Ending Levels Range

From **Tables 5.3** and **5.4** we can see that even though findings in Condition 1 show some sign of differences in the place where maximum engagement patterns are marked, most children in this study seems to have a very engaging experience because they all seems to be uniformly engaged by the end of both the conditions.

**Table 5.17** give the scores for both conditions. All the children finished in the range 8/10 to 10/10, except for one case Boy (Case 1) (12) that scored 6/10 for the final interval of Condition1.

The Ending Engagement Scores for The Last 40-minute Interval	Total number for each score for Condition 1 (LM\$ - 2 Loc - MBuFCFm)	Total number for each score for Condition 2 (ULM\$ - F Loc- FBu/FBy FmG)	Total number for Both Experiments
10/10	8	16	24
9/10	4	-	4
8/10	3	-	3
7/10	-	-	-
6/10	1	-	1
5/10	-	-	-
4/10	-	-	-
<b>Total Scores</b>	<b>16</b>	<b>16</b>	<b>32</b>

**Table 5.17:** The Ending Engagement Scores for the last 40-minute Interval for Condition 1 and 2

From the scores above we could say that at the end of the game all the children were engaged by the game because all of the scores were above 5/10.

### 5.10.8 Findings from Interviews

The interview sessions were conducted in the same way as in the pilot study, i.e. in a laddering pattern of questioning because children were not necessarily articulate. A tabulated representation of the major factors is in **Table 5.18** below.

Name of Choice	Total Number of Preferences	Boys	Girls	Difficult
Build, Buy and Decorate Mode (Construct Interactivity)	6	2	4	2
Live Mode (Simulation Interactivity)	8	5	3	-
Free Play	9	5	4	-
Condition 1	-	-	-	-
Condition 2	7	3	4	-
<b>Experience with The Sims</b>	9 have heard about it, 4 have actually played it	2	2	-

**Table 5. 18:** Children Preferences from Interview Data

The children were asked which of the three sessions they liked most: free play, Condition 1 and Condition 2 and which of the modes of using The Sims they preferred, 'live' or 'build and buy' mode. From the table above it could be seen that 9



out of 16 children enjoyed the free play session as compared to the two experimental conditions. When asked why, most of them said they enjoyed discovering the game. For those that preferred otherwise it was mainly due to the experiences they had at the time of play. Through video observations, it could be seen that the children that did not find the free play the best times of play were those that encountered a bad experience when playing it. Some said that they felt lost when playing it for the first time. They did not know what they were supposed to do and what they were supposed to get from it. Some thought that the game was about achieving certain levels, like most games they played before. Managing people's lives seems to be " a bit weird at first, but after awhile it was fun...you get to control them...god-like thing..."

Others liked free play because they found it fun playing with friends. Some got very useful tips from friends. Others expressed their preferences for playing alone rather than with peers. Some said, "They kind of control the game, you could not enjoy it much, I prefer to play alone". Some said it was useful to have friends to teach you how to play but prefer to play alone when they have the skills.

When the children were asked which part of the game they liked most they mentioned the 'live' (simulation) mode. Eight children expressed a likeness for playing the 'live' mode, because " you could be like God...telling and controlling people...tell them what to do..." However, when asked to choose amongst the sessions, Condition 2 got picked after free play. None mentioned Condition 1 as a preference.... When asked why they liked Condition 2, some of their comments were "There was so much money there ...did not know that we had to stop much earlier...have not had the chance to see and play with them...no time...I wish there was more time...". The ones that disliked Condition 1 find it too restricted. " I don't like it at first, ...not having enough money, I had to let them work, after a while it was ok..."

### **5.11 Analysis of Findings**

This section reviews the findings for the engagement scores and seeks an explanation of them by examining the interview and video recording data.

### 5.11.1 Overall Analysis of Findings of the Engagement Scale Scores and Averages for Condition 1 and 2

The overall analysis of findings for this section could be got from the interpretation of the results from:

- The Engagement Scale Scores for Condition 1 and 2 (Tables 5.3 and 5.4);
- The Averages of Engagement Scale Scores for Condition 1 and 2 (Figure 5.12 and Figure 5.13)
- And Averages of Engagement Pattern per Interval for Condition 1 and 2 (Figure 5.14 and Figure 5.15)

From the data in Table 5.3 and 5.4 of the Engagement Scale scores it could be interpreted that, overall, all the children in this study found The Sims to be very engaging. The averages of scores lie within a high engagement range of 7.8 for Condition 1 and 9.1 for Condition 2. The major aim of experiment, to achieve an engaging experience for the children has been achieved. When the averages of engagement scale scores for both conditions per child were plotted the results seen in the graph below Figure 5.20 (having most scores plotted at the upper end of the graph) proves that all the children had an engaging experience when doing this study for both conditions.

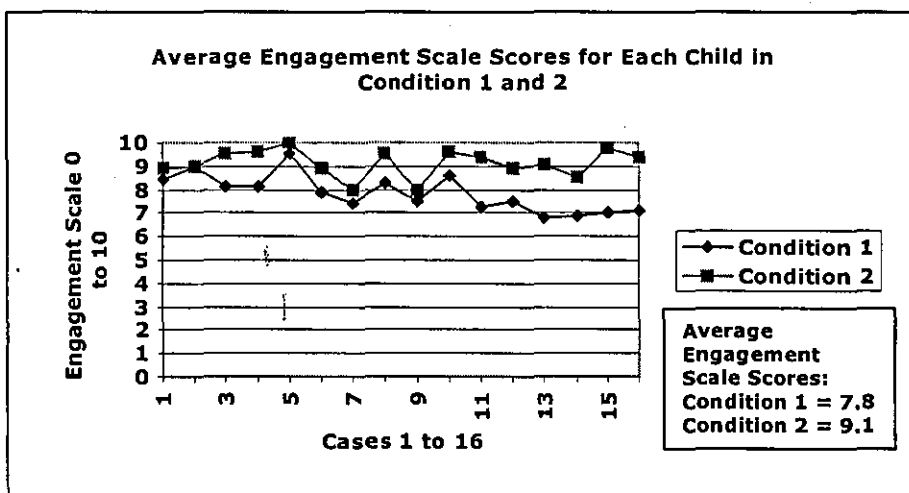
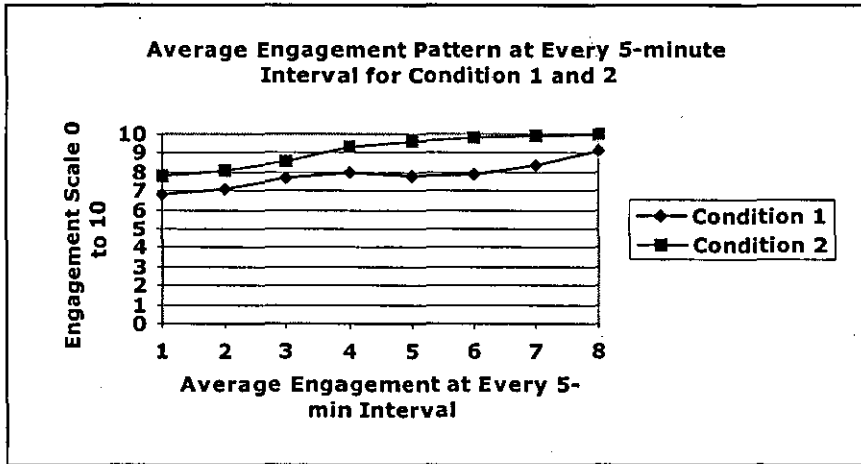


Figure 5.20: Average Engagement Scale Scores per child for both Condition 1 and 2

However, when the engagement patterns were compared between Condition 1 and 2 as in Figure 5.21 some identifiable form of pattern emerges when children did Condition 2 as compared to Condition 1. The average engagement scale scores show

that children were engaged to Condition 2 (9.1) more than Condition 1 (7.8). The ability to build and create due to the unrestricted resources in Condition 2 has gained a higher score than the ability to play a role in the restricted circumstances of the simulation mode in Condition 1.



**Figure 5.21:** Average Engagement Pattern per Child at Every 5- minute Interval of Condition1 and 2

Close observations of the video recordings of the children (with their picture inserts on the interfaces they were at that time) have revealed that the children face bigger turmoil when doing Condition 1 than Condition 2 (**Figure 5.21**). This is because in Condition 1 the child had to develop and use more skills than in Condition 2.

The children did not face any money constraints in Condition 2, and therefore were fully engrossed in creating or decorating a house. They did not have to solve any other problems because money was in abundance. They could build anything and buy anything. They reached the maximum engagement levels faster because their only obstacles were to acquire the skills to build and create or to decorate. In contrast, in Condition 1, they had to control the characters, fulfill their needs and desires, while at the same time getting enough money to accommodate the family and their life style when money was limited and time was tight.

The only obstacle for Condition 2 was time. Most children did not notice the time when doing Condition 2 and when they were told to stop they insisted on playing some more because they had not had the chance to see the characters living in the house they had created or decorated.

Therefore the following conclusions can be drawn:

- **All the children had an engaging experience** in this study because their average engagement scores were above the engagement range standard set earlier (5/10 and above) for both conditions
- **Engagement scores in Condition 1 tended to be more fluctuating than Condition 2.** The scores are sometimes high and sometimes low. Through observations it could be seen that the experimental conditions in Condition 1 tended to make more demands of the children so much so that:
  - **When the conditions were challenging but solvable** children tended to want to continue and therefore placed a high score if asked to stop and were therefore **most engaged**
  - But **when the conditions were too demanding**, the challenge made them feel panic and confusion. They then lost interest and wanted to give up and therefore placed a lower score if asked to stop because they became **disillusioned, disinterested and disengaged**
- The children **reached maximum scores faster in Condition 2 than Condition 1.** When the children did Condition 2, most of them placed the highest score of 10/10 at least at the final stage of the game, if not much earlier. Closer observation has revealed that the experimental conditions in Condition 2 had given the child:
  - **More freedom** in decisions, creations and decorations because money has not been the limit and therefore the main obstacles of maintaining the family basic needs of living to keep the budget running diminishes especially once the child had overcome the operative skills to build, create and decorate. Therefore this factor made them **more engaged.**
  - **Obstacles could be overcome in much shorter period of time** because the obstacles are purely operative skills like the drag and drop, positioning, deleting, do and undo, etc. There is no stress in learning those skills but there is in the skills of juggling family life to

'make ends meet'. Therefore the better they are with the skills the **more engaged** they would be.

- **More absorbed in the game** and did not notice that time flies and when asked to stop did not want to do so. They became **most engaged** and wanted to continue playing. This is because in most cases, the children were disappointed when told to stop because there is a part of them that wanted to see what happen to the characters living in the home they had created for them. This is a part that wanted them to complete an unfinished task, a part the researcher did not allow them to fulfil.

From observation and interview it was also revealed that it was the conditions and the time factor in the two experiments that caused differences in engagement patterns. Conditions in Experiment 1 (having little money and resources) made the children engage themselves in the Live Mode (simulation interactivity) to solve the problems they encountered due to the consequences of the actions they took before this. However, in Experiment 2, it was not the conditions of having unlimited money that imposed constraints but the time for them to stop. The children did not have the chance to be in any other mode than the build mode, that is, the construct interactivity mode. Therefore, these two factors of simulation and construct interactivity seem, in some way, to contribute to the form of engagement behaviour discussed in the coming sections.

### **5.11.2 Analysis of the Low Levels Engagement Pattern**

One of the engagement patterns of behaviour is the Low Level Engagement Pattern. **The lowest level of engagement is not very low**, i.e., very few scores less than 5/10, only 1 (4/10) in Condition 2, most about 31 cases (24 in Condition 1 and 7 in Condition 2) were at 7/10.

Closer look at **Table 5.5** has revealed that the lowest scores were mostly in the first 5-minutes of the game and in Condition 1. The number for this type of score decreased steadily as the children got deeper into the game. Only one child in Condition 1 put a score as low as 6/10 in the final 40-minute interval.

A typical example of the situation where this category occurs is best described if we looked at an individual case example. Below in **Figure 5.22** is the graph of the

engagement scores plotted for Girl (Case 5) (12) and the account she gave when doing Condition 1 and Condition 2 as seen on the video and in the interview.

#### **Condition 1:**

- The girl started by marking a 7/10 score. The score remained consistent at 7/10 for the next interval (after 10 minutes into the game) when she was creating a family, in the 'Create A Family' Mode.
- The engagement score later drops to Point 5/10 (**the lowest level engagement scores**) after 15-minutes into the game when she enters the neighbourhood. She tried the build mode and built a fence but lost confidence. After sometime she stopped doing this mode.
- She started to choose a ready-made house instead. She used the Buy Mode and started buying furniture and decorating the house.
- Soon her scores started to gradually **increase to 8/10** till she reached 10/10 after 25 minutes into the game.
- When she entered the live mode after about 30 minutes into the game, her scores **drops to 9/10**. She started playing with the characters.
- Her engagement scores **increased to 10/10**. She continues with the live mode, doing mundane things, go to work, serve dinner, take a bath, bladder, and watch TV. Her characters are only two in the family...not much to do...after about 40 minutes into the game her engagement score **decreased to 9** when the bell rang for her to stop.

#### **Condition 2:**

After doing Condition 1 the girl did Condition 2

- The girl started her next session by marking a **9/10** score as a starter point. After 10 minutes her score **drops to 8/10**. The girl had first to move the given family to the neighbourhood. She was unsure of what to do with so much money; either to build a house or buy a ready made one. She used quite some time to make a decision. After considering her previous experience she decided to buy a ready-made house.
- Her scores **increase to 10/10** and **remain consistent at 10/10 up to the end of the game**. She used the whole session to decorate the house and to buy things. Because there was still so much money she kept on buying and decorating till time passed. She did not want to stop when the bell rang.

When the child was asked about her opinion of Condition 1 she said the game got to be almost the same after sometime, with nothing much to do, just keep them happy, have enough food to eat, etc. In Condition 2, however, there was lots of money and "you just keep on buying things, no chance to play, no time..."

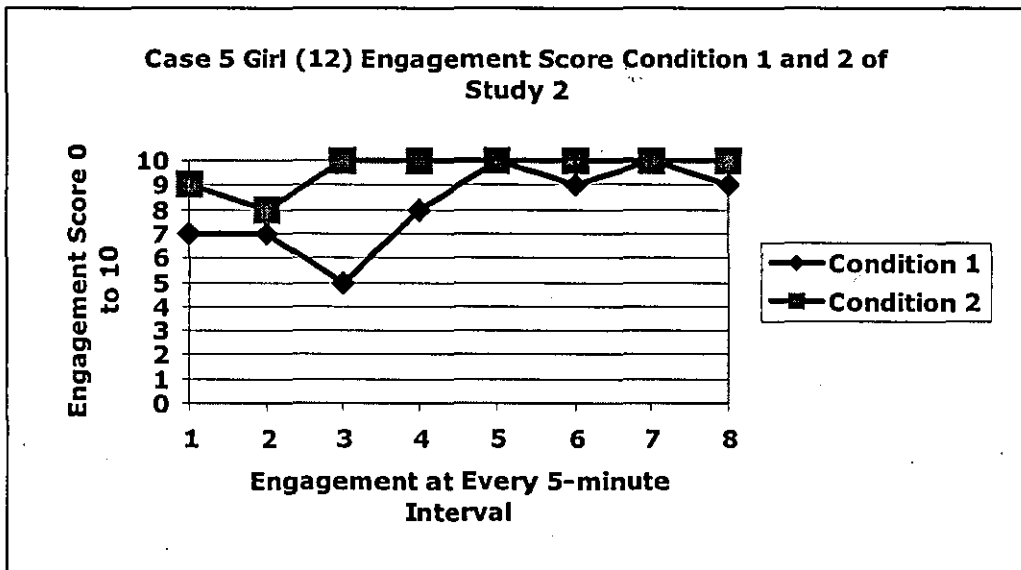


Figure 5.22: Graph of the Engagement Scores plotted for Girl (Case 5) (12)

Therefore for this girl her **lowest level of engagement was 5/10** placed in her Condition 1 experience and the score increased after that, fluctuating as she went through the game. Analysing her case suggests that "disengagement" occurred during first encounter, in this case, a change in mode from 'create a family' mode, which was quite straight forward, because the child only had to choose the criteria by scrolling through the bar, to the 'build' mode, creating a house from nothing. The child had no idea how to begin from the two given locations, one a little more expensive than the other. Which keys to choose to build the house? What to start first, the floor, the fence, etc.? After sometime she decided to opt out and choose a ready made one where she just needed to know some basic operating skills of dragging and dropping, positioning, rotating and deleting furniture and accessories. It is after choosing this option that her engagement scores started to increase. And this case study also revealed that simulation interactivity, found most in Condition 1,

caused a different form of engagement pattern to that of construct interactivity, as found most in Condition 2.

Therefore the following conclusions on low engagement level scores can be made:

- **The lowest range is not very low** implying that **all children are engaged**
- **Lowest scores were mostly at the beginning.** This is only natural because children are very cautious at first just as adults are.
- **Constraining conditions** caused some form of disillusion, disinterest and **disengagement**
- **"Disengagement"** seems to occur at a number of places and moments:
  - **During first encounter:** first time into the game, or first time into a new mode e.g. from live mode to build mode, etc.
  - **When faced with difficulty:** e.g. lack of skills in using the operative keys or a sudden encounter with a problem e.g. the need to solve 'the vicious circle' ; the need to fulfill basic needs like hunger when there is not enough money to buy food, but too weak to work to make more money, because there is no food to give more energy, etc.

Some children go through this period of **"disengagement"** or lowest level of engagement calmly while others were panicky. Some became speechless and restless. Some looked as though they needed someone to help them. When the bell rang at this point in time, the child placed a low mark in their engagement scores. As the children picked up the skills to overcome these difficulties their engagement scale scores usually got much higher until they reached a level when they did not want to stop and wanted some more experiences of this kind. The difficulty had now become a challenge and because of it they became very engaged, especially at the end of the game.

### **5.11.3 Analysis of the Starting Levels**

Another engagement pattern of behaviour is the score the children placed when they started the experimental session. The starting scores tend to be in a certain level range. Some were in the high scores range and some in the low score range.



From **Tables 5.3** and **5.4**, it could be seen that the starting levels range for both conditions lies in the high scores zone of 5/10 and above (28 out of 32). Three out of 28 placed the highest 10/10 scores and 4 out of 32 placed a 5/10 with one exceptional case of 4/10. **The most popular scores for starters is 8/10.** The general trend however was that, at whatever level they started, the score tends to decrease at the second or third interval, before rising again to much higher scores.

There are a number of reasons why some children start very high while some start much lower. From the interview data it seems this has a lot to do with past experiences. The children that placed higher scores are mostly those that have good exposures to some kind of child play, games and computer games. For these children, when the multimedia game was given to them, it immediately implied pleasure and fun. For them, the term 'game' usually suggests an engaging experience and this has resulted in them having high expectancy at the very beginning of the game. However, as they go through the game and when the game does not turn out to be as they expected due to obstacles, whether operational or psychological, the engagement scores start to fall, giving a form of disengagement. A full account of an example of this type of performance is given in **Figure 5.23** below.

However, there are also children that place low starting scores. Interview results have shown the reasons vary according to individuals. From the 3 that placed a 5/10 score, one had been playing with the game for about a month before this. When asked how did he find the sessions he said he was quite bored playing the simulation condition (Condition 1). He started his score with a 5/10 and ended low with a 6/10. He, however, regained his interest as he did Condition 2 because here he started his score with a high 8/10 and ended with a maximum 10/10.

Another boy played both sessions with low scores. He started his session doing Condition 2 first, placing a score of 4/10 at the beginning. Then he had a steady increase reaching a maximum after 25 minutes into the game. He still started low when he later did Condition 1 and only reached a maximum at the final interval. Through the interview sessions it was observed that this child is rather reserved in nature. He responded very vaguely in all the interview questions. Observing the video it could be seen that the child is very conscious in every move he made. He did

get engaged in the end for both sessions, faster in Condition 2 rather than Condition 1.

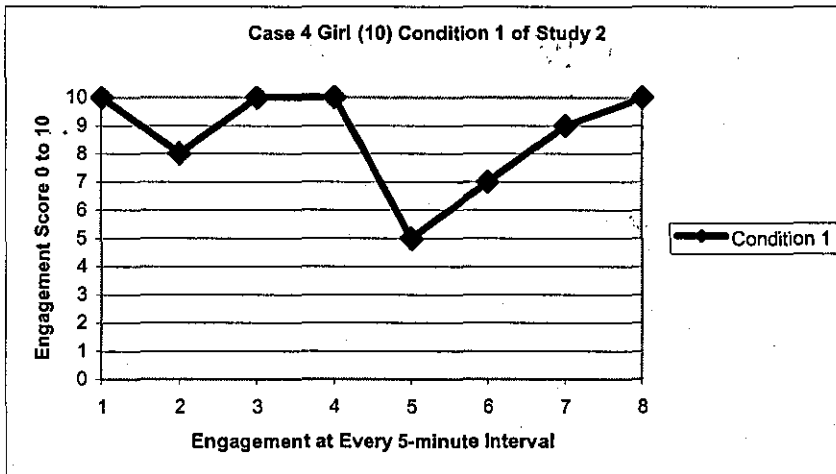


Figure 5.23: Case 4 Girl (10) doing Condition 1 of Study 2

Figure 5.23 is a typical example of the situation where the child Girl (Case 4) (10) demonstrated the phenomenon described in the analysis above.

- This girl **started with an engagement score at the highest level (10/10)**. Through video observations it could be seen that she was in the 'Create a Family' Mode at this stage. She created four family members.
- After 10 minutes her scores dropped to 8/10. At this stage the child was encountering a new mode 'moving into the neighbourhood'.
- She chose a ready-made house and started decorating it. Here her scores rose to 10/10 and remain consistent at 10/10 for another two intervals. She continued decorating until she ran out of money to buy more things. She had to change to a 'live mode' to get more money
- This time her scores dropped to 5/10. She was now in a mode where she had to control the lives of the individuals in the family she created.
- After that her scores gradually increased from 5/10 to 7/10, to 9/10 and then 10/10.

Therefore it could be concluded that the starting level ranges could vary from individual to individual depending on a lot of factors that influence the child at the time of starting to play. Some of these factors could be:

- **The influence of previous experience** on the child. It could be either e.g. the child had played other computer games before, good or bad, which made them cautious when starting a game; or, e.g. just had a good or bad experience from the session before the experiment
- **The personality of the child** e.g. some get excited quite easily, whilst others takes things one at a time and progress or regress from there.

#### 5.11.4 Analysis of Dips

Overall, the patterns show that most of the children that experience only one dip seemed to experience it as a single drop before their scores rise especially when reaching the end of the session. Children that had more than one dip seemed to have much more "trouble" and "unstable" performance as they went through the game as compared to others.

Closer observations have revealed that there are more dips occurring in Condition 1 (**Table 5.8**) than Condition 2 (**Table 5.9**). This is evident from the total number of dips in **Table 5.8** of Condition 1, which are 26, as compared to that of Condition 2 in **Table 5.9**, which is 6. These results imply that the conditions set for the children in Condition 1 were less engaging than those for Condition 2. In other words the interactivity type, 'simulation interactivity' found in Condition 1: the act of role play; the act of controlling the game using "virtually perceived" play role, etc. gave some children this "trouble" and "unstable" performance. It caused them to record both the high and low engagement scores, i.e., some of the time they wanted to continue and some of the time they wanted to stop.

However, in Condition 2, the children did not manage to reach the 'simulation' stage because there was no time. They spent most of their time trying to learn the skills of operating the keys either to build the house or decorate it using their imagination, i.e., buying whatever furniture cheap or expensive, etc. because they could afford it since money was unlimited. Thus, at most times, the dips for this experiment are of one single drop before a rise.

Why did dips occur? There are a number of reasons for these dips to happen. Through an intensive tape observation, in most cases dips tended to occur whenever the child encountered some form of environmental change or a new situation,

condition or problem. An example of an environmental change could be of a change from the 'Build Mode' to the 'Live' or 'Simulation' mode. Here, the child encounters a virtual "physiological environmental interface" change, that is, from still objects to moving objects. Seeing moving objects does give a different impact to seeing still objects and therefore could cause the child some anxious or nervous reaction that made them record the scores lower than before. The score rises after they get used to it.

Some children tend to record lower scores every time they encounter a new situation, condition or problem. Thus for these individuals there could be more than one dip in their patterns of engagement as they go through the experimental sessions.

Why do dips occur when a child faces a new situation, condition or problem? When the child is exposed to a new problem they had not experienced before, the child tends to get more anxious and worried. This might be their first dip. The fear factor soon gets overcome and this causes the child to record a higher score. However, there are situations, maybe due to the actions taken by the children themselves, that made the conditions or situations worsen. For example, suddenly money is exhausted and therefore the child could not continue to be in the 'building' mode but had to change to the 'simulation' mode of role play, to make the characters work to gain more money to keep the family going. The change in mode in this situation might cause a second dip. If they could solve this problem, as he or she did with the first problem, the score rises.

However, problems are not always the same. When they tried to use the same tools to solve the second problem they found that they could not solve it the same way as they did before. Therefore they got frustrated and confused. This reduced their level of engagement. If they still had ample time to solve the problem, their engagement level increased but, at that time and moment, if they were asked to stop they would not have minded. The next stage could be a further drop or an increase depending on the ability of the child to "pick up the pieces and try again" and acquire further skills as he or she got deeper and deeper into the game.

The other reason maybe because of the expectation they had set after facing the first problem. "Ah" since this is different from the one before, they started to believe that there will always be another problem to solve, and that the number of problems will become endless. Therefore they had a mindset that they are going to face a new problem with another uncertainty. For these children, these fluctuating instances of high and low dips kept on occurring and stopped when the child had got used to it and felt confident of solving it. When this moment came the child was usually already at the end of the session.

While some had short spells of these patterns at the initial stages, many others faced several dips past midway through the game before they reached their maximum satisfaction. The maximum satisfaction level, the moment they are most engaged and refused to stop, is therefore usually after they could control the game better.

Some concluding statements about the 'dips' category could be:

- **Dips are falls** in the engagement scale scores that shows a **sign of disinterest or disengaged**
- **There were more dips in Condition 1** (most of the simulation interactivity) **than in Condition 2** (most of the construct interactivity)
- **They occurred** when facing **new modes, situations, conditions or problems**
- They could occur as **a single drop before a rise** or **several drops before a rise**

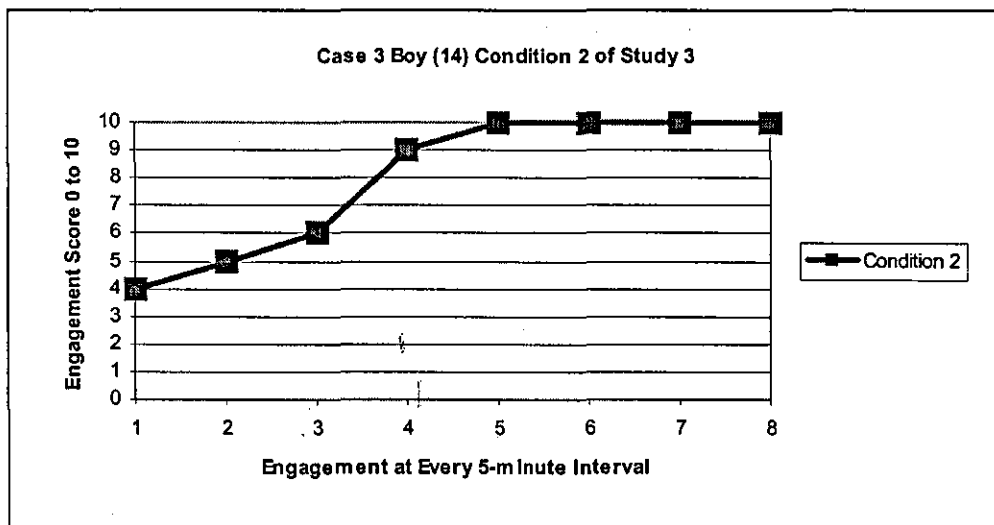
#### **5.11.5 Analysis of Findings of Gradual Increase and Gradual Decrease**

Six out of 16 showed a gradual increase in Condition 1 and 3 out of 16 in Condition 2. There is only one case of the **gradual decrease** pattern found in a case Girl 3 (9) as seen in **Table 5.12**.

Whilst most gradual increase patterns occur after dips some individuals have them from the start, starting low but then rising steadily to a maximum at the end of the game. Whether the gradual increase occurs after dips or from the beginning, there are a number of reasons why the children recorded their scores in this way.

One of the reasons could be that, after going through a few stages of learning from previous mistakes, the child controlled the game better. They began to understand most of the rules of the games, what to do and not to do. They know the strategy of the game. And therefore, as their level of confidence increases their level of engagement increases with it. Several problems that they had encountered before they now know how to solve. Their mood began to change and their level of interest began to increase till they reached the maximum level of satisfaction. The peak of gradual increment is at the stage where they become very engaged and their concentration shifts from the point of learning and acquiring skills to the point of setting goals of problem solving or task completion.

For those who show a steady increment from the start, the reason could be just that these individuals believe in picking up skills as they go along starting and increasing the scores as they go deeper and deeper into the game. **Figure 5.24** and **Figure 5.25** below shows typical examples of these gradual increase situations.



**Figure 5.24:** Case 3 Boy (14) doing Condition 2 of Study 2

**Figure 5.24** above shows the Case 3 of a boy aged 14 that had a much smoother gradual increment in engagement pattern as compared to a boy aged 11 of Case 8 as shown in **Figure 5.25** below when doing Condition 2. The boy in **Figure 5.24** at this time of play had made a gradual start in acquiring play skills and was

concentrating on building a house when the bell rang for him to stop. Since there was no money constraint his concentration was on designing and redesigning the house he had created and he did not realize that time was up. He refused to stop because he was still at the building and constructing mode and wanted to experience how the family was going to live in the house he had designed for them. There is therefore no closure to his task and that has proven to be the peak of his engagement.

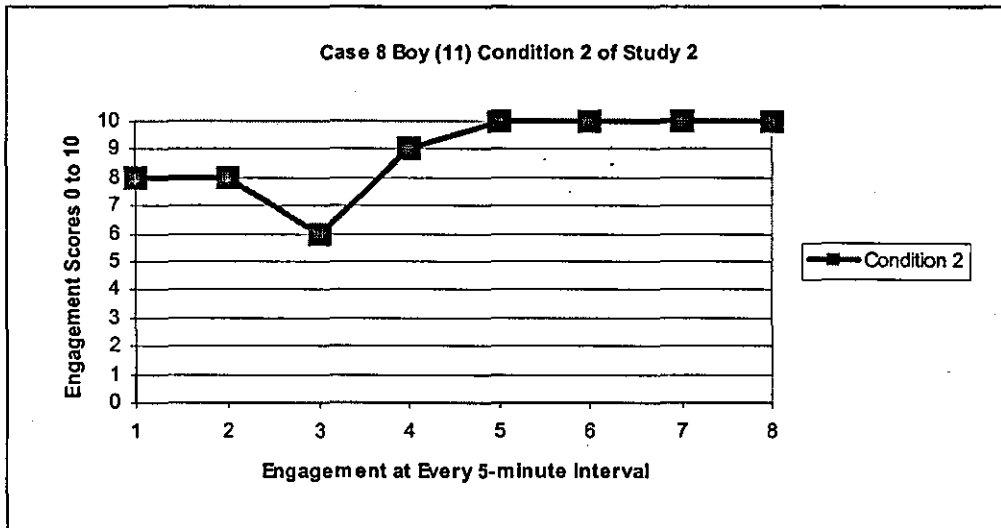


Figure 5.25 Case 8 Boy (11) doing Condition 2 of Study 2

In **Figure 5.25** the boy had a more turbulent start before making a smoother gradual increment as he went through the same experimental condition. Even though both did manage to reach a gradual increment pattern, the actual steps taken by these boys were different. One reason may be that, these two boys are different in ages; the boy in **Figure 5.24** Case 3 is 14 while the boy in **Figure 5.25** Case 8 is 11.

Through observation of the video it was seen that the 14 year old boy has used his maturity in age to start designing the house with a large floor plan for the big family that he had created, adding on more design features as he went along, building, creating and decorating. The approach of the younger boy showed his immaturity. He started off with a very small layout plan even though the family he had created was big. After sometime he changed his mind. He started looking at some ready-

made designs and used them as a base. It is from here, a point where he had acquired new understanding that his engagement scores increased.

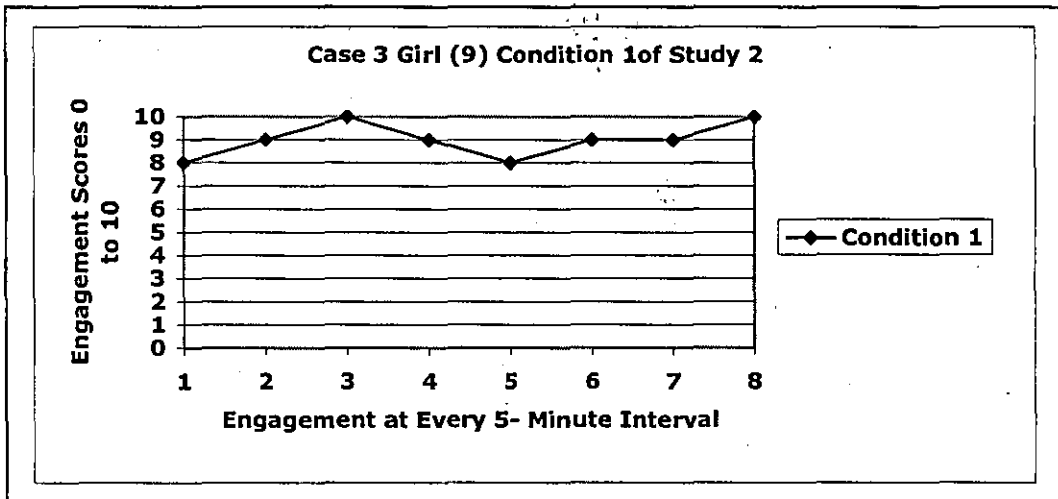


Figure 5.26: Case 3 Girl (9) doing Condition 1 of Study 2

A gradual decrease pattern however is when the individual faces problems and finds them getting more and more difficult to solve as times goes by. Their scores dropped lower and lower, interval after interval, till they reached a stage where they suddenly find themselves capable of solving it, a turning point for their scores to increase. **Figure 5.26** is the example of this type of engagement phenomenon.

This is the one case of a girl experiencing a gradual decrease in engagement. The description of the process she went through is as follows:

- The girl started her score 8/10, progressing to 9/10 creating a family in the 'Create a Family' Mode till it reached the highest score of 10/10.
- When she 'enters the neighbourhood', she chose a ready-made house, a very small one, for a big family that she created. At this point her score **dips to 9/10**
- Her scores went **further down to 8/10**. She looked confused about what to do since the house was very small and the family was large (a family of 5). She started to make an extension to the house and placed furniture like double beds, etc.



- At this point her scores started to **rise to 9/10**. She continued decorating the house having her scores **consistent at 9/10**. She was still in this mode when asked to stop, which she refused, and therefore placed a 10/10 at the end of the session.

From this case it could be seen that the girl experienced this **gradual decrease pattern** when she faces problems in accommodating the big family she had created in the small house she chose. She found the circumstances she created getting more and more difficult to solve. Her engagement scores started to drop lower and lower, interval after interval, till she reached a stage where she suddenly found a way to avoid the problem. This was her turning point. Her scores started to increase and never regressed.

Therefore for this category of gradual increase and gradual decrease it could be concluded that this form of engagement pattern happened for a number of reasons. Whatever the circumstances:

- **Gradual increase patterns** give an indication of a **steadiness in the acquisition of skills**. This is usually a normal learning pattern when a person's ability and skills increases from less skilled to more skilled.
- **Gradual decrease patterns** implied a sense of continuous lost of confidence of trying to solve an encountered experienced.
- **Most gradual increase patterns** are found **at the beginning or after dips**.
- **Gradual increase in Condition 2 seldom regressed after rising to a maximum**.

#### **5.11.6 Analysis of Findings of Plateau Category**

Closer observations have revealed that while some children marked a progressing score while doing a similar mode at intervals, others tend to place them as plateaus. Some placed their scores as plateaus when they were experiencing something mundane or routine. But the patterns were also of plateaus when the child reached a maximum level of engagement till the bell rings for them to stop.

For a conclusion to this section it could be said that there are a number of reasons why engagement levels remain consistent for a number of intervals before a change occur. Through observations plateaus could happen:

- When the child is **playing and using the same mode** or interface. This is a stage when the child is doing some form of repeated task or doing something mundane or routine task. For example, having each character in the game to do the routine chores like taking a shower, changing their clothes, going to the fridge, taking out some snacks, eating, cleaning up and watching TV. Usually, at this stage, there is no turmoil. Money is plentiful, everybody is happy...till suddenly something happens.
- When the child reached **a stage where the child began to master the trade**. This is the time when the child was very confident with the game. This is especially true when the child had reached his or her maximum level of engagement way before the time the last bell rang for them to stop. Any time during this stage the child was most engaged and would refuse to stop and their scores never regressed.

#### **5.11.7 Analysis of Findings of the Highest Level of Engagement Category**

The highest level of engagement is the maximum form of engagement behaviour found in the engagement scale. This is the level of the highest expectation, maximum satisfaction, a level when a child is most engaged and does not want to stop if asked to do so. In most instances the score never regresses after that. Some children even begged the researcher to allow them to continue playing. Some had to be asked many times to stop before they did.

One child made the researcher save his creation so that he could play with it again later on. This particular child created his own family for the game. He built a house and was at the stage of learning the skills of the game when he was asked to stop. He wanted so much to play the game, to find out more about the characters he had created that when asked to stop he simply refused.

Another child created the good and the bad guys in his session but by accident, when playing he mistakenly chose a different family to the one he created. He realised this after quite sometime into the game. The sequence was he had to create a family,

then built the house for the family to stay in and then play the game. When he was just a few minutes into the play mode he realised that the family he chose was the wrong one. The bell rang soon after and he felt very frustrated because he did not manage to see the effect of having created the bad and the good guys. His engagement level went 10/10. When asked where he would place his engagement scores at that time, he placed it up and above the page given to him.

From this section it could be concluded that maximum engagement scores occur:

- When the child reached the highest level of engagement, **a time when they do not want to stop if asked to do so.**
- Usually **towards the end of the experimental session.**
- **Reached faster in Condition 2 than Condition 1**
- Usually **never regressed after a maximum is reached.**

#### **5.11.8 Analysis of Findings from Interview**

From the interview it could be concluded that:

- The children found the **free play session most enjoyable** because there were no play condition constraints, no time constraints and no adult interference, etc.
- The ones that did not find free game fun were **those that were lost in the game.** The **goals** either directed by the designer or the ones they wanted to achieve were **unclear and uncertain.**
- They were **confused in their preferences between simulation and construct interactivity.** They did say they loved the 'build, buy and create' mode but also found the 'live' or simulation mode interesting. This factor clearly indicates that these two types of design feature could give different engagement patterns if placed side by side. The interesting thing to know is which one would be preferred.
- When asked to give a grading of 0 to 10 for this game all of them put a 10/10 score. Therefore to these children **the game was very engaging for them all.**

#### **5.12 Overall Conclusion of Study 2**

The aim of this study was to find 'engagement'. The overall conclusion was the experience was very engaging. The analyses from the engagement tables and other

graphical representations have demonstrated that all the children in this study were found to be engaged in both of the experimental conditions. This study has shown us what was engaging and given some clues about what was not engaging.

### **5.12.1 From the Engagement Tables and Other Graphical Representational Perspective**

When the graph representations of every individual were made, two prominent patterns are found to be very representative. One is that of the highest level of engagement and the other of dips or some form of disengagement.

The first sets of results suggest there are many factors that contribute to engagement. Initially it was thought that the causes of engagement were a number of interactive design features of the application. The more interactive design elements the application has, the more engaging it will be. This study, however, concludes that there are a number of other factors that contribute to the highest level of engagement.

Engagements are not only due to the ability to interact with the interactive design features but also because of trying to fulfill a drive from within, the intrinsic motivation. This study has highlighted two relevant forms of intrinsic motivation. One type is the factor about task closure and another about the task of achieving the level of aspiration.

Task closure is about the chance to complete an unfinished task. The children often wanted to solve a problem they caused themselves that they did not anticipate earlier, but at the moment are facing. They often wanted to complete a task they are at the moment doing, for example, when the child is still at the stage of designing the house when the bell rings. The child had not had the chance to go to a new mode they have not yet experienced. The child had therefore missed seeing what happens to the characters that live in the condition of an unlimited income.

The children refused to stop at this stage because they have not reached the sense of completeness. The drive is so much greater than any other drive one could imagine and to stop them at this stage is the most frustrating moment for them. Therefore the level of engagement at this stage on and beyond is at its highest.

However, patterns in the graph representation of the children have shown that dips do occur at some stage or other. When comparing the two experiments, dips are single drops before a rise for Condition 2, usually at the second or third initial intervals. But this is not true in Condition 1. From the study it was found that there were many more dips in Condition 1 than Condition 2. In other words the children's feeling at this situation is more turbulent.

The reason for this must be sought in the differing conditions each experiment imposed on the child. Money is limited in Condition 1 and unlimited in Condition 2, so much so that in Condition 2 the child is in a partially free condition with unrestricted resources and therefore is free to build and buy anything. They never reached the necessity to be in the 'live' mode in order to get more money. Money was always there. Since there is no need to find more money life management becomes unnecessary.

After acquiring the operative skills the children moved on and became more engaged in the game. There is so much to do "physically" in this virtual space, to decorate the house, to build, to extend, etc. Creative design became the primary interest and the line separating game play and creativity disappeared so much so that the children forgot that they were only in one mode, the construct mode. Therefore the agony of facing a change in mode, e.g. from 'build' to 'live' mode, diminished and this caused the number of dips to decrease.

Therefore the reason, for having only a single drop before a rise in Condition 2, is because the children did not have to experience a change in mode or interface. They were always in the build and buy mode when asked to stop. In Condition 1 the children were in a situation full of uncertainty and beyond their control. They could not anticipate what happens next and there was always the fear of losing control especially at the early stages of this session.

But as the child continued and when the child had acquired the skills to control and master the steps to take when a problem occurred, his anxiety shifted from one of acquiring skills to "what if" and "what next". Here game play becomes the main issue. This is where the levels of aspirations come into place. Now, the ability to

solve a new problem becomes a challenge and not a hindrance and therefore the child sustained the highest level of engagement. At this point dips become a thing of the past. It is also here that we see that it is not the interactivity that resulted in engagement but the inner drive of wanting to do more to overcome the challenge. This is also a moment when the children became addicted to the game.

### **5.12. 2 Gender and Age Perspective**

This study also has gender and age variables. From the study it could be concluded that even though all the children are engaged in some way or the other, it was found that there was no significant difference of levels of engagement across gender and age. Both sexes are equally engaged at some point or the other. However, there is some evidence that there are differences in the way each individual approached the game. Boys tend to be more conscious about strategies, for example, creating short cuts to achieve tasks whilst the girls seem to go by the rules.

There were also no significant difference in engagement scores for the three age groups (9 to 10), (11 to 12), and (13 to 14). Their patterns of engagement scores are similar in so many ways. Only the way they approach certain game strategies differs across age. For example, in one case of building a house, one older child could relate that when he or she created a big family he or she expected the house they built to be big, but for the younger child the reason often comes at a much later stage. Most of the younger children started off building a much smaller house layout as compared to the older children. Whatever the differences in approach and strategies, when engagement is concerned, the patterns of scores remains pretty much the same across age and gender. This gives an implication that The Sims can let them all play it the way they like.

### **5.12. 3 Important Variables Contributing to Engagement**

#### **a. Intrinsic Motivation**

One of the most highlighted factors that contributed to this discussion is the psychological implication that has been derived from findings in this study. The most prominent psychological implication is the drive from within that is the intrinsic motivation the user has towards the application. In most of these cases, the motivating factor that kept the children going and not wanting to stop is the drive of completing a task referred to as task closure. The fact that they did not want to stop

is because their tasks have not finished. They expected to do some more and when told to stop they felt as though it is hanging. That is the feeling they did not want to go back home with, so they begged the researcher to continue with it or simply just did not want to budge when asked to do so.

Another factor is the factor about levels of aspiration. This is about wanting to achieve a certain level of attainment. Having achieved one level makes them want to proceed to achieve a higher level, a bigger challenge and the drive of wanting to solve these challenges or problems to get on to a much higher level of challenge is known as level of aspiration. It is at this level that children became addicted to the game.

#### **b. Clear and Precise Instructions**

Another factor that has emerged from the study was the element of getting the right instructions or help. The study shows evidence that if the child was given some form of guidance especially if the guidance or instruction is precise and clearly understood by the child, the circumstances that follow during the child play is much smoother and this could therefore increase their levels of engagement.

This is especially true for children who failed to be under control at the beginning of the game. The children seemed lost and did not know what to do. If left unattended there is a possibility that the child would have left the session without completing it. From here it is evident that clear instructions from the multimedia application itself on how to operate and play the game is very important to a child. If this is not so, a child might just leave the game.

In The Sims, a tutorial mode was created to help the child to learn how to play the game. The multimedia application allows the child an option to use or not to use it during the interactive session. The application therefore was able to cater for both novice and expert users. This in a way has managed to increase the child's degree of engagement and could be considered as one of the contributing factors to the matter of engagement.

Having clear instructions set the goals right for the children. It is through intrinsic motivation from these goals that the children moved their emotional stand from

trying to complete a task as designated by the designer to a task they set themselves.

### **c. Collaborative Learning**

The study also implied that learning from peers seemed to be more productive when compared to learning from adult (the researcher). The child seemed more relaxed and asked more questions. But when the child had acquired the skills of playing the game the child would much prefer to play solitaire. Having other children during this session posed some form of nuisance to them. Dominating characters will be the ones that wanted to take over the game or the ones who will interfere or give instructions on what to do or not to do.

## **5.13 Summary of Findings from Study 2**

The study demonstrated that children found interacting with the Sims an engaging experience and this provides some initial support for the argument that an application with the five interactive features identified has engagement potential. The average engagement score for the unconstrained condition was 9.1 and for the constrained condition was 7.8, both within the range designated as engaging. It was hypothesised that the unconstrained condition would be more engaging because it provided richer interactive possibilities and there is support for this hypothesis. However, the data demonstrates a complex pattern because, in both conditions, the children achieved the maximum level of interaction at the end of the session. The difference between the conditions is that the children took longer in the constrained condition to achieve high levels of engagement and showed more variation in their scores than the children in the unconstrained condition. In relation to the five features identified as important, immediacy, feedback and goals were the same in both conditions. However, the constrained condition led the children into the simulation mode whereas the unconstrained condition meant that the children could stay in the construct mode throughout the session. This suggests that the construct mode has the greater potential to provide high levels of engagement. This conclusion will be examined more systematically in study three.



## 5.14 A Preliminary Engaging Multimedia Design Model

This study provides initial evidence that the five factors: simulation interactivity, construct interactivity, immediacy, feedback and goals that were suspected to engage children were truly important in determining children's engagement levels. The study has successfully highlighted how these features seem to engage child at some point in the game.

Therefore to create a multimedia that could engage children, the design features should include these features. If a model is to be built from it, a Preliminary Engaging Multimedia Design Model should include:

- A feature that allows them to build or create, **construct interactivity**
- A feature that allows them to role play and be in control, **simulation interactivity**
- A feature that allows them to be able to do it quickly and get immediate responses- what happens when you press this button, move this mouse to a certain direction, etc.- **immediacy**
- A feature that gives a kind of feed back or results preferably an immediate one and not too delayed -**feedback**
- A feature with goals directed for them or initiated by them -**goals**

It is from these factors the following chapters will be developed, that is, on designing, testing and redesigning An Engaging Multimedia Design Model for Children.

# Chapter 6

## An Engaging Multimedia Design Model for Children

### 6.0 Chapter Outline

The Engaging Multimedia Design Model described in this chapter was developed based on the analysis of findings of Study 2 in the previous chapter. This chapter will describe in what ways the five contributing factors during a very engaging experience for 16 children could be developed as a theoretical model to be tested in the next experiments.

#### Thesis Structure

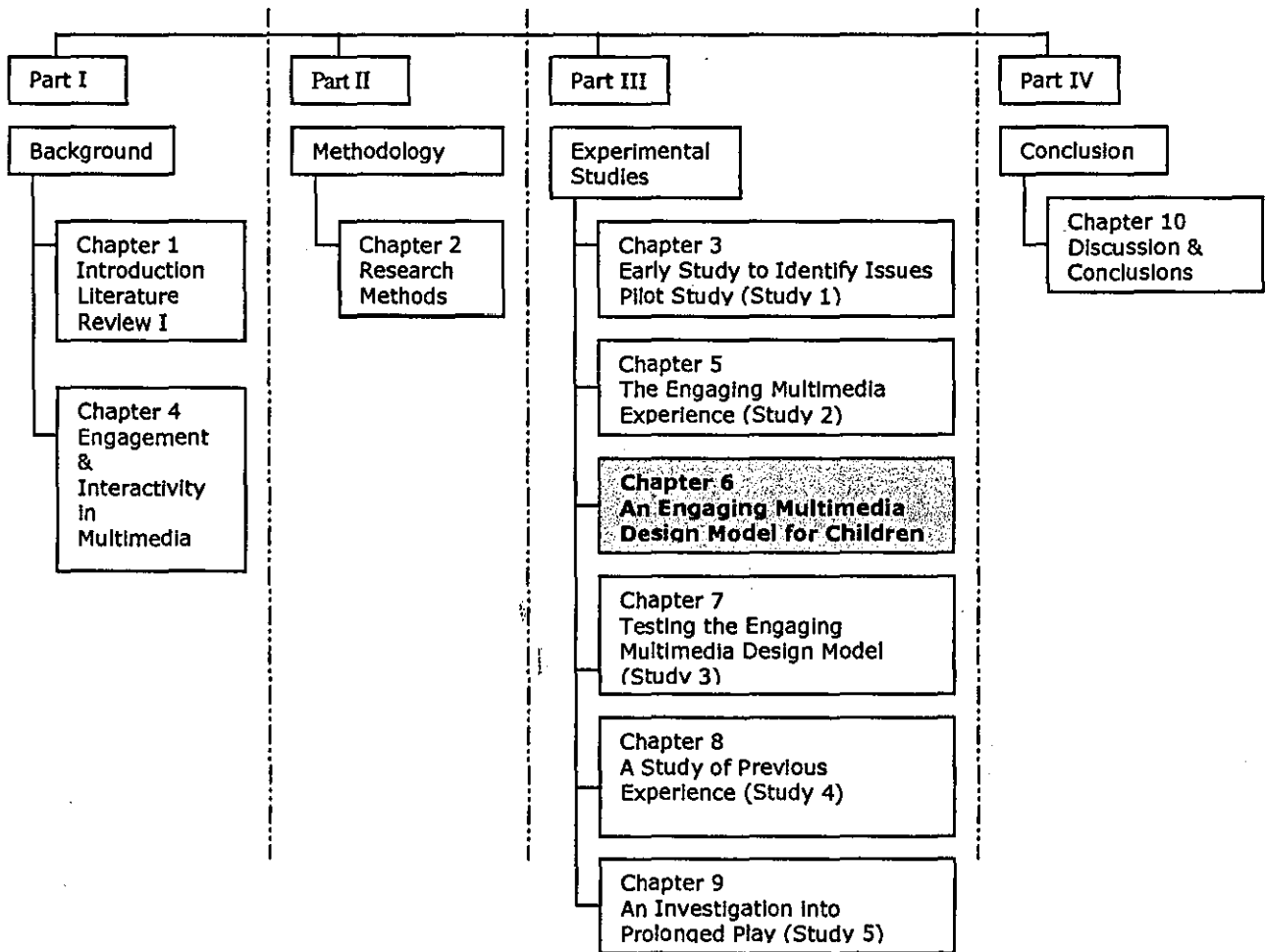


Figure 6.1: Chapter 6 in the Thesis Structure

## 6.1 Introduction

The first generation of children to grow up in a digital environment has been targeted by many digital industries who are attempting to create products targeted for children's use. Having gone through periods of success and failure, the educational software that was supposed to enrich and widen the child's "window" on the world has, to the disappointment of some designers and producers, generally failed to capture the interest and engagement of children.

A Design Model representing what children want in a multimedia application designed for them could prove to be useful for designers and evaluators to design systems that are both engaging and educational for them. This chapter will try to develop A Preliminary Engaging Multimedia Design Model from the experimental studies that had been conducted so far.

## 6.2 Models of User Behaviour

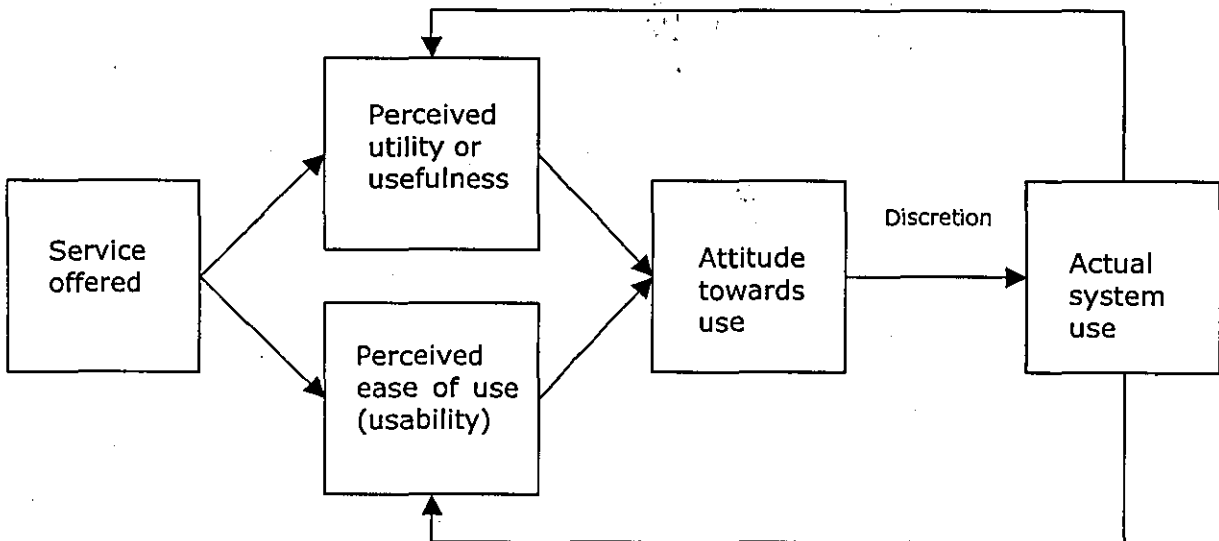
Before the model could be developed and tested it is useful to look into other models that have already been used to describe user behaviour with systems. Perhaps a look at other models could give a better insight in developing this model. Even though they might not be directly connected to children as users, it might help to give an insight into user attitudes and what users bring with them when interacting with systems designed for them.

### 6.2.1 The TAM Model

This model, **Figure 6.2**, was published by Davis (1993) is described in Eason (2003). The Technology Acceptance Model (TAM) presents factors that define end user's attitude to a technology service. In the model attitude is "a product of the end user's perception of the utility or usefulness of the service and the perception of its ease of use or usability". This model states that products that have high utility will still be used by users even if they have poor usability but whenever the utility value is marginal poor usability may result in "non-use of the service".

A modified version of the original TAM framework was made in Eason (2003). To Eason initial attitude towards use depends a lot upon the amount of discretion the user has in actual system use. If a user is free to choose to use or not use a system, "high-perceived utility" becomes prominent even with poor usability. However in most circumstances:

A person at work who is required to use a service may have no alternative but to persevere with poor usability. Actual system use provides feedback for the user which changes perceptions of utility and of usability. Unfortunately, all too often, it is the use of the system that reveals the usability problems and reduces the range and frequency of usage. (Eason (2003) p.4)



**Figure 6.2:** The TAM Model Factors Affecting End User Behaviour (After Davis (1993)) in Eason (2003)

This model is designed to explain what factors affect usage when the user has a task which may be largely externally defined. The user then has to judge how relevant the system is to the task in hand. In these circumstances whether the user is engaged by the system is less relevant – the user may have to go on using it to get their task done. In the present context the children are not given tasks by external agencies; the tasks (or goals) come from themselves and the application and they have to find intrinsic motivation to continue with it. This is where the features of the system that support engagement become important. Nonetheless, the model draws attention to the relationship between goal achievement and the usability of the system and there are important questions about how feelings of engagement would be affected if a child experienced usability problems.

### 6.2.2 Mental Models and Data Models

Another factor that can affect how users interact with the system is what they bring with them during interaction. Woodhead's (1991) description of the effects

of mental models and data models in the development of hypermedia systems and materials made us realise that users do bring with them some form of mental model when interacting with a system. According to him a user comes to a system with at least three models.

One model is at its most general level, that is, his or her "entire cognitive framework – comprising abilities, experience, attitudes, and expectations" According to him certain factors within this framework, such as spatial, logico-mathematical or verbal ability, can be quantified according to established psychometric scaling techniques. Another two models would be of the system itself (or any other computer-based system which he or she has had experience), and of his or her goals in relation to that system.

According to Woohead (1991) it is important that a system designer seek models that fit a community of users, a process referred to as 'accommodating' or 'affording' the user's interests.

The designer needs to provide a conceptual model that the user will be able to accommodate. This may draw on the user's specific computer experience and also on more general cognitive abilities and experiences. In other words the functional emphasis of the system and the structure of any given application must be sufficient to support the community of users across a range of requirements that cannot be completely specified in advance. (Woohead (1991) p. 136)

This kind of model draws attention to the fact that the children will come to the use of any multimedia application with attitudes and skills that are the result of previous experience and these will influence their experience of engagement. It is the features of the system plus the features of the individual that define whether an application will be found engaging.

### **6.3 The Engaging Multimedia Experience of Study 2**

From the findings of Study 2 it was found that the children had a very engaging experience by the multimedia application given to them. The average engagement score for Condition 1 was 7.8 and Condition 2 was 9.1. Both these scores were at the higher end of the scale demonstrating that the application was engaging for all the 16 children. All the five main factors identified earlier (simulation interaction, construct interaction, immediacy, feedback and goals)

that were suspected to engage children seemed to make a contribution to these results.

The first part of this chapter will review these factors that seemed to matter for a child to become engaged to it. Thereafter the factors are examined to create a provisional model. The model will be compared to other existing models and an experimental programme will be formulated to test the model.

## **6. 4 Designing for Children**

### **6.4.1 Usability that matters**

Does usability matter to children? Of course it does but what would be their reactions to system with usability problems? In a study about Usability of Websites for Children Norman (2002) found that the common belief amongst designers that children could master computer technology easily was wrong. Norman found that children were incapable of overcoming many of the usability problems in current websites. Many aspects of poor usability caused children to leave a website because they did not have the patience to prevail when faced with complexity.

To some extent, this finding has some bearings on the present study; children do leave an application that has poor usability especially when the study is about a moving target like the use of websites. When a system is more "physically" available like multimedia in CD form in Study 2, however, it was found that even though the children did get impatient when a design feature hinders the flow of the game e.g. the tools used to build the fence of the house in the Sims, the children did not leave. The circumstances were somewhat different in that they did not give up when faced with this complexity but sought help either from peers or the researcher or they kept trying and learning by trial and error. They did however express the difficult time they had in mastering it.

Therefore from this study it could be seen that if a child is engaged on the material that is in front of them they are willing to confront the difficulties. If the materials do not have this potential, even if they have lots of information and well designed interactive features in them, they will disregard it and abandon the material. An example of this situation in the Pilot Study could exemplify this statement.

When the multimedia about "The Ultimate Human Body" by Dorling Kindersley was given to a child she said, " there is too much information in here... I do not know where to look first... either to press this key or that key... ahhh...I give up."

Since the multimedia game itself, besides the element of game-play, had design features that successfully captured the child's intrinsic motivation the difficulty of the operative tools in The Sims did not hinder them. They wanted to try to overcome the problem. Their attitudes are similar to that of adult users as described by TAM when they used a system of high task utility, even though utility is not equivalent to engagement, people will overcome usability problems if they are fully engaged. Thus usability issues did not hinder children in being engaged in an application when the multimedia had features that made them want to stay engaged. This usability may be important but the primary concern has to be how to capture children's imagination so that they become engaged with the multimedia. A system could be very easy to use but still could not capture their imagination because it is boring or simply disinteresting.

#### **6.4.2 Design features that matter**

Some design principles are important but are not necessarily features that will engage children. Click able affordance design features could help users in their interaction with a system e.g. some overly flat-looking graphic could be primitive compared with a 3D version, but that does not necessarily mean that the 3D version could engage children more in the system. Some design features in interfaces could even confuse users. Design features that matter do not necessarily have to be something sophisticated and complex. Simple drag and drop, scroll bars, hot spots, etc. could be as engaging as anything else. It is not what it is that counts but what it is used for.

Looking at children and their behaviour can produce surprising insights that differ significantly from what we, as adults, perceive of them and their capabilities. Csikszentmihalyi (1997) in Norman (2002) says that children's activities and content preferences tend to appear illogical and spontaneous. Many adults conclude that most children are impulsive, irrational and seek only immediate thrills without any thought to consequences. A positive view is that children often act creatively on the basis of curiosity. However, children can easily be discouraged from trying something again if they experience disappointment and dissatisfaction when they interact with a multimedia application. Therefore it is

not so much the matter of what design features the multimedia has but what it can do to boost children's imagination that matters most.

Even though children love some tools that are easy for them to use, the fact that they are easy does not mean they will also be engaging. It depends a lot on the interactive actions that children experience when using the design features.

### **6.4.3 Initial hypothesis of what could be engaging**

Children liked something they can interact with. Early suspicion in this research programme that it was the number of interactive design features that mattered when designing for children was not supported by the results of the Pilot Study. The multimedia application may include interactive design features but this did not necessarily mean it could cause engagement levels to increase. The chosen CDs for the pilot study had many interactive design features but this did not necessarily mean the children wanted to use them.

Another initial hypothesis was that the higher the level of interaction the application has; the more engaged the children would be. A virtual reality (VR) environment would, for example, give a child the highest level of interactivity but would it be very engaging for children? The findings from Study 2 suggest that the whole issue is not about the level of interaction, or about number of features. Study 2, however, has demonstrated that that engagement with multimedia has to do with giving the children a high quality experience.

## **6.5 The Five Main Factors for an Engaging Multimedia Experience**

Study 2 created conditions that gave all the sixteen children an engaging experience. Therefore there is something about these conditions that is worth reviewing in order to build An Engaging Multimedia Design Model for Children.

Five factors were identified as important when creating the conditions in Study 2. Could a model be formed from these factors? Could the factors be separated or "dismantled" so that they can be tested? It would be interesting to build a multimedia application that incorporated these factors and test them one at a time to see which factor is most or least engaging. But to build a multimedia application of this kind would be difficult. An alternative is to look at a popular list



of multimedia applications and work backwards, i.e. choose something, which manifestly includes all the required factors, and then to test it by isolating the factors for separate study. Therefore, it is The Sims that will continue to be used to develop, test and restructure the model.

The five factors were as follows:

### **6.5.1 Construct Interactivity – allowing children to build something**

Construct Interactivity is a design feature that could serve a child's need for something that allows them to create. In The Sims this design feature was in the Create A Family Interface and the Build and Buy Mode. In Study 2 this feature was highlighted most in Condition 2 (**ULM\$ - F Loc - Fbu/ By FmG**) – Unlimited Money, Free Location, Free Build and Buy, Family Given. An experimental condition could be designed to focus on this feature alone.

### **6.5.2 Simulation Interactivity – allowing children to control events and objects**

Simulation Interactivity gives children a chance to play a role and to be in control. Simulation interactivity in The Sims could be got from the Live Mode. Condition 1 highlighted this feature (**LM\$ - 2 Loc - MBuFCFm**) – Limited Money, 2 Locations, Must Build, Free Create Family. It is also possible to design an experimental condition that allows the children to interact with this feature alone

### **6.5.3 Immediacy**

Being able to see what happens when an input device is used seems to be a very important factor to computer users. This is a kind of feedback that affects the dynamics of an interactive activity – the rapid input then output that produces a smooth flow of interaction. We have termed this feature immediacy. Direct manipulation allows the user to "feel" themselves moving and interacting with the interface by moving the mouse and seeing the result on the screen.

In The Sims this feature makes the interactive activity meaningful to users. This feature is seen in both experimental conditions in Study 2. This feature is used in simulation and constructs interactivity. In the live mode, it enables the user to manipulate and control the activity of the characters in the family created by

them. In the build and buy mode it enables the user to move things, position things, delete, build and create, etc.

This feature exemplifies the importance of a trace we make when we write with a pen or pencil; how would we feel if the pen or pencil we write with did not leave a mark? How do we feel when the "button" we press does not give an immediate trace, a mouse movement that does not move the cursor, etc? Therefore, immediacy is an important feature to consider in an engaging design model.

#### **6.5.4 Feedback**

Feedback is in some way related to immediacy but is not limited to an immediate response by the system to an input. It can also be longer term outcomes such as whether the higher level goals of the user have been achieved. "Physical" feedback in The Sims tends to be immediate, e.g. seeing the form of the house as the child builds it, looking at the impact of furniture placing as the child decorates it, etc. But feedback in The Sims can also be of an "emotional" or "psychological" form. Such forms tend to be delayed. The child playing with this game will face the consequences of their actions. The characters they create will make demands on them and the feedback is usually not immediate but a bit delayed. E.g., a character they created with a lazy (unhygienic) personality may later prove difficult in maintaining a hygienic environment. From the Pilot study, it was seen that children preferred immediate and not too delayed feedback. They preferred getting answers from quizzes in multimedia rather than looking for the answers in books.

Delayed feedback tends to dissuade children from playing a game. "Cyber Pet" is an example of a computer design feature used by children that is an example of delayed feedback. Hand held Cyber Pets are better than having them on a screen. The pet has to be nurtured. It needs to be fed and taken care of so that it grows, etc. This is easily done hand held. But when the pet concept was designed as a multimedia application, the children got impatient because the feedback on the actions they took were not immediate. The Sims delayed feedback seems to have been not too delayed since children did not have to wait long to see the results of their actions. Thus, the feedback sustained the interest of the children in the effects of their actions.

### **6.5.5 Goals**

Goals could be set by the designers or they could be set by the children. Most early goals are directed by designers but when the child wants to continue playing the goals are set by the child. From Study 2 it seemed that it was these goals that led the child to be engaged with the game. When the goals were clearly and precisely stated, as set by designers in the manual, etc. or as the child got them from their understanding of the game through learning by doing, from peers, etc. the goals factor become an important feature in keeping them engaged.

Both studies, the Pilot Study and Study 2 demonstrated the impact of goals on engagement. The absence of extrinsic motivation in the form of a set goal in the Pilot Study contributed to the children becoming disengaged with the multimedia applications. The presence of set goals and opportunity to set their own goals in Study 2 led to the children wanting to continue to play to attain a level or complete a task. Therefore, goals need to be included as a feature in the engaging model.

## **6.6 An Engaging Multimedia Design Model – A Preliminary Model**

The development of a preliminary model went through several stages which are reported below.

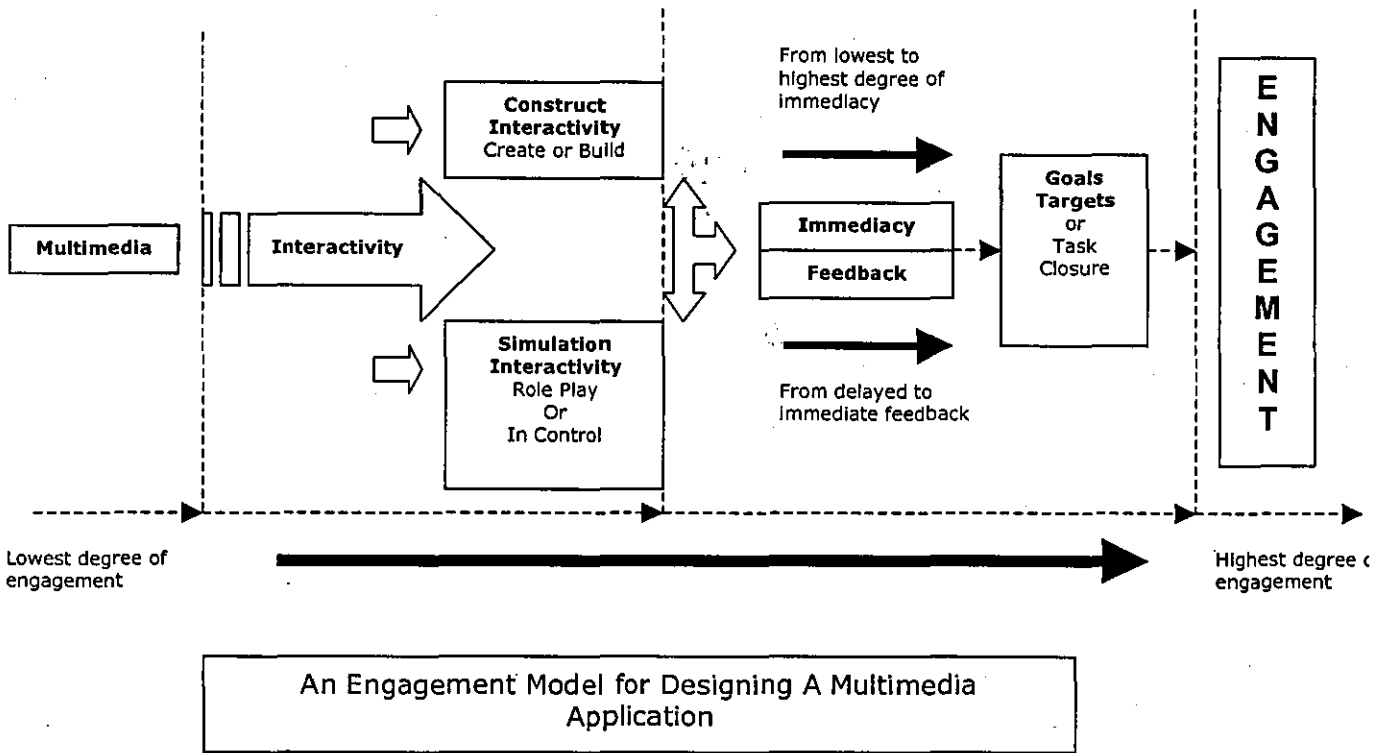
### **6.6.1 Stage One**

**Figure 6.3** below shows an early attempt at a model, which takes into account the degree of engagement from the lowest to the highest level, moving from left to right.

From Study 2 there are two features in the Sims that seems to be quite easily separated, the construct and the simulation interactivity. Both conditions in Study 2 have shown the capabilities of these features, but still in the interactivity domain. Thus, this feature is in the interactivity box in the model.

Further observations also revealed that there is a connection between immediacy and feedback, having immediacies from the lowest to the highest end of quick and immediate feedback to actions taken and feedback that ranges from delayed

to immediate. All these features are in some way connected to goals or targets or task closure.



**Figure 6.3:** An Engagement Model - A Preliminary First Attempt.

Whilst this diagram captures all the relevant factors, it does not explain the connections between them. Close observation in studies 1 and 2 has revealed that some of these factors are interrelated and intermingled so much so that engagement will only occur when they are all present.

### 6.6.2 An Analogy

An analogy was explored to try to understand the intentions of the features better. Consider a basic modern transport vehicle. There are certain features in a vehicle that needs to be there and must not be taken out when transporting something. Basically it needs an engine, some technical instruments to control it like a steering wheel, etc, a chassis as a base and tyres to connect it to the road (**Figure 6.4**).

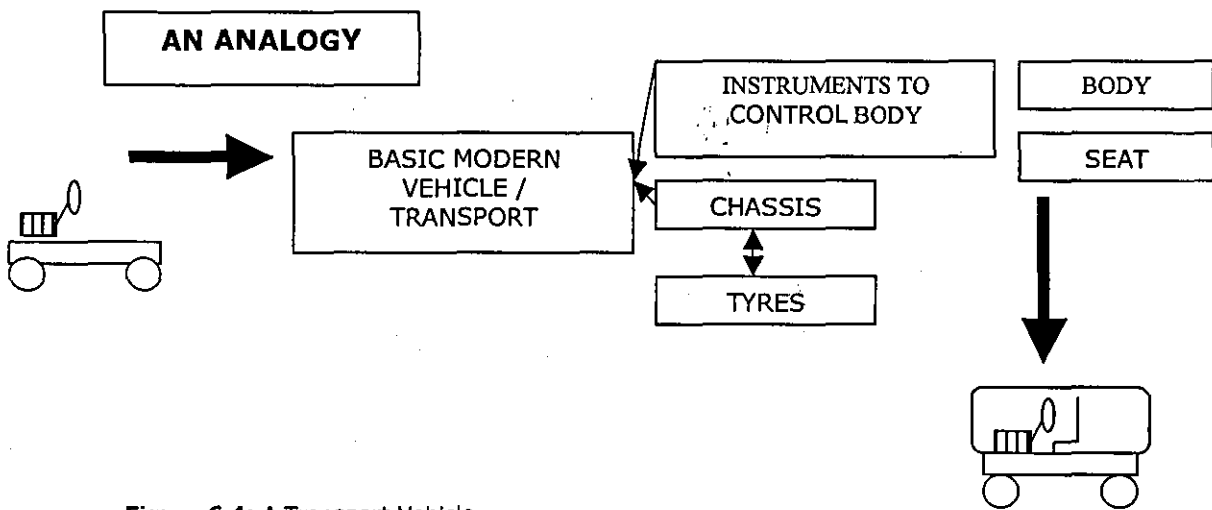
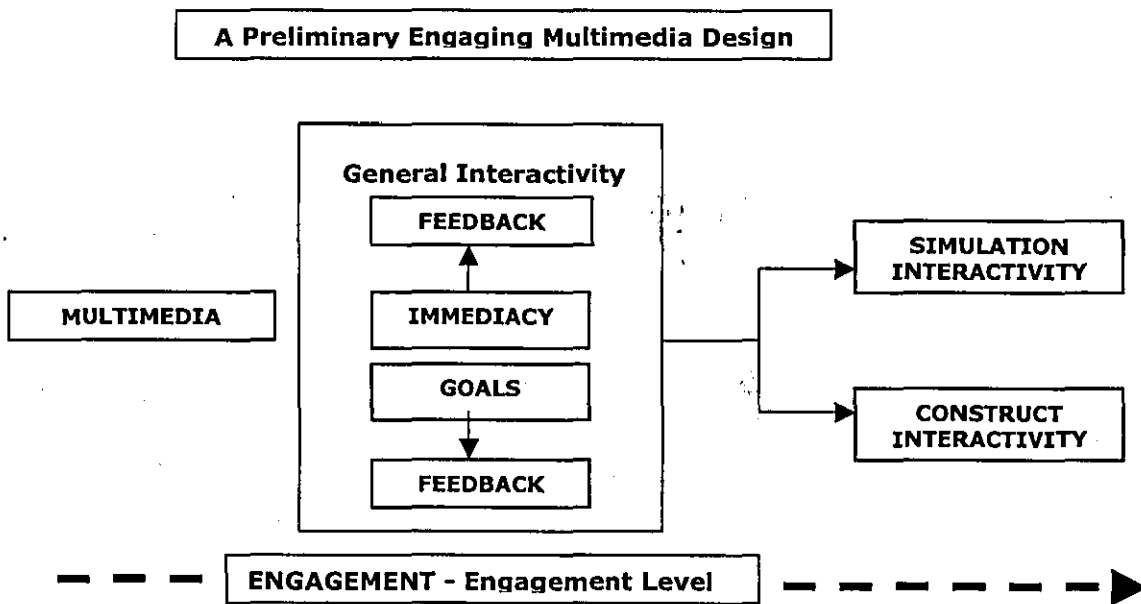


Figure 6.4: A Transport Vehicle

In this analogy many of the features have to work together to provide a means of transport from one place to another. The engine has to be in a chassis and that has to have a means by which the power of the engine is transmitted to the tyres. With these features the vehicle can move. But it can only be directed to a particular destination – to achieve a goal- if it has a steering wheel. A seat for the driver is obviously a good idea if the person is to be comfortable but is not actually a necessity in the way the other features are.

This model has the equivalent of a motive force and a means of directing the force to a selected destination. If this is transposed to the engagement model, then the multimedia is like the chassis and immediacy and feedback are the means of getting it to do something and knowing it had done it. These features have to be present if the person is to interact with it and have an opportunity to be engaged to it. Having goals is the equivalent of having a destination to go to. Simulation and Construct interactivity are like two major areas in which goals can be pursued. They do not both have to be present for an engaging experience to be obtained. The engagement model has been reorganised to represent these ideas in **Figure 6.5**.



**Figure 6.5:** A Preliminary Engaging Multimedia Design Model

The main proposition in this model is that, to be engaging, all forms of the general interactivity features have to be present in the multimedia application in a form the child can use. It appears that either simulation or construct interactivity can further add to the sense of engagement.

## 6.7 Conclusion

The model above (**Figure 6.4**) is preliminary and needs to be tested before it could be finalised. Some of the features identified earlier are inseparable: immediacy, feedback and goals. They appear to be in the multimedia at varying levels – lowest level of immediacy to that of the highest level; varying types – immediate to delayed feedback; varying tasks or goals – directed or non-directed. Immediacy, feedback and goals could be seen in construct experimental condition and simulation experimental condition. Therefore, to “dismantle” them to test what contribution they make to engagement is not a practical proposition.

However, there are two design features that can be tested separately to find similarities and differences of engagement levels between them. They are Construct and Simulation Interactivity. From the Pilot Study and Study 2, there is

evidence that these two features had some effect on the engagement patterns of children using them. Which type is more engaging than the other?

Having features that provide interactivity would probably, only highlight the degree in engagement achieved. What about non-interactivity? The model suggests that non-interactivity will lead to non-engagement. In order to test the model, there must be another experimental condition that would test this proposition. Therefore, the other element to test is the engagement level achieved with no interactivity.

The next study will therefore test this preliminary model in three experimental conditions:

1. No Interactivity
2. Simulation Interactivity
3. Construct Interactivity.

# Chapter 7

## Testing the Engaging Multimedia Design Model

### 7.0 Chapter Outline

This chapter presents and analyses findings from Study 3, an experiment to test the Engaging Multimedia Design Model developed in Chapter 6. It describes issues about methods used and characteristics of respondents. Results from the study will enable the researcher to determine forms of further investigation in later chapters in order to help develop the Engaging Multimedia Design Model to its final form

#### Thesis Structure

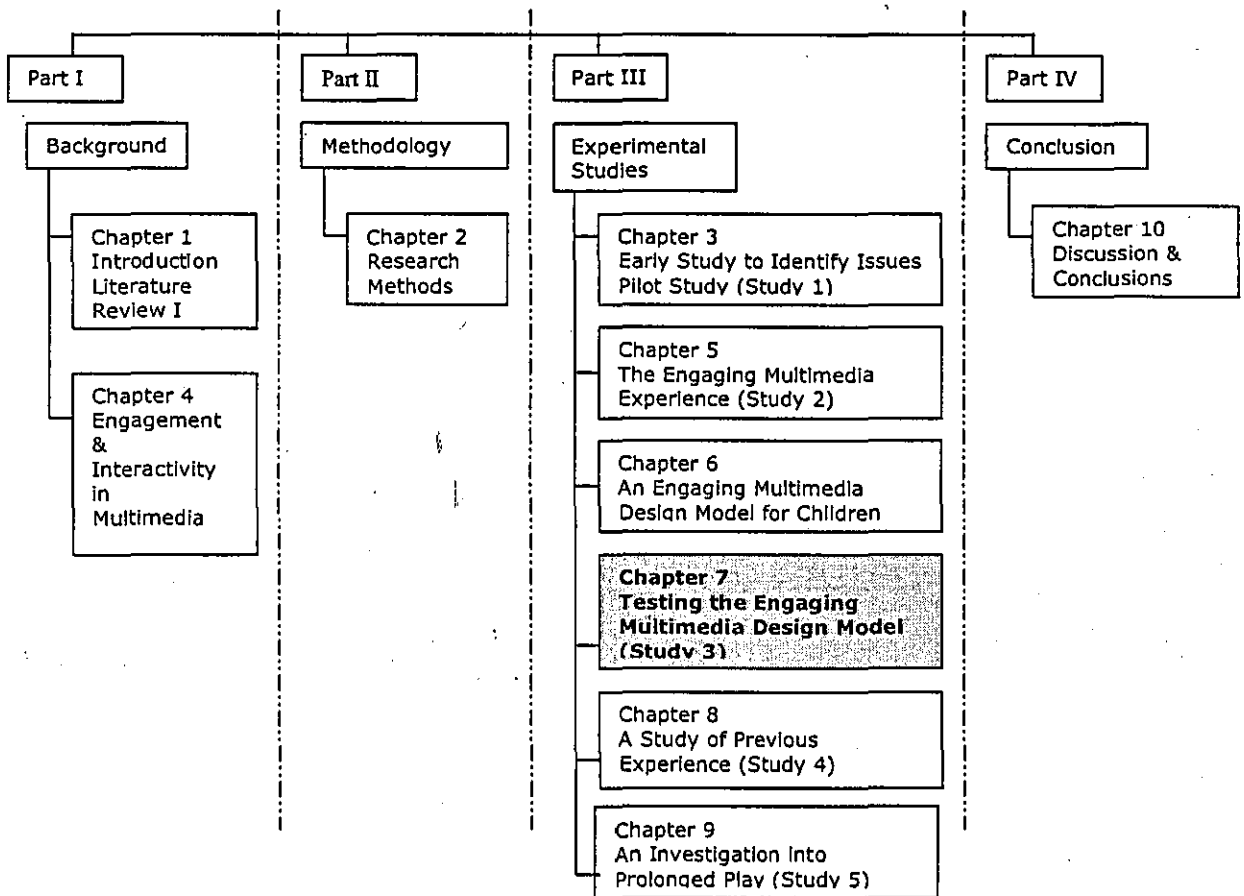


Figure 7.1: Chapter 7 in the Thesis Structure



## **7.1 Introduction**

After an intensive observation of the experimental situations in Study 2, an engaging multimedia experience, An Engaging Multimedia Design Model was formulated. The model is still a preliminary one and there is a need to do a study to see whether the factors suspected to be engaging as suggested could truly be reflected in the model. This could only be done by doing a study to test the model.

## **7.2 The Purpose of Study**

The purpose of Study 3 was to test the model. The Study will try to "dismantle" some parts of the model to test what contribution the five engaging factors (simulation interactivity, construct interactivity, immediacy, feedback and goals) make to the patterns of engagement.

In this study there will be a no-interaction condition in which none of the five factors are experienced by the child, i.e. they will not use the input devices and will not therefore experience immediacy or feedback. Their only 'goal' will be to passively watch. The proposition is that this will prove a non-engaging experience. There will be two 'engaging' conditions. The 'simulation' condition in which the entire general interaction features will be in place within a simulation role-play activity. There will also be a 'construct' condition in which the general interaction features will be used in a construction activity.

Children will be assigned to one of the three conditions and sessions will be 40 minutes in length as in Study 2. Measures of engagement will also be obtained in a similar manner and additional data will be obtained by video records and interviews.

Findings from this study may also reveal other factors that matter that will need to be considered in the further development of the model.

## 7.3 Testing the Engaging Multimedia Design Model

### 7.3.1 Introduction

Study 3 was conducted to test the model in three experimental conditions:

1. No Interaction – Condition 1
2. Simulation Interaction – Condition 2
3. Construct Interaction – Condition 3

A full overview of the conditions, what the children had to do in these sessions, and why they had to do it in this way are described in later sections. The next section tells us more about the characteristics of the selected children.

### 7.3.2 Selected Children: age and gender

Twenty-four children were recruited, equally divided according to gender. However the number involved according to age group varied. A detailed description of the subjects' characteristics could be seen in **Table 7.1** below.

Total	Gender	Age groups
24	12 M	(10-11) = 7 M, 8 F
	12 F	(12-14) = 5 M, 4 F

**Table 7.1:** Children according to gender and age groups

When analysing the results another factor was found to be important: the experience of the children with computers and the experience of the children with The Sims. The sample is presented in **Table 7.2**. The abbreviations used are included in all the findings and analysis of Study 3.

<b>Sims Experience (Sims)</b> With Experience = WE Without Experience = WOE	<b>Computer experience (Comex)</b> With Experience = WE Without Experience = WOE
Sims (WE) = 2 M, 2 F Sims (WOE) = 10 M, 10 F	Comex (WE) = 23 Comex (WOE) = 1

**Table 7.2:** Children according to experience

## **7.4 The Methods**

### **7.4.1 Experimental Location**

This study was carried out in as a natural setting as possible over a day in a weekend within a period of four to five months from August to December 2002. The experimenter had to manage two conflicting demands. The experiment needed tight control to get good data but the children had to feel comfortable and secure. For the latter reasons settings natural to the children were chosen.

The natural settings included the children's own home environment, the researcher's home, play areas and weekend extra-class settings. When the child was asked to play in a foreign setting rather than their own home their siblings and friends usually accompanied them. The other children were usually given other things to play with like board games, computer games and play stations while one was called to play a session. The researcher on most occasions managed to avoid other children from interfering in the game. There were also occasions when the child was distracted by his or her interest in the other games that seemed to be happening around when he or she was on a session. Such circumstances could not be avoided, as the subjects are children. The researcher sometimes had to go with the crowd and at times discard the session and try again another time in another setting.

### **7.4.2 Experimental Scenario and Time Span**

Twenty-four children were involved in this experiment. The experiment had three different conditions: no interaction, simulation interaction and construct interaction. Each child did only one of the conditions in a time span of 40 minutes. A standard briefing of how to play the session was given to each child before he or she started the 40-minute session. The child was also taught some basic skills and tools needed for the condition. They were then asked to place their engagement score on an engagement scale of 0 to 10 at 5-minute intervals. A semi-structured interview was conducted to ask the child about his or her reactions to the game.

### **7.4.3 Overview of Experimental Conditions**

Eight children were assigned to each condition, four boys and four girls. Age differences were not balanced in this study since the findings of Study 2

suggested that there was not much difference in engagement patterns across these age groups.

**i. No Interaction – Condition 1**

**a. What the children had to do**

Children doing this experimental condition were not allowed to interact with the multimedia application (The Sims). The application has a set of stories like soaps where users can watch if they did not interact with the application. **Table 7.3** shows the children participating in this condition. They were not permitted to touch the keyboard or move the mouse even when a dialogue box appeared and they wanted a respond. The child watched and listened all through the session of 40 minutes and recorded their feelings about it every 5 minutes.

Total	Gender	Age groups	Sims Experience (Sims) With Experience = WE Without Experience = WOE	Computer Experience (Comex) With Experience = WE Without Experience = WOE
8	4 M 4 F	(10-11) = 3 M, 3 F (12-14) = 1 M, 1 F	Sims (WE) = 1 F Sims (WOE) = 4 M, 3 F	Comex (WE) = 4 M, 3 F Comex (WOE) = 1 F

**Table 7.3:** Children Participating in Condition 1 (No Interaction)

**b. How was this condition set up?**

The researcher chose a family already set by the designer and moved it to a specific location and put the characters in live mode. When the characters did not receive any input they reacted as programmed by the designer. As a result a story about the characters was played out. For the entire 40-minute time span the child had only to look and see what happened to these characters and record their feelings every 5 minutes.

**c. Why was it done in this way?**

The purpose for doing the experiment in this way is to find out whether no interaction would mean no engagement. This outcome would support the hypothetical statement that more interaction means more engaged, less interaction means less engaged, no interaction means no engagement. The findings may help clarify whether the design features of the multimedia without interaction could create some form of engagement.

## ii. Simulation Interaction – Condition 2

### a. What the children had to do

Children in this experimental condition were allowed to play and interact with the application with some restrictions. **Table 7.4** shows the children participating in Condition 2. This condition gave the child a chance to play a role with the characters created for them; they were in live mode in the Sims. They were allowed to interact using the keys but only to instruct the characters to do things in response to the consequences that appeared on the screen resulting from the child's previous moves. The children had to be in control and to take care of the characters; fulfil their basic needs like hunger, hygiene, bladder, relationships, budget, etc and manage their life all through the 40 minutes session and recorded their feelings about it every 5-minutes. They were not allowed to go into any other mode like the build and buy mode.

Total	Gender	Age groups	Sims Experience (Sims) With Experience = WE Without Experience = WOE	Computer experience (Comex) With Experience = WE Without Experience = WOE
8	4 M 4 F	(10-11) = 2 M, 4 F (12-14) = 2 M	Sims (WE) = 1 M Sims (WOE) = 3 M, 4 F	Comex (WE) = 4 M, 4 F Comex (WOE) = none

**Table 7.4:** Children Participating In Condition 2 (Simulation Interaction)

### b. How was this condition set up?

The researcher chose a family already set by the designer and moved it to a specific location. The whole experimental condition was in a live mode. The child in this condition was allowed to play and respond to the dialogue as it appeared on the screen. They were instructed to take care of the characters after a short briefing of how to use the operative tools were given. They were also told some background about The Sims and how it is their responsibility to take care of the characters making them happy and fulfil their basic needs. These were the set goals for the condition. The child had 40 minutes to take care of them and record their feelings every 5 minutes.

### c. Why was it done in this way?

The purpose of this experimental condition is to find out whether the design feature simulation interactivity could cause engagement, at what level, where, when and how. The findings will help the researcher to identify engagement patterns and relate reasons as to why certain patterns conform to certain

conditions and not to others, to compare and contrast looking at similarities and differences with other experimental conditions.

**iii. Construct Interaction – Condition 3**

**a. What the children had to do**

Children in this experimental condition were also allowed to interact with the application with some restrictions. **Table 7.5** shows the children participating in Condition 3. This condition gave the child the chance to use the construct interactivity mode to create, build and decorate a house either bought ready-made or created by him or her until the 40-minute session was over. They were to record their feelings about it every 5 minutes. The only thing that the child was not allowed to do was to “play” with the characters, that is, be in the live mode.

Total	Gender	Age groups	Sims Experience (Sims) With Experience = WE Without Experience = WOE	Computer experience (Comex) With Experience = WE Without Experience = WOE
8	4 M 4 F	(10-11) = 2 M, 1 F (12-14) = 2 M, 3 F	Sims (WE) = 1 M, 1 F Sims (WOE) = 3 M, 3 F	Comex (WE) = 4 M, 4 F Comex (WOE) = none

**Table 7.5:** Children Participating in Condition 3 (Construct Interaction)

**b. How was this condition set up?**

The researcher created a family and gave this family unlimited resources (money) so much so that the child was able to create, build and buy anything. The experimental condition did not allow the child to go into live mode. They are all the time in the build and buy mode. After a short briefing of how to use the operative tools the children started to “play” (creating, building and decorating) using the construct interactivity tools. They were told to record their feelings every 5 minutes.

**c. Why was it done in this way?**

The purpose of this experimental condition is to enable the researcher to see the effect of construct interactivity in the child’s engagement patterns. This condition will help the researcher to see whether a child could be engaged when having only the “create, construct, build, buy and decorate” mode in the application to “play” with. And if it does, to find out at what level, where, when and how. The findings will enable the researcher to identify engagement patterns and make comparisons of similarities and differences in relation to other experimental conditions.

## 7.5 Data Gathering and Data Processing

The data for this study comprises:

- An engagement scale score marked by every child at 5-minute interval for each experimental condition – no interaction, simulation interaction and construct interaction
- A graph plotted of the engagement scale scores of every individual in every condition
- An average score marked at every interval for each experimental conditions
- A graph plotted of the average scores marked from the beginning to the end of every interval for each experimental conditions
- Semi-structured interview data conducted at the end of the experiment
- Video recordings of the sessions, to be studied only when the need arises, to explain some incident noted in the rating scales or referred to in the interviews.

All three experimental conditions used the Engagement Scale Scores in the same way as Study 2, i.e.

- From 5/10 to highest of 10/10, when they felt so engrossed that they did not want to stop
- From lower than 5/10 to lowest of 0/10, when they felt they would not mind stopping or they were bored or had had enough and wanted to stop playing the game.

## 7.6 The Results

Findings in this study were from data collected from the three experimental conditions: the averages of engagement scale scores of each child for each experimental condition; and the graphs plotted of them. This section will present the overall scores and patterns, averages, and some individual cases to emphasise issues. It is from these findings that a systematic analysis of engagement can be undertaken and forms of further investigation determined.

### 7.6.1 Overall Engagement Scale Scores for Each Experimental Condition

#### i. Condition 1 (No Interaction)

The overall engagement scale score per interval for each child doing Condition 1; No Interaction is presented in **Table 7. 6** below. **Figure 7.2** shows the averages of scores per interval plotted graphically.

Engagement Scale Scores for Study 3 Condition 1 (No Interaction)									
Cases	5- mins	10- mins	15- mins	20- mins	25- mins	30- mins	35- mins	40- mins	Average
Case 1 Boy (10-11) Comex (WE) Sims (WOE)	10	8	2	3	0	0	0	0	2.88
Case 2 Girl (10-11) Comex (WE) Sims (WE)	8	7	6	6	3	2	2	0	4.25
Case 3 Boy (10-11) Comex (WE) Sims (WOE)	8	7	5	5	2	2	0	0	3.63
Case 4 Girl (10-11) Comex (WOE) Sims (WOE)	10	10	10	10	10	10	10	10	10
Case 5 Girl (10-11) Comex (WE) Sims (WOE)	7	8	7	9	7	6	5	3	6.25
Case 6 Boy (10-11) Comex (WE) Sims (WOE)	10	6	4	2	0	0	0	0	2.75
Case 7 Boy (12-14) Comex (WE) Sims (WOE)	5	3	4	1	0	0	0	0	1.63
Case 8 Girl (12-14) Comex (WE) Sims (WOE)	4	5	6	2	0	0	0	0	2.13
Average	7.8	6.8	5.5	4.8	2.9	2.5	2.1	1.6	4.22
Total Sum	62	54	44	38	22	20	17	13	270

Table 7.6: Engagement Scale Scores for Condition 1 (No Interaction)

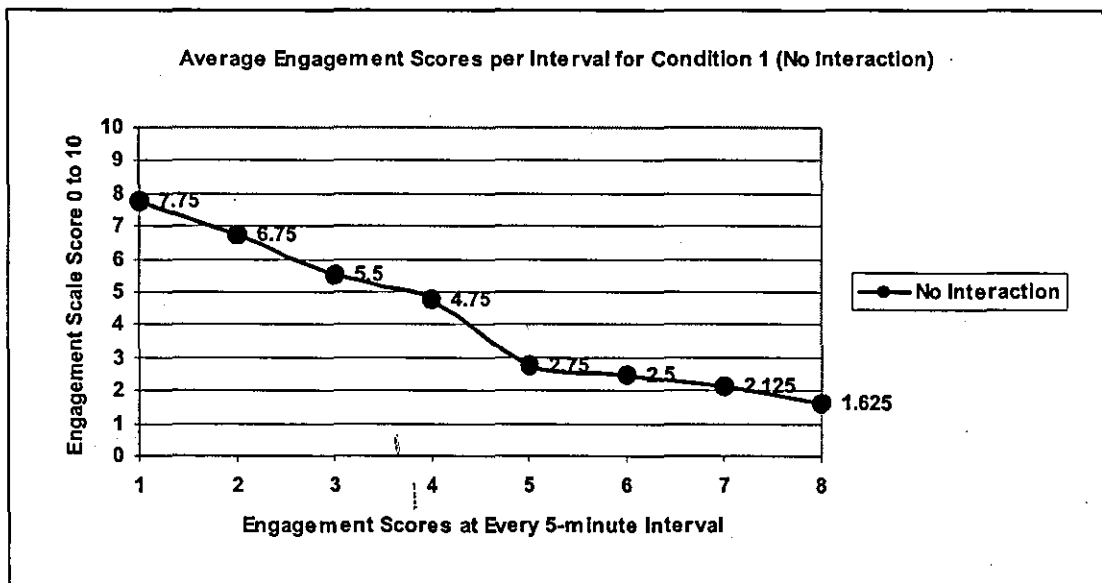


Figure 7.2: Average Engagement Scores Per Interval for Condition 1 (No Interaction)

## ii. Condition 2 (Simulation Interaction)

The overall engagement scale scores per interval for each child doing Condition 2; Simulation Interaction is presented in Table 7. 7 below. Figure 7.3 shows the averages of scores per interval plotted graphically.



Engagement Scale Scores for Study 3 Condition 2 (Simulation Interaction)									
Cases	5- mins	10- mins	15- mins	20- mins	25- mins	30- mins	35- mins	40- mins	Average
Case 9 Girl (10-11) Comex (WE) Sims (WOE)	5	8	7	10	10	10	10	10	8.75
Case10 Girl (10-11) Comex (WE) Sims (WOE)	8	9	7	9	10	10	10	10	9.13
Case11 Boy (10-11) Comex (WE) Sims (WE)	10	9	10	10	10	10	10	10	9.88
Case12 Girl (10-11) Comex (WE) Sims (WOE)	7	8	10	9	10	10	10	10	9.25
Case13 Boy (10-11) Comex (WE) Sims (WOE)	8	9	8	10	10	10	10	10	9.38
Case14 Boy (12-14) Comex (WE) Sims (WOE)	8	9	10	10	10	10	10	10	9.63
Case15 Girl (10-11) Comex (WE) Sims (WOE)	5	6	5	8	6	8	10	10	7.25
Case16 Boy (12-14) Comex (WE) Sims (WOE)	5	6	7	9	10	10	10	10	8.38
Averages	7	8	8	9.4	9.5	10	10	10	8.95
Total Sum	56	64	64	75	76	78	80	80	573

Table 7.7: Engagement Scale Scores for Condition 2 (Simulation Interaction)

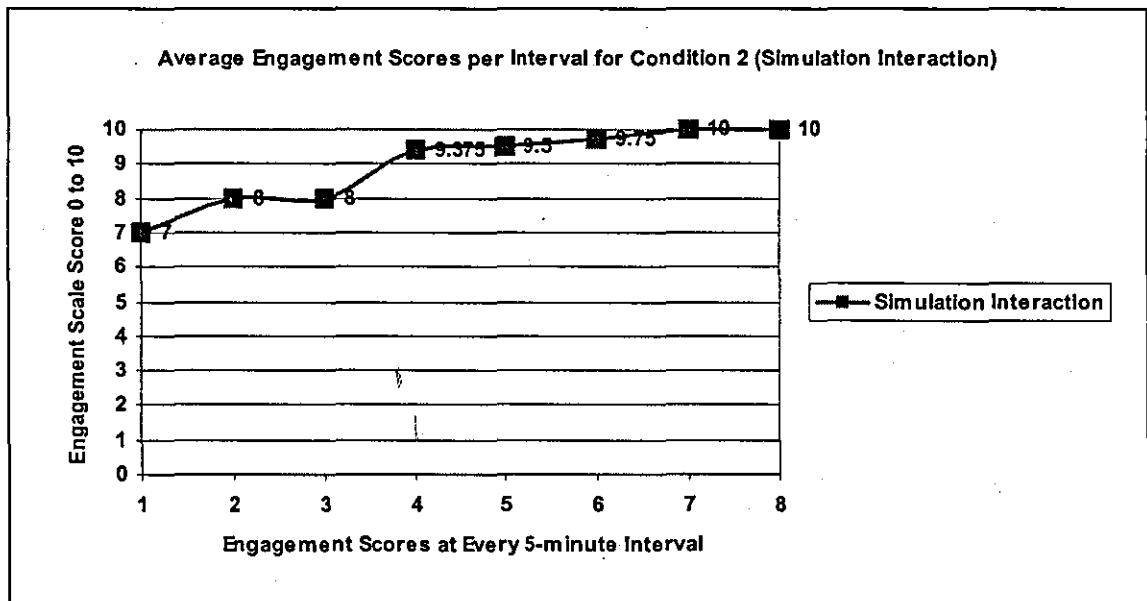


Figure 7.3: Average Engagement Scores Per Interval for Condition 2 (Simulation Interaction)

### iii. Condition 3 (Construct Interaction)

The overall engagement scale scores per interval for each child doing Condition 3; Construct Interaction is presented in Table 7. 8 below. Figure 7.4 shows the averages of scores per interval plotted graphically.

Engagement Scale Scores for Study 3 Condition 3 (Construct Interaction)									
Cases	5- mins	10- mins	15- mins	20- mins	25- mins	30- mins	35- mins	40- mins	Average
Case17 Boy (10-11) Comex (WE) Sims (WE)	10	10	10	10	10	10	10	10	10
Case18 Girl (12-14) Comex (WE) Sims (WOE)	8	9	8	6	10	10	10	10	8.88
Case19 Boy (12-14) Comex (WE) Sims (WOE)	10	10	10	10	10	10	10	10	10
Case20 Boy (10-11) Comex (WE) Sims (WOE)	7	5	9	9	10	10	10	10	8.75
Case21 Girl (10-11) Comex (WE) Sims (WOE)	8	7	7	9	9	10	10	10	8.75
Case22 Girl (12-14) Comex (WE) Sims (WE)	10	10	10	10	10	10	10	10	10
Case23 Boy (12-14) Comex (WE) Sims (WOE)	6	6	7	7	8	8	10	10	7.75
Case24 Girl (12-14) Comex (WE) Sims (WOE)	8	5	5	6	7	8	10	10	7.38
Averages	8.4	7.8	8.3	8.4	9.3	9.5	10	10	8.94
Total Sum	67	62	66	67	74	76	80	80	572

Table 7.8: Engagement Scale Scores for Condition 3 (Construct Interaction)

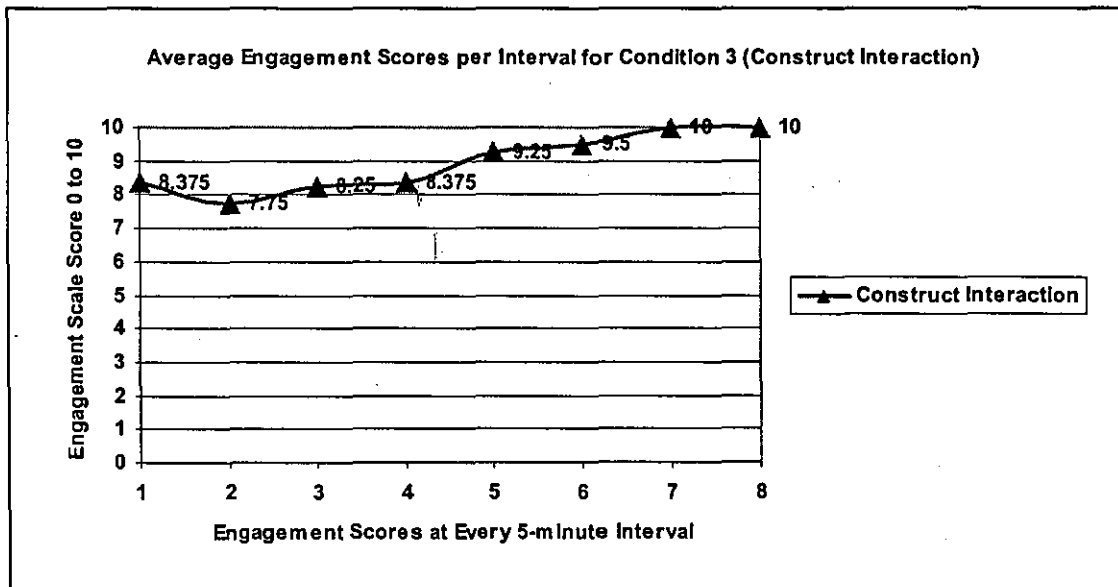


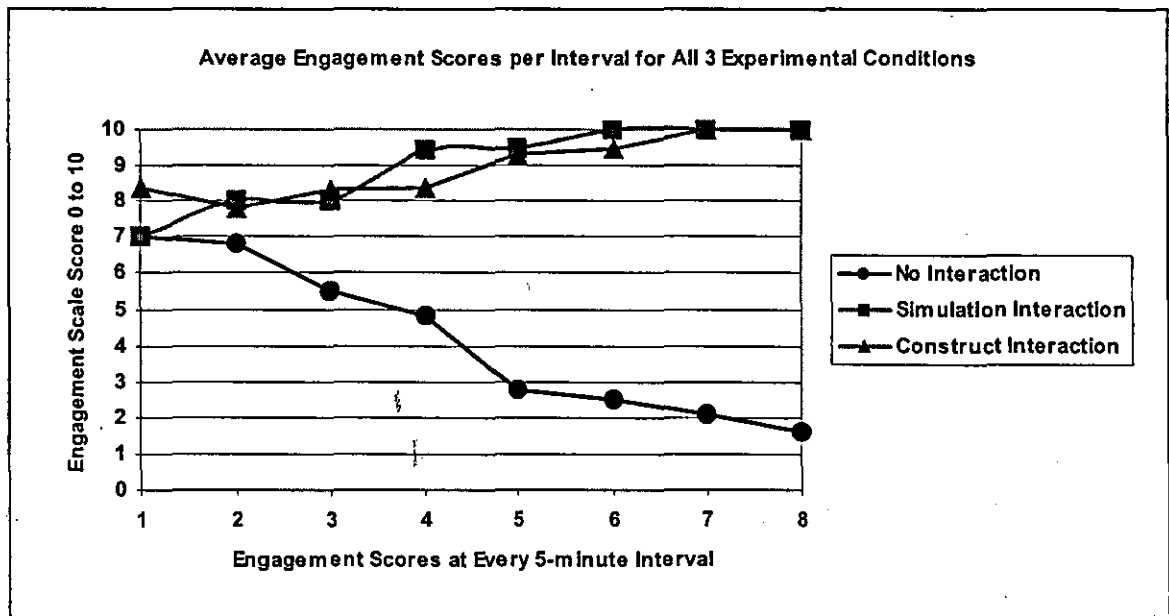
Figure 7.4: Average Engagement Scores Per Interval for Condition 3 (Construct Interaction)

#### iv. Overall Average Engagement Scores Per Interval

When the averages of engagement scores per interval for each experimental condition were put together as in **Table 7.9**, a graphical representation could be seen in **Figure 7.5** below.

Conditions	Average Score Every 5-minute Interval (to the nearest one decimal place)								Total Average Scores
	5-mins	10-mins	15-mins	20-mins	25-mins	30-mins	35-mins	40-mins	
No Interaction	7.8	6.8	5.5	4.8	2.9	2.5	2.1	1.6	4.22
Simulation Interaction	7	8	8	9.4	9.5	10	10	10	8.95
Construct Interaction	8.4	7.8	8.3	8.4	9.3	9.5	10	10	8.94

**Table 7.9:** Average Engagement Scores Per Interval for 3 Experimental Conditions



**Figure 7.5:** Average Engagement Scores Per Interval for All 3 Experimental Conditions

## 7.6.2 Engagement Patterns According to Categorisation as in Study 2

### i. The lowest level of engagement category

One of the ways of analysing this category is to look at the findings comparatively amongst all the three conditions. **Tables 7.10, 7.11 and 7.12** are findings from the 3 experimental conditions respectively. It is useful to note that the lowest level range for Condition 1 (No Interaction) is from 4/10 to 0/10 that is in the disengagement range, whilst the lowest range for both other conditions, Condition 2 (Simulation Interaction) and Condition 3 (Construct Interaction) had their lowest range from 7/10 to as low as only 5/10 which was not very low and in the engagement range.

Lowest Level of Engagement Scale Score Range = from 4/10 and below	Engagement Scores at Every 5-minute Interval for Condition 1 (No Interaction)								Total Score for Each Range
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
4/10	1	-	2	-	-	-	-	-	3
3/10	-	1	-	1	1	-	-	1	4
2/10	-	-	1	2	2	2	1	-	8
1/10	-	-	-	1	-	-	-	-	1
0/10	-	-	-	-	4	4	5	6	19
<b>Total Score per Interval</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>4</b>	<b>7</b>	<b>6</b>	<b>6</b>	<b>7</b>	<b>35</b>

Table 7.10: Lowest Level of Engagement Score Category Condition1 (No Interaction)

Lowest Level of Engagement Scale Score Range = from 7/10 and below	Engagement Scores at Every 5-minute Interval for Condition 2 (Simulation Interaction)								Total Score for Each Range
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
7/10	1	-	3	-	-	-	-	-	4
6/10	-	2	-	-	1	-	-	-	3
5/10	3	-	1	-	-	-	-	-	4
<b>Total Score per Interval</b>	<b>4</b>	<b>2</b>	<b>4</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>11</b>

Table 7.11: Lowest Level of Engagement Score Category Condition 2 (Simulation Interaction)

Lowest Level of Engagement Scale Score Range = from 7/10 and below	Engagement Scores at Every 5-minute Interval for Condition 3 (Simulation Interaction)								Total Score for Each Range
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
7/10	1	1	2	1	-	-	-	-	5
6/10	1	1	-	2	-	-	-	-	4
5/10	-	2	1	-	1	-	-	-	4
<b>Total Score per Interval</b>	<b>2</b>	<b>4</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>11</b>

Table 7.12: Lowest Level of Engagement Score Category Condition 3 (Construct Interaction)

## ii. The Starting Levels Range Category

The engagement scores for the first 5 minutes into each of the 3 experimental sessions was found to range from as low as 4/10 to highest 10/10. **Table 7.13** below demonstrates the starting levels range for each experimental condition, and shows that the scores for all three conditions were high in the engagement zone.

The Starting Engagement Scores for First 5-minute Interval	Total number for each score for		
	Condition1	Condition2	Condition3
10/10	3	1	3
9/10	-	-	3
8/10	2	3	-
7/10	1	1	1
6/10	-	-	1
5/10	1	3	-
4/10	1	-	-
<b>Average Scores</b>	<b>7.8</b>	<b>7.0</b>	<b>8.7</b>

**Table 7.13:** The Starting Levels Range Category for all 3 conditions

## iii. Dips

Dips are single drops before a rise. These dips are signs of disengagement, an engagement score much lower than the ones before and the ones after. Dips occur in all 3 experimental conditions. **Table 7.14, 7.15 and 7.16** are their occurrence for each child in each experimental condition.

Dips in Engagement Scale Score	Engagement Scores at Every 5-minute Interval for Condition 1 (No Interaction)								Total Score
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Case 1 Boy (10-11) Comex (WE) Sims (WOE)	10	8	2	3	0	0	0	0	1
Case 2 Girl (10-11) Comex (WE) Sims (WE)	8	7	6	6	3	2	2	0	-
Case 3 Boy (10-11) Comex (WE) Sims (WOE)	8	7	5	5	2	2	0	0	-
Case 4 Girl (10-11) Comex (WOE) Sims (WOE)	10	10	10	10	10	10	10	10	-
Case 5 Girl (10-11) Comex (WE) Sims (WOE)	7	8	7	9	7	6	5	3	2
Case 6 Boy (10-11) Comex (WE) Sims (WOE)	10	6	4	2	0	0	0	0	-
Case 7 Boy (12-14) Comex (WE) Sims (WOE)	5	3	4	1	0	0	0	0	1
Case 8 Girl (12-14) Comex (WE) Sims (WOE)	4	5	6	2	0	0	0	0	-
<b>Total Score per Interval</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>5</b>

**Table 7.14:** Dips as they occur in Condition 1 (No Interaction)

Dips in Engagement Scale Score	Engagement Scores at Every 5-minute Interval for Condition 2 (Simulation Interaction)								Total Score
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Case 9 Girl (10-11) Comex (WE) Sims (WOE)	5	8	7	10	10	10	10	10	1
Case10 Girl (10-11) Comex (WE) Sims (WOE)	8	9	7	9	10	10	10	10	1
Case11 Boy (10-11) Comex (WE) Sims (WE)	10	9	10	10	10	10	10	10	1
Case12 Girl (10-11) Comex (WE) Sims (WOE)	7	8	10	9	10	10	10	10	1
Case13 Boy (10-11) Comex (WE) Sims (WOE)	8	9	8	10	10	10	10	10	1
Case14 Boy (12-14) Comex (WE) Sims (WOE)	8	9	10	10	10	10	10	10	-
Case15 Girl (10-11) Comex (WE) Sims (WOE)	5	6	5	8	6	8	10	10	2
Case16 Boy (12-14) Comex (WE) Sims (WOE)	5	6	7	9	10	10	10	10	-
<b>Total Score per Interval</b>	<b>0</b>	<b>1</b>	<b>4</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>7</b>

Table 7.15: Dips as they occur in Condition 2 (Simulation Interaction)

Dips in Engagement Scale Score	Engagement Scores at Every 5-minute Interval for Condition 3 (Construct Interaction)								Total Score
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Case 9 Girl (10-11) Comex (WE) Sims (WOE)	10	10	10	10	10	10	10	10	-
Case10 Girl (10-11) Comex (WE) Sims (WOE)	8	9	8	6	10	10	10	10	1
Case11 Boy (10-11) Comex (WE) Sims (WE)	10	10	10	10	10	10	10	10	-
Case12 Girl (10-11) Comex (WE) Sims (WOE)	7	5	9	9	10	10	10	10	1
Case13 Boy (10-11) Comex (WE) Sims (WOE)	8	7	7	9	9	10	10	10	-
Case14 Boy (12-14) Comex (WE) Sims (WOE)	10	10	10	10	10	10	10	10	-
Case15 Girl (10-11) Comex (WE) Sims (WOE)	6	6	7	7	8	8	10	10	-
Case16 Boy (12-14) Comex (WE) Sims (WOE)	8	5	5	6	7	8	10	10	-
<b>Total Score per Interval</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>

Table 7.16: Dips as they occur in Condition 3 (Construct Interaction)

#### iv. Gradual Increase and Gradual Decrease Category

These engagement patterns are in evidence in different ways in the 3 conditions. There is one example of a gradual decrease in Condition 1 (No Interaction) whilst there are single examples of gradual increases in Condition 2 (Simulation Interaction) and Condition 3 (Construct Interaction). Table 7.17 shows the

gradual decrease in the No Interaction experimental condition. **Table 7.18** and **7.19** show the gradual increases in Simulation Interaction and Construct Interaction respectively.

Gradual Decrease Pattern	Engagement Scores at Every 5-minute Interval for Condition 1 (No Interaction)								Position of gradual decrease
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Case 5 Girl (10-11) Comex (WE) Sims (WOE)	7	8	7	9	7	6	5	3	Fluctuate - Gradual Decrease - Min

**Table 7.17:** Gradual Decrease Engagement Pattern In Condition1 (No Interaction)

Gradual Increase Pattern	Engagement Scores at Every 5-minute Interval For Condition 2 (Simulation Interaction)								Position of gradual increase
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Case14 Boy (12-14) Comex (WE) Sims (WOE)	8	9	10	10	10	10	10	10	Beginning: Gradual - Maximum

**Table 7.18:** Gradual Increase Engagement Pattern In Condition 2 (Simulation Interaction)

Gradual Increase Pattern	Engagement Scores at Every 5-minute Interval For Condition 3 (Construct Interaction)								Position of gradual increase
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Case24 Girl (12-14) Comex (WE) Sims (WOE)	8	5	5	6	7	8	10	10	Beginning: High - Plateau - Gradual - Maximum

**Table 7.19:** Gradual Increase Engagement Pattern in Condition 3 (Construct Interaction)

## v. Plateau

Plateaus are consistencies in engagement scores, for this research, 3 consistent scores in a row. Plateaus occur in all 3 conditions. **Tables 7.20, 7.21** and **7.22** are their occurrences in all the three conditions, No Interaction, Simulation Interaction and Construct Interaction respectively. For some children this type of engagement pattern tends to occur when they had reached their highest or lowest level of engagement, usually towards the end of their session, whilst for some they also seemed to occur a couple of times before they reached their final score at the end of the session.

Engagement Scale Scores for Study 3 Condition 1 (No Interaction)									
Cases	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	Total Score
Case 1 Boy (10-11) Comex (WE) Sims (WOE)	10	8	2	3	0	0	0	0	1 Plateau
Case 2 Girl (10-11) Comex (WE) Sims (WE)	8	7	6	6	3	2	2	0	2 Plateaus
Case 3 Boy (10-11) Comex (WE) Sims (WOE)	8	7	5	5	2	2	0	0	3 Plateaus
Case 4 Girl (10-11) Comex (WOE) Sims (WOE)	10	10	10	10	10	10	10	10	1 Plateau
Case 5 Girl (10-11) Comex (WE) Sims (WOE)	7	8	7	9	7	6	5	3	-
Case 6 Boy (10-11) Comex (WE) Sims (WOE)	10	6	4	2	0	0	0	0	1 Plateau
Case 7 Boy (12-14) Comex (WE) Sims (WOE)	5	3	4	1	0	0	0	0	1 Plateau
Case 8 Girl (12-14) Comex (WE) Sims (WOE)	4	5	6	2	0	0	0	0	1 Plateau
Total Scores of Plateaus									10 Plateaus

Table 7.20: Plateaus in Condition 1 (No Interaction)

Engagement Scale Scores for Study 3 Condition 2 (Simulation Interaction)									
Cases	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	Total Score
Case 9 Girl (10-11) Comex (WE) Sims (WOE)	5	8	7	10	10	10	10	10	1 Plateau
Case 10 Girl (10-11) Comex (WE) Sims (WOE)	8	9	7	9	10	10	10	10	1 Plateau
Case 11 Boy (10-11) Comex (WE) Sims (WE)	10	9	10	10	10	10	10	10	1 Plateau
Case 12 Girl (10-11) Comex (WE) Sims (WOE)	7	8	10	9	10	10	10	10	1 Plateau
Case 13 Boy (10-11) Comex (WE) Sims (WOE)	8	9	8	10	10	10	10	10	1 Plateau
Case 14 Boy (12-14) Comex (WE) Sims (WOE)	8	9	10	10	10	10	10	10	1 Plateau
Case 15 Girl (10-11) Comex (WE) Sims (WOE)	5	6	5	8	6	8	10	10	1 Plateau
Case 16 Boy (12-14) Comex (WE) Sims (WOE)	5	6	7	9	10	10	10	10	1 Plateau
Total Scores of Plateaus									8 Plateaus

Table 7.21: Plateaus in Condition 2 (Simulation Interaction)

Engagement Scale Scores for Study 3 Condition 3 (Construct Interaction)									
Cases	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	Average
Case 17 Boy (10-11) Comex (WE) Sims (WE)	10	10	10	10	10	10	10	10	1 Plateau
Case 18 Girl (12-14) Comex (WE) Sims (WOE)	8	9	8	6	10	10	10	10	1 Plateau
Case 19 Boy (12-14) Comex (WE) Sims (WOE)	10	10	10	10	10	10	10	10	1 Plateau
Case 20 Boy (10-11) Comex (WE) Sims (WOE)	7	5	9	9	10	10	10	10	1 Plateau
Case 21 Girl (10-11) Comex (WE) Sims (WOE)	8	7	7	9	9	10	10	10	1 Plateau
Case 22 Girl (12-14) Comex (WE) Sims (WE)	10	10	10	10	10	10	10	10	1 Plateau
Case 23 Boy (12-14) Comex (WE) Sims (WOE)	6	6	7	7	8	8	10	10	1 Plateau
Case 24 Girl (12-14) Comex (WE) Sims (WOE)	8	5	5	6	7	8	10	10	1 Plateau
Total Scores of Plateaus									8 Plateaus

Table 7.22: Plateaus in Condition 3 (Construct Interaction)



**vii. Maximum**

The highest engagement score of 10/10 is the maximum score of engagement. Maximum score is the score when the child would not want to stop when asked to do so. The score could be seen in all the 3 conditions (Table 7.23, 7.24 and 7.25)

Engagement Scale Scores for Study 3 Condition 1 (No Interaction)									
Cases	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	Total Max Scores
Case 1 Boy (10-11) Comex (WE) Sims (WOE)	10	8	2	3	0	0	0	0	1
Case 2 Girl (10-11) Comex (WE) Sims (WE)	8	7	6	6	3	2	2	0	-
Case 3 Boy (10-11) Comex (WE) Sims (WOE)	8	7	5	5	2	2	0	0	-
Case 4 Girl (10-11) Comex (WOE) Sims (WOE)	10	10	10	10	10	10	10	10	8
Case 5 Girl (10-11) Comex (WE) Sims (WOE)	7	8	7	9	7	6	5	3	-
Case 6 Boy (10-11) Comex (WE) Sims (WOE)	10	6	4	2	0	0	0	0	1
Case 7 Boy (12-14) Comex (WE) Sims (WOE)	5	3	4	1	0	0	0	0	-
Case 8 Girl (12-14) Comex (WE) Sims (WOE)	4	5	6	2	0	0	0	0	-
<b>Total Max Scores per Interval</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>10</b>

Table 7.23: Maximum score In Condition 1 (No Interaction)

Engagement Scale Scores for Study Condition 2 (Simulation Interaction)									
Cases	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	Total Max Scores
Case 9 Girl (10-11) Comex (WE) Sims (WOE)	5	8	7	10	10	10	10	10	5
Case 10 Girl (10-11) Comex (WE) Sims (WOE)	8	9	7	9	10	10	10	10	4
Case 11 Boy (10-11) Comex (WE) Sims (WE)	10	9	10	10	10	10	10	10	7
Case 12 Girl (10-11) Comex (WE) Sims (WOE)	7	8	10	9	10	10	10	10	5
Case 13 Boy (10-11) Comex (WE) Sims (WOE)	8	9	8	10	10	10	10	10	5
Case 14 Boy (12-14) Comex (WE) Sims (WOE)	8	9	10	10	10	10	10	10	6
Case 15 Girl (10-11) Comex (WE) Sims (WOE)	5	6	5	8	6	8	10	10	2
Case 16 Boy (12-14) Comex (WE) Sims (WOE)	5	6	7	9	10	10	10	10	4
<b>Total Max Scores per Interval</b>	<b>1</b>	<b>0</b>	<b>3</b>	<b>4</b>	<b>7</b>	<b>7</b>	<b>8</b>	<b>8</b>	<b>38</b>

Table 7.24: Maximum score In Condition 2 (Simulation Interaction)

Engagement Scale Scores for Study 3 Condition 3 (Construct Interaction)									
Cases	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	Total Max Scores
Case17 Boy (10-11) Comex (WE) Sims (WE)	10	10	10	10	10	10	10	10	8
Case18 Girl (12-14) Comex (WE) Sims (WOE)	8	9	8	6	10	10	10	10	4
Case19 Boy (12-14) Comex (WE) Sims (WOE)	10	10	10	10	10	10	10	10	8
Case20 Boy (10-11) Comex (WE) Sims (WOE)	7	5	9	9	10	10	10	10	4
Case21 Girl (10-11) Comex (WE) Sims (WOE)	8	7	7	9	9	10	10	10	3
Case22 Girl (12-14) Comex (WE) Sims (WE)	10	10	10	10	10	10	10	10	8
Case23 Boy (12-14) Comex (WE) Sims (WOE)	6	6	7	7	8	8	10	10	2
Case24 Girl (12-14) Comex (WE) Sims (WOE)	8	5	5	6	7	8	10	10	2
<b>Total Max Scores per Interval</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>5</b>	<b>6</b>	<b>8</b>	<b>8</b>	<b>39</b>

Table 7.25: Maximum score in Condition 3 (Construct Interaction)

### viii. The Ending Levels Range

The engagement scores range for the ending levels category for all 3 conditions could be demonstrated in Table 7.26 below. All children end in only one score, a score of 10/10, in the two conditions of Simulation and Construct Interaction. For Condition 1 of No Interaction however the ending is varied some endings with zeros whilst one has a 10/10 and another a 3/10.

The Ending Engagement Scores for The Last 40-minute Interval	Total number for each score for Condition 1 No Interaction	Total number for each score for Condition 2 Simulation Interaction	Total number for each score for Condition 3 Construct Interaction
10/10	1	8	8
9/10	-	-	-
8/10	-	-	-
7/10	-	-	-
6/10	-	-	-
5/10	-	-	-
4/10	-	-	-
3/10	1	-	-
2/10	-	-	-
1/10	-	-	-
0/10	6	-	-
<b>Average Scores</b>	<b>1.6</b>	<b>10.0</b>	<b>10.0</b>

Table 7.26: The Ending Levels Range in all 3 conditions

## **7.7 Data Analysis**

A description and analysis of engagement patterns by score at every 5-minute interval was made based on the three conditions given to the children: no interaction, simulation interaction and construct interaction. The analysis tests the impact of these three conditions on engagement.

In order to understand the engagement phenomenon the analysis is best discussed by examining a number of forms of data from each experimental condition. Some of the forms were:

- The engagement pattern of each child at the two extreme ends of the sessions
  - The 1<sup>st</sup> interval, that is, after 5 minutes into the game.
  - The final interval, that is, after 40 minutes into the game.
- Engagement patterns of every individual at eventful intervals of each experimental conditions from the 1<sup>st</sup> Interval to the Final Interval
- Individual case examples for each experimental condition to exemplify issues
- Comparing engagement patterns according to characteristics grouped and described in Study 2 for each experimental condition on issues of similarities and differences as they arises. The characteristics previously categorised were:
  - Low levels of engagement
  - The starting levels range
  - Dips
  - Gradual increase and gradual decrease
  - Plateau
  - Maximum
  - The ending level range

### **7.7.1 Analysis of Findings of No Interaction**

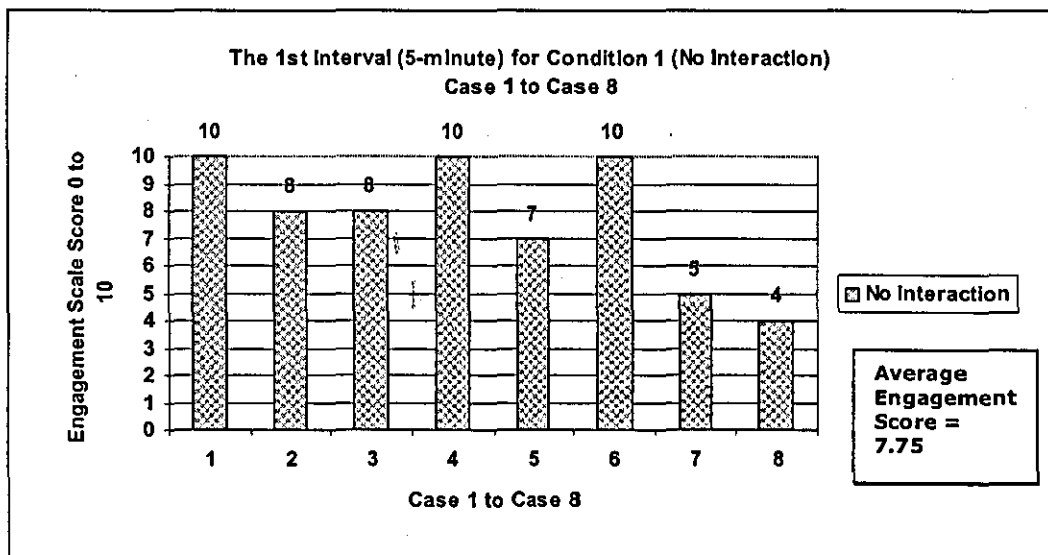
Before analysing the findings in this experimental condition of No Interaction it is useful to recapitulate the purpose of doing the experiment. The purpose was to find out whether no interaction could mean no engagement. Could the findings

support the hypothetical statement that says the more interaction, the more engaged, less interaction, the less engaged, no interaction means no engagement? Could design features in the multimedia create a form of engagement even when there is no opportunity for interaction?

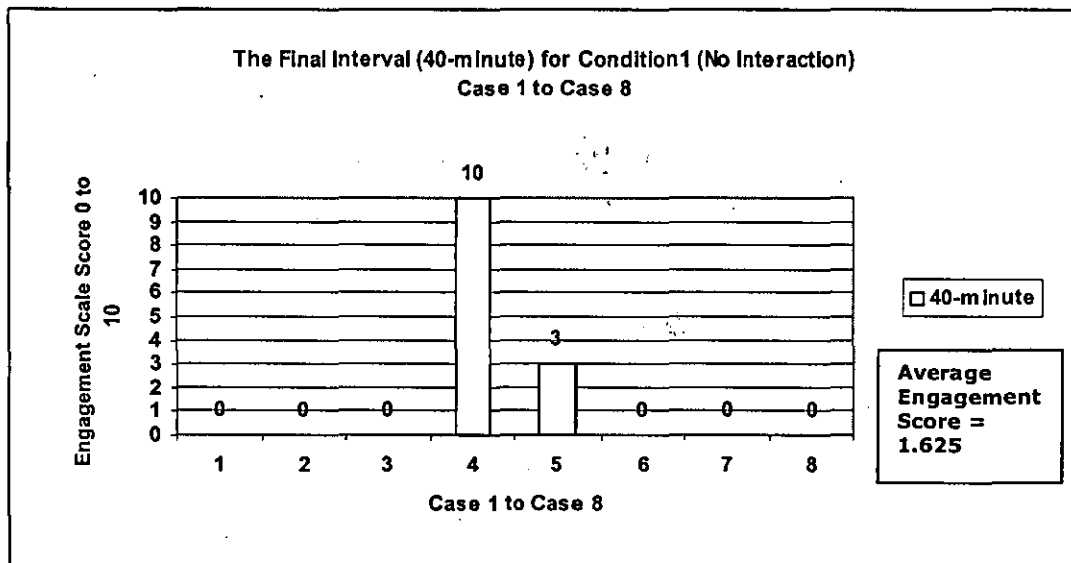
When analysing **Table 7.9** it could be seen that the **average engagement scale scores** for the session on **No Interaction** is **4.22**. This score clearly shows that the children were in the lower end of the engagement scale scores. Therefore, this session's interaction effect is a **disengagement effect**. The answers as to what degree, when, where and why could be seen as the scores are traced in the graphs plotted in **Figure 7.2**. A closer analysis is best described using factors as below.

**a. Engagement Pattern at 1st Interval (5-minute) and Final Interval (40-minute) for No Interaction**

The engagement pattern of each individual for this experimental session is seen in **Figure 7.6** and **7.7**.



**Figure 7.6:** Engagement at 1st Interval (5-minute) of No Interaction for all 8 children.

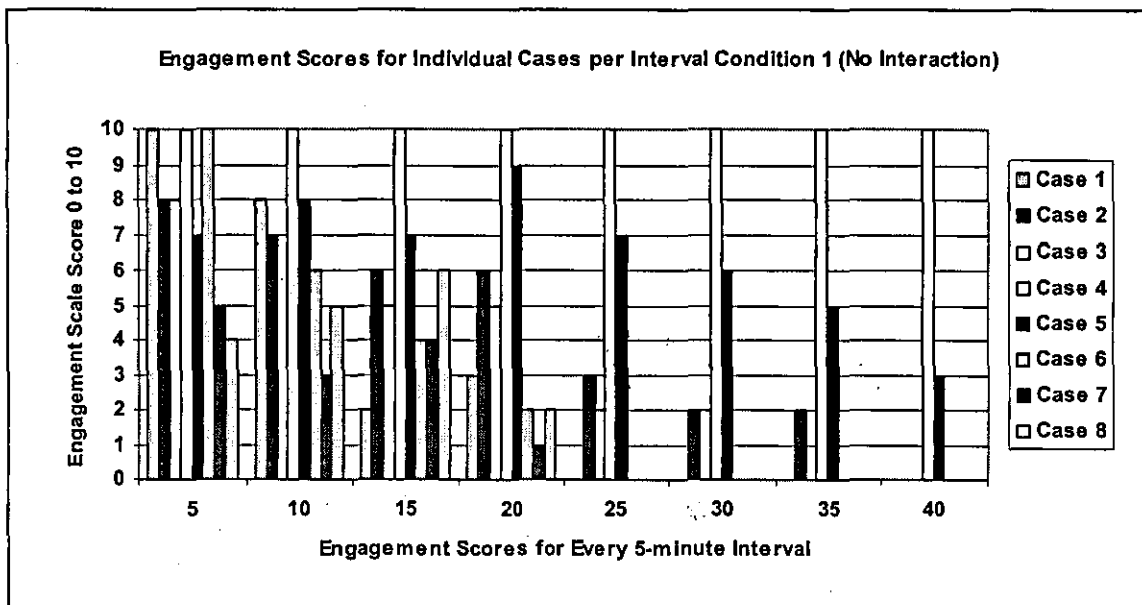


**Figure 7.7:** Engagement at Final Interval (40-minute) of No Interaction for all 8 children.

From the graphs it could be seen that the children's **highest scores** were at the beginning of the session **7.75** and later plunged to the **lowest scores** of **1.625** at the end of the session. This situation just exemplifies the fact that this condition of no interaction indeed has affected the engagement patterns of the children. The fall does indicate a disengagement effect. However, it does not cause disengagement to all children. Therefore the hypothesis that states more interactivity more engagement, less interactivity less engagement and no interactivity non-engagement does not necessarily work for some children. Further analysis had to be made to find out why.

**b. Engagement Scores for Individual Cases from 1<sup>st</sup> to Final Interval for Condition 1 (No Interaction)**

A closer look at the data may indicate a better description of what exactly happened to the children as they go through the session from the 1<sup>st</sup> interval to Final interval. Analysing **Figure 7.8** below has revealed some interesting findings.



**Figure 7.8:** Engagement Scores for Individual Cases from 1<sup>st</sup> to Final Interval of No Interaction for all 8 children.

From it could be analysed that 4 out of 8 of the children simply became “disinterested” or “disengaged” half way through the session, leaving 3 more still involved to some degree at this point, and 1 out of 8 who remained fully engaged till the end of the game. From the interviews it was apparent that the variations in engagement patterns were affected by the individual’s history. The findings convey evidence of individuality in engagement pattern for each case or subject under study. The children have individualised past experiences and characteristics and this in some way influenced each engagement pattern. This shows that there are other factors rather than design features that have some influence on these scores.

Some factors that have made these children place high scores in their initial stage of the session could be factors that come from within themselves whilst some from without. Some of the factors that come from within could be, for example, factors affecting the intrinsic motivation of wanting to learn and to know more or the thirst of just simply trying to satisfy curiosity. Whilst factors from without could be factors about, for example, word semantics of the connotation of the word “game” to be associated with the “play” and “fun” phenomena.

For example, as the researcher introduced the CD to the child, the word “game” was incorporated because the multimedia CD is a game CD. As games inspire children, the word automatically triggered the child’s interest; and they expected the CD to be “something we can play with”. However, as the child continued playing the condition of no interaction the engagement scores changed and for

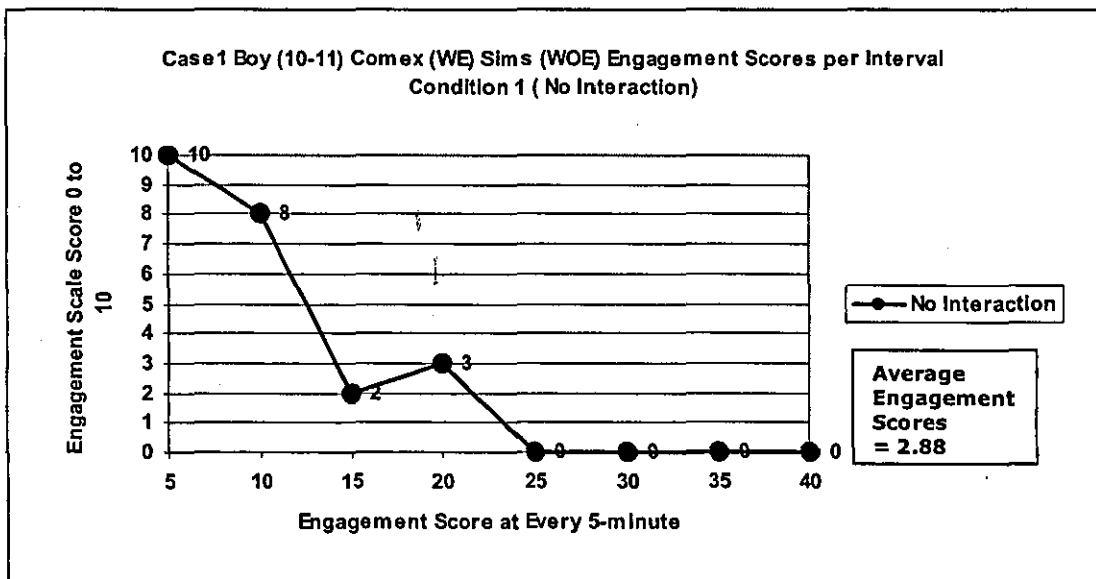
most it reached its lowest point of no engagement at 0 /10 especially towards the final stage of the session. As children differ some reached fast disengagement whilst others even stayed engaged to the end.

**c. Individual Case Examples**

A clearer picture of engagement patterns in the session under study is best obtained by looking at individual case examples. Below are descriptions of some of them.

**Case 1 of Study 3 (No Interaction)**

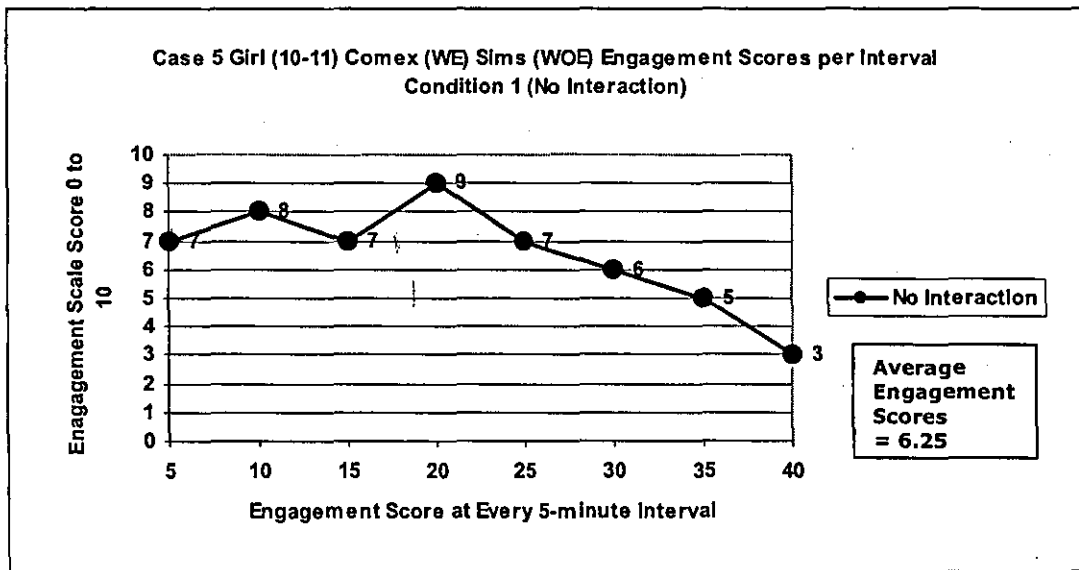
Case 1 is a boy in an age group of 10-11 years old. He had some experience with computer games but has not played The Sims before. Having been given an introduction to The Sims, the child was told not to do anything but to watch. He was told neither to touch the keyboard nor to move the mouse. He was just to sit still and watch what is on the screen and place his feelings about it at that time on the engagement scale of 0 to 10 of the smiley face. **Figure 7.9** below shows his pattern of engagement from the 1<sup>st</sup> 5-minutes of the game to the end of the game. The figure shows evidence of the high expectation the boy had of the game at first and how it deteriorates as time goes by.



**Figure 7.9:** Case 1 Engagement Scores per Interval of Condition 1 (No Interaction)

Case 5 of Study 3 (No Interaction)

However, not all children reacted the same way. **Figure 7.10** shows an example of a girl (Case 5). The figure shows a slightly different pattern of engagement. The girl is in the age group of 10 to 11 years old. She had some computer games experience but none of The Sims. The girl started off her first interval by marking at a lower value of 7 for her engagement scores but fluctuated for 20 minutes before declining. Even though the condition set for her does not allow her to do anything she still has hopes of getting something from the session. At times, the portrayal on the screen amazed her, whilst for most times she looked in despair. When asked about her reaction to the game she had this to say "... I didn't expect it to be like this...I thought it is a game but you just watch. It is just like watching TV... I prefer watching TV better..." When asked why she placed a higher score at some places, she said, "... The people did something silly...like playing with ants... its funny..." The engagement pattern for the whole session for this girl is in **Figure 7.10** below.



**Figure 7.10:** Case 5 Engagement Scores per Interval of Condition1 (No Interaction)



#### Case 4 of Study 3 (No Interaction)

To add to the diversity there was the isolated case of a child's engagement pattern of girl (Case 4). The child is from the same age group as the two cases mentioned above, that is, in the age group of 10 to 11 years old. The only difference between this child and all other children in this research is that this child had no experience with computers. She had never played any game with computers before. However, she is quite familiar with movie and music CDs.

During the session with her, it was observed that she was having quite an awkward time with the mouse even though she was very keen to use it. The researcher had to stop her many times from touching the mouse. Even when she tried she seems to lose the pointer and felt anxious about it. It was quite sometime before the researcher could calm her down and concentrate on the experiment of no interaction.

This girl placed a 10/10 score for the whole 40-minute session. When asked what she thinks about the CD, she says she likes it. When asked why she said, "...don't know I just like it" When asked to relate the story in the game she could not remember much "...something about a family I think". When the researcher asked her whether she expected the game to be in this way, she looked confused. When asked whether she had played any computer game before she said "No" and whether she had any experience with computers, she said, "No...never used one before... I have seen my mum use it for her work but we are not allowed to touch it." When asked what does she think about the game she said, "I like it" When asked whether she thinks that this is a game, she said, "yes"

Through further discussions the researcher found that the girl actually had no idea about electronic games either on computers or play stations. This is her first encounter and to her if this is how an electronic game is to be played, i.e. just to lay back and watch, then that is what it should be and she liked it. Since she had no experience with input devices that are associated with computers and play station games like joysticks, the mouse, etc. she was actually pleased just having to sit still and watch.

However, she was rather inquisitive about the presence of the input devices. She had seen her mother using it for word processing but had no idea how it could be used when playing a game on a computer screen. This case has shown that

learned experiences or previous knowledge have great influence on children's behaviour with computer applications.

A child might be curious about all the gadgets in front of them but if he or she has not had any experience in using them before it would be difficult for the individual to associate it with screen play. Since this child loves movie CDs her passion is transferred to this session when the child is not allowed to interact but just to watch the game on the screen. Therefore she was engaged the whole 40-minute of the game.

#### **d. Conclusion for Condition 1 (No Interaction)**

This condition was indeed disengaging to the children, to some but not to all of them. Condition 1 was conducted to study this disengagement effect. Further analysis of the findings has given rise to issues about the different points of reaching the level of disengagement amongst the children. From **Figure 7.8** 4 of 8 individuals reached a level of none engagement at a much earlier time than others, that is, after playing the game for about 25 minutes. The four individuals that reached their level of disengagement after 25 minutes into the game actually left the session before it ended.

When they were asked why they left they said, "This is not a game... there is nothing to play with... you cannot touch anything...just watch...its boring..." One of the children had this to say, "...I have seen this type of game before ... I have seen a demo once of a Microsoft Simulator...you just see how a pilot moves the plane or something...you could not touch or do anything...but it was just for a short time...I don't mind it really but this one...is too long. I would rather play something else..." One of them who left the session said, "I prefer to watch TV or a cartoon... you don't have to do anything but there is a story or something you can watch which is much more interesting."

#### **7.7.2 Analysis of Findings of Simulation Interaction**

The purpose of this experimental condition was to find out whether simulation interactivity, one of the factors that seemed to engage children in Study 2 was really engaging. If this type of interactivity by itself could cause an engagement effect, the findings will reveal at what level, where, when, how and why.

When analysing **Table 7.9** it was found that the overall **average engagement score** for Condition 2 (Simulation Interaction) is **8.95**. This score clearly shows

that the children were engaged in this session. This score is in the higher range engagement scale score, 5/10 and higher to highest 10/10. Therefore, this session's interaction effect is **an engagement effect**. The engagement effect for this session is as in **Figure 7.3**.

**a. Engagement Pattern at 1st Interval (5-minute) and Final Interval (40-minute) for Simulation Interaction**

The analysis of the simulation condition is best discussed by comparing both not only the extreme ends but also within the sessions. This is because there are important events happening during sessions.

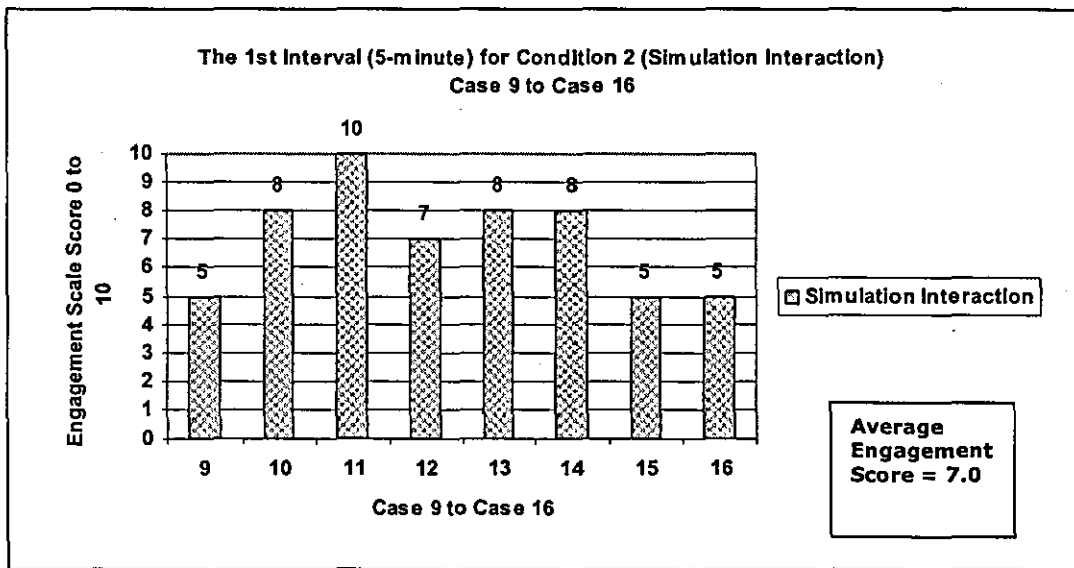


Figure 7.11: Engagement at 1st Interval (5-minute) of Simulation Interaction for all 8 children.

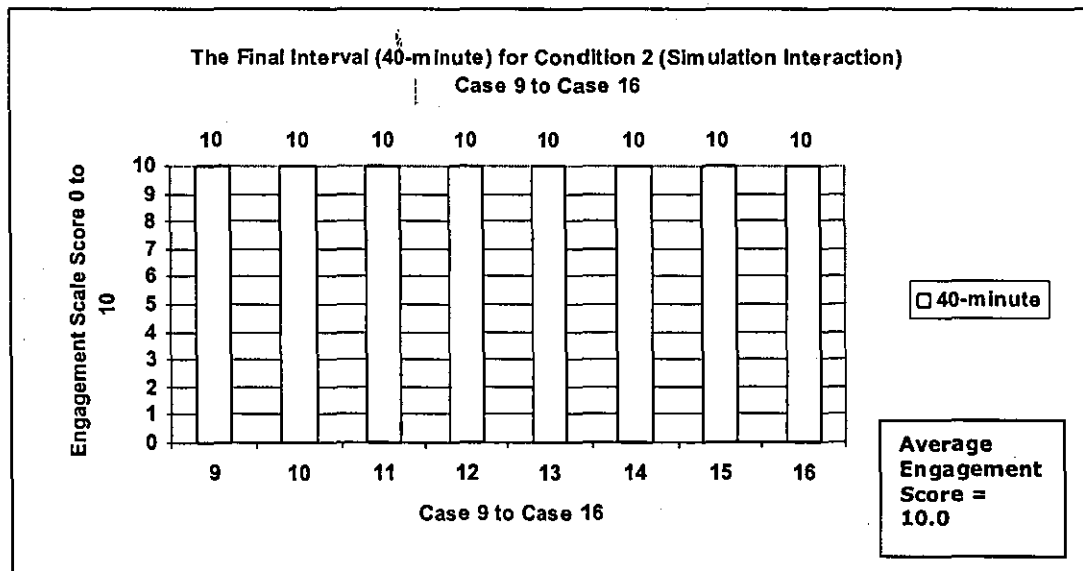
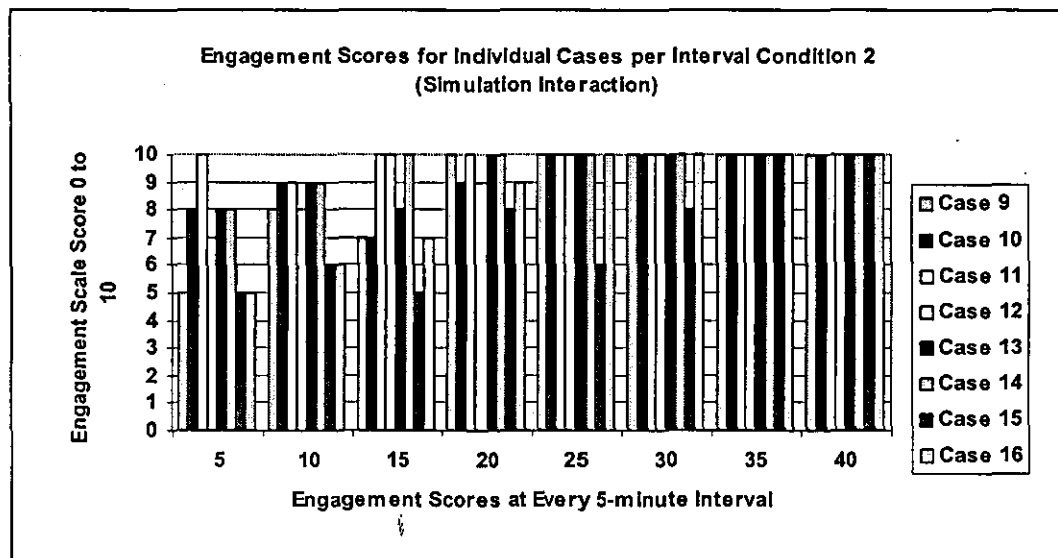


Figure 7.12: Engagement at Final Interval (40-minute) of Simulation Interaction for all 8 children.

From **Figure 7.11** and **Figure 7.12** it is obvious that overall the children's highest scores were 10 and were at the end of the session. Not one child in this session placed less than 10/10 at the last interval. All 8 children reached their maximum satisfaction at the last interval and therefore this interaction gives an engagement effect.

In **Figure 7.11** it could be seen that all the 8 subjects seemed to place their scores between the ranges of 5/10 to 10/10 in the first five minutes. The two most common scores are 8/10 and 5/10. The average score for Simulation Interaction for the first 5 minutes of the game is **7.0**.

**b. Engagement Scores for Individual Cases from 1<sup>st</sup> to Final Interval for Condition 2 (Simulation Interaction)**



**Figure 7.13:** Engagement Scores for Individual Cases from 1<sup>st</sup> to Final Interval of Simulation Interaction for all 8 children.

Looking at the scores of individual children in **Figure 7.13**, the pattern shows that most of these children go through fluctuating experiences from one interval to another. The average score for all the 8 children for Simulation Interaction at the first 5 minutes into the game of **7.0** is surprisingly lower than that of the session on No Interaction.

These children were given the live simulation mode and they went straight into a "playing" mode. The moving characters on the screen seemed somewhat anxiety

provoking to some children. Some found it slightly confusing as to where to watch first. The children were briefed about the indicating index by which they were to control the characters. Their aim was to act so that the indicator for hunger, bladder, comfort, social relationship, etc. did not go from green to red. If the child was in a situation where the indicator went green to red, the child had to act to correct this. So in this session one could see the "roller coaster effect" where sometimes the child seemed happy to be in control but at other times seemed lost and wanting to give up.

From **Figure 7.13**, some children (3 of the 8 subjects Case 11,12 and 14) in this session had reached the top level of satisfaction by the 3<sup>rd</sup> interval, after going through about 15 minutes of the game. However, only 2 (Case 11 and 14) of the 3 sustained this engagement effect till the end of the game, Case 12 experienced a dip, a single drop before a rise back again to the maximum, at the 5<sup>th</sup> interval (25 minutes) of the game. These occurrences of getting to the top and experiencing several dips before a rise that was sustained to the end of the game happened with some other cases too. Only after 35 minutes (7<sup>th</sup> interval) into the game did all 8 children reach the maximum level of engagement with no further dips (**Figure 7.13**).

From the differences in performance of the individuals within the two extreme ends of the session it could be said that the engagement pattern of these individuals is not consistent throughout. Some shows "signs of disengagement" even after at one time they had already reached a maximum. When an interview was conducted it was seen that some individual performances were influenced by the previous experience they had had with the game.

### **c. Individual Case Examples**

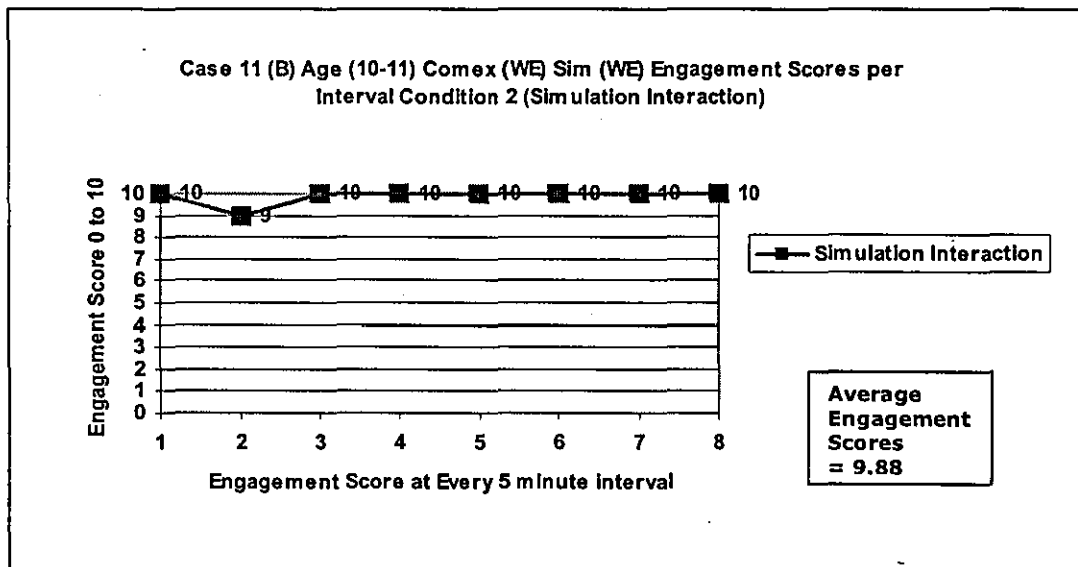
A more detailed account of the isolated cases in this condition could be discussed as individual case examples.

#### **Case 11 of Study 3 (Simulation Interaction)**

One of the boys that had previously played the game was surprisingly "disengaged" after playing about 10 minutes into the game. In the interview he reported that, even though he had encountered the game before, he found himself a bit lost after 10 minutes into the game. "I do not know who these

people are... whether they have got a job, how many are they, how many boys and girls, man or woman... I thought at first I know the game but after a while I got confused." **Figure 7.14** shows the engagement pattern of Case 11.

The engagement pattern outlined could give us an indication as to the importance of creating and ownership in game play. When the researcher created the characters in the game for them, the children do not know what to expect of them. Therefore, even though this child had some experience in The Sims he felt lost and anxious after 10 minutes into the game. As he began to know more about the characters he was able to control it better and therefore got very engaged and did not want to stop. He reached his maximum score of engagement at the 3<sup>rd</sup> interval, that is, 15 minutes into the game.

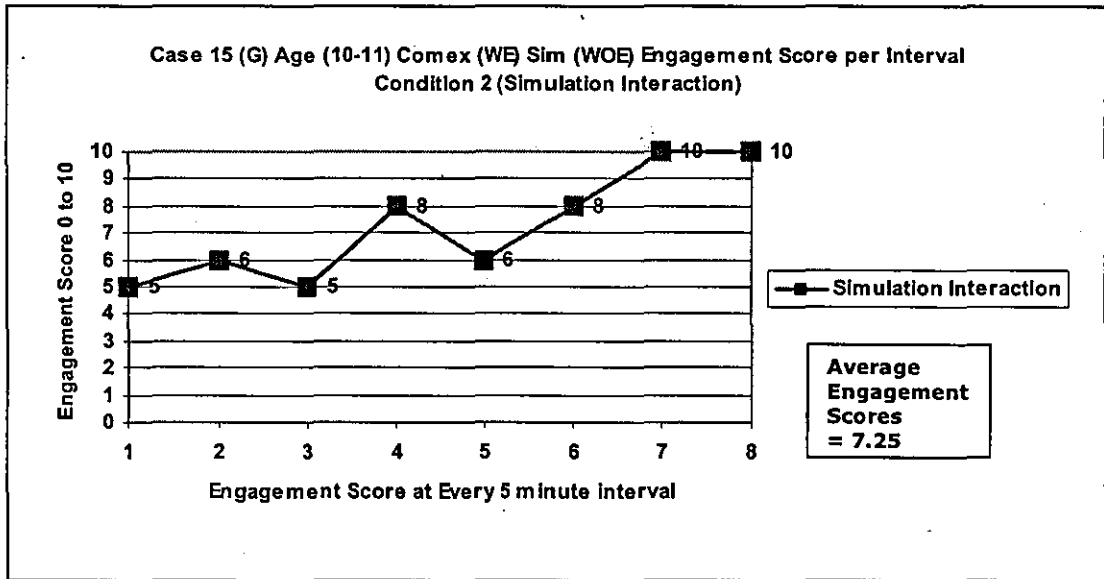


**Figure 7.14:** Case 11 Engagement Scores per Interval of Condition 2 (Simulation Interaction)

Case 15 of Study 3 (Simulation Interaction)

There is the only child that differed to the pattern of engagement shown by the other 7 subjects. The average engagement score of 7.25 for this girl is the lowest compared to the others. Even though the other 7 do show some signs of fluctuation they all reached their level of maximum engagement after 25 minutes into the game as could be seen in **Figure 7.13**. However, this child had quite a struggle and her pattern fluctuates all through the session until she reached the 7<sup>th</sup> (35 minutes) when she reached her maximum level of engagement and sustained it to the Final Interval. Her performance is presented in **Figure 7.15** below.

The pattern of engagement in this case is more of a "roller coaster". She started at quite a low score of 5/10. From 10 minutes to about 30 minutes she was very mixed in her feelings about the game. The video showed that this child was quite agitated at times. She often looked lost and confused. Only after about 35 minutes did she become fully involved in the game.



**Figure 7.15:** Case 15 Engagement Scores per Interval of Condition 2 (Simulation Interaction)

During the final period she looked more relaxed and seemed more pleased. When asked to stop she had this to say, " Please let me play some more. I just know how to play this game just now. I just did not know what to do before this...please, please...let me play!" This girl had faced a period of overloading for the first 30 minutes of the game. She became more relaxed towards the end of the game, as she has now been able to be in control and wished for more time so that she could enjoy it further.

When asked about the reasons why she placed low marks she said, "I did not know what to do, really..."

I put high when I could control it but sometimes there is so much to do ...the boy refused to go to school because he is hungry but there was no money to buy any food... I try to make it stop but it could not...the boy became very angry ...I panicked... erghh its frustrating..." The researcher then asked, "Why did you want to still play the game then?" The child replied, "...You know, after sometime I begin to know how to play it but you asked me to stop..." When asked why she did not continue much longer when given the chance to play, she said, "...At first I thought I could

solve it but it looks hopeless... I give up" The reason is "I don't know where to get them more money... it becomes too complicated!"

When asked whether she would like to play this game another time she said, "...Now that I know how to tell them what to do I think it would be interesting." Once they have acquired the skills, children seem to become more engrossed and therefore more engaged.

#### **d. Conclusion for Condition 2 (Simulation Interaction)**

It is obvious that Condition 2 (Simulation Interaction) has provided an engagement effect for the children. The interaction enabled them to control the lives of the characters. However, there were some difficulties. The sense of being overloaded had some effect on the engagement pattern of some of the children especially at the beginning of the sessions. Some individuals experienced more than one single dip giving a roller coaster effect. The interviews also gave evidence that previous experience of The Sims could affect the engagement pattern, a finding similar to Condition 1 of No Interaction.

#### **7.7.3 Analysis of Findings of Construct Interaction**

To recapitulate, the purpose of this experimental condition was to see if construct interaction engaged the children. Could this type of design feature, if done in isolation, that is, having only the "create, construct, build, buy and decorate" mode of the application to "play" with, engage children.

From **Table 7.9** the overall average engagement score for Construct Interaction is **8.94**, very slightly lower than the result for Simulation Interaction but definitely in the higher rank of the engagement scale scores. This score clearly shows that the children were engaged in this session.

#### **a. Engagement Pattern at 1st Interval (5-minute) and Final Interval (40-minute) for Construct Interaction**

The engagement pattern of the children for Condition 3 (Construct Interaction) is best described by looking at the graphs in **Figure 7.16** and **Figure 7.17**. From **Figure 7.16**, the number of children that placed a starting level of 10 in this condition is the same as that of Condition 1 of No Interaction, (3 out of 8 children), compared to Condition 2 (Simulation Interaction), which had only one child that placed a high score of 10 at the beginning interval (5 minutes into the game). However, the engagement pattern in this condition (**Figure 7.17**) had a



similar ending to that of Simulation Interaction, that is, all 8 subjects in both conditions reached their maximum level of engagement at the end of the session. These findings gave an indication that both the construct and simulation conditions led progressively to higher engagement scores.

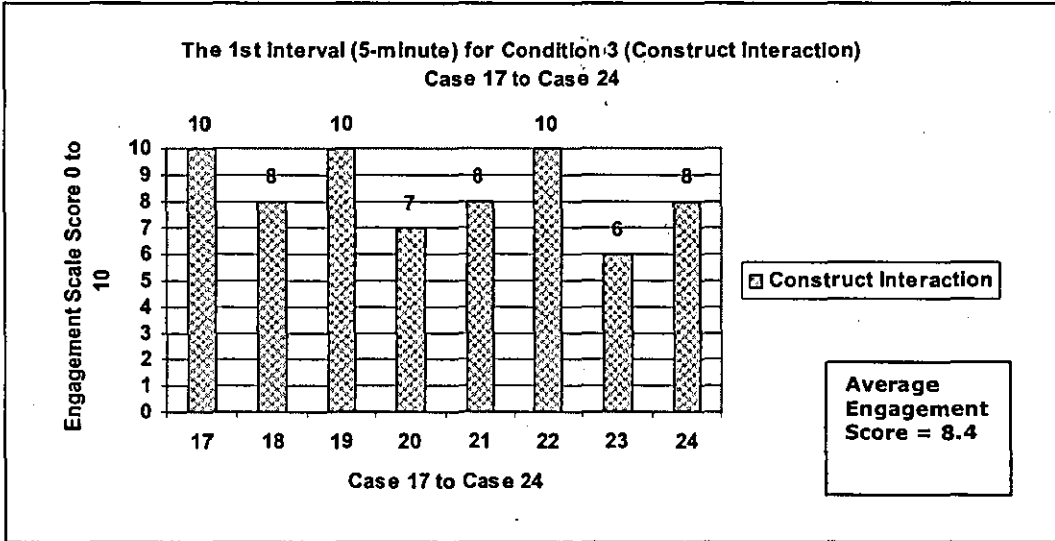


Figure 7.16: Engagement at 1st Interval (5-minute) of Construct Interaction for all 8 children.

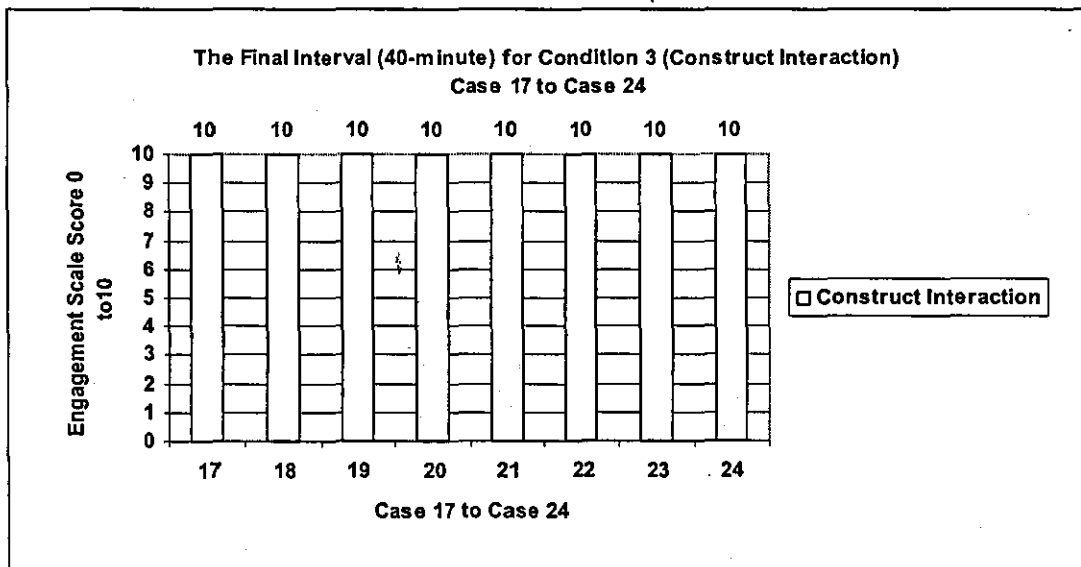
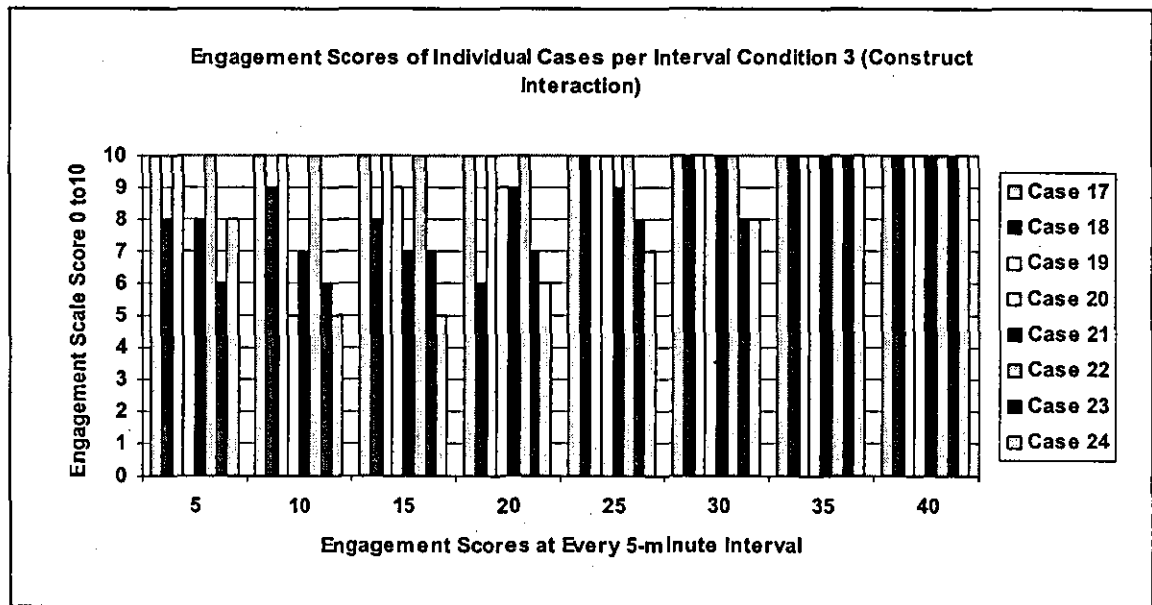


Figure 7.17: Engagement at Final Interval (40-minute) of Construct Interaction for all 8 children.

A closer observation of the overall engagement scores of individual cases for this condition will tell us more about engagement issues.

**b. Engagement Scores for Individual Cases from 1<sup>st</sup> to Final Interval for Condition 3 (Construct Interaction)**

It is interesting to note that there are also some eventful patterns in this condition as to that in Simulation Interaction. Therefore the analysis for this condition of Construct Interaction should also be based on events between two extreme ends, that is, within the first 5 minutes interval into the game and the final 40 minutes into the game.



**Figure 7.18:** Engagement Scores for Individual Cases from 1<sup>st</sup> to Final Interval of Construct Interaction for all 8 children.

Even though there were children who placed a high score at the initial interval in this session, their engagement pattern were surprisingly different to that of children in the other conditions. All the 3 children that placed the maximum score of 10 remained and sustained the score throughout the whole 40 minutes into the game (**Figure 7.18**). None of them sink to a lower level. An analysis according to cases would give a better scenario of why the performances were such.

**c. Individual Case Examples**

**Case 22 of Study 3 (Construct Interaction)**

One of the 3 children who placed a maximum level of engagement at the initial stage was Case 22, a girl, aged between 12 and 14 who had played The Sims before. This child knows how to use the operation tools to create a house and decorate. There was not much explanation to be made. She was very eager to

start the session from the very start. She built a house and decorated it. A cheat was added to give the children in this session an unlimited supply of money. Since the child had no worries about not having enough money, she just continued to build and build. She was therefore fully happy and engaged the whole session.

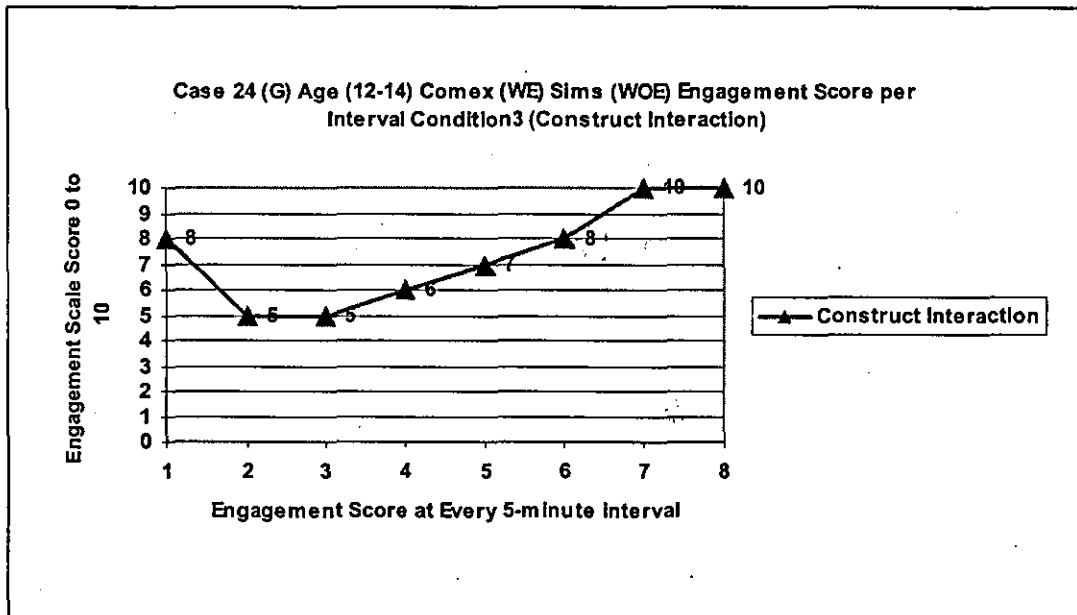
This case has shown how skilled users, familiar with the details of the game, can reach a level of maximum engagement very quickly and sustain it. However, previous experience in other forms of game could also have some influence when it comes to playing The Sims. Two from the 3 children mentioned that had reached their maximum level of engagement from the very start into the game, have lots of other game experiences. It took only a little while to teach these children to use the tools to construct. These children stayed at the maximum level of engagement throughout the session.

However, a child with little experience in computers and no experience in The Sims displayed a different pattern when performing in this session. **Figure 7.19** below shows an example of a case, Case 24, where a child had no experience in using these tools of operation.

#### Case 24 of Study 3 (Construct Interaction)

**Figure 7.19** is from Case 24 of Study 3 in the Construct Interaction condition. This girl is in the age group of 12 -14 years. She had no experience in playing The Sims. The researcher took quite a while to teach her to use the operating tools in this session. As soon as she was left to play the game alone she found herself struggling to cancel a step she had made.

Her initial high score of 8/10 at the first 5 minutes into the game dropped to 5/10. It remains the same for another 15 minutes into the session. She picked up her skills slowly and finally reached a high level of engagement after 35 minutes into the game. When asked about her difficult moments, she said, "When building the house, I do not know which tools to use... the fence one is very difficult ...so hard to cancel, the undo sometimes do not work... I had to try one by one." From the figure above it is clear that this child's level of engagement increased gradually. She reached her level of maximum engagement after a lengthy learning process.

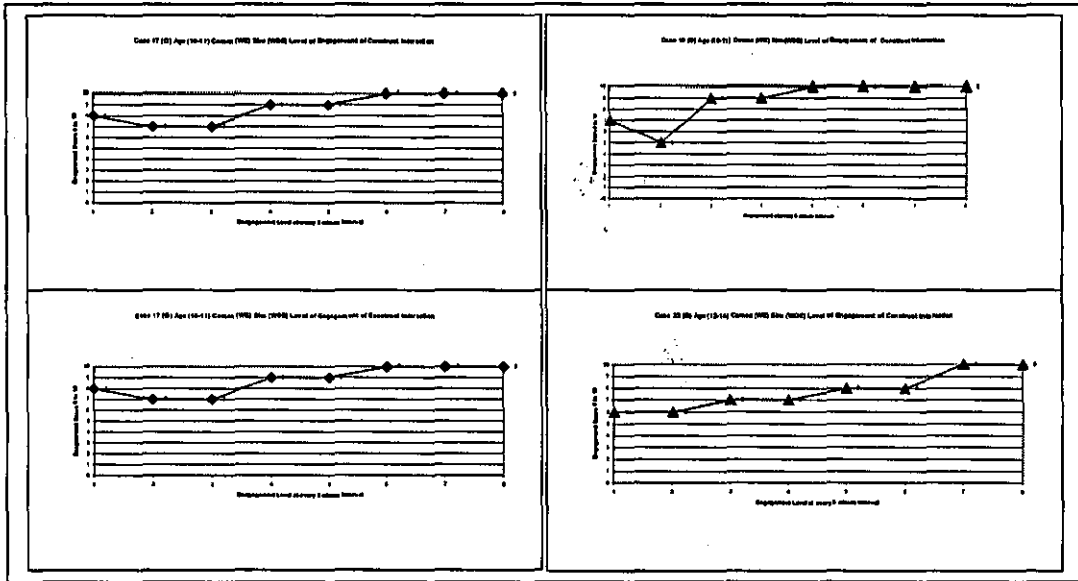


**Figure 7.19:** Case 24 Engagement Scores per Interval of Condition 3 (Construct Interaction)

**d. Conclusion for Condition 3 (Construct Interaction)**

This condition has given an engagement effect to the interactive activities of the children doing the session. The average engagement scores per individual were within the higher rank engagement scale scores. All the subjects reached the maximum level of engagement after 35 minutes into this session just as in Condition 2 of Simulation Interaction, **Figure 7.18** above.

On the whole the subjects in this session have more eventful performance than the other two sessions. **Figure 7.20** shows 4 examples out of the 8 subjects that have more turbulent graph representation than those in the other two sessions. This kind of pattern signifies the complexity of the tools of operation as compared to Simulation Interaction.



**Figure 7. 20** Four examples of subjects in the Construct Interaction Condition

However, once the user had acquired the skill to use these tools their performance and engagement scores remain the same to the end of the session. One of the subjects, Case 22, had played this game before and when asked to play this game placed a maximum level of engagement throughout the 40 minutes into the game. This child did not sink back, as did the child in the Simulation Interaction Case 11 in **Figure 7.14**, where the child had experiences in The Sims but still when playing on the session had times where he was “disengaged”. The probable explanation for this is the difference between simulation and construct interaction.

Construct Interaction requires the cognitive application of spatial intelligence. The child had to visualise the building or house he or she wanted to create and use appropriate tools to do the task. The knowledge of building from a floor plan and layout is not an obvious convention. Things like this need to be learned and experienced. So we find most of these children had very little idea where to start in this session, for example: which tools to use and for what purpose, where to begin e.g. the roof, the floor, or the fence? etc. However, once these skills have been acquired it stays with the child like skills in riding a bike, swimming, etc.

In Simulation Interaction the skills that had to be acquired were not only of motor skills but also mental skills. The children were given a family to manage and they

had to learn about them and respond appropriately to their needs. They had not created the characters and they did not know what to expect of them. Even if they had played the game before there was a lot of new learning needed to understand this particular family.

In the session on Construct Interaction the only skills they needed to learn was the operation of the tools. Once these skills were acquired the task remained consistent and the same on whatever occasion. The only problem with this interaction style is that, the child had to learn to master it first, and this has a lot to do with individual capabilities and previous experience. Some children with much experience of games of this type could acquire the skills before the first 5-minute interval was reached. Others struggled like Case 24 in **Figure 7.19**, one of the 5 children who had a turbulent pattern during the course of the session.

Therefore from this session it could be concluded that even though the skills to operate the tools are more difficult to acquire, they tend to be generalisable or almost the same in nature of operation throughout and therefore make less demand in the child. The child is able to reuse the skills in different situations and different places. There was no immediate effect of using these skills on the characters in the game because in this session they are just to creating and building and they never reached the stage of finding out what happened after the creation was completed.

## **7.8 Discussion**

### **7.8.1 Introduction**

Initially, the researcher believed that in all forms of computer application the design elements must allow users to interact with the system. Any form that did not is doomed to fail. From the literature the existence of interactivity is so important that initially the research hypothesis was that level of interaction correlates directly to level of user engagement. In other words, high level of interactivity gives high level of engagement; low level of interactivity gives low level of engagement. But the findings in Study 1 (The Pilot Study) and Study 2 (The Engaging Multimedia Experience) gave new insights into what engagement really means. There is more to it than just the number of interactive design features that could cause engagement.

Being engaged in multimedia application is not only about the presence of interactivity but also the types of interactivity that the multimedia possesses, the most prominent from Study 2, being simulation interactivity and construct interactivity. It has also got to do with the factors that are intertwined and inseparable in design features like: immediacy; a feature that gives immediate feedback involving the dynamics when an input devices are used like relating the movement of the cursor with that of the mouse; feedback involving outcomes from inputs according to timescale whether immediate or delayed received from the actions given during the course of interaction; goals either directed (as set by the designer) or undirected (as set by the user).

This study, Study 3, was conducted to examine the effect of the two distinctive interactive design features Simulation Interaction and Construct Interaction. If these features were the catalyst to increase levels of engagements when they were all bundled up together, what happens if these features were examined separately? Could the features still cause engagement? At what level is one better or worse than the other? Are there similarities or differences? And if there was no interaction at all, does it make a difference? What was the engagement effect, for how long, when, where, and why?

### **7.8.2 Significant Difference**

A Kruskal - Wallis test was performed in the rating scales for the three conditions and confirmed that there was a highly significant difference between no interaction and simulation interaction, a high significant difference between no interaction and construct interaction, and no significant difference between simulation and construct interactions. Details are in **Appendix A**

### **7.8.3 Triangulation Analysis**

There are occurrences of ceiling effects in the patterns of engagement for this study. Whenever a non-sensitive aspect of the scale was encountered a triangulation method of analysis using video recordings and interviews was used.

### **7.8. 4 Comparing Engagement Patterns amongst Conditions**

When comparing the scores and the patterns of average scores amongst conditions it could be seen that Simulation Interaction and Construct Interaction seemed to lead to very similar engagement effects. The differences between the points of averages were just 0.01, Condition 2 (Simulation Interaction) **8.95** and

Condition 3 (Construct Interaction) **8.94**. Therefore it could be concluded that these two design features have (to some extent) given an equally engaging effect on the interaction. No Interaction was hypothesised to have the lowest engagement effect, well below the engagement ranking scale of 5/10. The results showed that Condition 1 (No Interaction) did have a **disengagement effect of 4.22**.

Why do simulation and construct interactivity have engagement effects? The most probable reason for the success of simulation interaction is that this type of interaction gives a child a sense of play. Moving objects and animations have been shown to attract children to this kind of media and the findings in this experiment verify that this is true. However, to be able to create something of their own is also important and construct interaction is also an interaction that gives these opportunities and gives an engagement effect. Even though the No Interaction condition gave an overall disengagement effect, the scores reveal that some children were still engaged by it.

For all the conditions, initial intervals scores show that the game managed to captivate the children's attention, and inspired them to give high expectation scores after the first 5 minutes, including the No Interaction condition. The reason for this could be the same to that of the one mentioned earlier, that is, the child was attracted to the animation in the game and was excited about it thinking that they will be able to "play" with it. When the child found that they could not interact with it the average scores dropped drastically and were low after 40 minutes into the game. Closer analysis into categories will give a clearer picture into the patterns of behaviour according to conditions.

#### **a. The lowest level of engagement category**

Comparing the 3 tables, **Table 7.10, 7.11 and 7.12** has shown that how Condition 1 (No Interaction) has indeed given a disengagement effect by having the lowest level ranging from 4/10 to 0/10. In comparison, Condition 2 (Simulation Interaction) and Condition 3 (Construct Interaction) have their lowest scores ranging from 7/10 to 5/10, and indeed in the upper half of the engagement scale. There are more scores of this level in the No Interaction condition (**35**) compared to Simulation and Construct Interaction, (both at **11**).



### **b. The starting levels range category**

From **Table 7.13** the starting levels were from as high as 10 to as low as 4. 5 of the 8 children in the No Interaction condition placed their starting scores at the upper end of the engagement scale score from 8/10 to 10/10. 6 of the 8 children in Construct Interaction condition places their starting scores in this range too. The Simulation Interaction condition has 4 in this upper end. This finding is simply saying there is something about the effect of seeing moving objects on the screen for the first time that has contributed to this finding. Seeing moving objects at the beginning tends to give children and adults too, some kind of stimulus. As one of the children put it "...You sort of don't know where to look at first..."

### **c. Dips**

**Table 7.14, 7.15 and 7.16** give the occurrence of dips for each child in each experimental condition. Dips tend to signal some anxiety or uncertainty. From all the 3 conditions, Simulation Interaction conditions scored the highest of **7.0**, followed by No Interaction conditions of **5.0**, whilst Construct Interaction had the least **2.0**. From these scores it could be said again that moving images do cause some form of instability to engagement patterns because both conditions, Condition 1 (No Interaction) and Condition 2 (Simulation Interaction) have moving images in them. Another factor could be because of the elements of being in control in the Simulation Interaction condition especially when the characters created were not the ones they created themselves. It brings in the feeling of uncertainty, e.g. the new boss's feeling when first taking charge of an already established firm. There is always the question of "Am I doing the right thing?"

Even though the objects are moving, the anxiety is less in Condition 1 (No Interaction) because the child was there only to look at things. The anxiety might come from the feelings of "what happens next". Such feelings were absent for most children in the Construct Interaction condition because the children were just creating and decorating things. Their excitement is to see a finished product and that will never be reached because as creators and designers humans often never seem to be satisfied.

### **d. Gradual increase and gradual decrease**

**Table 7.17** shows the gradual decrease in No Interaction experimental condition. **Table 7.18** and **7.19** are the gradual increases in Simulation and Construct

Interaction respectively. These patterns show signs of slow deterioration or improvement. Gradual decrease shows signs of an increasing tendency to be disengaged and gradual increase signs of being more engaged. In the No Interaction condition the gradual decrease pattern for this study seems to lead to total disengagement. For the Simulation and Construct Interaction gradual increase seemed to suggest improvement in skills of "play": either the skills of being in control of the simulation; or the skills to use the operative tools to create, build and decorate as in the construct condition. For this study gradual increase, led to engagement levels up to a maximum, where they are so engrossed and do not want to stop even when asked to do so.

#### **e. Plateau**

Closer observation of these plateau patterns seemed to suggest that the children are concentrating on something: either trying to acquire a certain skill or task (e.g. building a fence, layouts, floorings, etc) within the three intervals of construct interaction; or doing repetitive tasks or mundane things (e.g. take a shower, prepare breakfast, clean the floors, watch TV, etc) within the three intervals of simulation interaction; or have reached the highest score of satisfaction or the lowest score of dissatisfaction.

When discussing the plateau in **Tables 7.20, 7.21 and 7.22** one issue is that they show the time when the conditions reached plateaus of total engagement or total disengagement for individuals. For No interaction 4 out of 8 children reached plateau of disengagement after 25 minutes in the game. In fact some of these children left the game after the 30 minutes. For the Simulation Interaction plateaus of total engagement, that sustained till the end began to emerge from 3 individual cases after 15 minutes into the game, while for Construct Interaction it was evident for 3 children from the very start at the first interval after 5-minutes into the game.

#### **f. Maximum**

10/10 is the maximum engagement score an individual could place in the scale of engagement scores for this study. Some engagement scores seemed to be free standing before a fall, but others were the only score marked throughout the session. When this occurred it was pretty obvious that the children were very engrossed with the game. **Tables 7.23, 7.24 and 7.25** show these scores marked by individual children according to the conditions set for them. Total

maximum scores for Construct Interaction are **39**; Simulation is **38** and No Interaction **10**. These findings strengthen the conclusion that the conditions did have an effect on engagement patterns; the Construct and Simulation promoting an engagement effect and No Interaction condition a disengagement effect. The variations in findings within each condition were mainly due to the differences in individual's history. For Simulation and Construct Interaction the maximum scores are found after 35 minutes of the game for all individuals, whilst in No Interaction condition, the maximum score comes from one person, having it at maximum all through the session and another 2 only at the first interval.

#### **g. The ending levels range**

**Table 7.26** is just table that highlights the engagement effects of the experimental conditions. Both the Simulation and Construct Interaction shows the ending levels at 10/10, a sign of total engagement effect, whilst the No Interaction condition mostly has ending levels at 0/10, a sign of total disengagement effect.

### **7.9 Conclusions**

This study has in many ways proven that The Engaging Multimedia Design Model developed in Chapter 6 does predict the engagement patterns of behaviour amongst children. The study has shown that when immediacy, feedback and goals are linked with simulation, a strong affect engagement is seen. Similarly when these three factors are linked with construct interaction, an engagement effect occurs. The study also has some ways supported the argument that no engagement does lead to some form of disengagement.

From this study, it is also evident that the steady nature of acquiring skills in playing with animated materials in Simulation Interaction tended to require the creation of mental models of the families and therefore the performance could lead to variations. As for Construct Interaction, this design feature tended to make great demands of individuals' motor skills capabilities, and as such was better for some than others.

Hence, Study 3 has revealed variations that are more influenced by the individual children than by experimental conditions. Even though there are many factors that could influence these variations, the most probable factor seems to be the

type and degree of experience the child had prior to these experimental conditions. Previous experience the child had prior to playing this game influenced the way the child reacted to each condition, either at its initial stage, intermediate or at the end of the session.

Close observations and from interviews has revealed some experience categories. Children with:

- Lots of experience with the game (The Sims) or other computer games
- Less experience with the game (The Sims) or other computer games
- No experience with the game (The Sims) but some experience with other games
- No experience with the game (The Sims) or other computer games

Before a further test could be made about the experiences factors further discussion affecting them could help to exemplify them

#### **a. Lots of experience with the game (The Sims) or other computer games**

From this study it was found that the experience children had in playing the game before determined their initial reaction to this game. Children that have lots of experience with the game or other computer games have very obvious pattern of initial reaction. These children placed high scores on the engagement scale. These children have high expectations of the game. The high engagement scores indicated that the child must have had very pleasant experience with other games. There is also a chance that the child had positive experiences in playing this game prior to this experiment that is, either he or she is already an addict of this game or has heard wonderful things about the game from friends. At this stage the child does not want to understand the condition he or she is asked to do. What they wanted to do was to play the game.

For children with this type of experience the ability to play was fulfilled when the interactive design feature was Simulation Interaction or Construct Interaction. However, when they were told not to interact, their motivation to continue ceased sooner rather than later. In the condition of No Interaction, this category of children was the first to give up the game. Some just walked out while there were

some loyalists who stayed on hoping that there is a chance somewhere that they will be able to "play"

**b. Less experience with the game (The Sims) or other computer game / No experience with the game (The Sims) but some experience with other games**

Some children have much lower scores than 10/10 for their initial reactions to the game. From observation it could be seen that this was especially true for children having less experience with the game or other computer games; or for children that have no experience with the game but some experience with other games. These children were more cautious with every step they took. They started much lower and the next few intervals either increased or decreased their engagement scores depending upon their performance with the experimental conditions.

This kind of experience, however, did not have much influence on engagement scores in the condition of No Interaction. For the No Interaction experimental condition, the child is not allowed to interact with the system. He or she is just asked to watch the "game" for the whole of the 40 minutes session. Even though nine out of ten children reached their minimum score of engagement at some point during this session, some much earlier than others, surprisingly there were also children that had a positive increment in the level of engagement in their engagement pattern behaviour through the stages in this condition before it gets to its minimal engagement score.

From observation and interview it was apparent that some children did get amused by the reaction of the characters in the game they were observing. Two out of the 8 children found some situation funny. One said, "It was funny to see the children playing with ants". When the researcher asked why, the child said, "...You see they are not ...I don't know" (from the way the child tried to explain, the researcher was able to elicit how frustrated the child felt at the time when the child was not allowed to interact with the characters). She continued, "...The boy just frown and looked up at you then a bubble appeared with questions marks and stars... he looked angry too!" Since the child was not allowed to react to the game, to move the mouse or touch any keys, the child just had to watch the characters and some of their reactions made her laugh. Another child recalled her instant of highest engagement score when one of the characters "wees" on the floor because she could not instruct them to go to the toilet "That is funny," she said.

Some of these examples are just to show us that even if there is no interactive design feature in a multimedia CD, it could contribute to some form of engagement if the design feature includes some form of narrative and storyline in its content. Storytelling and narration does inspire children besides animation. Therefore in the experimental condition of No Interaction the child is not influenced by the criteria of having less or no experience in the game nor with or without experience with the game or any other kind of computer game. When one child who was addicted to this game was given this condition of No interaction her reaction to it was positive from the very start to the end. Even though she said she had never played the game in this way she was amused by the story conveyed and enjoyed it very much.

The study shows there is a need to find out more about elements of experience. The question that rises from this study is whether previous experience with The Sims could influence the child's engagement pattern between the two interactive design styles, simulation and construct interaction. A comparative study needs to be made between two groups of children, one group with The Sims experience and the other without The Sims experience.

## **7.10 Summary**

In this study three conditions of interaction were studied: no interaction, simulation and construction. The results were broadly in the direction of predictions. No interaction led to the lowest level of engagement, an average of 4.22 overall and an average in the final part of the session of 1.6. The two interaction sessions produced high levels of engagement; the simulation construction conditions both produced an average of 8.95 and the maximum average of 10.0 for the final part of the session of 10.0. The results give support for the model of interactive factors but the prevalence of the ceiling effect in the scores for both the interactive conditions makes it difficult to distinguish the role of specific factors in achieving engagement. However, an analysis of the profiles of results for different users and reference to the video and interview evidence demonstrates a number of phenomena.

In the no interaction condition session, for example, most users became disengaged quite quickly but there were two children who stayed engaged and the interviews demonstrated that both children had different game play

experience either with other computer games or the Sims. One child had no experience with any kind of computer game, while another is an addict of The Sims game. However in both the construction and simulation conditions it was the children with little experience who struggled at first and were not particularly engaged although they all overcame their difficulties and achieved maximum degrees of engagement at the end of the sessions. In both conditions there were children with experience who started at maximum engagement and remained at this level throughout the session. The interview and video records show that the children without experience struggled with different kinds of learning in the simulation and construction conditions; with understanding the families in the simulation and with the psychomotor skills necessary to use the construction facilities. This study suggests that, whilst the interactive features already identified are important in the achievement of engagement, another factor – the past experience of the children and the models and skills they bring to the session – has to be added to give a fuller account of what leads to engagement.

# Chapter 8

## A Study of Previous Experience – Study 4

### 8.0 Chapter Outline

This chapter presents and analyses findings from Study 4 which is a further test of the Engaging Multimedia Design Model developed in Chapter 6.

#### Thesis Structure

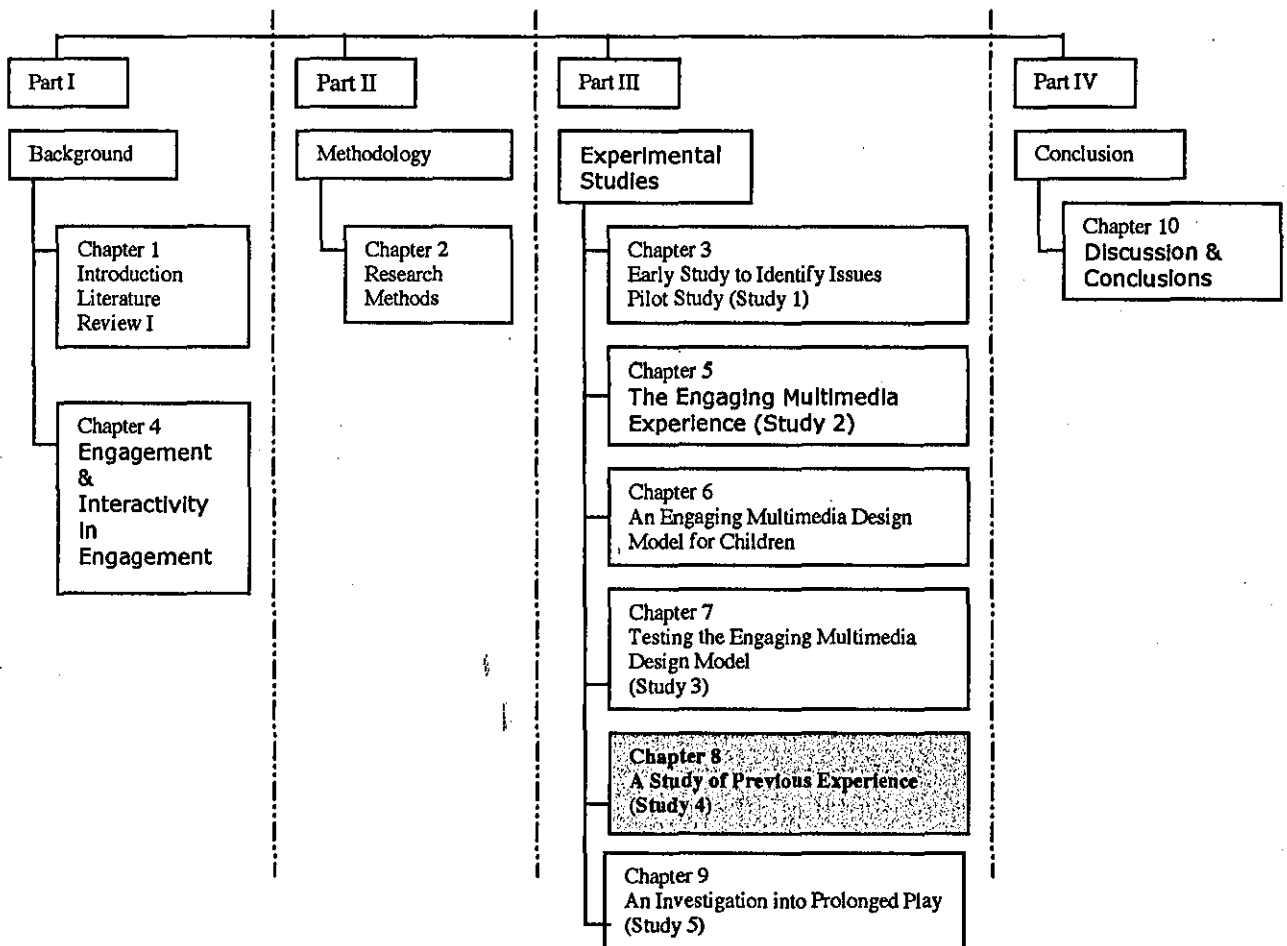


Figure 8.1: Chapter 8 in the Thesis Structure



## 8.1 Introduction

Study 3 has demonstrated that that The Preliminary Engaging Multimedia Design Model goes some way to explaining engagement patterns. It demonstrated that non-interaction, in most cases, led to disengagement whilst both construct and simulation interaction led to high levels of engagement. However, there were interesting findings in relation to each condition. A few children, those with little or no experience of playing computers games, did not become disengaged in the no interaction condition. It was also evident that in the simulation interaction the children had to develop an understanding or a 'mental model' of the behaviour of the characters before they become fully engaged. The construct interaction condition required the children to develop specific motor skill before they could become fully engaged. Hence, Study 3 revealed that there are other factors influencing individuals than the factors in the model. Closer observation suggested that the variations are mainly due to the differences in the children's history.

## 8.2 Further Tests – Study 4

### 8.2.1 The Purpose of the Study

From Study 3, there was a need to examine further issues about individual differences mainly about degree of experience. The specific question to examine was whether previous experience with The Sims could influence the child's engagement pattern with the two interactive design types, simulation and construct interaction. Therefore, the purpose of doing Study 4 will be to conduct a comparative study between two groups of children, one group with The Sims experience **Sims (WE)** and the other without The Sims experience **Sims (WOE)** to examine the patterns of engagement between them.

### 8.2.2 Selected Children: age and gender

Just as in other studies the children in this study were equally divided according to gender differences having age range varying from 10 to 14. There are only 8 children involved in this study, 4 having The Sims Experience and another 4 without The Sims Experience. The study took one whole day. Each child did both conditions one after the other. The order of the experimental conditions was interchanged to overcome order and learning effects.

The experimental procedure and the measures will be identical to previous studies but, in this case, the children will undertake both the simulation and the construction condition. This will enable a direct comparison to be made between the effects of the two conditions. The hypothesis is that children with experience (the WE group) will achieve earlier engagement in both conditions than those without experience (the WOE group). However, it is also hoped that the study will reveal more about how experience or the lack of it affects the experience of engagement in both conditions.

## **8.3 The Methods**

### **8.3.1 Experimental Location**

This study was carried out in a place familiar to the children, a weekend extra-class classroom. The children have used this place for their gatherings and some weekend language classes and social activities. This location was chosen so that the children felt comfortable and safe. Food and soft drinks were supplied in an adjacent room and the other children and siblings were given other games and activities to play when one was called to participate in the experiment.

### **8.3.2 Experimental Scenario and Time Span**

Eight children were involved in this experiment, 4 in Sims WE group and another 4 in Sims WOE group. This experiment had two experimental conditions: simulation interaction and construct interaction. Each child did the two conditions one after another, giving them about 5 to 10 minutes rest in between sessions. Each session took 40 minutes. A standard briefing of how to play the session was given to each child before he or she started the game. The child was taught the basic skills and tools needed for the condition. They were then asked to place their engagement score on the engagement scale of 0 to 10 at every 5-minute interval as before. A short semi-structured interview was conducted to ask the child about his or her reactions to the game at the end of the two sessions.

## **8.4 Simulation Interaction**

### **8.4.1 What the children had to do**

This experimental condition had the same condition as the ones in Study 3, that is, the child when doing this condition was allowed to play and interact with the application with some restrictions. When doing this condition the child had to play a role with the characters created for them. They were expected to instruct the characters to do things in response to the consequences from the child's previous moves. The child is in control of these characters. The child had to take care of them, fulfil their basic needs like hunger, hygiene, bladder, relationships, budget, etc and manage their family life. The child needs to record their feelings about it at every 5-minute interval for 40 minutes. In this experimental condition the child is in the live mode (simulation interactivity).

### **8.4.2 How was this condition set up?**

The researcher set up this experiment the same as Condition 2 (Simulation Interaction) in Study 3. The same family was also chosen from the ones listed by the designer. The family was moved to a specific location. Having the experimental condition in a live mode allows the child in this condition to play and respond to the dialogues as they appear on the screen. A short briefing of how to use the operative tools was given. Some background about The Sims were also given, much more detailed to the ones that had no experience than the ones that had because most of those that had played the game before seemed more eager to get on with the game than to listen to the researcher's explanation of it. The children were told that it was their responsibility to take care of the characters making them happy and fulfilling their basic needs. They were also told that they had 40 minutes to take care of them and record their feelings of it at every 5-minute interval.

## **8.5 Construct Interaction**

### **8.5.1 What the children had to do**

The children had also to do construct interaction experimental condition. This condition is the same as the one in Condition 3 (Construct Interaction) in Study 3. When doing this experimental condition the child was allowed to interact with the application with some restrictions. This condition gave the child the chance to use

the construct interactivity mode to create, build and decorate a house either bought ready-made or created by him or her until the 40-minute session was over. They were to record their feelings about it at every 5-minute interval.

### **8.5.2 How was this condition set up?**

This experiment was set up as that of Condition 3 (Construct Interaction) in Study 3. The researcher created a family and gave this family unlimited resources (money) so much so that the child was able to create, build and buy anything. The child is in the build and buy mode until the 40 minutes are over. A short briefing of how to use the operative tools was given to the child before they started to "play" (creating, building and decorating) using the construct interactivity tools.

## **8.6 Data Gathering and Data Processing**

The data for this study comprises of:

- An engagement scale score marked by every child at every 5-minute interval for both experimental conditions, simulation interaction and construct interaction
- A graph plotted of the engagement scale scores of every individual for both conditions
- An average scores marked at every 5-minute interval for both experimental conditions
- A graph plotted of the average scores marked from the beginning to the end of every interval for both experimental conditions
- A Semi-structured interviews conducted at the end of both experiments
- Video recordings of the sessions, to be looked at to follow up incidents reported in the interviews and in the engagement scores.

## **8.7 The Results**

Findings in this study were from data collected from both experimental conditions: the averages of engagement scale scores of each child for both experimental condition; and the graphs plotted of them. This section will look at overall scores and patterns, the averages of each group, the ones with The Sims Experience and the

ones without The Sims experience, highlighting some individual cases to emphasise issues.

## 8.8 Overall Engagement Scale Scores According to Experience for Both Experimental Conditions

### 8.8.1 Engagement Scale Scores for Sims (WE) Group

The overall engagement scale scores per interval for each child in With The Sims Experience **Sims (WE)** group for both experimental conditions, simulation interaction and construct interaction could be seen in **Table 8.1** and **Table 8.2** respectively.

Simulation Interaction Sims (WE)	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	Average Score per Child
Case 1 Girl, 14	10	9	9	8	8	9	10	10	9.13
Case 2 Boy, 12	5	5	3	4	6	7	10	10	6.25
Case 3 Boy, 10	5	5	6	8	10	10	10	10	8
Case 4 (8) Girl, 10	10	10	10	10	10	10	10	10	10
<b>Average Scores Per Interval</b>	<b>7.5</b>	<b>7.25</b>	<b>7</b>	<b>7.5</b>	<b>8.5</b>	<b>9</b>	<b>10</b>	<b>10</b>	<b>8.34</b>

**Table 8.1:** Engagement Scale Scores for Simulation Interaction **Sims (WE)** Group

Construct Interaction Sims (WE)	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	Average Score per Child
Case 1 Girl, 14	10	10	10	10	10	10	10	10	10
Case 2 Boy, 12	10	8	6	5	10	10	10	10	8.63
Case 3 Boy, 10	6	7	8	9	10	10	10	10	8.75
Case 4 (8) Girl, 10	10	10	10	10	10	10	10	10	10
<b>Average Scores Per Interval</b>	<b>9</b>	<b>8.75</b>	<b>8.5</b>	<b>8.5</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>9.34</b>

**Table 8.2:** Engagement Scale Scores for Construct Interaction **Sims (WE)** Group

### 8.8.2 Engagement Scale Scores for Sims (WOE) Group

The overall engagement scale scores per interval for each child in the Without The Sims Experience **Sims (WOE)** group for both experimental conditions; simulation interaction and construct interaction could be seen in **Table 8.3** and **Table 8.4** respectively.

Simulation Interaction Sims (WOE)	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	Average Score per Child
Case 5 (4) Girl, 14	5	7	9	10	10	10	10	10	8.88
Case 6 (5) Boy, 13	6	5	6	7	8	10	10	10	7.75
Case 7 (6) Boy, 14	5	6	7	8	9	9	9	9	7.75
Case 8 (7) Girl, 10	6	7	6	8	9	10	10	10	8.25
<b>Average Scores Per Interval</b>	<b>5.5</b>	<b>6.25</b>	<b>7</b>	<b>8.25</b>	<b>9</b>	<b>9.75</b>	<b>9.75</b>	<b>9.75</b>	<b>8.16</b>

**Table 8.3:** Engagement Scale Scores for Simulation Interaction Sims (WOE) Group

Construct Interaction Sims (WOE)	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	Average Score per Child
Case 5 (4) Girl, 14	4	5	7	9	10	10	10	10	8.13
Case 6 (5) Boy, 13	5	6	4	7	8	9	10	10	7.38
Case 7 (6) Boy, 14	10	7	5	6	8	9	9	9	7.88
Case 8 (7) Girl, 10	10	5	6	7	10	10	10	10	8.5
<b>Average Scores Per Interval</b>	<b>7.25</b>	<b>5.75</b>	<b>5.5</b>	<b>7.25</b>	<b>9</b>	<b>9.5</b>	<b>9.75</b>	<b>9.75</b>	<b>7.97</b>

**Table 8.4:** Engagement Scale Scores for Construct Interaction Sims (WOE) Group

## 8.9 Average Engagement Patterns Simulation Interaction Vs Construct Interaction

When the average engagement scores were tabulated for each group of children the following graphs could be plotted.

### 8.9.1 Simulation Interaction Vs Construct Interaction Sims WE Group

A graphical presentation of the average engagement scores of children with the Sims experience could be seen in **Figure 8.2** below. The average scores for Simulation Interaction Experimental Condition is **8.34** and for Construct Interaction Experimental Condition is **9.34**.

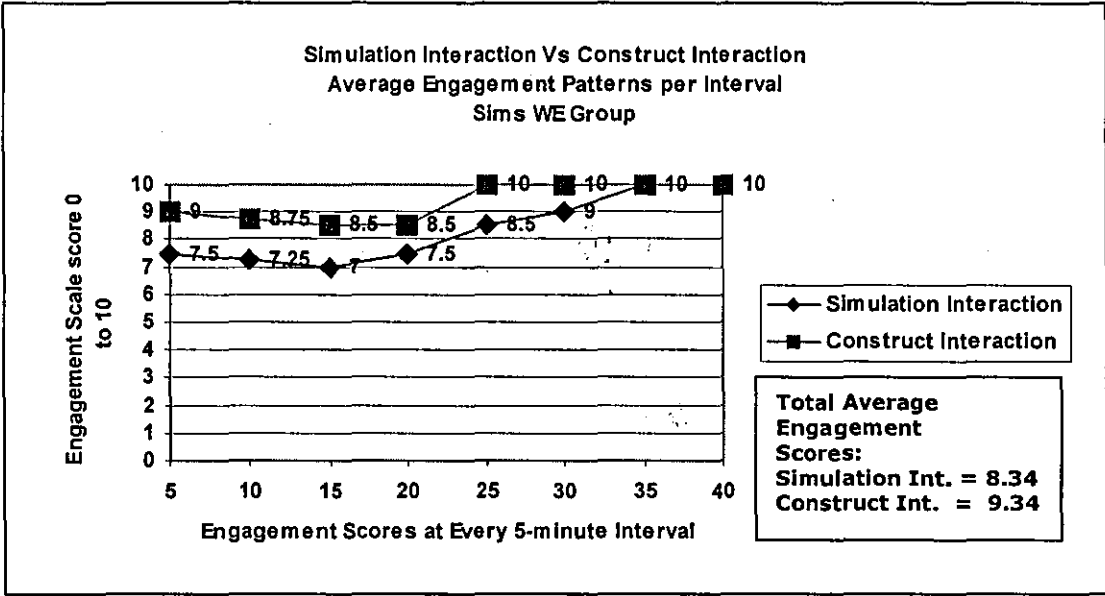


Figure 8.2: A graphical presentation of average engagement patterns per interval Simulation Interaction Vs Construct Interaction for Sims WE Group

### 8.9.2 Simulation Interaction Vs Construct Interaction Sims WOE Group

Figure 8.3 is a graphical presentation of the average engagement scores of children without the Sims experience. The average scores for Simulation Interaction Experimental Condition for this group is **8.16** and for Construct Interaction Experimental Condition is **7.97**

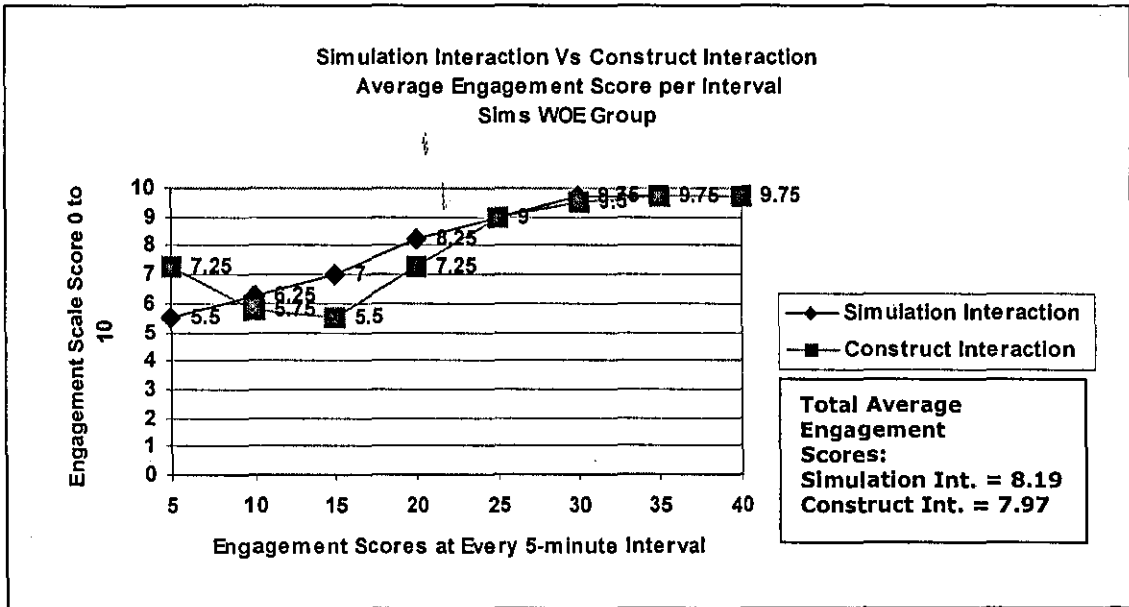


Figure 8.3: A graphical presentation of average engagement patterns per interval Simulation Interaction Vs Construct Interaction for Sims WOE Group

## 8.10 Engagement Patterns According to Categorisation as in Study 2 and Study 3 for both groups Sims WE and Sims WOE

### 8.10.1 The lowest level of engagement category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction

From **Table 8.1** for Simulation Interaction Vs **Table 8.2** for Construct Interaction the lowest level of engagement category for the group of children with Sims experience could be tabulated as seen in **Table 8.5** below.

Engagement Category Lowest Level of Engagement Scale Score Range = from 4/10 and below	Engagement Scores at Every 5-minute Interval For Simulation Vs Construct Sims WE Group								Total Score for Each Range
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
<b>Simulation Interaction</b>									
4/10	-	-	1	-	-	-	-	-	1
3/10	-	-	-	1	-	-	-	-	1
<b>Total Score per Interval</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Construct Interaction</b>									
4/10	-	-	-	-	-	-	-	-	0
3/10	-	-	-	-	-	-	-	-	0
<b>Total Score per Interval</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

**Table 8.5:** The Lowest Level Category Simulation Interaction Vs Construct Interaction for Sims WE Group

For the group without Sims Experience this category could be tabulated as seen in **Table 8.6** below.

Engagement Category Lowest Level of Engagement Scale Score Range = from 4/10 and below	Engagement Scores at Every 5-minute Interval For Simulation Vs Construct Sims WOE Group								Total Score for Each Range
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
<b>Simulation Interaction</b>									
4/10	-	-	-	-	-	-	-	-	0
3/10	-	-	-	-	-	-	-	-	0
<b>Total Score per Interval</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Construct Interaction</b>									
4/10	1	-	1	-	-	-	-	-	2
3/10	-	-	-	-	-	-	-	-	0
<b>Total Score per Interval</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>

**Table 8.6:** The Lowest Level Category Simulation Interaction Vs Construct Interaction for Sims WOE Group



### 8.10.2 The Starting Level Range category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction

The starting level range was from as low as 4/10 to as high as 10/10. From **Table 8.7** below most of the children in the experience group Sims WE placed their scores at the upper end of the score, 10/10, two in simulation condition and three in the construct condition. The low starters were within the range of 5/10, two in the simulation condition and 6/10, one in the construct condition.

The Starting Engagement Levels for the First 5-minute Interval	Total number for each score Sims WE Group		Total number for each score Sims WOE Group	
	Simulation Interaction	Construct Interaction	Simulation Interaction	Construct Interaction
10/10	2	3	-	2
9/10	-	-	-	-
8/10	-	-	-	-
7/10	-	-	-	-
6/10	-	1	2	-
5/10	2	-	2	1
4/10	-	-	-	1
<b>Total Number</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>4</b>

**Table 8.7:** The Starting Engagement levels In Simulation Vs Construct Interaction for Sims WE Group and Sims WOE Groups

Children without the Sims experience Sims (WOE) tended to place the starting level near the middle or lower end, 4/10, one in construct condition, 5/10 one in construct and two in simulation condition. There are also those who placed a 6/10, two in simulation. Two children doing the construct condition placed a 10/10 score at the start of the game.

Children with Sims experience tended to have a much higher expectation of the game therefore placing their starting scores at a higher end compared to children without The Sims experience. The ones that placed higher scores were those who were keen game players.

### 8.10.3 Dips category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction

Tables 8.8 and 8.9 are records of dips from the Sims WE group and Tables 8.10 and 8.11 are records of dips from the Sims WOE group. From these tables it can be concluded that dips tend to occur slightly more for those without The Sims experience than for the ones with the Sims experience.

Dips in Simulation Interaction for Sims (WE) Group	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	Total Dips per Child
Case 1 Girl, 14	10	9	9	8	8	9	10	10	0
Case 2 Boy, 12	5	5	3	4	6	7	10	10	1
Case 3 Boy, 10	5	5	6	8	10	10	10	10	0
Case 4 (8) Girl, 10	10	10	10	10	10	10	10	10	0
<b>Total Dips per Interval</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>

Table 8.8: Occurrence of Dips in Simulation Interaction Sims (WE) Group

Dips in Construct Interaction for Sims (WE) Group	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	Total Dips per Child
Case 1 Girl, 14	10	10	10	10	10	10	10	10	0
Case 2 Boy, 12	10	8	6	5	10	10	10	10	1
Case 3 Boy, 10	6	7	8	9	10	10	10	10	0
Case 4 (8) Girl, 10	10	10	10	10	10	10	10	10	0
<b>Total Dips per Interval</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>

Table 8.9: Occurrence of Dips in Construct Interaction Sims (WE) Group

Dips in Simulation Interaction for Sims (WOE) Group	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	Total Dips per Child
Case 5 (4) Girl, 14	5	7	9	10	10	10	10	10	0
Case 6 (5) Boy, 13	6	5	6	7	8	10	10	10	1
Case 7 (6) Boy, 14	5	6	7	8	9	9	9	9	0
Case 8 (7) Girl, 10	6	7	6	8	9	10	10	10	1
<b>Total Dips per Interval</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>

Table 8.10: Occurrence of Dips in Simulation Interaction Sims (WOE) Group

Dips in Construct Interaction for Sims (WOE) Group	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	Total Dips per Child
Case 5 (4) Girl, 14	4	5	7	9	10	10	10	10	0
Case 6 (5) Boy, 13	5	6	4	7	8	9	10	10	1
Case 7 (6) Boy, 14	10	7	5	6	8	9	9	9	1
Case 8 (7) Girl, 10	10	5	6	7	10	10	10	10	1
<b>Total Dips per Interval</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3</b>

Table 8.11: Occurrence of Dips in Simulation Interaction Sims (WOE) Group

### 8.10.4 Gradual Increase and Gradual Decrease Category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction

Gradual Increase performance could be seen in a few individual cases. There were no examples of gradual decreases. **Table 8.12** below shows performance from the Sims experience group. One child had this when doing the simulation condition while another when doing the construct condition.

Engagement Category	Engagement Scores at Every 5-minute Interval Simulation Interaction Vs Construct Interaction for Sims WE Group								Position of gradual Increase
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Gradual Increase Pattern									
Simulation Interaction Case 1 Girl, 14	10	9	9	8	8	9	10	10	High- Decrease - Gradual Increase - Maximum
Construct Interaction Case 3 Boy, 10	6	7	8	9	10	10	10	10	Low- Gradual Increase - High-Maximum

**Table 8.12:** Occurrence of Gradual Increase in the Sims (WE) Group

For the children without the Sims experience, this performance was, in two cases, the same child Case 6 (Boy, aged 13) when doing both the experimental conditions, and when doing the simulation experimental condition (**Table 8.13**)

Engagement Category	Engagement Scores at Every 5-minute Interval Simulation Interaction Vs Construct Interaction for Sims WOE Group								Position of gradual Increase
	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	
Gradual Increase Pattern									
Simulation Interaction Case 6 (5) Boy, 13	6	5	6	7	8	10	10	10	Low- Dips - Gradual Increase - Maximum
Simulation Interaction Case 7 (6) Boy, 14	5	6	7	8	9	9	9	9	Low- Higher - Gradual Increase - Highest
Construct Interaction Case 6 (5) Boy, 13	5	6	4	7	8	9	10	10	Low- Higher - Dips - Gradual Increase - Maximum

**Table 8.13:** Occurrence of Gradual Increase in the Sims (WOE) Group

### 8.10.5 Plateau Category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction

Plateaus represent a consistency in activity, a stagnant performance, an evidence of being in a similar mood to the ones before, e.g., trying to get used to certain operative skills, doing the same thing over and over again, etc. From the previous studies and also in this study a child usually reached a plateau when he or she has reached a maximum level of satisfaction and they did not regress after that. For some children this maximum plateau was reached much earlier than for others. **Tables 8.14, 8.15, 8.16 and 8.17** show its occurrences under the different experimental situations for each group of children

Simulation Interaction Sims (WE)	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	No. Plateaus per Child
Case 1 Boy, 12	10	9	9	8	8	9	10	10	3 plateaus
Case 2 Girl, 14	5	5	3	4	6	7	10	10	2 plateaus
Case 3 Boy, 10	5	5	6	8	10	10	10	10	2 plateaus
Case 4 (8) Girl, 10	10	10	10	10	10	10	10	10	1 plateau
<b>Total Scores of Plateaus</b>									<b>8 plateaus</b>

**Table 8.14:** Occurrence of Plateaus for Simulation Interaction in the Sims (WE) Group

Construct Interaction Sims (WE)	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	No. Plateaus per Child
Case 1 Boy, 12	10	10	10	10	10	10	10	10	1 plateau
Case 2 Girl, 14	10	8	6	5	10	10	10	10	1 plateau
Case 3 Boy, 10	6	7	8	9	10	10	10	10	1 plateau
Case 4 (8) Girl, 10	10	10	10	10	10	10	10	10	1 plateau
<b>Total Scores of Plateaus</b>									<b>4 plateaus</b>

**Table 8.15:** Occurrence of Plateaus for Construct Interaction in the Sims (WE) Group

Simulation Interaction Sims (WOE)	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	No. Plateaus per Child
Case 5 (4) Girl, 14	5	7	9	10	10	10	10	10	1 plateau
Case 6 (5) Boy, 13	6	5	6	7	8	10	10	10	1 plateau
Case 7 (6) Boy, 14	5	6	7	8	9	9	9	9	1 plateau
Case 8 (7) Girl, 10	6	7	6	8	9	10	10	10	1 plateau
<b>Total Scores of Plateaus</b>									<b>4 plateaus</b>

**Table 8.16:** Occurrence of Plateaus for Simulation Interaction in the Sims (WOE) Group

Construct Interaction Sims (W0E)	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	No. Plateaus per Child
Case 5 (4) Girl, 14	4	5	7	9	10	10	10	10	1 plateau
Case 6 (5) Boy, 13	5	6	4	7	8	9	10	10	1 plateau
Case 7 (6) Boy, 14	10	7	5	6	8	9	9	9	1 plateau
Case 8 (7) Girl, 10	10	5	6	7	10	10	10	10	1 plateau
<b>Total Scores of Plateaus</b>									<b>4 plateaus</b>

Table 8.17: Occurrence of Plateaus for Construct Interaction in the Sims (W0E) Group

### 8.10.6 Maximum Category for Sims WE and Sims W0E for Simulation Interaction Vs Construct Interaction

Tables 8.18, 8.19, 8.20 and 8.21 show the occurrence of maximum scores in both groups of children in both experimental conditions.

Simulation Interaction Sims (WE)	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	Total Maximum Scores per Child
Case 1 Boy, 12	10	9	9	8	8	9	10	10	3
Case 2 Girl, 14	5	5	3	4	6	7	10	10	2
Case 3 Boy, 10	5	5	6	8	10	10	10	10	4
Case 4 (8) Girl, 10	10	10	10	10	10	10	10	10	8
<b>Total Maximum Scores Per Interval</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>4</b>	<b>17</b>

Table 8.18: Occurrence of Maximum Scores for Simulation Interaction in the Sims (WE) Group

Construct Interaction Sims (WE)	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	Total Maximum Score per Child
Case 1 Boy, 12	10	10	10	10	10	10	10	10	8
Case 2 Girl, 14	10	8	6	5	10	10	10	10	5
Case 3 Boy, 10	6	7	8	9	10	10	10	10	4
Case 4 (8) Girl, 10	10	10	10	10	10	10	10	10	8
<b>Total Maximum Scores Per Interval</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>25</b>

Table 8.19: Occurrence of Maximum Scores for Construct Interaction in the Sims (WE) Group

Simulation Interaction Sims (W0E)	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	Total Maximum Score per Child
Case 5 (4) Girl, 14	5	7	9	10	10	10	10	10	5
Case 6 (5) Boy, 13	6	5	6	7	8	10	10	10	3
Case 7 (6) Boy, 14	5	6	7	8	9	9	9	9	0
Case 8 (7) Girl, 10	6	7	6	8	9	10	10	10	3
<b>Total Maximum Scores Per Interval</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>11</b>

Table 8.20: Occurrence of Maximum Scores for Simulation Interaction in the Sims (W0E) Group

Construct Interaction Sims (WOE)	5-min	10-min	15-min	20-min	25-min	30-min	35-min	40-min	Total Maximum Score per Child
Case 5 (4) Girl, 14	4	5	7	9	10	10	10	10	4
Case 6 (5) Boy, 13	5	6	4	7	8	9	10	10	2
Case 7 (6) Boy, 14	10	7	5	6	8	9	9	9	1
Case 8 (7) Girl, 10	10	5	6	7	10	10	10	10	5
<b>Total Maximum Scores Per Interval</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>12</b>

**Table 8.21:** Occurrence of Maximum Scores for Construct Interaction in the Sims (WOE) Group

### 8.10.7 The Ending Levels Category for Sims WE and Sims WOE for Simulation Interaction Vs Construct Interaction

**Table 8.22** represents the ending level range for both groups of children for the different experimental conditions.

The Ending Engagement Scores for the Last 40-minute Interval	Total number for each score Sims WE Group		Total number for each score Sims WOE Group	
	Simulation Interaction	Construct Interaction	Simulation Interaction	Construct Interaction
10/10	4	4	3	3
9/10	-	-	1	1
8/10	-	-	-	-
7/10	-	-	-	-
6/10	-	-	-	-
5/10	-	-	-	-
4/10	-	-	-	-
<b>Total Numbers</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>4</b>

**Table 8.22:** The Ending Engagement Levels Range for both Simulation and Construct Interaction Experimental Conditions for Sims WE Group and Sims WOE Group

## 8.11 Data Analysis

Study 4 was conducted to investigate whether there are still other factors that might contribute to patterns of engagement besides the factors already in the model.

### 8.11.1 Engagement Scale Scores; Simulation Interaction Vs Construct Interaction for Sims WE Group

Looking at **Table 8.1** and **Table 8.2**, it could be seen that there is a difference in the average score per child for both experimental conditions: simulation interaction is **8.34**, while construct is **9.34**. Both scores are indicators of an engagement effect

but having experience of The Sims meant the children in this group responded more positively to the construct interaction condition than the simulation interaction condition.

Through interviews it was found that these children liked creating things because it gave them a sense of ownership. "I like to build and create my own house...its fun... it gives you a chance to look at your own creation not someone else's ..." When asked about their liking for the simulation experimental condition they had this to say " I thought it was fun at first but ...after sometime I realised I did not actually know who those people are...I had to look at them again...you know...see whether they had a job or something... you know..."

When the experienced group were asked why they find construct more interesting the answers reveal more about individual differences. One child said: " I like the building and decorating one...because I like to build and decorate." Another said, "I like it (build and decorate) for awhile I think...after sometime maybe I'll get bored...because you just get the same furniture ...again and again...I don't know... at least the other one (simulation mode) you can play with the characters and try to get them more money...or something"

In the construct mode the child was free to build anything or to buy something ready-made and to decorate it. This sense of freedom is important in a child and tends to have an effect on engagement patterns. While in the simulation mode the child was given a family to take care of which someone else had created. The child needed to look at all the characters to determine what they are and what is expected of them as they are in charge of the situation. It took a much longer time than anticipated and this affected their engagement pattern scores. Therefore simulation interactivity tended to be "least favoured" though just a little below construct interactivity with this group of children.

#### **8.11.2 Engagement Scale Scores Simulation Interaction Vs Construct Interaction for Sims WOE Group**

What about children without The Sims experience? Looking at **Table 8.3** and **Table 8.4**, the average score per child is higher in Simulation Interaction than Construct Interaction: Simulation Interaction is **8.16** and Construct Interaction **7.97**. When the

children were asked which one they prefer they said Simulation because " I can play with it...the other one is just build, build, build..."

One child had this to say "I never liked The Sims...It is a never ending game...I prefer the ones that you have to reach certain targets ...levels...the more the better. Some games have loads...yet it is still achievable...you can get to it some how...this one...I don't... it never ends..."

Another child said " I like The Sims no matter what it is...I will always find something interesting to play with it...make some crazy things and have a laugh of it...extensions packs would be a bonus...I like it whatever..."

### **8.11.3 Conclusion**

**Figures 8.2 and 8.3** provide further information. Children with the Sims experience tend to reach their maximum level of engagement much earlier in Construct Interaction than Simulation Interaction, that is, after 25 minutes into the game. The score does not quite reach a maximum 10/10 for children in the non-experience group, having a gradual increase in the Simulation Interaction condition compared to a sharp fall before a rise in the Construct Interaction condition, having reaching the maximum range after 35 to 40 minutes.

A possible interpretation of these patterns is that the acquisition of motor skills required for Construct Interaction is much easier to recall and reacquire for the experienced group of children than it is for the non-experienced children to acquire for the first time. When the experienced children were doing the Simulation Interaction they had to acquire a mental model of the particular characters which for some took a longer time. The reasons could be mainly because the characters in the simulation mode are very foreign to them because they did not create them. They could not easily anticipate their behaviour and this takes time and it was only when they were well into the game that they get to a maximum engagement level, after 35 minutes.

The difference of performance in the construct mode for the Sims WE group exemplifies the factor about previous length of play. The findings give some indication of how much playing this game before had affected the performance of the children. In the interviews it was found that some children had not played the game



for quite awhile and they were rather slow in catching up with the motor skills necessary. Skilled users placed their scores at a maximum from start to finish in the construct experimental condition but they did not do so when doing the simulation mode. A detailed analysis according to categorisation will help to understand this further.

#### **8.11.4 Significant Difference**

To test whether there was a significant difference between the children without the Sims experience, WOE Group and children with the Sims experience, WE group in their engagement pattern for simulation and construct, a general linear model test was performed for related measures. The results show that there was a significant difference at every stage of the sessions. The details of the test are available in **Appendix B.**

#### **8.11.5 Triangulation Analysis**

There are some data that could not be easily detected by the engagement scale scores. The occurrences of ceiling effects in the patterns of engagement for this study are some of them. When ever these non-sensitive aspects of the scale is encountered a triangulation method of analysis using video recordings and interviews were used.

### **8.12 Comparing Engagement Patterns According to Categorisation**

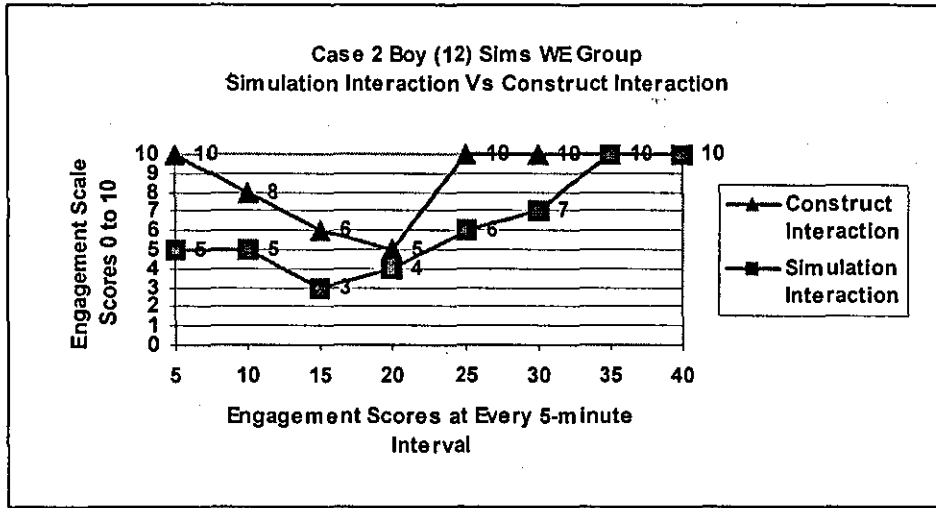
#### **8.12.1 The Lowest Engagement Level Category**

##### **a. Overall results Simulation Vs Construct Interaction for Sims WE and Sims WOE Group**

**Table 8.3** reveals two cases of low engagement levels in the Sims WE group and both are in the Simulation Interaction experimental mode. In the Sims WOE group two cases are found in the Construct experimental mode. Close observation reveals that the two lowest scores in the Sims WE group came from the same child whilst in the Sims WOE Group it came from two different children. Looking at individual cases examples can help explain these patterns.

**b. Individual Case Example - Case 2 Boy (12) in Sims WE Group**

**Figure 8.4** is a case of a child that had never liked The Sims. The boy Case 2, Sims WE, aged 12, had played with The Sims, but since he is a game enthusiast, he had many other games but The Sims is one he least favoured. He found the game boring because he preferred games with targets and levels.



**Figure 8.4:** Engagement Patterns Simulation Vs Construct Interaction of Case 2 Boy (12) in Sims WE Group

He did the Simulation Experimental condition first and placed a low score of 5/10 at the first encounter and later dropped as low as 3/10 after 15 minutes in the game. However, his interest after that fall rises again slowly till it reaches a maximum 10/10 score after 35 minutes into the game.

When the Construct Experimental condition was given to him, he started off at a maximum score of 10/10, a score that might be influenced by his previous experience with the condition before this. His engagement levels started to decrease again till it reached a low score of 5/10 after 20 minutes into the game before a sharp rise to a maximum 10/10 after 25 minutes into the game and he continued to be in this level till the end. **Figure 8.4** shows his performance for both experimental conditions.

There are some interesting points to note regarding this child's performance in both conditions. Interview has revealed that this boy is negative about the game from the very start. From the video recordings it was observed that the child was bored doing

the simulation game, looking at other places and feeling restless and bored. But since he was left uninterrupted for a while he started to pay more attention to the game and got engaged after 35 minutes. When he did the construct experimental condition the experience he had from the previous session influence his initial starting point. After sometime when he was told he could only play with the constructing tools he lazily constructed something on the screen, deleting and reconstructing and deleting again. Then, as though, he had just remembered that he could buy a ready-made house, build extensions and decorate, he clicked on this option. It is during this time when his scores reached its maximum. This situation explains the sharp rise in engagement pattern after 25 minutes into the game.

### **8.12.2 The Starting Level Range Category**

#### **Overall results of Simulation Vs Construct Interaction for Sims WE and Sims WOE Group**

The overall starting level range was from as low as 4/10 to as high as 10/10. **Table 8.7** shows that children in the Sims WE group placed high scores at the initial stage of the game as compared to those in the Sims WOE group. From the eight experimental sessions of the Sims WE group, 5 out of 8 placed a starting score at 10/10, whereas in Sims WOE group the starting level scores in 6 out of 8 experimental sessions were within range from 4/10 to 6/10.

These findings emphasise that experienced children tend to have a much higher expectation of the game at the beginning compared to non-experienced children. This is further evidence that the game had already successfully sustained the children's interest. These findings suggest a need to find out how long this might be the case; how long can children play the Sims and sustain a sense of engagement?

### **8.12.3 Dips Category**

#### **Overall results Simulation Vs Construct Interaction for Sims WE and Sims WOE Group**

The Sims WE group had only one dip and it was evident that the children were less "emotionally disturbed" in their behaviour whilst playing the game. We might expect that children without experience, the Sims WOE group would show many dips because of the newness of experience, foreign encounters, anxiety and uncertainty,

etc. There are 2 dip cases in Simulation Interaction and 3 in Construct Interaction when this group of children did these sessions. There is thus some indication that their lack of experience led to disturbing episodes.

#### **8.12.4 Gradual Increase and Gradual Decrease Category**

##### **Overall results Simulation Vs Construct Interaction for Sims WE and Sims WOE Group**

**Table 8.12** shows two case examples of children in the Sims WE group while **Table 8.13**, has three case examples in the Sims WOE group. There were no examples of gradual decrease.

#### **8.12.5 Plateau Category**

##### **Overall results Simulation Vs Construct Interaction for Sims WE and Sims WOE Group**

For this study all the children in both groups sustained a maximum plateau at the end of each session. There is one child in the Sims WE group in the Simulation Interaction condition that maintained a maximum plateau from the very beginning to the end of the session, and two in the Construct Interaction condition. All four children who did the construct interaction in this group reached their maximum plateau after 25 minutes into the game (**Table 8.15**), whilst when doing the simulation their scores were rather mixed (**Table 8.14**).

These findings give an indication that experience does play a role and has more influence on engagement patterns with construct interaction than simulation interaction. The scores in **Tables 8.16** and **8.17** show similar kinds of findings as those found in Study 2 and Study 3. The interviews conducted in this session suggest that skilled game players tend to reach maximum engagement patterns much quicker than new game players. Case 3 (Girl aged 14) had lots of experience in playing other games, and had played SimCity, a slightly similar game scenario to this. When asked to compare them she had this to say "In SimCity you had to put building on places...you build roads, pipes, etc...here you build your own building...house I mean...rather cool... I have never played it before but I like this..."

### **8.12.6 Maximum Category**

#### **Overall results Simulation Vs Construct Interaction for Sims WE and Sims WOE Group**

The highest scores reached in these sessions are usually the fullest 10/10. **Tables 8.18, 8.19, 8.20 and 8.21** are occurrences of maximum scores for both groups of children doing the simulation and construct interaction conditions. Looking at the number of maximum scores indicated by the children shows that children in the Sims WE group placed more maximum scores than Sims WOE group. The Sims WE group, had **25** maximum scores for the Construct Interaction condition and **17** for the Simulation Interaction condition. The Sims WOE group had much lower total maximum scores; in Simulation Interaction condition it was **11**, compared to **12** for the Construct Interaction condition.

### **8.12.7 The Ending Levels Range Category**

#### **Overall results Simulation Vs Construct Interaction for Sims WE and Sims WOE Group**

**Table 8.22** shows that for both experimental conditions for both groups of children the end result was maximum scores except for 2 cases of 9/10 in the WOE group. Both groups were therefore engaged in both experimental conditions at the end of the sessions. This finding tells us little about the effect of the experience factor. With or without experience the two conditions, simulation and construct interaction are capable of creating an engagement effect.

## **8.13 Discussion**

Study 3 gave some indication that there were other factors that might contribute to engagement patterns besides the five factors in the preliminary Engaging Multimedia Design Model: simulation interactivity, construct interactivity, immediacy, feedback and goals. It also revealed that three of these factors are intertwined and inseparable and are present both in simulation and construct interaction: immediacy, feedback and goals. When the model was tested together with a no interaction condition, it was found that there is an emerging factor that seemed to also have an impact of engagement patterns that is the individual's history of the game.

This study, Study 4, was conducted to find out what happens if two groups of children, with the Sims experience (Sims WE Group) and children without the Sims experience (Sims WOE Group) were given a chance to play these two conditions, simulation and construct interaction condition. What would their engagement patterns be? Are there similarities and differences? Does experience have any effect or impact on engagement patterns?

The answer was yes. Experience does have some influence on engagement patterns. Children with Sims experience seemed to get engaged much faster than those without experience. The analysis also shows that Construct Interaction tended to sustain engagement more than Simulation Interaction for the children with experience.

One way of interpreting the different effect of construct Vs simulation is that motor skills acquisition for Construct Interaction, e.g. skills in using operative tools is easier for those with past experience than the mental model development needed for Simulation Interaction, e.g. dealing with emotions, being able to be in control etc. The experienced group did the Construct Interaction experimental condition with engagement patterns that were much steadier than they displayed in Simulation Interaction experimental condition. Their past experience of using the operative tools seems to have meant they were much easily recalled rather in the way a child can recall a cycling skill.

Clearly both groups of children were fully engaged in both the experimental conditions despite their differences in experience. This study seems to prove that on their own simulation and construct interactivity do give an engagement effect. When they are linked with the experience factor, experience sustains and speeds up the engagement effect.

This study and all the previous studies had a time span of 40 minutes. The findings from this study seem to suggest a further study is necessary to find out more about the impact of this application on its users over a longer period. The next study will look at its impact on children who had been playing this game for a month or more.

Study 5 will aim to find out where, when and how the game exhausts its ability to engage children.

### **8.14 Summary**

This study confirms that children with experience of a specific multimedia application achieve engagement faster and obtain a higher average engagement score than those without experience. This applies to both experimental conditions; 8.34 compared with 8.16 for the simulation condition and 9.34 compared with 7.97 for the construct condition. The children with no experience had lower scores because they took considerable time developing the necessary knowledge and skill at the beginning of each session and they gave lower engagement scores during this period. They did, however, achieve maximum scores at the end of each condition. The children with experience also took some time to become fully engaged in the simulation condition because they had to learn the specific characteristics of the family in the simulation. In the construction mode the children with experience quickly achieved high scores because they already possessed the necessary psychomotor skills to use the construction tools in the application.

# Chapter 9

## Study 5 - An Investigation into Prolonged Play

### 9.0 Chapter Outline

This chapter analyses findings from a further investigation into engagement to assist the shaping of the final form of the Engaging Multimedia Design Model. It describes the sources of data collected to study prolonged play, the analysis of these data and discusses the contribution they can make to the final model.

#### Thesis Structure

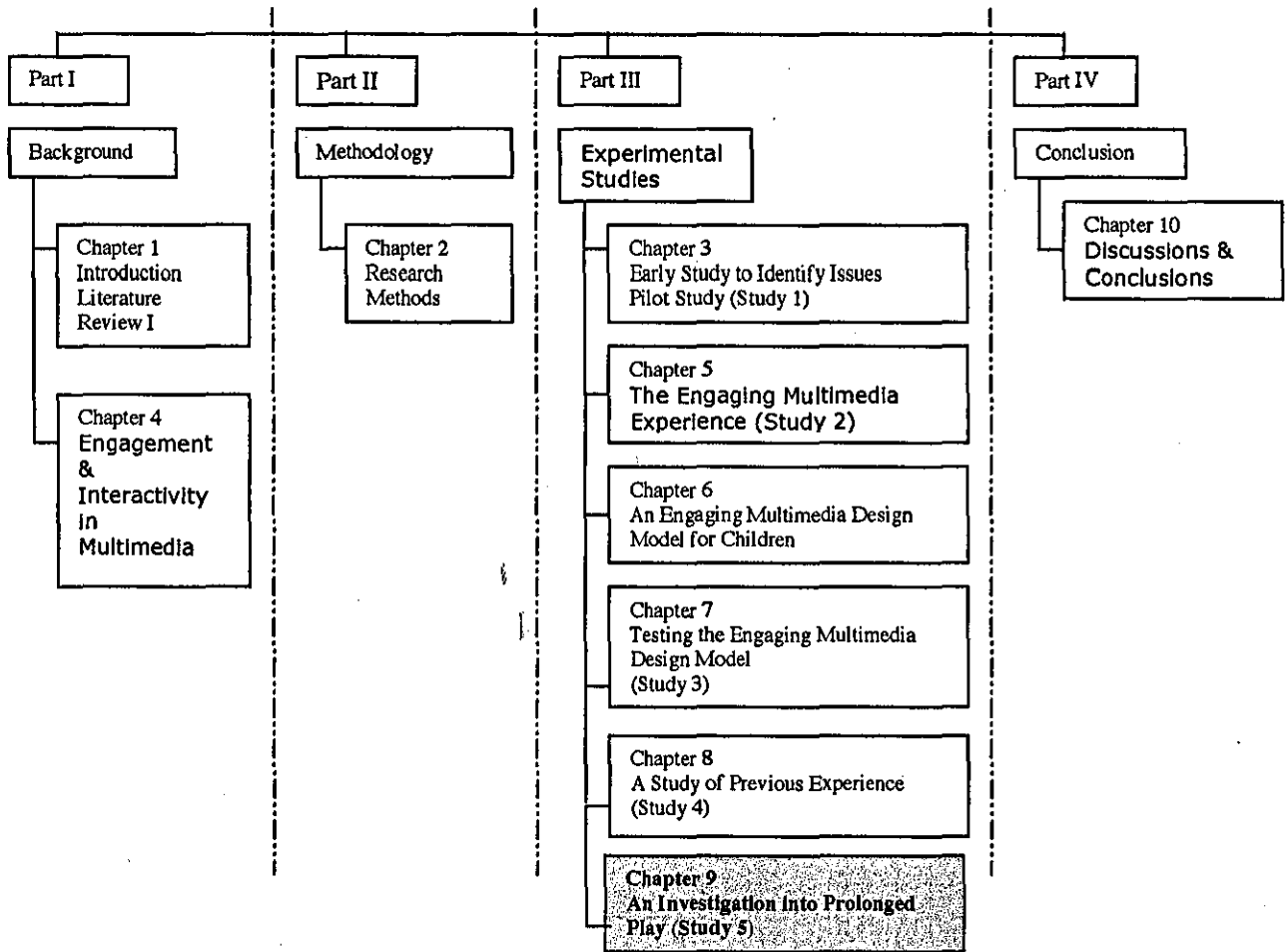


Figure 9.1: Chapter 9 in the Thesis Structure



## **9.1 Introduction**

Study 4 has revealed two important conclusions. One issue is that past experience had an influence on engagement patterns. Children with Sims experience seemed to get engaged much faster than those without experience. Another is that Construct Interaction sustains engagement more than Simulation Interaction. From these two conclusions it has been hypothesised that motor skills acquisition required for Construct Interaction is more easily transferable to a new play session than the mental model building skills required to understand the demands of a new simulation.

## **9.2 Study 5**

### **9.2.1 Introduction**

All previous studies were of events happening in a short time span of 40 minutes. What about if there is more time given? The findings from Study 4 suggested that events over a longer period shaped what engaged children in the multimedia application.

### **9.2.2 The Purpose of Study**

The purpose of this study is to examine the phenomenon of engagement over a longer period than the forty minutes of the experimental sessions. The basic question is whether engagement can be sustained over a prolonged period and, if so, what factors contribute to it. It was not possible to create an experimental study over an extended period and therefore this study uses a number of sources of data to examine the long term issues. Three kinds of data are used:-

- A re-examination of data from study 2. In this study there were two children who had used the Sims for over a month before the experimental session. The data on their trials in study 2 will be compared with the data from two inexperienced children in the same trial to examine the effect of the prior play.
- A questionnaire will be issued to children known to be regular users of the Sims to examine the relative roles of construction and simulation to their prolonged engagement with the game.

- An analysis will be undertaken of the views of regular users as posted as customer reviews on an independent website.

### 9.2.3 Selected Children: age and gender

The selection of children for this study is not as structured as in those of previous studies. For this study, the data came from three sets of data from three different groups of children. The research however tried to keep as close to the 10 to 14-age range as possible and from both genders.

## 9.3 The Investigation

Data for this study was collected from three groups of children. The investigation involves:

- Revisiting the video recordings of children involved in previous studies, Study 2 in particular
- Responses to questionnaires distributed to willing children
- Further scrutiny of customers' reviews from independent web site sources.

This provides three groups of data:

- **Group 1:** Revisiting data from two children in Study 2, a boy and a girl that had been playing The Sims for over a month, in comparison to those that had just played them during the Study 2 session. These children participated in the two experimental conditions in this study. A close examination of their engagement patterns might give more insight into the longer-term engagement phenomenon.
- **Group 2:** These data were from children that were not specifically selected to do an experiment, but were respondents to questionnaires distributed to those that have The Sims experience, had played or were currently playing The Sims. These children were from various schools that were willing to participate.
- **Group 3:** These data were from comments of children as customer reviewers from independent sites. Their lists of responses could give further evidence of their reaction to the design features after some length of play.

## 9.4 Data from Group 1

There are four children with previous experience in Study 2 but Case 1 Boy (12) and Case 2 Girl (14) were specifically chosen because these two cases were in particular known to have a prolonged play experience with The Sims. These children had played the game during the month before the experimental design of Study 2.

Both children did both conditions as follows:

### 1. Simulation (Condition 1) of Study 2 (LM\$ - 2 Loc - MBuFCFm)

In this the experimental condition the children were given limited money to spend (\$20,000) - Limited (L) Money (M) \$ = **(LM\$)**; with only two locations to choose from in the neighbourhood - Two Locations = **(2 Loc)**; a house that must be built by themselves but freedom to create their own family members - Must Build (MBu) Free (F) Create (C) Family (Fm) = **(MBuFCFm)**

The opportunity to be in a simulation mode gave the child the challenge of maintaining family life within limited money constraints. The experiment was like actual game play but the restrictions above limited their ability to develop. The children were allowed to build and create a house but in a location that was specified for them within a set budget. They were given a sense of control and role play to keep the family going, maintain relationships, basic needs, moods and desires within the family and its neighbourhood. These children were given 40 minutes to complete the game.

### 2. Construct Session of Condition 2 of Study 2 (ULM\$ - F Loc - FBu/By FmG)

In this experiment money was unlimited (up to \$1 million and more) - Unlimited Money \$ = **(ULM\$)**; the child was free to choose a location in the neighbourhood - Free Location = **(F Loc)**; The child was free to build his or her own house or buy a ready made ones but the family members were created for them - Free Build (FBu) or Buy (By) Family (Fm) Given = **(FBu/By FmG)**

The purpose was also to enable the researcher to identify factors that affected engagement in the construct and build mode. Since the children were given unlimited money to spend they had more freedom of choice. They were free to

choose a location in the neighbourhood; free to build a house or buy a ready made one. They could choose any place, anywhere because money was unlimited. The game structure was modified to fit this experimental condition. Even though they were not able to create their own family the children faced no money constraints to maintain the family life in the simulation mood, if they are able to get to this stage in the 40-minute period.

### 9.4.1 The Findings

The implications of prolonged play on the performance of the selected children are best described by comparison to the performance of the other children in the study. The non-selected children come from two groups, those with some experience of The Sims and those that were newly introduced to the game during the Study 2 period.

#### a. Comparing Prolonged Play Children with Children With The Sims Experience

Table 9.1, 9.2, 9.3 and 9.4 below are performance of the two groups of children: one with The Sims experience with a known length of play before doing this experiment and another with The Sims experience but it was not known how recently or how long they had played The Sims.

Prolonged Play Cases of Experiment 1- Simulation Condition	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	Average Scores
Boy 1 (12)	5	6	7	9	10	8	6	6	7.1
Girl 2 (14)	6	7	7	8	7	7	6	8	7
Average Scores	6	7	7	8	7	7	6	8	7

Table 9.1: The Two Selected Prolonged Play Children in Study 2 doing Condition 1 (Simulation)

Cases With The Sims Experience of Experiment 1- Simulation Condition	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	Average Scores
Boy 7 (11)	6	6	7	8	8	7	8	8	7.3
Girl 6 (11)	8	10	10	8	10	10	10	10	9.5
Average Scores	7	8	8.5	8	9	8.5	9	9	8.4

Table 9.2: Another two children in Study 2 with Sims experience doing Condition 1 (Simulation)

There is little difference between these children. Three of them started quite low (6) and showed slight improvements in engagement scores through the session but did

not reach the maximum. Girl 6 started higher and reached and sustained the maximum after 25 minutes.

Prolonged Play Cases of Experiment 2 – Construct Condition	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	Average Scores
Boy 1 (12)	8	10	10	8	10	10	9	10	9.4
Girl 2 (14)	10	10	10	9	9	10	10	10	9.8
Average Scores	10	10	10	9	9	10	10	10	9.8

Table 9.3: The Two Selected Prolonged Play Children in Study 2 doing Condition 2 (Construct)

Cases With The Sims Experience of Experiment 2 – Construct Condition	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	Average Scores
Boy 7 (11)	8	9	8	10	10	10	10	10	9.4
Girl 6 (11)	10	10	10	10	10	10	10	10	10
Average Scores	9	9.5	9	10	10	10	10	10	9.7

Table 9.4: Another two children in Study 2 with Sims experience doing Condition 2 (Construct)

From Table 9.3 and 9.4 all the scores for the construct condition are very close and high 9.8 with the Prolonged Play group and 9.7 with the experience group. Comparing the findings according to experimental conditions of simulation Vs construct, construct tended to receive higher scores than simulation from the beginning to the end of the session.

b. Comparing Prolonged Play Children with Children Without The Sims Experience

The rest of the children in the study had no experience in playing The Sims. The effect of engagement pattern of prolonged play is best described when comparing the average scores of the selected prolonged play children with the non- experience children doing the same experiment. Table 9.5 and 9.6 below shows the averages from these two groups of children doing Experiment 1 and 2.

Cases from Study 2 Experiment 1	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	Average Scores
Average Scores for Prolong Play Children	6	7	7	8	7	7	6	8	7.0
Average Score for other children doing Simulation	7	7.1	7.7	7.9	7.4	7.9	8.8	9.5	7.9

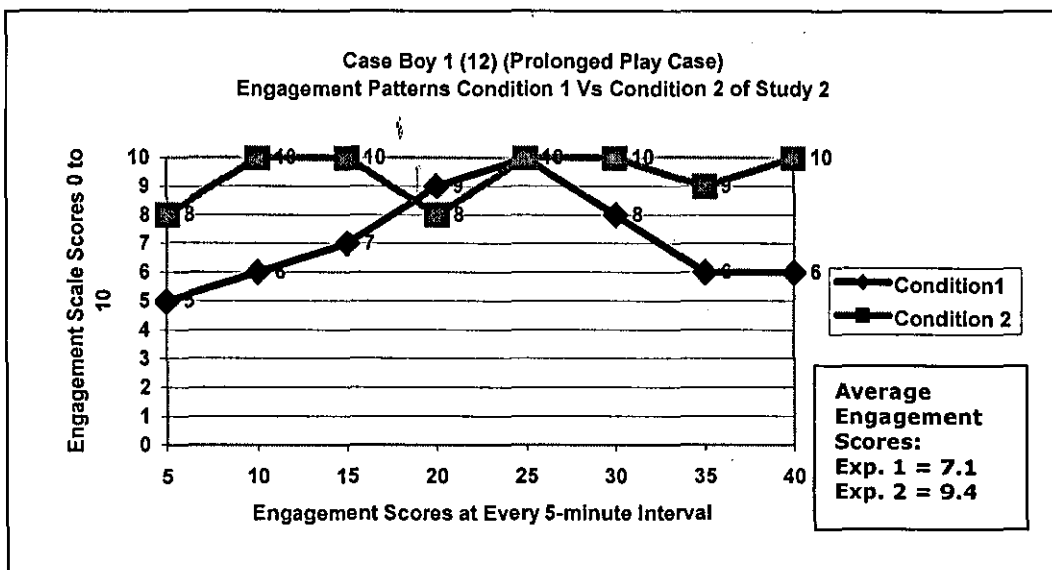
Table 9.5: Average Engagement Scores of Prolonged Play Children and No Experience Children doing Condition 1 (Simulation Condition of Study 2)

Cases from Study 2 Experiment 2	5 min	10 min	15 min	20 min	25 min	30 min	35 min	40 min	Average Scores
Average Scores for Prolong Play Children	10	10	10	9	9	10	10	10	9.8
Average Score for other children doing Construct	7.4	7.5	8.3	9.3	9.5	9.8	9.9	10	9.0

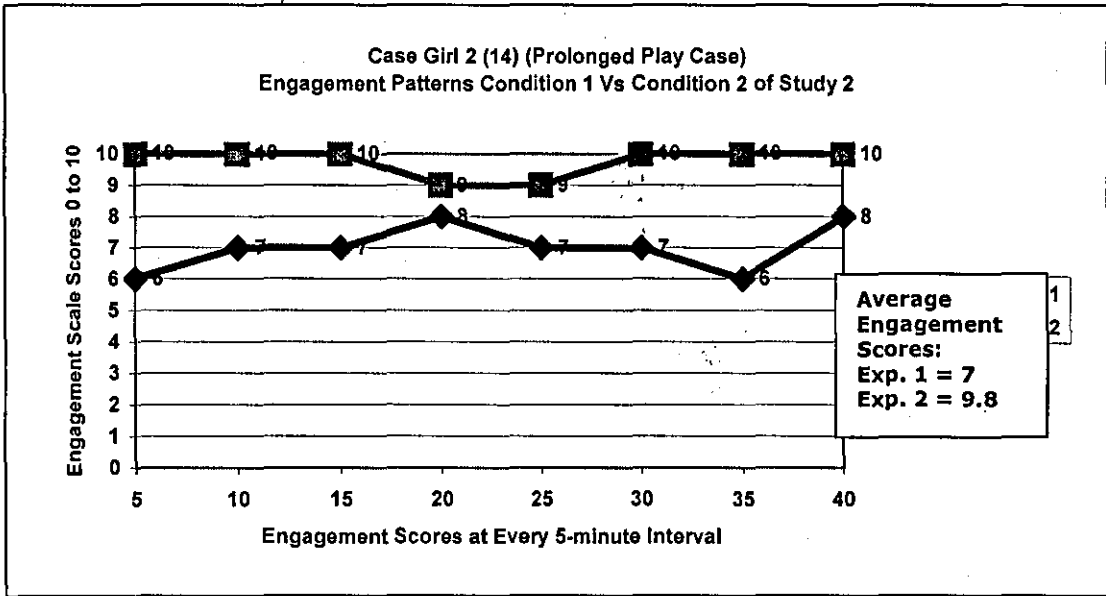
**Table 9.6:** Average Engagement Scores of Prolonged Play Children and No Experience Children doing Condition 2 (Construct Condition of Study 2)

From the tables it could be seen that the non-experience children also find the simulation condition less engaging (7.9) than construct (9.0). Therefore from the average scores it could be concluded that overall the construct condition tended to score higher than simulation be it after prolonged play or only on a recent experience.

Besides looking at averages, this comparison was also made by looking at the individual performance of the non-experience children compared with that of the prolonged play children. **Figure 9.2** and **9.3** give the evidence of engagement patterns traced from **Tables 9.1** and **9.3** of the two selected children when doing Condition 1 and Condition 2 within the time limit of 40-mintues.



**Figure 9.2:** Case Boy 1 (12) (Prolonged Play Case) Engagement Patterns Condition 1 (Simulation) Vs Condition 2 (Construct) of Study 2



**Figure 9.3:** Case Girl (14) (Prolonged Play Case) Engagement Patterns Condition 1 (Simulation) Vs Condition 2 (Construct) of Study 2

Their performance could be compared to the individual performance of the rest of the non-experience children in Study 2. **Table 9.7** and **9.8** below shows the patterns of engagement of the rest of the children. A closer analysis of the scores in the next section will enable us to understand more about engagement beyond the 40-minute experimental sessions.

Engagement Scale Scores for Condition 1 Simulation Condition of Study 2 of Non- Experience Children									
Cases	5- mins	10- mins	15- mins	20- mins	25- mins	30- mins	35- mins	40- mins	Average
Girl 1 (14)	7	6	8	8	9	9	10	10	8.4
Girl 3 (9)	8	9	10	9	8	9	9	10	9
Girl 4 (10)	10	8	10	10	5	7	9	10	8.1
Girl 5 (12)	7	7	5	8	10	9	10	9	8.1
Boy 2 (10)	7	8	9	7	9	6	9	8	7.9
Boy 3 (14)	5	6	7	7	8	7	9	10	7.4
Boy 4 (14)	6	8	8	7	9	10	8	10	8.3
Boy 5 (12)	8	8	8	8	5	6	7	10	7.5
Boy 6 (10)	8	7	10	9	7	9	9	10	8.6
Boy 8 (11)	7	7	6	8	7	8	8	9	7.5
Girl 7 (11)	5	5	6	7	6	8	8	9	6.8
Girl 8 (11)	6	6	5	7	6	7	9	9	6.9
<b>Average</b>	<b>7</b>	<b>7.1</b>	<b>7.7</b>	<b>7.9</b>	<b>7.4</b>	<b>7.9</b>	<b>8.8</b>	<b>9.5</b>	<b>7.9</b>

**Table 9.7:** Engagement Scores for Other Children Without Experience doing Condition 1 - Simulation Condition of Study 2

Engagement Scale Scores for Condition 2 Construct Condition of Study 2 of Non-Experience Children									
Cases	5- mins	10- mins	15- mins	20- mins	25- mins	30- mins	35- mins	40- mins	Average
Girl 1 (14)	9	8	8	10	8	9	9	10	8.9
Girl 3 (9)	7	7	9	9	10	10	10	10	9
Girl 4 (10)	8	8	10	10	10	10	10	10	9.5
Girl 5 (12)	9	8	10	10	10	10	10	10	9.6
Boy 2 (10)	6	7	8	10	10	10	10	10	8.9
Boy 3 (14)	4	5	6	9	10	10	10	10	8
Boy 4 (14)	9	8	9	10	10	10	10	10	9.5
Boy 5 (12)	6	7	7	8	8	8	10	10	8
Boy 6 (10)	8	9	10	10	10	10	10	10	9.6
Boy 8 (11)	8	8	6	9	10	10	10	10	8.9
Girl 7 (11)	8	8	8	9	10	10	10	10	9.1
Girl 8 (11)	7	7	8	8	8	10	10	10	8.5
<b>Average</b>	<b>7.4</b>	<b>7.5</b>	<b>8.3</b>	<b>9.3</b>	<b>9.5</b>	<b>9.8</b>	<b>9.9</b>	<b>10</b>	<b>9</b>

**Table 9.8:** Engagement Scale Scores for Other Children Without Experience doing Condition 2 – Construct Condition of Study 2

## 9.4.2 Analysis of Findings of Group 1

### a. Analysing the Comparison of Performance between Prolonged Play Children With The Sims Experience Children

The two children identified as prolonged play children had a known experience of The Sims in the previous month. The other two children also had experience but this was not known at the time of the experiment: they could, for example, have not played the game for several months. The analysis shows that, with the exception of Girl 6, the pattern for these children in the simulation condition is very similar, i.e. starting at a level of 5 or 6, averaging **7.1** and not reaching the maximum at the end. Girl 6 was more positive from the start **8** and had 6 maximum scores.

Having constraining conditions in choices of place to play made these children feel some frustration. They had been playing The Sims about a month and had used all the options in the game. Getting a location specified for them by the researcher and knowing that those two particular locations gave them limited access to money was limiting for them.

When the children were interviewed about playing this session one of them had this to say, " I have played in that place before... you cannot do much there... not enough



money. It gets a bit boring...after sometime...you have to get them a job, find more money... and all that. I played with it so many times like that. Some times it is interesting. I am quite bored with the game now..."

In the construct condition the average engagement scores for all four children are close to the maximum, with very high scores from the beginning to the end of the sessions. This condition gave the children more freedom and enabled them to be creative. They were most of the time engrossed with what they were doing: creating, building and decorating. Their previous experience of playing the game, their prolonged play sessions had an effect in preparing them to get maximum benefit from this condition.

The skills in constructing which they had acquired after a month of playing the game seemed to have helped to ease their way into this session. Through video observations these children were not seen to be struggling to learn to use the operative tools. Their performances were similar to the addictive child earlier described in Study 4. Their experiences in playing the game were much more recent than some children chosen in Study 4 of groups with Sims experience. Their memories were much fresher and recent and therefore there are no traces of struggling with the game for the first 15 minutes into the game.

There were signs of slight 'disengagement' after about 20 minutes for 3 of the children. This was more marked when viewing the video recordings. There were signs that they had exhausted the potential of the 'materials' available to them. There were the same sets of furniture to scroll to, the same set of floorings, windows, plants, etc. Having lots of money seems to make it affordable to buy all the furniture, do all the extensions, etc. The only thing that kept them engaged had been in making the house bigger and bigger. But then the question that arises "how many swimming pools could there be in a house?" With that much money the number is endless, but yet the shape, the accessories, etc. that came with it is the same.

When an interview was conducted the children had this to say... "You keep on using the same furniture again and again ... it would be interesting if there are some more stuffs..." "I quite like it ...half way through the game I decided to design my actual house and plan the extensions to make it much bigger... it is quite fun actually..."

#### b. Analysing the Comparison of Performance of the Prolonged Play Children with Children Without The Sims Experience

Both groups achieved higher average scores for construct than for simulation, i.e. **7.0** and **7.9** for the prolonged and non-experience groups for simulation respectively, **9.8** and **9.0** for the construct condition. The construct condition was the more engaging.

However, the pattern over the session was different for the two groups. In the simulation session the prolonged group did not show a steady rise to the maximum; they were frustrated by the limitations imposed on them. However, the non-experience group show a steady rise from **7.0** to **9.5** by the end; they were gradually getting more engaged.

In the construct condition the prolonged play children started high and stayed fully engaged. The no-experience group averaged **7.4**, **7.5** and **8.3** for the first 15 minutes before starting a steady increase to maximum scores at the end.

In both conditions the non-experience group are showing a learning experience. As they master the different skills they need for the two conditions, they gradually get more engaged. The construct condition has sufficient resources for the prolonged play group to be fully engaged throughout but there are signs that they have exhausted the opportunities of the constraining simulation condition.

#### **9.4.3 Conclusion**

Thus for the two children it can be concluded that prolonged play does have an effect on engagement patterns and engagement tends to cease not so much due to the length of play but when the materials provided by the game have been used to exhaustion.

A related factor about prolonged play is that when a child has had complete freedom to play the way they fancied sudden restrictions to what they can do tend to cause them to become 'disengaged' with the game. This finding was also in evidence during the free play sessions of Study 2. Some of the children in this study had expressed

their likings for the free play sessions given to them before doing conditions 1 and 2, much more so than actually doing conditions 1 and 2.

In the condition where they had limited money, the children sometimes had bad experiences, e.g. the characters had to do to work because there was no money but they sometimes refused to do so because they were too weak and had not eaten any food for there was no money to buy them. When they go to the construct session, some children still thought about restriction. "This is too expensive...better not buy it...but oh yeah...there are still lots of money left. I forgot about that!"

Thus from the data of children in this group it could be said that simulation interaction tended to limit the chances for the children to set their own goals as compared to construct interaction. Once a child had acquired the basic motor skills to operate they start to set their own targets but in the simulation condition the nature of the restrictions tended to limit the space the selected prolonged play children could play with. The children could only play "god" to a certain extent, which later tended to be repetitive. After sometime all the possibilities of role-play tend to be exhausted and they became less engaged.

In the construct condition, however, the design feature allowed the children to set many more goals themselves. They could build a house and always be able to redesign new ones. The only exhausting factor is the materials used to build and decorate, that is when they were to continue building and expanding on the same house they had built. Having the time span of 40 minutes, limited the child's ability to explore other possibilities. Thus, after sometime into the session, the possibilities became exhausted too. There are lesser choices of furniture, lesser choices of what else to buy and decorate, etc. This in many ways affected their engagement pattern and therefore we see some form of 'disengagement' occurring in the duration of the session for the children who had played this game before.

Even though the possibilities of the two design features, simulation and construct, tended to get exhausted over time, it is useful to note that construct interactivity seemed to give much greater goal setting possibilities than simulation interactivity after prolonged play.

## 9.5 Data from Group 2

From the findings of the previous studies there seemed to be a need to find out more of the reactions of children who play The Sims not under the confinement of an experimental session. What do children who have played The Sims for a longer period of time say about the game, their likes and dislikes, whether they are still playing with it, or have stopped, and if they had stopped when, where and why. Perhaps from their answers we might see the long-term effect of the two design features of construct and simulation interaction. Perhaps it will help to reveal the design features that sustain children's interest and the ones that exhaust them.

A questionnaire was designed to seek answers to these questions and was distributed to children that have The Sims experience, had played the game or were currently playing it. Questionnaires were distributed and 12 responses were obtained.

### 9.5.1 The Questionnaire

The questionnaire asked ten questions in a friendly and easy way (using Comic Sans font, etc.). The questions were rather short and simple because children do not like long demanding ones. Although Construct and Simulation design features were a subject of interest they were not addressed directly. Evidence about them was deduced from the answers especially to questions 4, 5, and 9 (**Appendix C**).

The questions asked were:

1. Are you still playing The Sims? (Yes or No)
2. Are you a fan or ex-fan?
3. How long have you played The Sims?
4. Could you tell me something about your happiest moments when playing The Sims?
5. Could you tell me something about your most boring moments of playing The Sims?
6. If you are still playing, could you tell me why you still want to play it?
7. If you do not like to play it anymore could you tell me why you stopped?
8. When did you stop?
9. How long have you played before you stopped?
10. What other things do you want to tell me about The Sims?
  - Anything you like or dislike?
  - Anything I do not know that you knew?

- Any picture of a house you have created? (You could send it to my email address if you like)
- Any funny, interesting, sad, boring, or frustrating story you want to tell me about The Sims?

### 9.5.2 The Findings

Most of the children that answered the questionnaire, (9 out of 12), said they were still playing The Sims. All of them said that they were fans of The Sims, including the ones that had stopped playing. The children had played the game from 6 months to two years.

In order to know which features still sustained interest the comments in the answer to the open-ended questions were classified under two categories: one of simulation **(S)** and another of construct **(C)**. Some comments are technical **(T)**; about the computer or the way the game works on it. There were also other comments about external factors that influence how the children play the game **(E/I)**. Most of the comments could also be evaluated as positive (+ve) or negative (-ve).

Below are their comments and the categories in which each of them were placed:

1. When they were asked to describe their happiest moments when playing The Sims, some of them have these to say:
  - “ When they have babies, because you get to name it and it is always a boy” **(S) +ve**
  - “ Building is really fun, the challenge is to make them happy” **(C) +ve**
  - “ When playing The Sims my happiest moment is building the houses and trying to make them as big as possible” **(C) +ve**
  - “ Building houses and keeping track of finances” **(C) +ve**
  - “ My happiest moment is when I get to build a house for The Sims and we can build the house using our imagination” **(C) +ve**
  - “ I like building the house and buying the items” **(C) +ve**
  - “ When I could afford extensions for the house so that I could make my Sims happier quicker” **(C) +ve** and **(S)+ve**

<b>Total counts</b>	<b>(C) +ve = 6 : (S) +ve = 2</b>
---------------------	----------------------------------

2. The description of their boring moments were:
  - “ When they don't work and get depressed” **(S) -ve**

" Waiting for the game to load, when they are asleep or at work" **(T) -ve** and **(S)-ve**

" My most boring moments are when The Sims are just sitting watching T.V. or just watering the plants, etc." **(S) -ve**

" When they were in bed or at work" **(S) -ve**

" The boring moment is when The Sims go to sleep and snore all night" **(S)-ve**

" The most boring moment is when The Sims go to work and school" **(S) -ve**

" Waiting for the game to load and looking after the babies" **(T) -ve** and **(S) -ve**

<b>Total counts</b>	<b>(S) -ve = 7 : (T) -ve = 2</b>
---------------------	----------------------------------

3. When asked why they are still playing it, they had this to say:

" Because I love it!" **(E/I)**

" I like playing it because it is cool controlling people's lives and making them do what you tell them to" **(S) +ve**

" Because it is fun to play and control people's lives" **(S) +ve**

" It's just fun to play it because it's like a real family doing their daily work" **(S) +ve**

" I still play it because I like watching it doing things e.g. painting, swimming, etc." **(S) +ve**

" Because there is an obstacle to overcome everyday" **(S) +ve**

<b>Total counts</b>	<b>(E/I) = 1 : (S) +ve = 5</b>
---------------------	--------------------------------

4. When asked if they do not play it anymore could they tell why they stopped they had this to say:

" Because I get stressed when they don't work and get depressed" **(S) -ve**

" I still like to play The Sims but I don't have time anymore, the new extension pack does not work well with my computer, I stopped playing since" **(T) -ve** and **(E) -ve**

" My mum made me stop because I am kind of addicted to it... time passes very quickly... I forget to do things often... mum gets angry..." **(E/I) -ve**

<b>Total counts</b>	<b>(S) -ve = 1 : (T) -ve = 1 : (E/I) -ve = 2</b>
---------------------	--

5. A comment from an older fan:

" I recommend getting stuff from the Internet. There are all kinds of cheating objects, such as a coffee-machine that can make your Sims go for ever (although it is also addictive, so they hang around the computer), a batman comic shelf that improves your skills, a painting device that boosts your charisma as well as your creative skills, charisma shower, doors that enable children to act like adults and so on - of course - lots of furniture, that just looks cool. But you need a high-speed connection and plenty of room on your hard disc to get them" **(T)**, **(S)** and **(C)**

<b>Total counts</b>	<b>(S) = 1: (C) = 1: (T) = 1</b>
---------------------	----------------------------------

But what if they are not able to get expansion packs or access to Internet because of the "incompetent machines" that they possessed? These fans also have some other things to say about The Sims within the structure that they had. Some of their comments were:

" Overall I think The Sims is a great game and I would recommend it to anyone. Some funny moments are when The Sims houses catch fire and you see them all running for their lives. It can be frustrating when The Sims are not happy because when they are not happy they won't do anything e.g. cook or clean and go to work." **(S) +ve** and **(S) -ve**

" I have not got any of the new expansion packs so the features seem boring" **(T) -ve**, **(S) -ve** and **(C) -ve**

<b>Total counts</b>	<b>(S) +ve = 1 : (S) -ve = 2 : (T) -ve = 1 : (C) -ve = 1</b>
---------------------	--

How did children try to overcome this limitation? For some they had this to say:

" I know a cheat for money" **(T)**, **(S)** and **(C)**

" You can make a floating house by making a wall downstairs. Then make a second floor. Then make the upstairs like a real home. Then put stairs anywhere you want. Then delete the walls downstairs and there you have it, a floating house" **(C) +ve**

" The funniest moment of The Sims is when they are so tired and fell asleep. A frustrating moment of The Sims is when a boy or a girl gets to be sent to the other school and it will automatically be lost from your family" **(S) +ve** and **(S) -ve**

"It was funny when my Sims got stuck in the maze I made and it couldn't find the exit. Also its funny when the burglar gets caught" (C) +ve and (S) +ve

**Total counts (S) = 1 : (T) = 1 : (C) = 1 : (C) +ve = 2 : (S) +ve = 2**

From the lists of 42 comments classified under the four categories of (C), (S), (T) and (E), some are positive, some are negative whilst others are neutral statements. **Table 9.9** below shows the counts according to the categories mentioned.

Comments	+ve statements	-ve statements	Neutral Statements	Total Statements
Simulation (S)	10	10	2	22
Construct (C)	8	1	2	11
Technicality (T)	-	4	2	6
External / Internal (E)	1	2	-	3
<b>Total Comments</b>	<b>19</b>	<b>17</b>	<b>8</b>	<b>42</b>

**Table 9.9:** Classification of questionnaires

### 9.5.3 Analysis of Findings of the Questionnaire

Before an analysis could be made it is best to note how the responses relate to engagement. 'Fun' in this context is taken to mean the children are engaged. 'Poor' are moments when they are doing things that are less engaging. Analysing the data can therefore give us more information about what they were finding engaging and what they were not finding engaging.

#### a. Simulation Interaction Category (S)

From the responses given by this group, as seen in **Table 9.9**, the Simulation Interaction feature had more comments that were engaging than any other category. The irony is that this feature also had the most negative statements. In fact this feature had an equal number of positive and negative statements. Why does it get a mixed response?

Analysing the positive statements reveals that children find the elements of play in simulation an engaging experience. They were able to set a target for managing their families and then see what happened. Some of the challenges would be to complete a task (a phenomenon known as task closure) and they liked to set and achieve higher attainment levels to fulfil the new levels of aspirations.



Some examples of when children get engaged are when there is a drive from within themselves to complete a task they had embarked on in the game, like, after building the extension to the house they created, they wanted to see what the characters would do with it. After increasing the charismatic skills what do the characters get from it (in the game the character get promoted and thus earned more money)? With more money what else is needed, etc? Much of what is happening is affecting the function of the mental model skills of the individuals. Thus from these statements we can see that Simulation Interaction enables the users to experience an intrinsic motivation phenomenon from within, making them want to continue playing and not wanting to stop.

The simulation feature allowed the children to achieve goals either set for them by the designers or set by them. This happened during the 40-minute experimental periods and also during prolonged play. When we analyse the statements closely in the context of prolonged play we can see that playing simulations for a longer period does ultimately lose its engagement power.

As the children get deeper and deeper into the game after prolonged play, the game's challenge became exhausted. The role that they could play in simulation interaction became repetitive, mundane and ultimately boring. Thus the children, even though they had quite a lot of positive things to say about simulation made an equal number of negative statements about the feature after prolonged play. An example of a negative statement would be "My most boring moments are when The Sims are just sitting watching T.V. or just watering the plants, etc." One of the likely reasons why this is so is because the children have exhausted the goal setting challenges set by the game for them whilst the ones they could set for themselves are very limited in Simulation Interaction.

#### b. Construct Interaction Category (C)

Even though there are fewer statements referring to the Construct Interaction feature, only 11 statements (**Table 9.9**), the majority of them are positive ones (8), only one negative and two neutral statements. Why was this feature been referred to so positively?

Analysing the positive statements reveals that this feature gives the children a chance to explore more of their creative potential. The children used the constructing materials to build houses of their own. They were free to build and create whatever they like and decorate it with the furniture the feature provides. The feature allows them to set targets for themselves. When the children were in this construct mode, the live mode is at a stand still. They do not have to cope with managing family lives, problems, etc. Once they have acquired the motor skills in finding more ways of manipulating the operative tools, etc., the children achieve as many goals as they like in building, expanding and decorating the house. Thus this feature has the ability to capture children's engagement behaviour for hours and hours, which explains why it receives only one negative statement.

This feature enables the child to explore and use their imagination much longer than simulation does. Here the children are able to set their own goals and have more chance to find ways of achieving them than that of the simulation feature. This feature tends to make greater use of motor skills to use the operative tools to build and construct. Once the children had acquired these skills all they needed to do was to set their own goals to create and decorate. The opportunities are endless as long as the game can supply the materials and tools to fulfil the expanding nature of their imagination.

### c. Technicality (T)

Some of these children (6) have expressed frustration with the technical features of the application. Most of these technical problems were derived from the low capacity of their computer systems to cope with the demands the game made. Thus some of their comments were about the problems of loading, the demands on the system of expansion packs, etc. The problem could be resolved either by upgrading their system or buying a new one, which for some was not possible. This factor emphasises the fact that the game may still be engaging after prolonged play but the limitations of the technical system may cause them to stop playing it.

#### d. External / Internal Factors (E/I)

The comments in this category are rather emotional in nature. Some of them come from within the children whilst some are external in nature. This category did not reflect upon the design feature or the system. One positive comment "Because I love it!" could not be interpreted because of the limitation of the questionnaire method.

The next two (E/I) statements are negative statements. In one statement the reason for stopping, besides the new expansion does not work with the system, was about an external reason of time. The child said that they did not have the time anymore to play the game. Another external reason of stopping was their mother made them stop. Both these statements show that the game still engages the children after prolonged play but there are other external reasons beyond their control that make them stop.

#### **9.5.4 Conclusion**

From the questionnaire survey it is obvious that children do find this application very engaging over a long period. The ability of the application to achieve this depends a lot on the design features incorporated in it. The two design features, simulation and construct interaction, do indeed sustain the engagement levels of children even after prolonged play. From the responses of these children it could be said that these features work very well together rather than in isolation as they were used in the experimental studies.

It was also found that it was not always the design features that exhausted the engagement level but the technical limitations of the system that made them feel frustrated. It is a situation similar to that of a child who had exhausted possibilities of their Lego building blocks to build even more imaginative buildings. The child had a choice either to dismantle or start building a new one with the blocks they have already got or wait for a time and money to get new ones, something different or more challenging e.g. moving from "Dublo Lego to Technic Logo", from bigger blocks to smaller blocks, from building houses to aeroplanes, etc. For some they might just outgrow it before they could not afford to buy the new versions. This is the same as saying they have exhausted the possibilities of the game and therefore moved on to other things. These children seemed to do a lot of work on simulation and ventured a

lot into the possibilities of construction but the prolonged usage exhausts all these possibilities in the end. From the answers to the questionnaire it could be deduced that the boring effect is reached much faster in simulation than construct.

## **9.6 Data from Group 3**

Looking at children as customer reviewers on independent web sites can give further evidence of their reaction to the design features after some length of play. This is where the data from this group of children was obtained. Group 3 are some collections of children's comments about The Sims since its release in February 2000 until recently.

The comments could be categorised to reflect the children's preferences for the design features of this application. From the customer's reviews their expressions of preferences, either the descriptions of what they did with it or their frustrations with it seemed to fall into a number of categories: length of play, simulation interaction mode (**S**), construct interaction mode (**C**), technicality (**T**) and some neutral statements (**N**) which refer to attitude, etc. The latter comments were rather non-specific, especially in determining whether it is construct or simulation they are talking about.

### **9.6.1 The Findings**

The children's reactions to the game can be organised by the phases of The Sims' versions, from the earliest to the latest:

i. The Early Version Phase (sometime in the year 2001)

The phase when there was the basic - The Sims with no additions and expansion packs.

ii. The Later / Recent Version Phase (sometime in the end of the year 2003 and beginning of 2004)

When the game had matured over time there are expansion packs. They could play on line. The coming version even has 3Ds and in play-consoles.

### 9.6.2 The Positive and Negative Views of Prolonged Play of the Early Version

There are lots of views that could give some indication about the effect of engagement on prolonged play. **Table 9.10** below is a list of positive and negative comments given by boys (B) and girls (G) in the customer's review.

No	Positive Views	No	Negative Views
1.	"They say time flies when you are having fun and that is certainly true with this game" (G) (N)	1.	"Initial trill" (B) (N)
2.	"Two weeks after receiving the game I am still strong with 2,000,000 in the bank and a fantastic original game" (G) (N)	2.	"Can play up to 5 hours after that the same thing over and over again" (B) (N)
		3.	"Dull game no staying power" (B) (N)
		4.	"After 3 weeks it is all done...a couple of months later you take it out and rediscover it again" (B) (N)
		5.	"Great game for the first week then it becomes rather repetitive" (B) (N)
		6.	"Boring after a while" (G) (N)
		7.	"Living a whole bunch of people's lives gets boring after awhile...prefer designing cities" (G) (S)

**Key:**  
Boys comment (B)  
Girls comment (G)

**Table 9.10:** Positive and Negative Views of Boys (B) and Girls (G) About Length of Play

### 9.6.3 Other Comments During Early Version Phase

There are a number of comments during the earlier version phase worth mentioning because these comments have led to the version that exists today: more user friendly, with expansion packs, online Sims, game consoles, 3D graphics (yet to be released at the time of writing) etc.

Some comments about the technical system (T) were:

- "Hard to play" (B) (T -ve)
- "Design not user friendly" (B) (T -ve)
- "Graphics not particularly realistic" (B) (T -ve)
- "Great graphics and believable actions" (G) (T +ve)
- "Need more extra" (B) (T -ve)

Other neutral (N) comments were:

- "If you are a fan of gun wielding this is not the game for you" (B) (N -ve)
- "Voyeuristic game" (B) (N)
- "Almost nothing you can't interact with" (B) (N +ve)
- "Laughable game that annoys more than it entertains" (B) (N +ve)

- "Too open-ended and offers no hint of objectives and goals for players to reach" (B) (N -ve)
- "Pretty mundane and tedious game" (B) (N -ve)
- "A smaller game than SimCity, basically it is about SimLife" (B) (N -ve)
- "No overall goal therefore repetitive and boring" (B) (N -ve)
- "Good and evil purposes is your choice" (B) (N +ve)
- "Not fast moving therefore good" (G) (N +ve)
- "No fighting, which I hate" (G) (N +ve)
- "Have mixed feelings but now completely addicted" (G) (N +ve)
- "Advantages: Highly Addictive Disadvantages: Highly Addictive" (G) (N)
- "It's been superbly designed so that if you want something doing you have to work for it"(G) (N +ve)
- "It isn't as complicated as it sounds and there's a tutorial for novices"(G) (N +ve)
- "The game has endless possibilities and has been very well developed" (G) (N +ve)
- "You may be frustrated after a while – no real goal – just build and make them happy and then watch them live – many little intricacies to entertain you" (G) (N -ve)

A summarised count of statements made according to gender can be seen in **Table 9.11** below.

Comments Categorisation	+ve Statements		-ve Statements		Neither +ve nor -ve		Total Number
	Boys	Girls	Boys	Girls	Boys	Girls	
Technicality Statements	-	-	4	1	-	-	5
Neutral Statements	3	6	5	1	1	1	17

**Table 9.11:** Positive and Negative Statements of Boys and Girls in the Early Version Phase

#### 9.6.4 Views about Construct and Simulation Mode of Prolonged Play

The views about Construct and Simulation Mode are affected by the phases of the application. In order to look at the effects of Construct and Simulation, the views are also best categorised under the earlier version phase and the later or more recent version phase. **Table 9.12** below is comments about the earlier version, and **Table 9.13** about the later or recent version.

Phases of The Sims Development		Construct		Simulation	
The Earlier Phase	1	"Can bull doze or build" (B) (+ve)	1	"Prefer to destroy and annoy The Sims" (B) (+ve)	
	2	"You can get rid and create a new one" (B) (+ve)	2	"Allows to take control" (B) (+ve)	
	3	"Choose the easy route of starting out with a small house" (G) (N)	3	"Laughable game that annoys more than it entertains" (B) (+ve)	
			4	"A simulation is an insult as it becomes so real to the point you are drawn into become part of the fabrication created" (B) (+ve)	
				5.	"Game for power- mad people who like the idea of controlling lives" (B) (+ve)
				6.	"You basically control your own little world" (B) (N)
				7	"The idea of controlling excited the megalomaniac in me. I could create nasty families in some houses and perfect families in others" (B) (+ve)
				8	"If you are a simulation fan you must have this and you'll be converted within a few hours" (B) (+ve)
				9	"Who would have thought that running people's lives would be so much fun" (B) (+ve)
				10	"Once they commute from your little neighbourhood they're out of control" (B) (N)
				11	"Play God or the devil" (B) (N)
				12	"Game for the bossy type, if you like to run peoples lives and take over then this is the game for you" (B) (N)
				13	"This is the ultimate God game" (B) (+ve)

**Key:**  
Boys comment (B)  
Girls comment (G)

**Table 9.12:** Views about Construct and Simulation Mode of Early Version Phase

All the views given about these two features (**Table 9.12**), construct and simulation during the earlier version phase are positive views. The gender factor could not be examined because most of these views come from boys. As the years goes on the version becomes more sophisticated and grows with the child. More is demanded of these two features Construct and Simulation Interaction. **Table 9.13** below are views of the later or more recent version of The Sims.

Phases of The Sims Development		Construct		Simulation
The Later / Recent Phase	1	"House can be built on hills so no need to flatten the land"	1	"Sims aged so you can watch your Sims grow up e.g. being pregnant, going to their first job, getting married. There are options to stop aging" "Relationships more realistic, react when other Sims walk into the room"
	2	"3D, e.g. more realistic looking skin"		
	3	"Genetic traits -DNA"		
	4	"Weather- rain, storms, lightning and more"	2	
	5	"Able to build doors and windows on diagonal walls"		
	6	"Can build more than two stories high"		
	7	" A 'Create-a-Sim' option has replaced the old way of 'dressing' your Sims. No two Sims will be the same. You start by making your Sims entire appearance from preset templates and a lot of sub sliders"		
	8	"More career paths with levels. Teenagers and elders have separate career paths. E.g. elders, upon retirement, receive a pension and will receive money and not have to work anymore"		
	9	"There are also weekdays and weekends, and your Sims establish work schedule"		
	10	"You could customised objects e.g. change colour of sofas"		

**Table 9.13:** Views About Construct and Simulation Mode of Later / Recent Version Phase

These comments show how the designer of the game, Will Wright, tried to implement what he aimed to create when he said that the next generation of The Sims (Sims 2) would be " more expressive, more interesting and more lifelike, but they'll still have that funny, open-ended, chaotic atmosphere like you see in this first game". One customer's comment of the recent version was "The game is more story telling based than the first. Maxis (the publisher) looked at many types of visual story-telling techniques and styles while making the game. The Sims 2 allows more emotions, action, comedy, and fun for both Sims and players"

### 9.6.5 Analysis of Findings of Group 3

#### a. The Positive and Negative Views of Prolonged Play of the Early Version

From the above findings it could be seen that the game has grown with the child ever since its release sometime in 2000. This is evident in the comments given by the children over the years so much so that for the data of Group 3 the comments from customers' reviews had to be categorised into two phases, the early version and later or recent version of The Sims.



As far as prolonged play is concerned, most of the evidence was from the Earlier Version Phase. There are both positive and negative views about the game in the earlier form (the form used in the experiments of this research study is this version without the expansion packs). When the questionnaire was distributed, the references to making babies were to the deluxe combination pack of The Sims and Living In.

On the issue of length of play, the positive views were about how the game was enjoyable and fun for the children after two weeks. Fun means they are engaged. In this period they did not realise how time flies.

The negative views were also about periods of play. From the comments, the exact time frame from the time they get engrossed and engaged to the time when they get bored is not clearly defined and varies from child to child. When one says that she was "still strong" meaning still enjoying the game after two weeks, another reports finding things getting repetitive after the first week. Therefore the time they started to get bored with the game begins within the range 5 hours, first week, after awhile, after 3 weeks to something not specified like "no staying power".

It is difficult to pin point whether they were referring to construct or simulation for these answers except for one comment that simulation became boring after awhile. For this section at least it could be concluded that after prolonged play the design features do not create a long lasting engagement effect. Though not specifically stated whether it is for simulation or construct, the game tended to be repetitive over time; the same thing over and over again and therefore becomes dull and boring. A technique one of the children used to overcome this was to stack the game away for a couple of months in order to rediscover it later on.

#### b. Other Comments During Earlier Version Phase

There are also some comments about the early version that is important to note. Some of the technical and neutral comments about the early version have led to the development of 'The Sims' to what it is today: more user friendly, with expansion packs, online Sims, game consoles, 3D graphics, etc.

Looking at the list, some children found the game difficult to play and therefore expressed the need for the game to be more 'user friendly'. Looking at the way children play the game, they usually overcome this issue as they continue playing it. The more and more practice they have in using the operative tools the better they become in overcoming the motor skills acquisition problems. In the previous studies this research found expressions like "It was difficult at first but after that it was ok" (a child in Study 2).

Some children found the graphics impressive whilst others found them not realistic enough. This might be a reason why a 3D version is coming soon. Whether a 3D version could make a difference into engagement patterns remains a question.

When the game became repetitive, even though there is only one example here, many children demanded other things be added on to it. This demand was also seen from the children in group 1 and group 2 data mentioned earlier. Many of the children in the questionnaire mentioned the expansion pack issues. This is why expansion packs are present in most of the later versions.

The neutral statements add additional information. Some said the game was laughable, others too open-ended. Some praised the possibilities of the game whilst others find it pretty mundane and tedious. Some even found it repetitive and boring. Some liked it because it was not fast moving whilst others advise fighter gamers to disregard it. Quite a number however began to question the goals and objectives of the game.

In other words for this section of analysis it could be said that as the children proceed with the game, the possibilities became exhausted and they therefore demanded new things. The purpose of these demands is to enable them to set new goals so that it continued to engage them.

#### c. Views about the Construct and Simulation Mode of Prolonged Play

What have these children to say about Construct and Simulation? What effect have they on the prolonged play of this group of children? From the views given in **Table 9.12** it could be seen that most views were about the simulation perspective. The

children were mainly describing their experience while playing the simulation condition after they had used the construct condition. Most comments were positive about both design features. These show the importance of having the two design features together during play because during prolonged play what kept the children engaged is the way the game allows the exploitation of its possibilities. In the construct mode they could try different creations and then see what happened to the characters in the simulation mode. In construct you could set your own goals and in simulation you could see what you achieved. Therefore as the years have gone by and more recent versions has been available the comments on these two design features have become more about what they are now able to do with it than expressions about their feelings whilst doing it.

The reviews of the later version (**Table 9.13**) are about the potential the new version gives to players. But the issue of prolonged play remains unclear for this newer version because for many children, having it would mean buying a new computer system, which is possible for some but impossible for others. Therefore for some children they will in the end move on to other things, without being able to test the engagement potential of the new version.

## **9.7 Overall Discussion and Conclusions**

While The Sims can remain engaging after prolonged play some features do reach a limit of exhaustion. Role-plays became repetitive after some time because children tend to want a bit more from them, e.g. what happens to the characters at work, at school? What about shopping, going places on holidays etc? There is a need for more constructing tools and decorations, e.g. Furniture colours to customise, more house storeys than only two, more skin colours, faces, fashions etc.

Yet these two features still dominate the engagement phenomenon. As long as the choices keep coming in the game it will continue to be engaging. They seem to exhaust what they have already got, and then want to move on. Prolonged play has different implications for construction and simulation. Prolonged use lifts the level of aspiration of the children as in "not trying to do what they did before but trying to do something more." So they need more construction options and more realistic simulations.

Taking the data from all the three groups of children together it can be deduced that the issue of engagement in prolonged play is about how much longer the feature allows the children to set and achieve new and different goals. When the chances become exhausted the children became less engaged. What was happening to the simulation feature was that as the children used it more and more in whatever way the simulation was set up they found they had been there before, they had done that, and they got bored with it.

However, what kept them going in the construct mode was the fact that they could still construct different worlds that got more and more outrageous like floating houses, etc. which is all about fulfilling a need to create something different. But in the end even this gets exhausted. So we find the construct mode keeps them going for much longer than simulation and that is why it gets a higher score in the experimental sessions from those with experience of prolonged play.

When even that gets exhausted, the development of the system has so far answered the demands of the children to "give me something new to build with, give me something else to work with." That is why they want the Internet; they want the extension pack, etc. What the children want is a bigger and bigger set of tools to play.

Prolonged play is about fulfilling the need for the children to set further goals around construction and meet higher and higher goals. They like, for example, to be free of the constraints of the earlier construction tools, designing in diagonals instead of blocked type rooms. And what they really like is when the new release gives them some more of these opportunities.

But after awhile they get to a point where they have exhausted all the play potential of the simulation and they have even exhausted all the construct potential. We then get them talking about the new possibilities of the new extensions. The important thing is they needed the application to grow because they grow. In fact, not only children, anyone who is using it, wants the design to mature with them.

However, it is important to note that if designers keep trying to meet the needs of the experienced user the design could become a barrier for those who are beginners. This is where a goal setting design is needed. There is a need to design packages for different stages, one that fulfils the needs of the beginner with lower capability and another for the user who had reached a certain level of capability e.g. the intermediate, the higher levels, etc. Modern games are in that kind of form and this happened because people outgrew whatever was created for them. That is why the game industry has turned to consoles where the creator can design levels and goals to suit the capability of the user. The systems too need to be changed to accommodate these demands. Higher speed systems were needed or else the more sophisticated game would not work.

## **9.8 Summary**

Three separate sources of data were examined to test the effects of prolonged play:

- The two children from Study 2 who had used the Sims for a month before the session scored an average of 7.0 for the simulation condition and 9.8 for the construction condition compared with 7.9 and 9.0 for the inexperienced children. The inexperienced children showed a typical learning curve reaching maximum engagement at the end of each condition. However, the experienced children started and stayed at the maximum for the construct condition but for the simulation condition their scores deteriorated towards the end of the session. The interview results show that they became frustrated by the limitations of the particular simulation whereas the construct condition enabled them to keep trying new things.
- The twelve children who responded to the questionnaire identified the construct and simulation modes as the reasons for continuing to play the game and that it was the combination of the modes (build a 'world' and then see how it works in simulation mode) that was most effective. There were frustrations about the simulation and also technical frustrations when the play potential is exhausted and a technical upgrade would be necessary to provide a new set of opportunities.
- The analysis of the customer responses could not address engagement directly but the positive and negative views expressed suggest that it is the new releases that have kept the children interested over a long period. It

seems that the most experienced users get most continued reward from the construct mode when they are able to exploit the potential of the new capability.

The children exhaust the potential of each version of the game to set themselves new goals when they use it over a prolonged period and it is only when the game itself becomes more sophisticated that they are able to retain their sense of engagement.

# Chapter 10

## Discussion & Conclusions

### 10.0 Chapter Outline

As a concluding chapter to the whole thesis this chapter discusses a number of issues derived from the studies conducted throughout the research study. It summarises the model in terms of research results, discusses appropriate research to evaluate the model and to develop it further and examines the implications for the design of multimedia applications.

Thesis Structure

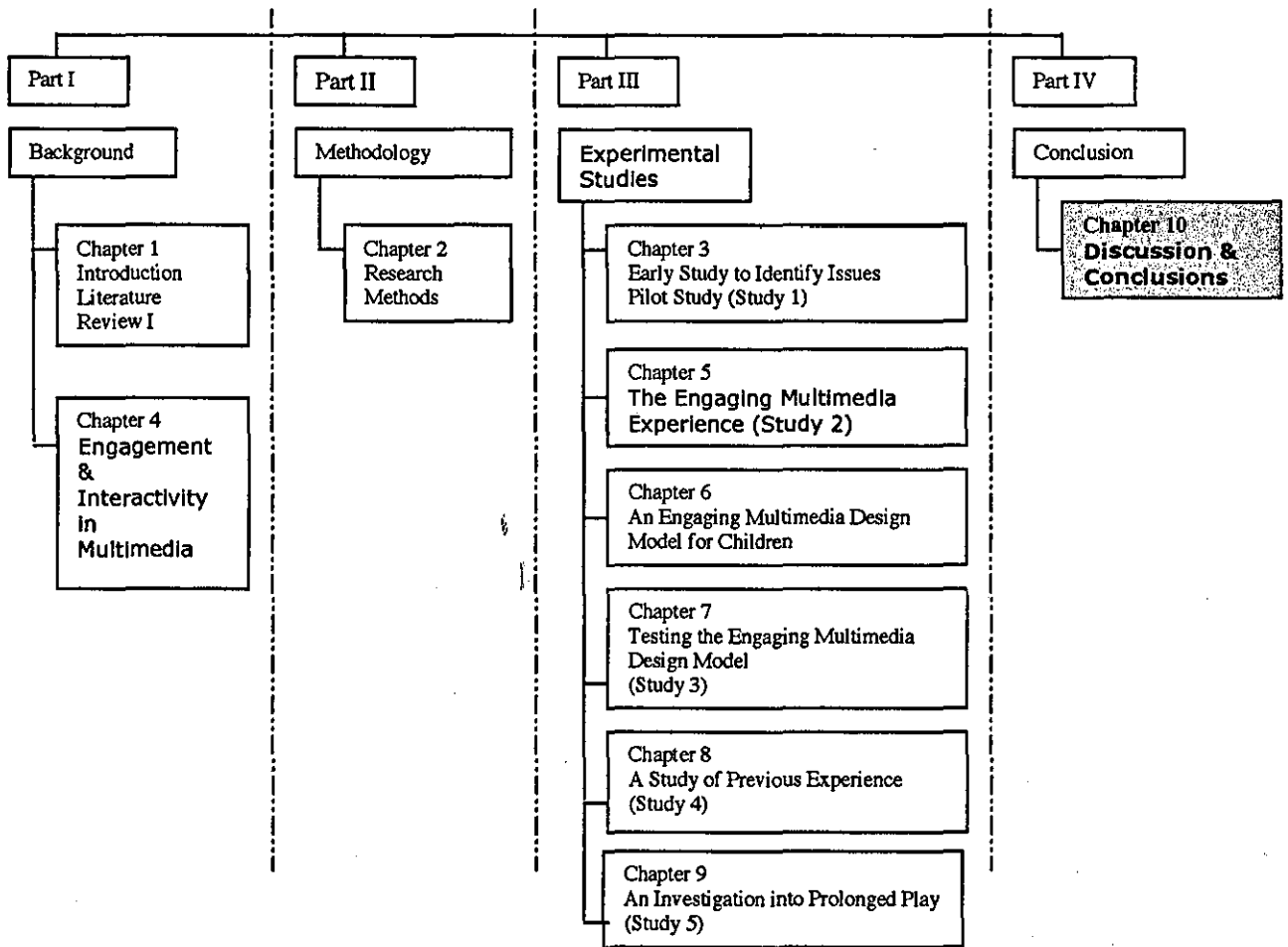


Figure 10.1: Chapter 10 in the Thesis Structure

## **10.1 Introduction**

Multimedia has great potential both in leisure and education. There are lots of multimedia applications designed for children. A lot of imagination has gone into these designs but evidence from the pilot study and literature has demonstrated that there is still the big BUT that the children find them boring. The kernel of the whole research was about discovering if this is true and if so to find out what we can do to make the multimedia appropriate for children. Therefore the central issue of this chapter is to review how far this research has achieved these goals and what future research is necessary.

## **10.2 Methodological Review – Research Strengths and Limitations**

It had been a great challenge to develop this study and to get the Engaging Multimedia Model to its present form. There are many ups and downs in doing this type of research. Any piece of research has to have a focus but it cannot investigate everything. The methods used in this research have their strengths and limitations that need reviewing before the contribution of the research results can be assessed.

### **10.2.1 Research Method Strengths**

#### **a. Assessing Engagement:**

First and foremost this research has been able to make a systematic assessment of engagement across a variety of situations. In particular it has been able to look systematically at what engages children in an engaging application, "The Sims". By measuring engagement at every 5-minute interval with these children in this application, this research has obtained quite strong evidence of the way engagement changes over time and what is causing these changes. The simple rating scale worked well with children who would have had difficulty with anything more complex.

#### **b. Varying and Changing Variables**

This research also had strengths in the ability, to some extent, to vary the conditions that might be affecting engagement. The results from these studies have shown how engagement rises and falls in relation to these variables.



### **c. Content Analysis**

This research emphasised the engagement scale scores, as a simple way of getting responses from children that measured changes in the dependent variable. The interview data provided a lot of data to help explain why the engagement scores were what they were. The video records also provided evidence of key events that were affecting the responses of the children. Full analysis of the qualitative data was not attempted but the triangulated approach contributed a lot to measuring the degree of engagement and explaining what was affecting the children.

### **10.2.2 Limitations**

What were the limitations of the research methods that were adopted?

#### **a. Limitations in Measuring Engagement**

One of the weaknesses of the experiment was that, once the investigations turned to forms of multimedia that were predicted to be engaging, most of the marks were at the top end of the engagement scale. This meant that it was not easy to use the scale to separate out degrees of engagement. However, the qualitative data from the videos and the interviews helped to identify the circumstances when extreme engagement occurred, i.e. when the children were really upset not to be able to continue. In future experiments, however, it would be valuable to re-calibrate the scale to avoid this ceiling effect by having scales reflecting more the different degrees of engagement.

#### **b. What happens with Prolonged Play? – The Time Factor**

This research reveals what happens in 40-minute periods. Study contributes a bit about longer periods but not a lot. This is one constraint of this research study. There was limited time to pursue further in this area. Therefore other research could look at this area of prolonged play more intensively in order to see what sustains engagement and for how much longer, in order to see how, when and where does the engagement effect ends.

### **c. What happens with Other Application? – Other Settings**

It is important to note that this research only reveals what happens in relation to one application, that is, "The Sims". Suppose the application was something else that is also engaging, perhaps something educational that is of more specific in nature, would the same patterns be found? Would the variables construct and simulation have meaning in other application and could they be used to produce the same patterns? That has to remain as an open question because this research has only been able to do one application.

The next research should be to confirm the results in another setting and with another set of children because one cannot deny the fact that it might be possible that the effects in this research were entirely of "The Sims" or of the children. These research results have yet to be generalised and to obtain results from other applications would clarify the generality of the model.

The model has been constructed from the results of studying 'The Sims' but it is offered as a model of engagement in relation to all multimedia applications. All the variables, with the exception of previous experience, originate from the literature and there are good reasons to believe the model will have explanatory power beyond The Sims. We might anticipate, for example, that interactivity that enables the user to control and test out effects (as in simulation) and interactivity in the form of a tool set for building and construction will be important engaging components of a wide variety of multimedia applications.

### **e. What happens to Gender and Age Performance in Other Applications and Settings?**

The results of this research have suggested there is not a lot of difference between the boys and the girls within this age range. The Sims was an attractive and engaging game for both boys and girls. As Study 5 suggested, girls valued it because it was slower paced than many fighting applications but boys did enjoy this kind of game as well. This may not be true in other applications. There may be some differences between children that are more important when using other applications and therefore the next study could work upon this area as well as paying fuller attention to differences in gender performance.

This study used children in the age range 10 to 14 which is a period of dramatic development in children. The aim was to create a model which applied across this age range and hence the effect of age differences was not studied directly. Age was a variable balanced in each study so that it did not confound the effects of other variables. Nevertheless, as the study of prolonged play shows, children mature quickly and develop new skills, aspirations and goals and any game that cannot cope with different levels of interest and capabilities will have limited engagement potential. A systematic study of age and mental maturation would be another research area worthy of investigation.

#### f. Disassociating the Effects of the Variables in the Model

One of the limitations of the research programme was that it proved impossible in the context of using the Sims to disassociate the five features in the model. It was therefore impossible to test, for example, the effects of immediate or delayed feedback on engagement. It was possible to separate the effects of construct and simulation but this too caused a problem because, as the study of prolonged play demonstrated, it was the integration of the two, i.e. construct and then play the simulation, which sustained engagement in many instances.

A detailed examination of the model would therefore entail the development of a multimedia vehicle for the research which would allow the manipulation of each of the variables to be able to explore, for example:-

- the nature of feedback e.g. immediate or very delayed
- the way the children interact e.g. individual, in groups, etc.
- the use of varying input devices e.g. joysticks instead of mouse, etc.
- the use of audio e.g. with sound effects and without sound effects, etc.
- the effects of immediacy on the development of motor skills e.g. speed of skill acquisition amongst children, between genders, across age ranges, etc.
- the effects of changing the level of aspiration of goal setting e.g. especially the effects of what happens after a longer period of time, etc. It is important to study what happens if the goal is set too high and the child is faced with a series of disappointments. Would they give up? How to determine what is the right level of challenge could be an important research topic.

From both the strengths and limitations listed, it is concluded that this research at present is at the stage of knowing that the question of making a multimedia application successful has a lot to do with what will engage children. It is to be hoped that the model that has been developed can be tested in other settings and used as a guide in the development of multimedia applications.

### **10.3 Lessons learned about working with children**

In reviewing the research methodological approach of this thesis it is important to note that the subjects under study were children. Because they are usually unpredictable, there is a lot of homework needed before researching on them. The whole research process of this thesis had gone through a lot of hurdles and obstacles; from selecting age groups, to selecting materials, to designing experimental conditions, to finding experimental locations, pastoral, food, transport, tokens, etc. One of the more successful features of this programme is that this effort was rewarded by the collection of valuable and reliable data from the children who took part in the study and lessons can be learned about what worked and did not work.

Some prominent examples where lessons were learned were the choosing of methods that work with children, modifying research instruments to make them relevant for children and finding ways of helping children to articulate their responses to the multimedia applications.

#### **10.3.1 Researching Children**

At a surface level researching children could be similar to researching adults. Research is about giving children things to do, observing what they are doing and guiding them to try to do things, etc. However, this is not as straightforward as it seems with children.

It is much more difficult getting children to provide answers e.g. that design is terrible and what it ought to be, etc. Children are often used in a UCD (User Centred Design) method but they tend to be used to reflect about what they think and what

they want which, may be, is much more un-reflective than it would be with an adult. So how did this research overcome this problem?

A practical approach was to look at how they used an application. Looking at how they used the system was much easier than eliciting answers by written questions. But one could not get much by looking at short sessions. The challenge was to get them to use an application in many different ways and from this to ask them why e.g. that thing was difficult for you, why was this more fun, etc. Therefore, this thesis used a variety of methods to get its data from children. It started with a grounded, unstructured survey and moved on to more experimental studies to 'test' what matters to children.

### **10.3.2 Research Instruments**

There was a need to make instruments friendlier to children users. The engagement rating scale was a very simple representation of how the children felt and they quickly grew to use it without it interfering with their interaction with the Sims. The smiley faces representation seemed to help them relate to how they felt. Any written questions and instruments to be used by the children in this study used typography and font sizes that suits children e.g. a *Comic Sans Serif* was used in experimental instructions to children to give it a 'child-like' effect.

### **10.3.3 Helping children to articulate**

Getting answers from children is rather difficult for some children. Children are not necessarily articulate. An engagement scale score of 0 to 10 with smiley faces was created as a simple way of getting responses from them to partly overcome this problem. Besides that, this research used lots of laddering techniques of questioning in the interview sessions to elicit answers. These sessions could sometime be quite time consuming. Questioning them in places and conditions they are comfortable and at ease with e.g. while eating with them, etc. was helpful but did not always work.

## **10.4 Other Issues to Ponder**

### **10.4.1 If given another chance**

Overall the whole research study had been exciting and interesting. If given a chance to do it in another way the options maybe to do it the same way with the same methods again but this time with more updated technology. At the time the study was conducted, digital cameras were rare and performance unpredictable. There was no software that could detect facial expressions and interfaces at the same time. Therefore the most interesting findings were the ones done in the usability labs where cameras are placed at different points in the room to get the same effect.

The settings were somewhat the same in other places of study but images were not as good a quality as the ones in the lab, because some cameras had to be placed in awkward positions and at times faced unforeseen obstructions. Having web cam and software that could detect interfaces and facial expressions at the same time could save time and may make it more portable. The number of children could be doubled and more studies could be conducted and examined rather than taking limited number of children in the usability lab, in homes and activity rooms, etc. at any one time.

### **10.4.2 Other Future Research Opportunities**

There are a lot more areas to look into about children and multimedia. When concentrating on methods the researcher would plan to use a similar approach to investigate children's reactions to other design elements like illustrations in books to animations in multimedia, looking at preferences of likes and dislikes, etc. The idea would be to develop a model that will help us to understand which of these design elements (illustrations and animations) works best for children, where, when and how. It would be interesting to know whether what they said they wanted was really what they actually liked. Maybe, going a bit further into the future, it would be interesting to investigate issues about differences in playing experience between 2D virtual games and 3Ds and the 'eye toy' 4Ds of the VR world.

There are also other areas worth investigating when using games as an investigative vehicle. With The Sims in particular, a further study could be about how cultural knowledge transfers or cross-cultural transfer affects the creativity and imagination

of children when interacting with multimedia. Since The Sims has been translated into many languages a likely example would be e.g. of children between nations. There are also other areas affecting gender like problem solving and strategies. Another could be about feelings and reactions of players playing Sims on-line with multiple players, etc.

Whatever the investigations the findings would enable us to know further what really matters to children and this would in turn help us understand them more when designing educational materials for them. Maybe it is worth pondering about the polemic between these responses given by two children. One child said, "We can still learn in games if well designed..." whilst another said " A game is a game whatever... I can't learn from it." For the researcher the best way to please both sides is to disguise it. Why not design something educational the "game-like" way? Would that do the trick? Maybe the Engaging Multimedia Model could give us a clue on how to go about designing multimedia of this kind for children.

## **10.5 The Research Programme**

The overall purpose of this research was to find out what really matters when designing multimedia for children. The story began by finding out what works and what did not and the whys behind it all. In this preliminary scoping study it was revealed that multimedia, as an approach, was rated higher than books but the children found the multimedia applications shown to them much less interesting than the corresponding books. These findings seem to suggest that the children did realise the potential of multimedia but did not like the design of the multimedia applications given to them.

The pilot study demonstrated that the most important factor about children preferences with the multimedia CDs had to do not only with the ability for them to interact with the system but also to have design features that could draw the user's attention so that he or she would not want to stop when asked to do so.

This sense of "engagement" or "being engaged" will enable the user fully immersed, the moment in the timeline of interaction when they are totally cut off from their surroundings through a force derived from within - intrinsic motivation. This Stanton (1998) refers to as hedonic. Therefore, the whole business of fulfilling the children's

need is to find multimedia that has properties that helped them to achieve this state and remain in it.

As a result the experimental programme became focused on the features of the multimedia that could create this sense of engagement. The study started to develop a theoretical framework that was later tested and retested and ended in the formulation a multimedia design model that engages children. Each experimental study conducted illustrated how engagement really worked in a multimedia environment.

## **10.6 What did the children want?**

What did the children want that could make one multimedia systems more engaging than another? Findings from the pilot study demonstrated some needs that would help them stay engaged:

- Children wanted a system that allowed them to be in control or in charge.  
Books were preferred because they preferred to read rather than be read to. They could flip through the pages and feel them. They were more in control of what they wanted to see because they could look at the information at their own pace. Therefore the system should allow some form of manipulation to let the user being in control and to role-play.
- Children wanted a system that allowed them to create.  
Some comments about Internet systems were not knowing to whom they were aimed and not giving them a chance to put their name to it. This wish of wanting to create is all about having a chance to get some form of ownership or personalisation into the system they are interacting with and not having everything already there "created" for them like the information CDs for children.



- Children wanted to see what the impact would be if they did this or that to the system.  
They wanted some form of immediacy to enable them to see immediately what happens if an action is taken like a position of the cursor change when a mouse moves to a certain direction, etc. Not knowing what is going on is disturbing to children.
- Children wanted feedback preferably immediate rather than delayed.  
When they were asked to compare finding answers from books to that of quiz answers in multimedia the children preferred multimedia because the feedback was immediate and not too delayed.
- Children wanted goals and purpose for doing something either set by them or set for them.  
In the pilot study, the children were free to play around with the multimedia given to them. The purpose was to see whether the design features in the multimedia could give some form of motivation to attract them to it. The findings show that goals are important for children, either set by them or set for them, that is, either extrinsically or intrinsically motivated. Since the children did not receive any external direction to use the system they got bored looking at the information CDs after sometime, except for one application, which was a game CD. Compared with the other CDs this game CD, even though some admitted it was for younger children, engaged the children, particularly in trying to solve and finish a picture puzzle. Therefore, when an external drive is not present, the multimedia must have goals either directed to the children, by the system or it must make it possible for the children themselves to set and achieve their own goals (task closure) or to arrive a certain level of attainment.

To sum up the findings from the pilot study it appeared that what children wanted was an application that let them: be in control, work at their own pace, manipulate the system, play a role in the action, create, see the things done on the screen immediately, have feedback that is not too delayed, and have goals either set for them or set by them.

A review of the literature about engagement and related concepts reinforced these conclusions and led to a provisional statement of the five design features that contributed to the experience of engagement.

## 10.7 The Five Design Features

The five design features are:

- **Simulation interaction** which allows the child to act on behalf or to role-play
- **Construct interaction** which allows them to build and create
- **Immediacy** which refers to seeing every movement made when interacting with the system
- **Feedback**, which is best if immediate rather than delayed
- **Goals** that are clear either set by them or set for them when no external motivation is present

A provisional proposition was that having all these factors present should make a multimedia system engaging.

In order to test these properties the research needed a multimedia application, which possessed these attributes and which could be manipulated, for example, to increase or decrease some of these properties. A review of current multimedia systems showed that The Sims received very high ratings from children and, on inspection; it had all the necessary attributes. It was, in consequence, chosen as the vehicle for the experimental programme.

As a popular game about Life Management The Sims lets children do role-play and be creative. It gives immediacy to actions made from input devices on screens. It gives feedback: immediate when they are building and rather more delayed when seeing the consequences for families. Its goals are either directed or non-directed. Most initial goals are task directed by designers but when the child wants to continue playing, the child can set the goals.

## 10.8 Towards a Model of Engagement

Even though it did not prove possible to disentangle all of these factors so that they could be separately tested, the following overall conclusions could be drawn from the

experimental programmes set out to test the role of these five factors in creating an engaging experience. The findings were:

- When all five features are present children achieve a high engagement score over a 40 minute period
- Enabling children to set higher goals for themselves, as in construct interaction, often led to more sustained engagement
- Children with prior experience of the game became engaged much faster than those without experience
- The Construct Interaction condition tended to sustain permanent skill retention better than the Simulation Interaction suggesting that motor skills are more reusable than mental model skills
- Children continue to develop and therefore their aspirations with any application change over time. They continued to be engaged by the application whilst they could still achieve new goals with it

A model built from this summarises the results from these studies and having initially demonstrated how the five factors interplay to create an engagement experience, there is now an inclusion of a further factor, the sixth factor of the past experience of the child.

## 10.9 The Model of Engagement

### An Engaging Multimedia Design Model

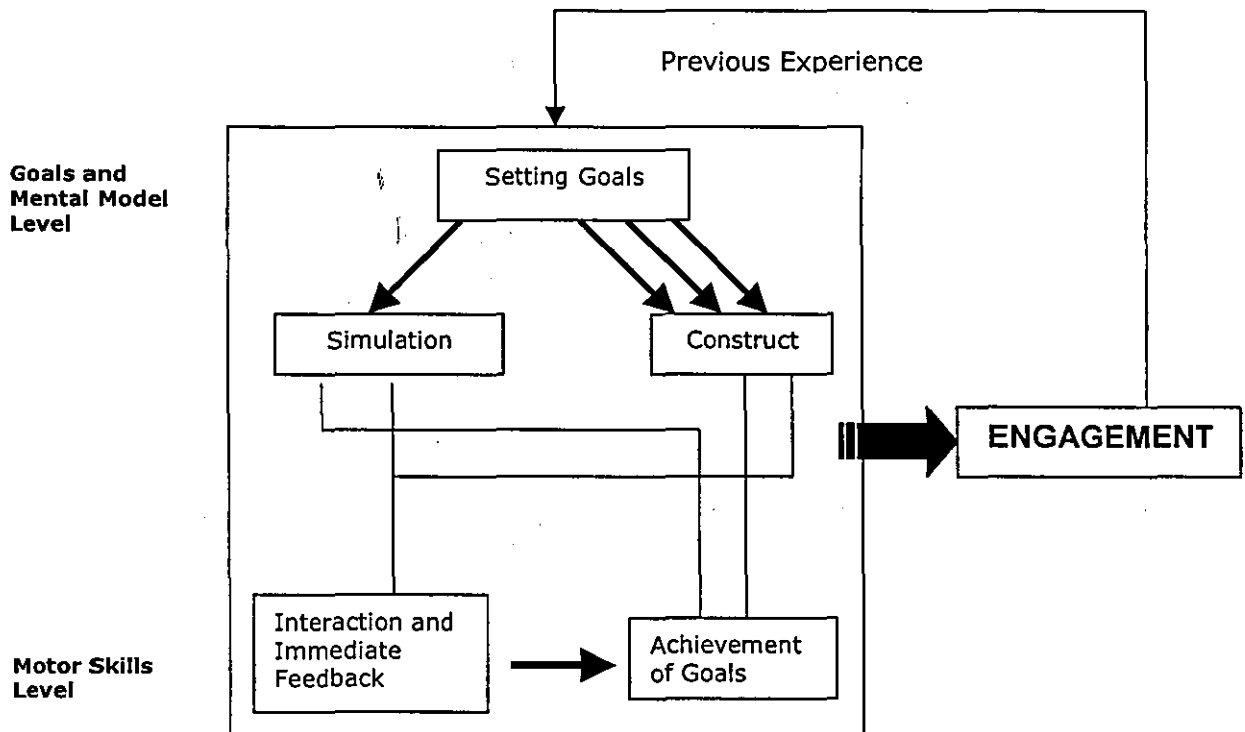


Figure 10.2: The Engaging Multimedia Design Model for Children

### **10.9.1 Introduction**

The initial hypothetical statements have been no interaction chances means non – engagement, less interaction means lower level of engagement and more interaction means higher level of engagement. Through tests on an engaging application it was demonstrated that for most children, except for one or two that were quite happy just to look at it, no interaction does mean non-engagement. This finding supports the hypothetical statement that interactivity is premier in any form of engagement because no interaction does mean non – engagement. Therefore, basically a multimedia has got to be interactive in order for it to be engaging. The children have got to be able to do something and see the impact on it for them to be engaged to it.

There are a number of interplaying factors that seems to contribute to the engagement phenomenon. A better understanding would be to look at the model in relation to the findings from the set of experimental programmes conducted in this research.

### **10.9.2 Interaction and Immediate Feedback- Motor Skills Level – Achievement of Goals**

The model proposes that the consequence of being able to interact and to get immediate feedback causes some form of engagement. The cognitive skills that were being used at this stage are motor skills. The operative tools that are involved are e.g. operating a mouse click, drag and drop, etc. The interactive activity uses a certain level of motor skill that enables the user to interact with the system and gets immediate feedback from it and all the interactive activity that occurs at this lower end of the model are about getting immediate feedback. Engagement levels tended to reflect whether the children had mastered these skills; if they had not and they encountered problems, the level went down. When they had the skills, the level went up as they tackled higher goals.

Initially it was thought that if these factors tied together well then a basic set of goals was achievable and therefore could cause the user to be engaged. The children will use a certain level of these motor skills, easily learned by those with experience

but harder for those without it, to achieve the goals. But was it so? Is having a set of motor skills to operate an interactive session, which gives immediate feedback enough to give an engaging experience?

Evidence from the pilot study suggested that it was not necessarily as straightforward as this. Children were not necessarily engaged just by having some design feature that allowed them to interact using some basic operative tools like clicking a mouse button to e.g. find out the meaning of the word in bold, or click to see how the heart beats, etc. The children quickly get bored when they had only a few things of this kind to start with; but they also got bored even when the design features are in plentiful variety.

The purpose of the pilot study was just to see whether the design features in the multimedia could attract children's interest to it. It was found that having the capability to interact did not necessarily mean that the children could be engaged by it, some might, but only for a short time span. On most occasions the children found them boring. It became evident that the interaction in these circumstances tended to cause children a sense of passivity because the design feature, though interactive, lacked the ability to allow the children to do anything with it that would lead to an engaging experience.

Thus results from the pilot study suggested that children felt bored because there was nothing to do. The CDs had useful information. So what? It is useful if they are e.g. researching something, etc. but if otherwise a game CD was most preferred. It is of no wonder the educational CDs bought for children by parents in the homes are left on the shelves till an external force, e.g. looking up information for homework, etc. is present that causes them to use them.

In other words for a child to appreciate and like a multimedia application there must be some kind of activity occurring between the user and the computer application that helps them stay engaged. Schank (1993) suggested that students learn well when they are engaged in active exploration, interpretation, and construction of ideas and products with multiple resources.

Therefore in a situation such as the pilot study there was no way to sustain a child's interest with the educational CDs except for one game CD, if there is no force either external or internal to make them do it. The pilot study demonstrated that having the ability to interact and get immediate feedback using basic motor skills was necessary but not sufficient for engagement; they did not help children achieve a set of goals that is intrinsically motivating if external motivation is not present.

Therefore the main conclusion of the pilot study was that the forms of application that were shown did not engage the children. The children were viewing them rather than interacting with them and they soon became bored. What else then needs to be present for a multimedia to be engaging and to sustain engagement?

### **10.9.3 Simulation –Mental Model Skills Levels - Achievement of Goals**

Children wanted a system that allowed them to be in control or in charge. Therefore not only should the system allow a certain form of interactivity, the system should also have features that enable the children to manipulate so that they could be in control and role-play. This form of interactivity, which in this research is referred to as simulation, could engage children and sustain engagement.

At this stage in the model, the children are considered to have acquired the motor skills needed to operate some operative tools and to be able to move on to the level of goals and mental model skills. The simulation feature gives the child the ability to achieve goals, either set for them by the designer or set by them from within (intrinsic motivation). This leads to them wanting to complete tasks to achieve goals which Lewin refers to as task closure, or wanting to reach a target to fulfill a level of aspiration. The cognitive skills affected in the simulation mode were the mental modal skills.

From the experimental conditions set up for this research, it was demonstrated that this type of interactive activity did contribute to engagement. However, the variations in them, like the rise and fall, speed to reach maximum engagement, etc. were influenced by the previous experience of the children with the system under study. Findings from the experiments have demonstrated that this interaction type

tends to engage children and sustain engagement much faster and longer with experienced children than children without experience.

These studies also revealed that the mental model skills tended to be a little more unpredictable than motor skills when achieving goals were concerned. This is because individuals tend to have to develop specific mental models for each simulation e.g. it is harder to understand a situational event than to ride a bike (if someone had the skills already).

Motor skills, which tended to be operational, like skills in riding a bike, swimming, etc. even though sometimes hard to acquire, seem to be easier to re-use in a new situation. The Test Operate Test Exit (TOTE) paradigm (Annett, 1969) operates very well in motor skills. You do it (operate). You test it. It works or does not work. You test it again and move on. Let's take an example of a situation when you want to go to work. You start the engine of the car. The operating systems work. Without further ado, you go to your destination. You just continue driving without even realising the mechanisms involved in driving the car to get there (depressing the clutch, changing gear, etc.).

The children had set a goal they wanted to achieve and used the motor skills to get them to reach the target. If the motor skills needed to be reacquired or a new one needed to be learned, e.g. changing an operating tool from mouse click to drag and drop, etc., the TOTE feedback loop needs to be rerun again before the goal could be achieved. When children had to rethink motor skills, the engagement level tended to dip before rising again as goal achievement was once again a possibility.

Mental model skills, however, tend to be more situational in nature, at least as far as this experiment was concerned. Thus, when looking at it in the TOTE feedback loop perspective, the simulation interaction behaviour in the experiments gave a "roller coaster effect" to the children's engagement levels. The fact that the goals were set for the children instead of letting them set their own goals affected the engagement phenomenon even more. In this experimental study, e.g. the fact that the characters have already been set by the experimenter, meant the children had to figure out for themselves in the play session what the characters were and how they would behave. This delayed the time when they could set their own targets, e.g. decide on

actions and see if the characters behaved as expected. Results of the studies demonstrated that, even though this type of interaction did sustain engagement for a long period of time, it reached its maximum level of engagement slower than construct interaction, even for children with previous experience.

#### **10.9.4 Construct –Mental Model Skills Levels - Achievement of Goals**

Children wanted a system that allowed them to create. Therefore not only should the system allow a certain form of interactivity, the system should also have features that enable the children to create something, to make it part of their own and a chance to put their "name" to it. This form of interactivity allowed them to get some form of recognition for their capability and to not have everything already there "created" for them. This research refers to this factor as construct and the model proposes that this engages children and sustains engagement.

In construct, the motor skills used can be used each time. It is much easier to use operating tools to build and create a house than to manage the life of the characters in the simulation mode. Thus the children doing this type of interaction get to set their own targets much faster than the ones doing the simulation type of interaction. That is why they reached their maximum engagement level much faster in construct than in simulation. The TOTE feedback loop exists here but the effects of rise, fall and regressions in engagement patterns is much less here and tended to be at a much earlier point in the play session than when playing the simulation mode.

The model has many arrows leading from 'setting goals' to 'construct' because 'construct' has many opportunities for children to set and achieve different goals. The 'tools' allow the child to build many different things, even a floating house. As a result, construct mode has more potential for engaging children than simulation because it gives more opportunities than the simulation mode.

#### **10.9.5 Previous Experience and Sustained Engagement**

What makes children engaged and allows them to stay engaged has a lot to do with the drive that gives energy and direction for a person to continue doing something mostly to achieve some form of rewards either extrinsic (praise, marks, money,



success, etc) or intrinsic like Lewin's field theory of task closure, level's of aspiration, etc.

Yet for children, as far as learning through play is concerned, engagement steps in when the line of demarcation between the two kinds of rewards disappear. For the children in this research, at least, engagement is all about the drive from within, an intrinsic motivation of not wanting to stop, a point in time when the drive from without becomes "irrelevant" to the situation under study. There are a number of reasons why this phenomenon happens.

At most times it is all about goals setting. Some design features sustained engagement better than others because of the wider scope of freedom of goals setting the design promoted as in Construct Interaction. Others tended to restrict freedom of goals setting thus hindering the extension of creation and imagination, which in turn resulted in a much shorter engagement span as in Simulation Interaction.

Goals, intentions, dreams, and desires are in most circumstances affecting the mental model skills of the individuals, whilst tools used to achieve these goals are affecting the motor skills of the individuals. Therefore 'being engaged' is about having these skills interchanging until the goal is reached. The previous experience factor accelerates the process to reach this engagement phenomenon. The more experienced the child is the faster the child reached this stage of 'being engaged', when they could set their own goals.

The limit in engagement is reached when the design system exhausts the chance to set and achieve advanced goals. Therefore engagement can be sustained as long as the system can successfully continue to give chances for users to set more goals. That is why in The Sims, the designer had ventured into designing for playing in consoles and play stations setting targets and levels, and for playing on-line giving more add-ons and extension options, and multiplayer networking systems. The reason was to give chances to users to set more advanced targets and goals beyond the ones they have already reached to sustain this 'being engaged' phenomenon.

From all the studies that followed after the pilot study it was evident that The Sims sessions were found to give a very engaging experience because the system allowed the children to reach the stages of setting their own goals. And from the model the faster the design feature allowed them to reach that stages the faster will they be engaged to it. Since motor skills acquisition in construct interactivity is much easier to re-use, the children got to the setting goals stage much faster than mental model skills acquisition in simulation interactivity. For this game at least having experience in the game affects the speed to reach this stage.

As far as sustaining the engagement phenomenon is concerned there are still open questions. The question is for how much longer does this effect last if the children are given a much longer period of play. One thing that seemed to surface is the possibility that construct interactivity might sustain a much longer engagement effect than simulation interactivity because construct interactivity tends to allow the children more room to manoeuvre in their creative activities.

This research has gone some way into this area of prolonged play but not as much as to give a firm conclusion about it. Enough to say that children at this prolonged stage play will continue to set further targets and goals but will move on to other things eventually, especially when the desire to continue is hindered by the inability to fulfil factors that are rather external and beyond the user's control e.g. when the system fails to deliver because the graphics became more sophisticated and demand more of the system than it is capable of, and / or / costs more to upgrade or buy a new one, etc.

#### **10.9.6 The Scope and Limitations of the Model and How it Might be Further Developed**

Any model is inevitably limited by the situations and data that led to its creation. It might be considered that this is a model of what affects the engagement of children of a certain age in a certain cultural setting when using the Sims in 40 minute periods. Some effort has been made to test the model beyond these constraints, e.g. by considering other multimedia applications in the pilot study and by looking at prolonged play in the final study. However, it was not possible to carefully control these studies and the data often does not relate strongly to the model. One way of

examining the generalisability of the model is to compare it with the other models of human behaviour discussed in chapter six.

The Technology Acceptance Model (TAM) is a well established model relating to how people use systems in work settings and sees usage arising from the 'pull' factor of utility and inhibiting factor of usability problems. The engagement model presented here stresses the 'pull' factors of having a set of goals and the interactive capabilities to achieve them. It does not dwell on the usability difficulties if the child finds they have trouble using the system functions but they are clearly important from the data in the experiments. A system may have the potential to be engaging but if a child is overstressed by the difficulties of using it they clearly can become disengaged. An interesting way of developing the model would be to examine more closely the effect of varying the usability of the system to see how the child's desire to achieve goals is affected when there are operating problems to overcome.

The mental models approach of Woodhead (1991) sees successful use being dependent on the match between the 'models' users bring to the system and the 'models' contained in the system. This is expressed in the engagement model in terms of the effect of previous experience and the closer this experience is to using the particular application the more likely it is that the user will experience engagement when using it. One interesting feature of the engagement model is that it distinguishes between generic motor skills the user needs to operate a range of applications and the specific knowledge (the cognitive model) that relates to a particular application (and even perhaps to a particular simulation).

The fact that the engagement model is consistent with models created for adult users in other settings suggests that it will be found to be generalisable beyond the use of the Sims. There are, however, a range of specific tests that could be undertaken which would both test the model and extend its applicability. Some of these are as follows:-

- Longer periods of use and increasingly levels of aspirations. Gather more systematic data about what happens to engagement over longer periods of use especially as the level of aspiration for goal achievement changes.

- Examine more systematically the relation between the goals that are set and the usability of the system. What levels of usability actually interfere with engagement sufficient to cause disengagement?
- Test the model with a range of different multimedia applications that also have a reputation for engaging children. Do they for example, include the equivalent of the simulation and construct mode of interaction? The model would very strongly predict that prolonged engagement will only occur when the child can achieve control over the application in order that they can be creative with it.
- Examine the issue of where goals are set. The model recognises that the child may set the goals or the system (or some combination of the two). However, in many circumstances the goals or the framework of use might be set for the child by an adult – by a teacher or a parent, for example. How does this source of motivation influence the engagement level achieved by the child?
- Explore the relation between engagement and learning. This research has not addressed the learning of the children but has focused on their experience of engagement. The media debate that the issue of whether multimedia use leads to learning remains contentious. The process of engaging with a multimedia application does appear to have many of the characteristics of learning; of mastering the system, of setting and achieving goals etc, but no formal study has been made of the skills or knowledge that the children retain at the end of engaging forms of interaction. We may hypothesise that an engaging experience with an educational multimedia application will produce learning and such a hypothesis should be testable.

## **10.10 Implications of Designing for or with Children**

### **10.10.1 Designing Multimedia for Children**

There are a number of implications in the designing of multimedia in relation to the findings of this research and the model. This research has given insights for designers to ponder be they designers of children's edutainment applications or those solely for educational purposes. It is not enough to lay down the rules of instructional design. Nor of using some form of design convention or principles designers usually follow when designing multimedia. The designers should ask themselves some of the following questions when designing for children, be it a multimedia application, an electronic game, a virtual reality experience for children,

or anything that involves getting children interacting with a technological invention or system, etc.

1. How are the children going to interact with this application or system?

Interaction must be present in order to engage them. Passivity is a put off in any kind of systems design. Therefore the main factor would be to know what the designer wants the children to do with the application or system.

2. Is the interaction design style appropriate for them, usable, etc?

The next question to ask is how to make the design appropriate for each age and level of attainment? Having something that is too difficult and unachievable will make the children leave, discard the multimedia and never want to come back. Having it too easy, not challenging enough, etc. will lead to the same result. The aim is to make it just about right, which at times, could prove to be very difficult. It needs lots of iterative design sessions to achieve that which is most appropriate.

3. What goals can they set with this application?

When designing for children (this could happen for adults too), there is a tendency for designers to set their own goals in the design they create, through assumptions more than from direct evidence. Such moves defeat the design motto "customers (in this case "users") come first". Therefore some designs fail to reach a standard that pleases children. Thus, it is no wonder that children express their dismay in not getting what they really want.

Whatever the application or system for children it is very important that the system allows goal setting opportunities. Therefore for educational multimedia to be successful the goal, if not present in the application, must come from an outside or external force. The application must include in its package e.g. a teacher's guidance pack, classroom activities pack, parents and child activity pack, etc. anything external that could highlight the goal settings opportunities that will help the children to become engaged. It might not be the "very exciting and fun" kind of engagement for the children, but children do what they have to do when learning is concerned.

The learning mindset is there in every child. The only thing needed is some kind of force to instigate it.

4. What chances have they got of improving or increasing their competence in respect to this?

When the purpose of the design is to help children become engaged but also to stay engaged, then the feature must allow the children chances to improve or increase their competence in achieving other goals either set for them or set by them. The wider the opportunities given to improve or increase their competence the longer they will stay engaged by the system. The most important factor to remember is the goal must always be something achievable fairly quickly and not too delayed.

### **10.10.2 Designing Educational Multimedia for Children**

There are two significant areas to consider when discussing issues about designing educational multimedia through the engaging multimedia design model's perspective: one, in its design context and another in its user's context.

#### 1. Design Context

In an educational multimedia design context, the designer should consider including design features that let children play a role as in simulation and to create as in construct. The feedback must be kept immediate. Tools must promote immediacy and be easily manipulated and goal-setting opportunities must be ever growing and meaningful. If these elements are present in an educational multimedia it is likely to be the engaging for the child.

Doing the design in the suggested way could help maintain children's interest in the software created for them more than having just bare facts on the screen like those of encyclopaedic multimedia format design for children. Children do learn well when they are engaged in active exploration, interpretation and the construction of ideas and products, etc (Schank, 1993)

## 2. User's Context

This research has indirectly highlighted the importance of the way educational multimedia should be used in the schools and the home. If an educational multimedia is to be used in the schools, the package must include guidance and activity packs monitored by teachers and parents. Having the schools campaign, encourage and set up themes and programmes that encourage children to use these materials to find information is a bonus point to stimulate the full usage of multimedia in the schools and the homes.

Cultural psychologists have revealed that educational multimedia in the homes are not the likely choice for children's use in their homes unless the parents are also involved when using it. Having parents besides their children in such an activity is an idealistic ambition. Very few parents have such a chance to be able to do that with their children.

From the findings in this study it could be suggested that if parents, teachers, etc do plan to use multimedia CDs, some guidelines would be:

- a. Treat educational CDs as reference sources like having a set of encyclopaedia in a home, one or two on history, others on the sciences, geography, languages, dictionaries, etc. for children to look up for homework or any form of educational home activity.
- b. Buy edutainment CDs if the plan is to let children play them on their own. Some suggestions would be finding the ones that encourage them to role-play, be a pilot, an architect, a doctor, a parent, a teacher, etc.
- c. Add also some that allow them to construct, create something, build, and rebuild, etc. Suggestions to designers, e.g. in making the "Human Body" multimedia CD more appealing to children would be to let the children create their own "human", "play god", maybe for example, find ways that make children realise the reason why the stomach intestines were not placed in the upper part of the body, the logic about rain formation, what if the ecosystem is disturbed, etc. Instead of giving them information after information, that they could read by flicking the pages of an information book. Trying to solve problems,

and building logic from critical reasoning, would definitely help children to learn and understand things rather than spoon-feeding them with information.

Multimedia has great potential and using it in a manner that could help children be engaged would realise this potential. These suggestions restate the argument that children 'do learn through play'. Some do not totally agree with this statement. The question they pose would be: how much of play time should be given, of what type, when, where and how? But, if the elements of what engages children are included in the educational design materials, at least, the time they are involved in free play is time well spent.

### **10.10.3 Designing with Children**

Looking back finding answers about the best design for children is not only about including them in the design process, i.e. using them as informants, testers or evaluators. It is not enough having them as design partners, as the literature shows even when designing for adults, the ones that are most likely to be engaged with the system were those users that are involved in the design process. They are not therefore designing for "actual users" or "onlookers" or "outsiders".

From the perspective of the model there are two more roles children could play in design. As design partners the children could have a chance to convey what they want in the application, to suggest goals they want the application to set for them or allow them to set and another about the activity the children went through during the partnership.

#### **1. Setting goals**

As design partners the children will have a chance to convey their wishes to the designer's about what they want the application to do that will allow them to set goals that they would want to achieve if given the application. For example, if a question asked were, "What would you want the multimedia to let you do"? The reply might be, "to talk to me, answer my questions, allow me to draw something like a pencil, etc." Some things could be designed, like a voice recognition feature, a "drawing pen" of scriptures recognition feature, etc. but some might be impossible but could be compromised. The most



important task is to give the children opportunities to have tools that they can build something with in relation to these goals. What we have found out by working with children as partners in developing a multimedia application is that the designers are still the designers.

We should not expect the children to be the designers of a set of complicated tools. What comes out of the partnership is the ability to hear what the children want to enable them to manipulate the system in a certain kind of way. How that is done is by having the children tell the designers what they want which at times is difficult to achieve. So what they want to do is to get the children to point to the materials which possess the things they need. Some of these things may lead to other levels of competence.

## 2. The activity as design partners

Putting the two contextual factors of giving a chance for them to role-play and to construct, as in the model, would mean wanting the children as design partners to be involved in the role play of constructing it.

Taking the perspective of the model it could be predicted that children that were involved as design partners will be the ones that are most engaged by the system that is being developed. The literature has shown that participants of participatory design methods are the ones that most favour the system created for them. It is impossible and naive to suggest engaging all children in the world in the creation of an application. If that is the case, the question is, what about the ones not involved in the design?

The whole activity of children as co-partners of developing something is actually involving children in the constructing mode. From this research context it could be said that the fact that they could construct is what engages them. That is why children as designer partners look engaged in the project they are involved in. The trouble is they are the ones who have got that engagement but it will not necessarily transfer to the children outside. It is quite possible that what they are designing will only allow the outside children to be in a simulation mode. These other children will want the construct part of it too. The onlookers or actual users too want to be able to

change some of the elements in the system, so the designers must leave some tools in the system to enable the outside children or actual users to construct as well.

It could be argued that having children as participants in design is quite a big issue and their involvement has a lot to do with their ability to construct. The construct interactivity is very much like having children do their own design because it invites the children to participate in further development of these applications. Applying the engagement model to children who are design partners, we could anticipate that these children will be very engaged indeed during the course of the system's creation.

A better practise for designers using this design approach, however, would be, at the end of the development, to allow other users the same chance and opportunities as their design partners so as to make actual users feel they are also part of the creation team themselves. That is why in "The Sims" the availability of a chat room, a design archive and an option to upload ones design to an e-group are important. It has expanded its networking capabilities even further thus maintaining its popularity; it gives its users the pride and satisfaction of making a statement of his or her own creation either to themselves or to others.

It is useful to remember that, after all, the whole factor of being engaged is about fulfilling the inner desire of being fully satisfied which, in most cases, never seems to reach an ultimate end. We can never get to satisfy everybody and if we reach a level of satisfaction it is only for that instant in that situation. People are bound to move on to find another level of attainment and try to fulfil it. The problem will therefore be a never-ending problem. Designing systems to accommodate and support the ever-increasing aspirations of users is always going to be a challenge.

## BIBLIOGRAPHY

- Adams, C. and Kleiss, J. (2003) *An Overview of Ergosoft's Usability Testing Method* Ergosoft Laboratories, Inc. (1999 – 2003) p. 1- 3.
- Ahmed, N. a. K., Masood Mehmood (2000) "Building a Holistic, Anticipatory, Role-Playing Game Environment for Informal Teaching and Learning." *ACEC2000* Available at: <http://www.cegv.vic.edu.au/acec2000/> Accessed Date: 07 / 08 / 2002 Abstract.
- Ambron S. & Hooper K. (Eds.) (1988) *Interactive Multimedia*. Redmond, WA: Microsoft. In Sims, R. (1994) *Interactivity: A Forgotten Art?* ITForum Paper 10: Available at: <http://itech1.coe.uga.edu/itforum/paper10/paper10.html> Accessed Date: 15 / 10 / 2001.
- Amazon.co.uk (2004a) "PC & Video Games - The Sims 2 (Customers Review 1 – 34)." Available at <http://www.amazon.co.uk/>. Accessed Date: 07 / 03 / 2004.
- Amazon.co.uk (2004b) "PC & Video Games - The Sims: Delux Edition - The Sims & The Sims: Livin' It Up Add On (Customers Review 1 - 18)." Available at <http://www.amazon.co.uk/>: Accessed Date: 07 / 03 / 2004.
- Anderson et. al (2001) *Handbook of Industrial, Work and Organizational Psychology* London, Sage Publications.
- Anglin, G. J. (1987). "Effect of Pictures on Recall of written Prose: How Durable Are Picture Effects?" *ECTJ - Educational Communication and Technology: A Journal of Theory, Research and Development* (35) (1) p. 25 - 30.
- Annett, J. (1969). *Feedback and Human Behaviour*. London, Penguin Books.
- Arnheim,R.(1974). *Art and Visual Perceptions: Psychology of the Creative Eye*. California: University of California Press.
- Atkinson, P. (1990). *The Ethnographic Imagination* London: Routledge
- Baber, C. (1993). "Usability is Useless." *Interfaces* (22) p. 24-25.
- Baecker, R. M., Grudin, J. , Buxton, W.A.S. and Greenberg, S., Ed. (1995) *Human-Computer Interaction - Toward the Year 2000*. San Francisco, Morgan Kaufman.
- Bahaman, A., S., and Suandi, T. (1999) *Statistics for Social Research with Computer Application*. Kuala Lumpur, Universiti Putra Malaysia.

- Balasubramaniam, V. (1994) "State of the Art Review on Hypermedia Issues and Applications." Available at: <ftp.isg.sfu.ca/pub/duchier/HT.tar.gz>  
Accessed Date: 20 / 10 / 2000.
- Barfield, L. (1993) *The User Interface Concepts & Design*. Reading, Addison-Wesley.
- Barker, P. (1994) Designing Interactive Learning. In T.de Jong & L. Sarti (Eds.), Design and Production of Multimedia and Simulation-based Learning Material. Dordrecht: Kluwer Academic Publishers. In Sims, R. (1994) *Interactivity: A Forgotten Art?* ITForum Paper 10:  
Available at: <http://itech1.coe.uga.edu/itforum/paper10/paper10.html>  
Accessed Date: 15 / 10 / 2001.
- Barker, J. (2000) "An Investigation of Play Studies." *ACEC2000*:  
Available at: <http://www.cegv.vic.edu.au/acec2000/>  
Accessed Date: 07 / 08 / 2002. Abstract.
- Barnhart, T. (2002). *Conceptual Frameworks and models for Effective Delivery of Distance Education*. PhD Thesis, Loughborough University.
- Bates, A. W. (1984). *Broadcasting in Education - An Evaluation*. London, Constable.
- Batro, A. M. (1973). *Piaget: Dictionary of Terms*. Oxford, Pergamon Press.
- Bayard, C. (1988). *Interactive Video: Introduction and Handbook*. Great Britain, The National Interactive Video Centre.
- Bekker, M., et. al. (2003). "KidReporter: A User Requirements Gathering Technique for Designing with Children." *Interacting with Computers* (15) (2) p. 187-202.
- Bekker, M., and Markopoulos, P. (2002). "Designing and Evaluating Technologies for Children."  
Available at: <http://www.ip0.tue.nl/homepages/mbekker/childproject.htm>  
Accessed Date: 16 / 12 / 2002.
- Bell, J. (1993) *Doing Your Research*. Buckingham, Open University Press.
- Best, J. B. (1999). *Cognitive Psychology*. London, Wadsworth Publishing.
- Billinghurst, M., and Starner, T., (2000). "An Overview of the International Symposium on Wearable Computers 1998." *SIGCHI Bulletin* (32)(1).

- Blackwell, A. (1999). "Advanced Graphics & Human Computer Interaction (HCI)." *Human Computer Interaction Notes (2)*:  
 Available at: <http://www.cl.cam.ac.uk/Teaching/1999/AGraphHCI/HCI/> (1-37)  
 Accessed Date: 03 / 06 / 2001.
- Blattner, M.M. and Dannenberg, R.B. (1992) *Multimedia Interface Design* New York, ACM Press and Addison-Wesley in Barnhart (2002).
- Bopry, J. (1999). "The Warrant for Constructivist Practice Within Educational Technology." *Educational Technology Research and Development (ETR&D)* (47) (4) p. 5-26.
- Borchers, J. O. (2000). "CHI Meets PLoP: An Interaction Patterns Workshop." *SIGCHI Bulletin* (32) (1).
- Bourne, L. E., Dominowski, R.L. and Loftus, E.F. (1979). *Cognitive Processes*. New Jersey, Prentice Hall.
- Brouwer-Janse, M. D., et. al (1997). "User Interfaces for Young." *Interactions* (March -April) p. 35- 46.
- Bruno, F. J. (1986). *Dictionary of Keywords in Psychology*. London, Routledge.
- Bryman, Alan (Ed) (1988) *Doing Research in Organizations* London, Routledge
- Burn, A. (1998). "Pleasures of the Spectatorium: Young People, Classrooms and Horror Films (BL)." Available at <http://www.thesis.com/idx/049/it049000087.htm>  
 Accessed Date: 14 / 10 / 2003. Abstract.
- Button, G. (1991). *Ethno methodology and the Human Sciences*. Cambridge: Cambridge University Press.
- Butzgy, M. (1999). "Writing for Multimedia." Available at: [http://home.earthlink.net/~atomic\\_rom/intro.htm](http://home.earthlink.net/~atomic_rom/intro.htm)  
 Accessed Date: 16 / 10 / 2003.
- Carlsmith, J.M. et al (1976) *Methods of Research in Social Psychology*. London, Addison -Wesley.
- Calvert, S. L. (1999). *Children's Journey through the Information Age*. Boston, McGraw-Hill.
- Card, M., Newell (2003). "Theories - GOMS Model." Available at <http://tip.psychology.org/card.html>  
 Accessed Date: 20 / 06 / 2003.

- Carroll, J.M. (1995). *Scenario-Based Design*. New York, John Wiley & Sons.
- Carroll, J. (2003). "Theories - Minimalism."  
Available at <http://tip.psychology.org/carroll.html>  
Accessed Date: 20 / 06 / 2003.
- Cassell, J., et al. (2001). "The Conversational Humanoid - 3rd Generation." *Gesture & Narrative Language - A research group at the MIT Media Lab*:  
Available at: <http://www.media.mit.edu/gnl/projects/humanoids/index.html>  
Accessed Date: 06 / 09 / 2002.
- Cassell, J. (2001). "Beat - The Behaviour Expression Animation Toolkit."  
Available at: <http://www.media.mit.edu/groups/gn/projects/beat>  
Accessed Date: 06 / 09 / 2002.
- Cassell, J., et al. (2001). "Making Space 3 for Voice: Technologies to Support Children's Fantasy and Storytelling" *Personal and Ubiquitous Computing* (5) p. 169 – 190  
London, Springer –Verlag
- Catharine, F. (2001). *Designing for Children: marketing design that speaks to kids*.  
Gloucester, Mass, Rockport Publishers.
- Cawkell, T. (1996). *The Multimedia Handbook*. London, Routledge.
- Char, C.A. (1989) *Computer Graphic Feltboards*. New Software Approaches for Young Children's Mathematical Exploration. San Francisco, American Education Research Association 1989.
- Cianciolo, P. J. (1981). *Picture Books for Children*. United States of America, American Library Association.
- Clarke, A. M. (1992). "Human Factors Guidelines for Multimedia." *RACE project 1065 ISSUE, HUSAT Research Institute*: Loughborough, Loughborough University. In INUSE (European Usability Support Centres (1997) 2<sup>nd</sup>. Ed. (Version 2.1).
- Clements, D.H. and McMillen, S. (1996) "Rethinking 'Concrete' Manipulations"  
*Teaching Children Mathematic* (2) p. 270- 279.
- Cockburn, A., McKenzie, B., and JasonSmith, M. (2002). "Pushing Back: Evaluating A New Behaviour for the Back and Forward Buttons in Web Browsers."  
*International Journal of Human Computer Studies* (57) p. 397-414.

- Cockett, W. A. (1995). "Multimedia and the Curriculum (Towards A Cybernetic Department)." Available at <http://www.theses.com/idx/o45/it045003552.htm>:  
Accessed Date: 14 / 10 / 2003 Abstract.
- Cohen, L. and Manion, L. (1980). *Research Methods in Education. (1<sup>st</sup>. Ed.)* London: Croom Helm.
- Cohen, L. and Manion, L. (1989). *Research Methods in Education. (3<sup>rd</sup>. Ed.)* London: Croom Helm.
- Cole, M., O'Keefe, M., Siala, H. (2000). "From the User Interface to the Consumer Interface." *Information Systems Frontiers* 1(4):  
Available at: <http://www-sg.ebsco.com/direct.asp?>  
Accessed Date: 21 / 8 / 2000. Abstract.
- Collins, J., Hammond, M. and Wellington, J. (1997). *Teaching and Learning with Multimedia.* London, Routledge.
- Colman, A. (1982). *Game Theory and Experimental Games - The Study of Strategic Interaction.* Oxford, Pergamon Press.
- Colman, A. M., Ed. (1994). *Companion Encyclopaedia of Psychology.* London, Routledge.
- Computeruser.com (2003). "High-Tech Dictionary."  
Available at <http://computeruser.com/resources/dictionary/>:  
Accessed Date: 16 / 10 / 2003.
- Conway, J. (1997). "Educational Technology's Effect on Models of Instruction."  
Available at: <http://copland.udel.edu/~jconway/EDST666.htm>  
Accessed Date: 02 / 03 / 2001.
- Corsini, R. J. (1984). *Encyclopedia of Psychology.* Chichester, John Wiley & Sons.
- Cotton, J. (1995). *The Theory of Learning.* London, Kogan Page.
- Crano, W.D. and Brewer, M. B. (1973). *Principles of Research in Social Psychology.* London, McGraw-Hill.
- Crawford, C. (1990) Lessons from Computer Games Design. In B. Laurel (Ed.) *The Art of Human-Computer Interface Design.* Reading, MA: Addison-Wesley. In Sims, R. (1994) *Interactivity: A Forgotten Art?* ITForum Paper 10:  
Available at: <http://itech1.coe.uga.edu/itforum/paper10/paper10.html>  
Accessed Date: 15/10/ 2001.

- Creswell, J. W. (1994). *Research Design - Qualitative & Quantitative Approaches*. London, Sage Publication.
- CSCL (1998). "CSCL-A Brief Overview & Interesting Links for Further Study." Available at: [http://www.uib.no/People/sinia/CSCL/web\\_struktur-958.htm](http://www.uib.no/People/sinia/CSCL/web_struktur-958.htm)  
Accessed Date: 02 / 03 / 2001.
- Czikszentmihalyi, M. (1990) *Flow: The Psychology of Optimal Experience*. New York, Harper & Row Publishers in Heeter, C. (2000).
- Damarin (1982). Fitting the tool with the task: A problem with the instructional use of computers. Paper presented in the annual meeting of the American Educational Research Association, New York. In Sims, R. (1994) *Interactivity: A Forgotten Art?* ITForum Paper 10: Available at: <http://itech1.coe.uga.edu/itforum/paper10/paper10.html>  
Accessed Date: 15/10/ 2001.
- Daniel, L. G. (1997). "Kerlinger's Research Myths: An Overview With Implications for Educational Researchers." *The Journal of Experimental Education* (65) (2) p. 101-118.
- Davis, B. G. "Tools for Teaching - Motivating Students." Available at: <http://uga.berkeley.edu/sled/bgd/motivate.html>  
Accessed Date: 15 / 10 / 2001.
- Dehn, D. M. (2000). "The Impact of Animated Interface Agents: A Review of Empirical Research." *International Journal of Human-Computer Studies* (52) p. 1-22.
- Diaper, D. (2002). "Scenarios and Task Analysis." *Interacting with Computers* (14) (4) p. 379-395.
- Dickinson, D. (1995) Multimedia myths. *Australian Personal Computer* (16) (10) p. 144-145. In Sims, R. (1994) *Interactivity: A Forgotten Art?* ITForum Paper 10: Available at: <http://itech1.coe.uga.edu/itforum/paper10/paper10.html>  
Accessed Date: 15/10/ 2001.
- Dillon, A. (1994). *Designing Usable Electronic Text - Ergonomic Aspects of Human Information Usage*. London, Taylor & Francis.
- Divitini, M., Farsheian, B.A., and Tukka, Tuomo (2000). "Internet-based Groupware for User Participation in Product Development." *SIGCHI Bulletin* (32) (1).
- Dix, A., et. al. (1993). *Human Computer Interaction*. London, Prentice Hall.
- Dix, A. (2002). "Absolutely Crackers: Designing an Experience." *Interfaces* (50) p. 21.



- Dobroth, K., McInerney, P., and Smith, S. (2000). "Organizing Web Site Information: Principles and Practical Experience." *SIGCHI Bulletin* (32) (1).
- Doherty, A.(1998). "Towards a Classification of Internet Interactivity."  
Available at: <http://www.csis.ul.ie/ta-pg/andrewdoherty/interact.html>  
Accessed Date: 25 / 07 / 2002.
- Donker, A., & Markopoulos, P. (2001). *Assessing the Effectiveness of Usability Evaluation Methods for Children*. Paper presented at the PC-HCI2001, Patras, Greece. In In Bekker, M. M.et. al Proceedings of the international workshop 'Interaction Design and Children', August 28 -29, 2002, Eindhoven, The Netherlands.
- Dowling, M. (2001). "Abraham Maslow." *The Electronic Passport Homework to Abraham Maslow: Available at: <http://www.mrdowling.com/602-maslow.html>*  
Accessed Date 21 / 10 / 2003.
- Draper, S. W. (1999). "Analysing Fun as a Candidate Software Requirement."  
*Personal Technology* 3(1) p. 1-6. London, Springer-Verlag.
- Druin, A., and Solomon, C. (1996a). *Designing Multimedia Environments for Children*. Chichester, John Wiley & Sons.
- Druin, A. (1996b). "CHIKid Voices - It's Too Bad They Don't Let You Be A Kid."  
*Interactions* (September + October) p. 11 - 20.
- Druin, A., et al (1999). *The Design of Children's Technology*. San Francisco: Morgan Kaufman.
- Druin, A., Bederson, B., Boltman, A., Miura, A., Knotts-Callaghan, D., & Platt, M. (1999). *Children as our technology design partners*. In A. Druin (Ed.), *The Design of Children's technology* (pp. 51 - 72). San Francisco, CA: Morgan Kaufmann.
- Druin, A. ed. (2002). "Computers and Kids - Age Matters." *SIGCHI Bulletin* 5 (September / October 2002).
- Duffy, T.M. and Waller, R. (1985) *Designing Usable Texts*. London: Academic Press
- Eason, K. (1988). *Information Technology and Organisational Change*. London, Taylor & Francis.
- Eason, K. (1992). "The Development of A User-Centred Design Process - A Case Study in Multi-Disciplinary Research." *Inaugural Lecture: Loughborough University*.

- Eason, K. (2002). "Cognitive Aspects of Ergonomics: The Role of Psychology in Designing Artefacts for Effective Use by People." *Ken's lecture notes: Loughborough University*
- Elliott, G. J., Jones, E., and Barker, P., (2002). "A Grounded Theory Approach to Modelling Learnability of Hypermedia Authoring Tools." *Interacting with Computers* (14) (5).
- Ellis, P., and Ellis, Steve (2001). "Measuring User Experience."  
 Available at: <http://www.webtechniques.com/archives/2001/02/ellis/>  
 Accessed Date: 18 / 02 / 2002.
- Ellis, C., and Flanerty, M. G., Ed. (1992). *Investigating Subjectivity Research on Lived Experience*. London, Sage Publications.
- Emmott, S. J., Ed. (1995). *Information Superhighways - Multimedia Users and Futures*. London, Academic Press.
- England, E., and Finney, A. (1999). *Managing Multimedia- Project Management for Interactive Media*. England, Addison-Wesley.
- Esprit (1997). "Esprit Success Stories for the Information Society." *European Commission -Europe Towards the Global Information Society*.
- EUSC (1996). "Basic Characteristics of Users with Special Needs and their Telematics Requirements." *EC Telematics Applications Programme Information Engineering, European Usability Support Centres (EUSC) D6.1 (1) p. 1-40*.
- Eysenck, M. W., Ed. (1990). *The Blackwell Dictionary of Cognitive Psychology*. Oxford, Blackwell Reference.
- Fang, I., and Salvendy, G. (2000). "Keyword Comparison: A User-Centered Feature for Improving Web Search Tools." *International Journal of Human -Computer Studies* (52) p. 915 - 931.
- Foldoc (2003). "Free On-line Dictionary of Computing."  
 Available at: <http://www.nightflight.com/foldoc-bin/foldoc.cgi?>  
 Accessed Date: 16 / 10 / 2003.
- Forrest, J. F. and Shaw, D.F. (1994). "The 1994 Definition of Instructional Technology and Related Affection Resulting from the Adoption of Internet-Based Instruction." *1994 definition Forrest & Shaw:*  
 Available at: <http://frontpage.hypermall.com/jforrest/nova/it1994.htm>  
 Accessed Date: 20 / 10 / 2000.
- Frenel, K.A.(1998) *The Next Generation of Interactive Technologies Communications of the ACM* (32) (7) p. 872 - 881

- Fulano de T, J. (2000). "The Educational Theory of Abraham Maslow." 2000  
*New Foundations:*  
Available at: <http://www.newfoundations.com/GALLERY/Maslow.html>  
Accessed Date: 21 / 10 / 2003.
- Gagne,R.M., Briggs,L.S. and Wager, W.W. (1992) *Principles of Instructional Design 4<sup>th</sup> Edition* Forthworth, Harcourt Brace Jovanovich College.
- Gamble, N., and Easingwood, N., Ed. (2000). *ICT and Literacy - Information Communications Technology, Media, Reading and Writing*. London, Continuum.
- Game Rankings. (2004). "The Sims: Superstar -PC."  
Available at: <http://www.gamerankings.com/comments/51482,589629>  
Accessed Date: 03 / 03 / 2004.
- Gardner, H. (1984) *Frame of Mind: The Theory of Multiple Intelligences*. London, Heinemann.
- Gardner, H. (1993) *Multiple Intelligences: The Theory in Practice*. New York, Basic Books.
- Gates, Bill (1995) *The Road Ahead* England, Viking.
- Genesis Designs (2002) "Human Computer Interface."  
Available at: <http://www.geneshci.com/Theory.htm>  
Accessed Date: 03/ 06 / 2003.
- Georganas, N. (1997) "Multimedia Applications Development Experiences." *Multimedia Tools and Applications* 4(3), p. 313 – 332 in Barnhart , T. (2002).
- Gibson, J.J (1971). "The Information Available in Pictures." *Leonardo*, 4, 27-35
- Glaser, B.G, and Strauss, A.L.(1968). *The Discovery of Grounded Theory*. London: Weidenfeld and Nicolson.
- Gombrich, E.H (1969). "Art and Illusion." *A Study in the Psychology of Pictorial Representation*. New Jersey: Princeton University Press.
- Gonzalez, R. Cranitch, G. and Jo, Jun (2000) *Academic Directions of Multimedia Education* Communications of the ACM 43 (1) p. 89 – 95.
- Gould, J.D. and Lewis, C. (1985). *Designing for usability: Key Principles and what designers think*. Communications of the ACM , 28 p. 300-11. In Preece (1994).

- Green, K. C. (2002). *Forecasting Decisions in Conflict Situations: A Comparison of Game Theory, Role-Playing, and Unaided Judgement*. New Zealand, Victoria University of Wellington.
- Green, N., and Novick, D.(2000). "Natural Language in Computer Human-Interaction." *SIGCHI Bulletin* (32) (1).
- Green, W.S. and Jordon, R.A. (1999) *Human Factors in Product Design* London, Taylor & Francis.
- Greenfield, P. M. (1984). *Mind and Media*. Great Britain, Fontana.
- Greenfield, J., and Folger, R. (1988). *Controversial Issues in Social Research Methods*. London, Springer-Verlag.
- Gregory, R. I. (1978). *Eye and Brain*. 3rd. ed. New York, McGraw Hill.
- Hancock, S. (1998). *A Guide to Children's Reference Books and Multimedia Material*. Brookfield, Ashgate.
- Haber, R. N., Ed. (1966). *Current Research in Motivation*. London, Holt Rinehart and Winston.
- Haines, T. (1999). *Walking with Dinosaur*. London, BBC Worldwide 1999.
- Hanna, L., Risdén, K., Czerwinski, M., & Alexander, K., J. (1999). *The Role of Usability Research in Designing Children's Computer Products*. In A. Druin (Ed.), *The Design of Children's Technology* (pp. 4-26). San Francisco: Morgan Kaufmann.
- Hanna, L., Risdén, K., & Alexander, K., J. (1997). "Guidelines for usability testing with children." *Interactions*, 1997(5) p. 9-14.
- Harker, S. D. P. (2003). "Programme Module; 02HUP131 Human Factors in Information Technology." Available at: [http://coin.lboro.ac.uk/owa/w1002.module\\_spec?select\\_mod=02HUP131](http://coin.lboro.ac.uk/owa/w1002.module_spec?select_mod=02HUP131)  
Accessed Date: 29 / 01 / 2003.
- Harrison, A. F., and Bramson, R.M. (1982). *The Art of Thinking*. New York, Berkley Book.
- Harre, R., and Lamb, Roger, Ed. (1983). *The Encyclopaedic Dictionary of Psychology*. Oxford, Blackwell Reference.
- Hayes, S. a. (1988). *A Student's Dictionary of Psychology*. London, Elworld Arnold.

- Healey, P. G. T., et al. (2002). "Introduction: Interactive Graphical Communication." *International Journal of Human-Computer Studies* (57) p. 243-246.
- Hedberg, J. G., Harper, Barry. and Brown, Christine (1993). "Reducing Cognitive Load in Multimedia Navigation." *Australian Journal of Educational Technology* 9(2) p. 157-181  
Available at: <http://cleo.murdoch.edu.au/gen/aset/ajet9/su93p157.html>.  
Accessed Date: 25 / 06 / 01.
- Heeter, C. (2000). "Interactivity in the Context of Designed Experiences." *Journal of Interactive Advertising* 1(1): 1-19 Available at: <http://jiad.org/vol1/no1/heeter>  
Accessed Date: 15 / 10 / 2001.
- Hendrix, C. and Jones, R. A. (1972) *The Nature of Theory and Research in Social Psychology*. London, Academic Press.
- Hills, P. (Ed.) (1980) *The Future of the Printed Word*. London, Frances Printer.
- Hix, D., and Harrison, H.R. (1993). *Developing User Interfaces: Ensuring Usability Through Product and Process*. New York, John Wiley.
- Hix, D. and Schulman, R. (1991) *Human-Computer Interface Development Tools* Communications of the ACM. (34) (3) p. 75 – 87.
- Hourcade, J. P., et al. (2003). "The International Children's Digital Library: viewing digital books online." *Interacting with Computers* 15 (2) p. 151 -167.
- Hoysniemi, J., Hamalainen, P. Turkki, L. (2003). "Using Peer Tutoring in Evaluating the Usability of A Physically Interactive Computer Game with Children." *Interacting with Computers* 15 (2) p. 203 - 225.
- Hughes, B. (2000) *Dust or Magic: Secrets of Successful Multimedia Design*. London, Addison - Wesley.
- Isakowitz, T. , Stohr, E.A. and Balasubramaniam, P. (1995) *RMM: A Methodology for Structured Hypermedia Design* Communications of the ACM (38) (8) p. 34 – 81  
IBM (2003). "Design Basics."  
Available at: [http://www-3.ibm.com/ibm/easy/eou\\_ext.nsf/Publish/6](http://www-3.ibm.com/ibm/easy/eou_ext.nsf/Publish/6)  
Accessed Date: 21 / 10 / 2003.
- INUSE (European Usability Support Centres) (1997) *Design Guide for Multimedia* July (2<sup>nd</sup> Ed) Version 2.1
- INUSE (2000). "Handbook of User-Centred Design."  
Available at: <http://www.usability.serco.com/trump/ucdstart/overview.html>  
Accessed Date: 20 / 10 / 2000.

Inglis, F. (1990). *Media Theory*. Cambridge, Basil Blackwell.

ISO 13407 (1997) "User-Centred Requirements Handbook"

Available at: <http://www.usability.serco.com/trump/ucdstart/overview.html>

Accessed Date: 06 / 04 / 2001.

ISO 14915. "Multimedia User Interface Design – Ergonomics requirements for human computer interfaces." *Design Principles and framework*. (International Standard Unpublished Draft in Barnhart (2002).

ISO 9241 (1997) "Standards: User Interface Standards in the ISO Ergonomics Technical Committee."

Available at: <http://www.acm.org/sigchi/bulletin/1997.1/standards.html>

Accessed Date: 10 / 06 / 2002.

Iversen, O., S. ("002) *Designing with Children : The Video Camera as an Instrument of Provocation* Interaction Design and Children August 28-29, 2002. Eindhoven.

Jonassen, D. (Ed.) (1998). Instructional Designs for Microcomputer Courseware. Hillsdale, NJ, Lawrence Erlbaum. In Sims, R. (1994) *Interactivity: A Forgotten Art?* ITForum Paper 10:

Available at: <http://itech1.coe.uga.edu/itforum/paper10/paper10.html>

Accessed Date: 15/10/ 2001.

Jankowski, N. W., Hanssen, L., Ed. (1996). *The Contours of Multimedia – Recent Technological, Theoretical and Empirical Developments*. Luton, John Libbey Media.

Jones, S. (2003). *Encyclopaedia of New Media*. London, Sage Publications.

Jordan, P. W. (1998). *An Introduction to Usability*. London, Taylor & Francis.

Jordan, P. W. (2000). *Designing Pleasurable Products*. London, Taylor & Francis.

Jung, C. G. (1971). *Psychological Types*. Princeton, Princeton University Press.

Kerawalla, C. (2002). *Children's Use of Home Computers from A Cultural Psychological Perspective*. Loughborough, PhD Thesis Loughborough University.

Keogh, T., Barnes, P., Joiner, R., et. al (2000). "Gender, Pair Composition and Computer Versus Paper Presentation of An English Language Task." *Educational Psychology* 20(1): Available at: <http://www-sg.ebsco.com/online/direct.asp?>  
Accessed Date: 21 / 8 / 2000 Abstract.

- Kim-Phuong, L., et al (2000). "Metacognitive Processes in Human-Computer Interaction: Self-Assessments of Knowledge as Predictors of Computer Expertise." *International Journal of Human Computer Interaction* 12(1): Available at: <http://www-sg.ebsco.com/direct.asp?> Accessed Date: 21 / 8 / 2000.
- King, P. and Tester, J. (1999) *The Landscape of Persuasive Technologies* Communications of the ACM. (42) (5) p. 31 – 38.
- Kirwan, B. and Ainsworth, L.K. eds. (1992) *A Guide to Task Analysis* London: Taylor & Francis
- Klein, J., Moon, Y., and Picard, R. W., (2002). "This Computer Responds to User Frustrations: Theory, Design and Results." *Interacting with Computers* 14 (2) p. 119-140.
- Knaellopoulos, P. A. (2000). "A Study of Children's Understandings of their Musical Improvisations (BL)." Available at <http://www.thesis.com/idx/050/it050012782.htm>: Accessed Date: 14 / 10 / 2003 Abstract.
- Kostomaj, M. (2002). "Is A Lot of Interactivity Necessarily A Lot of Fun? What Makes an Interactive Story System Fun for Children?" *Interfaces* (50) p. 21.
- Kvale, S. (1996). *Interviews*. London, Sage Publications.
- Lafreniere, D. (1996). "CUTA ( Collaborative User's Task Analysis ) : A Simple Practical, Low-Cost Approach to Task Analysis." *Interactions* (September + October) p. 35 - 39.
- Laguna, K. D., Babcock, R. L. (2000). "Computer Testing of Memory Across the Adult Life Span." *Experimental Aging Research* 26(3): Available at: <http://www-sg.ebsco.com/online/direct.asp?> Accessed Date: 21 / 8 / 2000. Abstract.
- Lai, J., et al (2002). "BlueSpace: Personalizing Workspace Through Awareness and Adaptability." *International Journal of Human Computer Studies* (57) p. 415-428.
- Larson, G. O., Montgomery, K. , and Nikoomanesh, Y. (1999). "Ensuring A Quality Media Culture for Children in the Digital Age." *Center for Media Education (CME)*.
- Lawler, R. W. (1985). *Computer Experience and Cognitive Development : A Child's Learning in A Computer Culture*. Chichester, Ellis Horwood.

- Lee, S-Y. (2001). *Emotional Responses to Web-based Interactive Storytelling*. Information Systems Division of the International Communication Association for the 2002 Conference, Extended Abstract.
- Lewin, K. (1952). *Field Theory in Social Science*. London, Tavistock Publications.
- LeBlanc, P. J. "Social Constructivist Theory and the Design of Writing Software: The Race Between Theory and Technology."  
 Available at: [http://www-csc195.indiana.edu/csc195/outlook/53\\_LeBlanc.html](http://www-csc195.indiana.edu/csc195/outlook/53_LeBlanc.html)  
 Accessed Date: 11 / 01 / 02.
- Levenson, H. (1974). "Activitism and Powerful Others: Distinctions Within the Concept of Internal-External Control." *Journal of Personality Assessment*. p. 377-383.
- Lindzey, G. and Aronson, E. (1968) *The Handbook of Social Psychology*. Vol. 2 (2<sup>nd</sup> Ed) London, Addison – Wesley
- Littleton, K., and Light, P., Ed. (1999). *Learning with Computers: Analysing Productive Interactions*. London, Routledge.
- Liu, Y. (2001). *Interactivity and Its Measurements - Upcoming at Experiential E-Commerce Conference*, East Lansing, Michigan, Rutgers University.
- Livingston, S. and Bovill, M. (1999) *Young People New Media*. London, Research Report Children, Young People and the Changing Environments.
- Lopuck, L. (1996). *Designing Multimedia*. USA, Peachpit Press.
- Lynn, N., Ed. (2003). *Encyclopaedia of Cognitive Science*. London, Nature Publishing Group.
- Macaulay, D. (1997). *The New Way Things Work*. England, Dorling Kindersley.
- MacPherson, K. (2000). "Children Help Scientists, Engineers Design the Toys of Tomorrow."  
 Available at: <http://www.post-gazette.com/magazine/20000620toys3.asp>  
 Accessed Date: 09 / 11 / 2000.
- Maguire, M. C. (1998). "User-Centred Requirements Handbook." (1-4)  
 Available at: <http://www.nectar.org/respect/5.3/index.htm>  
 Accessed Date: 13 / 4 / 2000.



- Mahmood, M. A. (2000). "Variables Affecting Information Technology End-User Satisfaction: A Meta-Analysis of the Empirical Literature." *International Journal of Human -Computer Studies* (52) p. 751-771.
- Malone, T. W., and Lepper, Mark R. (1987). *Making Learning Fun*. In: Aptitude, Learning and Instruction, NJ, Hillsdale.
- Mandel, T. (1997). *The Elements of User Interface Design*. Chichester, John Wiley & Sons.
- Marinilli, M. (2003). "The Theory Behind User Interface Design, Part One." Jupitermedia Corporation.  
Available at: [http://www.developer.com/design/article.php/10925\\_1545991\\_2](http://www.developer.com/design/article.php/10925_1545991_2)  
Accessed Date: 03 / 06 / 2003.
- Markopoulos, P., and Bekker, Mathilde., (2003). "Interaction Design and Children – Editorial." *Interacting with Computers*. (15) (2) p. 141-149.
- Markopoulos, P., and Bekker, Mathilde., (2003). "On the Assessment of Usability Testing Methods for Children." *Interacting with Computers* (15) (2) p. 227-243.
- Marr, D. (1982) *Vision: A Computational Investigation into the Human Representation and Processing of Visual Information*. San Francisco, W.H. Freeman.
- Marshall, C. and Rossman, G. (1995) *Designing Qualitative Research* 2nd Ed. London, Sage.
- Maslow, A. H. (1968). *Toward a Psychology of Being*. New York, Van Nostrand Reinhold.
- Maslow, A. H. (1987). *Motivation and Personality* (3rd Ed.) New York, Harper & Row.
- Maternaghan, M. (1993). "The Trouble with HCI." *Interfaces* (22) p. 7.
- Maynard, Sally (2001). *Books with Pictures and Conversations? : a study of electronic books for children and their readers* . PhD Thesis, Loughborough University.
- McCarthy, J. (2002). "The Enchantments of Technology." *Interfaces* (50) p. 22.
- McCormick, E. J., and Ilgen, Daniel (1985). *Industrial and Organizational Psychology*. New Jersey, Englewood Cliffs.
- McInerney, P. and Sobiesiak, R. (2000). "The UI Design Process - Planning, Managing, and Documenting UI Design Work." *SIGCHI Bulletin* (32) (1).

- McKnight, C., et al (1991). *Hypertext in Context*. Cambridge, Cambridge University Press.
- McKnight, C., Dillion, A. and Richardson, J., Ed. (1993). *Hypertext - A Psychological Perspective*. London, Ellis Horwood.
- McLuhan, M. (1964). *Understanding Media - The Extension of Man*. New York, McGraw-Hill.
- McLuhan (1994) in Jones, S. (2003). *Encyclopaedia of New Media*. London, Sage Publications.
- Meek, M., et al (1977). *The Cool Web: The Pattern of Children's Reading*. London, The Bodley Head.
- Miles, G. M., Howes, A. (2000). "A Framework for Understanding Human Factors in Web-Based Electronic Commerce." *International Journal of Human -Computer Studies* (52) p.131-163.
- Miller (1961) in Haber, R. N., Ed. (1966). *Current Research in Motivation*. London, Holt Rinehart and Winston.
- Milligan, C., and Mudock, Max., (1996). "Testing with Kids & Teens at IOMEGA." *Interactions* (September + October). p. 51 - 57.
- Monk, A., et. al., (2002). "Funology: Desiging Enjoyment." *SIGCHI Bulletin* (September / October 2002).
- Moss, C. (2002). Working the web: e-learning. *The Guardian*. London.
- Mowlana, H. (1985). "International Flow of Information: A Global Report and Analysis." *UNESCO 99*.
- Murphy, C. M., and Wood, D.J. (1981). "Learning from Pictures: the Use of Pictorial Information by Young Children." *Journal of Experimental Child Psychology*. (32) p. 279-297.
- Murray, R. (2002). *How to Write a Thesis*. Buckingham, Open University Press.
- Narayan, N. H., Hegarty, M. (2002). "Multimedia Design for Communication of Dynamic Information." *International Journal of Human -Computer Studies* (57) p. 279-315.
- Neuman, W. L. (2000). *Social Research Methods - Qualitative and Quantitative Approaches*. London, Allyn and Bacon.

- Nectar (2000). "User-Centred Requirements Handbook."  
Available at: <http://www.nectar.org/respect/5.3/a.htm>  
Accessed Date: 13 / 04 / 2000.
- Nelson, T.H. (1990). The right way to think about software design. In B. Laurel (Ed.), *The Art of Human Computer Interface Design*: Reading, MS, Addison-Wesley  
In Sims, R. (1994) *Interactivity: A Forgotten Art?* ITForum Paper 10:  
Available at: <http://itech1.coe.uga.edu/itforum/paper10/paper10.html>  
Accessed Date: 15/10/ 2001
- Newell, A., Simon, H. (2003). "General Problem Solver (GPS)."  
Available at <http://tip.psychology.org/simon.html>:  
Accessed Date: 20 / 06 / 2003.
- Newell, A., et al (2003). "Soar."  
Available at: <http://tip.psychology.org/newell.html>:  
Accessed Date: 20 / 06 / 2003.
- Nielsen, J. (1998). "Electronic Books - A Bad Idea."  
Available at: [useit.com](http://useit.com) Accessed Date: 07 / 12 / 2002.
- Nielsen, J. (1998). "The Web Usage Paradox: Why Do People Use Something This Bad?" Available at: [useit.com](http://useit.com) Accessed Date: 07 / 12 / 2002.
- Nielsen, J. (2002). "Kid's Corner: Website Usability for Children."  
Available at: [useit.com](http://useit.com) Accessed Date: 20 / 07 / 2002.
- Nielsen Norman Group (2001-2002) [CD-ROM] *Usability of Websites for Children*.  
Available at: <http://www.ngroup.com/reports>.
- Nilsson, R. M., and Mayer, R. (2002). "The Effects of Graphical Organizers Giving Cues to the Structure of A Hypertext Document on User's Navigation Strategies and Performance." *International Journal of Human Computer Studies* (57) p. 1-26.
- Norman, D. A. (1988). *The Psychology of Everyday Things*. New York, Basic Books.
- Norman, D.A. (1993). *Things That Make Us Smart: defending human attributes in the age of the machine* New York, Addison- Wesley.
- Norman, D. A. (1988) in Baecker et. al (1995) *Human-Computer Interaction – Toward the Year 2000*. San Francisco, Morgan Kaufman.
- Novick, D. G., and Scholtz, J. C., (2002). "Universal Usability." *Interacting with Computers* 14 (4) p. 269-270.

- Noyes, J. (2001). *Designing for Humans*. New York, Taylor & Francis.
- Nunberg, G. ed. (1996). *The Future of the Book*. California, University of California Press.
- Oakhill, J., Garnham, A., Ed. (1996). *Mental Models in Cognitive Science*. Essex, Erlbaum (UK) Taylor & Francis.
- Oliver, R. L., and Burke, R.R. (1999). "Expectation Processes in Satisfaction Formation." *Journal of Service Research*. (1)(3).
- Oosterholt, R., Kusano, Mieko, Vries, Govert de (1996). "Interaction Design and Human Factors Support in the Development of A Personal Communicator for Children." *CHI 96*. Vancouver, Canada, ACM.
- Page, E. (2003). "Editorial Page." *Behaviour & Information Technology*. (22)(3).
- Papert, S. (1980). *Mindstorms: Children, Computers, and Powerful Ideas*. New York, Basic Books.
- Perkins, R., Keller, D.S., and Ludolph, F. (1997). "Inventing the User Interface." *Interactions*. (January – February) p. 41-53.
- Perry, C. (2000). "Presenting a Thesis."  
Available at: <http://www.geocities.com/phdtheses/phdform.htm>  
Accessed Date: 29 / 03 / 2002.
- Pettifor, E. (1996). "Self Actualization redefined in terms of frequency of peak experiences." *Redefinition of Self-Actualization*:  
Available at: <http://www.wjna.com/personlity/sadef.html>  
Accessed Date: 21 / 10 / 2003.
- Pheasant, S. (1986). *Bodyspace - Anthropometry, Ergonomics and Design*. London, Taylor & Francis.
- Picard, R. W., and Klein, J. (2002). "Computers that recognise and respond to user emotion: theoretical and practical implications." *Interacting with Computers* (14) (2) p. 141-169.
- Picking, R. (1996). *The Potential for Hypermedia to Support Educational Practice in A College of Music*. Loughborough University, PhD Thesis.
- Pinsent, P., Ed. (1993). *The Power of the Page*. London, David Fulton Publishers.
- Porta, M. (2002). "Vision-based User Interfaces: Methods and Application." *International Journal of Human Computer Studies* (57) p. 27-73.

- Preece, J. (1994). *Human-Computer Interaction*. England, Addison-Wesley.
- Preece, J. (2003). "Task Analysis."  
 Available at: <http://www.uwasa.fi/~mj/hci/hci7.html>:  
 Accessed Date: 20 / 06 / 2003.
- Preece (2002) *Interaction Design: Beyond Human-Computer Interaction*.  
 New York, John Wiley & Sons.
- Press, Larry (1995) *McLuhan Meets the Net* Communications of the ACM (38) (7)  
 p. 15 - 20
- Price, S., et. al., (2003). "Using 'Tangibles' to Promote Novel Forms of Playful Learning."  
*Interacting with Computers* (15) (2) p. 169 - 185.
- Punch, K. F. (1998). *Introduction to Social Research*. London, Sage Publication.
- Ravden, S. and Johnson, G. ((1989) *Evaluating Usability of Human-Computer Interfaces*. Chichester, Ellis Horwood.
- Read, J.C. & MacFarlane, S.J. (2000) *Measuring Fun* Computers and Fun 3 , York, England. In Read, J.C., & MacFarlane, S. J. (2002a).
- Read, J.C. & MacFarlane, S.J. & Casey, C. (2001a) *Expectations and Endurability – Measuring Fun*. Computers and Fun 4 York, England in Read (2002a)
- Read, J.C. & MacFarlane, S.J. & Casey, C. (2001a) *Measuring the Usability of Text Input Methods for Children*. HCI 2001, Lille France in Read (2002a)
- Read, J. C., & MacFarlane, S. J. (2002a). *Endurability, Engagement and Expectations: Measuring Children's Fun*. In Bekker, M. M.et. al Proceedings of the international workshop 'Interaction Design and Children', August 28 –29, 2002, Eindhoven, The Netherlands.
- Read, J. C. et. al (2002b) *An Investigation of Participatory Design with Children – Informant, Balanced and Facilitated Design*. In Bekker, M. M.et. al Proceedings of the international workshop 'Interaction Design and Children', August 28 –29, 2002, Eindhoven, The Netherlands.
- Resnick, M., , Bruckman, Amy., and Martin, Fred., (1996). "Pianos not Stereos – Creating Computational Construction Kits." *Interactions* (September + October) p. 41- 50.

- Rhodes, D.M., & Azbell, J. W. (1985). Designing Interactive Video Instruction Professionally. *Training and Development Journal*, 39 (12), 31-33 In Sims, R. (1994) *Interactivity: A Forgotten Art? ITForum Paper 10*:  
Available at: <http://itech1.coe.uga.edu/itforum/paper10/paper10.html>  
 Accessed Date: 15/10/ 2001.
- Rierber, R. W. (1999). *The Collected Works of L.S. Vygotsky -Volume 5 (Child Psychology)*. London, Kluwer Academic.
- Risden, K., Hanna, E., & Kanerva, A. (1997) *Dimensions of Intrinsic Motivation in Children's Favourite Activities*. Society Research in Child Development. Washington DC. In Read, J. C., & MacFarlane, S. J. (2002a).
- Robson, J. (2000). "Evaluating On-line Teaching." *Open Learning* 15 (2):  
Available at: <http://www-sg.ebsco.com/online/direct.asp?>  
 Accessed Date: 21 / 8 / 2000 Abstract.
- Rothgab, C. L., Ed. (1973). *Abstracts of the Standard Edition of the Complete Psychological Work of Sigmund Freud*. New York, Jason Aronson.
- Rutkowska, J. C., and Crook, C. (1987). *Computers, Cognition and Development: Issues for Psychology and Education*. Chichester, Wiley.
- Ryder, M. (2001). "Constructivism."  
Available at: [http://carbon.cudenver.edu/~mryder/itc\\_data/constructivisim.htm](http://carbon.cudenver.edu/~mryder/itc_data/constructivisim.htm)  
 Accessed Date: 02 / 03 / 2001.
- Sadoski, M., Goetz, E. T. and Fritz, J. B. (1993). "Impact of Concreteness on Comprehensibility, Interest, and memory for Text: Implications for Dual Coding Theory and Text Design." *Journal of Educational Psychology* 85(2) p. 291-304.
- Said, N. S. (1995). *The Use of Illustrations in Children's Information Books*. Master Dissertation, University of Wales, Aberystwyth.
- Said, N. S. (2004). *An Engaging Multimedia Design Model (Doctoral Consortium)*. Interaction Design and Children (IDC 2004 ) June 1-3, University of Maryland, USA, New York, ACM.
- Scaife, M., and Rogers, Y. (1998). *Kids as Informants: Telling Us What We Didn't Know or Confirming What We Knew Already?* In A. Druin (ed.) *The Design of Children's Technology: How We Design, What We Design, And Why*. Morgan Kaufman (in press).
- Scala (2003). "Scala, Inc. - Multimedia Directory."  
Available at <http://www.scala.com/multimedia/multimedia-definition.html>:  
 Accessed Date: 16 / 10 / 2003.

- Schank, R. C. (1993) "Learning Via Multimedia Computers" *Communications of the ACM* (36) (3)
- Scheirer, J., et. al., (2002). "Frustrating the User on Purpose: A Step toward Building An Affective Computer." *Interacting with Computers* 14 (2): 93-118.
- Schneider, K., G., (1996). "Children and Information Visualization Technologies." *Interactions* (September + October): 68-73.
- Schwier, R.A. & Misanchuk, E.(1993) Interactive Multimedia Instruction. Englewood Cliffs, NJ, Educational Technology Publications. In Sims, R. (1994) *Interactivity: A Forgotten Art?* ITForum Paper 10:  
 Available at: <http://itech1.coe.uga.edu/itforum/paper10/paper10.html>  
 Accessed Date: 15/10/ 2001
- Screven (1999) "Information Design in Informal Settings: Museums and other public settings" in Information Design, Robert Jaconson, ed. , Cambridge, The MIT Press, p. 131 – 192. In Heeter, C. (2000). "Interactivity in the Context of Designed Experiences." *Journal of Interactive Advertising* 1(1): 1-19  
 Available at: <http://jiad.org/vol1/no1/heeter>  
 Accessed Date: 15 / 10 / 2001.
- Selvidge and Phillips (2000) *E-Books: Are We Going Paperless?*  
 Available at: <http://psychology.wichita.edu/surl/usabilitynews/3W/ebook.htm>  
 Accessed Date: 03 / 06 / 2003
- Shepherd, A. (2001). *Hierarchical Task Analysis*. London, Taypor & Francis.
- Shneiderman, B. (1987). *Designing the User Interface: Strategies for Effective Human-Computer Interaction*. Reading, Addison-Wesley.
- Shneiderman, B. (1987) in Preece, J. (1994). *Human-Computer Interaction*. England, Addison-Wesley.
- Sims, R. (1994) a "Seven Levels of Interactivity: Implications for the Development of Multimedia Education and Training."  
 Available at: <http://ftp.qut.edu.au/pub/papers/apitite/alltext/sims2.txt>  
 Accessed Date: 16 / 12 / 2002. p.14
- Sims, R. (1994) b *Interactivity: A Forgotten Art?* ITForum Paper 10:  
 Available at: <http://itech1.coe.uga.edu/itforum/paper10/paper10.html>  
 Accessed Date: 15/10/ 2001
- Sims, R. (1997). "Interactivity: A Forgotten Art?" *Instructional Technology Research Online*: Available at: <http://intro.base.org/docs/interact/>  
 Accessed Date: 25 / 09 / 2001.

- Sims, R. (1999). "Interactivity and Narrative: Strategies for Effective Learning." *Educational Multimedia, Hypermedia and Telecommunications - 11th World Conference 1999*: 703 - 708.
- Sims, R. (2000). "An Interactive Conundrum: Construct of Interactivity and Learning Theory." *Australian Journal of Educational Technology* 16(1): 45 - 57.
- Skaalid, B. (1999). "Human-Computer Interface Design."  
Available at: <http://www.atl.ualberta.ca/bonnie/theory/interface.htm>  
Accessed Date: 21 / 10 / 2003.
- Slater, M., Sadagic, A., Usoh, M., Schroeder, R. (2000). "Small-Group Behaviour in A Virtual and Real Environment: A Comparative Study." 9 (1):  
Available at: <http://www-sg.ebsco.com/online/direct.asp?>  
Accessed Date: 21 / 8 / 2000 Abstract.
- Smith, D. C., Cypher, Allen., Schmucker, Kurt., (1996). "Making Programming Easier for Children." *Interactions* (September + October): 59-67.
- Smith, P. K., Cowie, H. and Blades, M. (1998). *Understanding Children's Development*. Oxford, Blackwell.
- Squires, D., and Preece, J. (1996). "Usability and Learning: Evaluating the Potential of Educational Software." *Computers Educ.* 27 (1): 15 - 22.
- Stallman, R. (2001) *Why Software Should Not Have Owners* The Public Domain, Sarai Reader. P. 175 – 227
- Stanton, N. (1998). *Human Factors in Consumer Products*. London, Taylor & Francis
- Stein, J. (1999) "Designing User Satisfaction Surveys for Interlibrary Loan Services" *Performance Measurement and Metrics* Vol. 1 (1)  
Available at: <http://www.aslib.co.uk>
- Stevens, G. (1983). "User-friendly Computer Systems? : A Critical Examination of the Concept." *Behaviour and Information Technology* 2(1): 3-16.
- Stienstra, M. (2002). "Tangible Interaction Tools as A Means to Create A Fun Experience." *Interfaces* 50: 20-21.
- Straker, A. (1989). *Children Using Computers*. Oxford, Blackwell Education.
- Strauss, A. and Corbin, J. (eds.) (1997). *Grounded Theory in Practice*. London: Sage.



- Suchman, L.A. (1987). *Plans and situated Actions*. Cambridge, Cambridge University Press
- Sutcliffe, A. G. (1995). *Human Computer Interface Design*. London, Macmillan Press.
- Tallyn, M. E. (2000). "Applying Narrative Theory to the Design of Digital Interactive Narratives with the Aim of Understanding and Enhancing Participant Engagement (BL)."  
 Available at: <http://www.thesis.com/idx/050/it050011967.htm>:  
 Accessed Date: 14 / 10 / 2003 Abstract.
- Tannenbaum, R. (2001). "Learner Interactivity and Production Complexity in Computer-Based Instructional Materials." *ACM IT Magazine and Forum*:  
 Available at: [http://www.acm.org/ubiquity/views/r\\_tannenbaum\\_4.html](http://www.acm.org/ubiquity/views/r_tannenbaum_4.html)  
 Accessed Date: 08 / 01 / 2002.
- Task Card Overview. (2001). "Developing Higher Order Thinking Skills and Multiple Intelligences - Gardner's View of Intelligence."  
 Available at: <http://www.metronet.com/~bhorizon/teach.htm>  
 Accessed Date: 02 / 03 / 2001
- The Publishers Association. (1981). "Electronic Publishing - An Introductory Guide."
- The Sims Online Review. (2003). "The Sims Online Review."  
 Available at: <http://www.firingsquad.com>  
 Accessed Date: 03 / 03 / 2004.
- Thomas, B. H., and Demezuk, V., (2002). "Which Animation Effects Improve Indirect Manipulation?" *Interacting with Computers* 14(3): 211-229.
- Thong, J. Y. L. (2002). "Understanding User Acceptance of Digital Libraries: What are the roles of interface characteristics, organisational context, and individual differences." *International Journal of Human Computer Studies* 57: 215-242.
- Tom, S. (1985). *The Three Cs: Children, Computers and Communication*. Chichester, Wiley.
- Toms, E. (2000). "Understanding and Facilitating the Browsing of Electronic Text." *International Journal of Human -Computer Studies* 52: 423-452.
- Tsang, Y. M. (1991). *Textbook Design - A Study of Key Factors in Educational Text Design*. Master Dissertation, University of Wales, Aberystwyth.

- Tucker, R. N., Ed. (1989). *Interactive Media - The Human Issues*. London, Kogan Page.
- Tuorto, M., Langdon, J., and Torquato, M. (2001). "Curriculum and Instructional Design - Unit 2."  
Available at: <http://www.sinc.sunysb.edu/Class/est565/Unit2/sld001.htm>  
Accessed Date: 08 /01 / 2002.
- Tyfa, D. A. a. H., M. (2000). "Speech Recognition for Command Entry in Multimodal Interaction." *International Journal of Human Computer Studies* 52: 637-667.
- Tversky, B. a. M., J. B. (2002). "Animation: Can It Facilitate?" *International Journal of Human -Computer Studies* 57: 247-262.
- Underwood, J. D. M., and Underwood G. (1990). *Computers and Learning - Helping Children Acquire Thinking Skills*. Oxford, Basil Blackwell.
- Vaucelle, C. (2001). "Sam: An embodied Conversational Storyteller for Children." *TOT Talk- October 1999*:  
Available at: <http://www.media.mit.edu/groups/gn/projects/castlemate/>  
Accessed Date: 06 / 09 / 2002.
- Vaucelle, C., and Tristan, J. (2002). "Dolltalk: A Computational Toy to Enhance Children's Creativity."  
Available at: <http://web.media.mit.edu/~cati/dolltalk.html>  
Accessed Date: 06 / 09 / 2002.
- Venkatesh, Y. (2000). "Creating an Effective Training Environment for Enhancing Telework." *International Journal of Human-Computer Studies* 52: 991-1005.
- Wace, G. (1986). " Interactive Video." *Council for Educational Technology* (1).
- Waller, R. (1987). "The Design of Print Media." *Communication and Education* (23): 4-9.
- Walker, S. R., L. (2000). "Screen Design for Children's Reading: Some Key Issues." *Journal of Research in Reading* 23(2):  
Available at: <http://www-sg.ebsco.com/online/direct.asp?>  
Accessed Date: 21 / 8 / 2000 Abstract.
- Wartella, E. et al (2000). *Children and Interactive Media*. Compendium: Markle Foundation

- Webopedia.com (2003). "Multimedia."  
Available at <http://www.webopedia.com/TERM/m/multimedia.html>:  
Accessed Date: 16 / 10 / 2003.
- Webnox, C. (2003). "Hyperdictionary."  
Available at <http://www.hyperdictionary.com/dictionary/>:  
Accessed Date: 16 / 10 / 2003.
- Webster, J. and Ho, H. (1997) *Audience Engagement in Multimedia Presentations The Data Base for advances in Information Systems – Spring 1997* (28) (2)
- Westernik, J., Majoor, B., Rama, M. (2000). "Interacting with Infotainment Applications: Navigation Patterns and Mental Models." *Behaviour & Information Technology* 19(2): Available at: <http://www-sg.ebsco.com/online/direct.asp?>  
Accessed Date: 21 / 8 / 2000 Abstract.
- White, R. (1995). "When It Comes to Children's Play, Simplify, Simply, Simplify." *White Hutchinson Entertainment Group* 25 (2).
- White, R. (1996). "Children's Edutainment Centers: Learning Through Play." *White Hutchinson Leisure & Learning Group*:  
Available at: <http://www.whitehutchinson.com/leisure/articles/76.shtml>  
Accessed Date: 03 / 03 / 2004.
- White, R. (2000). "Child's Play: More Complicated than It Looks." *White Hutchinson Leisure & Learning Group*:  
Available at: <http://www.whitehutchinson.com/leisure/articles/102.htm>  
Accessed Date: 03 / 03 / 2004.
- White, R. (2001). "A Spoonful of Sugar Makes an existing LBL(location-based leisure) a Smart Destination." *White Hutchinson Leisure & Learning Group*:  
Available at: <http://www.whitehutchinson.com/leisure/articles/65.shtml>  
Accessed Date: 03 / 03 / 2004.
- White, R. (2003). "That's Edutainment." *White Hutchinson Leisure & Learning Group*:  
Available at: <http://www.whitehutchinson.com/leisure/articles/edutainment.shtml>  
Accessed Date: 03 / 03 / 2004.
- Whitworth, B., and Moor, Aldo De (2003). "Legitimate by Design: Towards Trusted Socio-technical Systems." *Behaviour & Information Technology* 22 (1): 31-51.
- Wilkinson, J., Breakwell, G.M., Hammond, S., Ed. (1995). *Research Methods in Psychology*. London, Saga Publication.

- Willows, D.M.& Houghton, H. A. (eds.) (1987). *The Psychology of Illustration in Basic Research* London: Springer Verlag
- Wilson, J. (1999). "Defining Metacognition: A Step Towards Recognising Metacognition as A Worthwhile Part of the Curriculum." *AARE Conference*, Melbourne.
- Winters, E. (2001). "Seven Styles of Learning."  
Available at:<http://www.bena.com/ewinters/styles.html>  
Accessed Date: 02 / 03 / 2001.
- Woolley, M. (2003). "Choreographing Obsolescence - Ecodesign: the Pleasure / Dissatisfaction Cycle." *DPPI'03* Pittsburgh, Pennsylvania, USA, ACM 1-58113-652-8/03/0006.
- Woolworths.co.uk (2002). "Customers Review."  
Available at:[http://www.woolworths.co.uk/Show.jhtml?prod\\_id=11268118](http://www.woolworths.co.uk/Show.jhtml?prod_id=11268118)  
Accessed Date: 29 / 01 / 2002.
- Wright, P., Bartram, C., Rogers, N., et. al (2000). "Text Entry on Handheld Computers by Older Users." *Ergonomics* 43(6):  
Available at: <http://www-sg.ebsco.com/online/direct.asp?>  
Accessed Date: 21 / 8 / 2000 Abstract.
- Wright, P. C., Robert, E.F., Harrison, M.D. (2000). "Analyzing Human-Computer Interaction as Distributed Cognition: The Resources Model." *Human - Computer Interaction* 15(1):  
Available at: <http://www-sg.ebsco.com/online/direct.asp?>  
Accessed Date: 21 / 8 / 2000 Abstract.
- Yin, R. K. (1993). *Applications of Case Study Research*. London, Sage Publication.
- Zimmerman, M. L., and Perkin, G. W. (1982). "Instructing Through Picture: Print Materials for People Who Do Not Read." *Information Design Journal* 3(2): 119-134.
- \_\_\_\_\_ (1994). *Collins English Dictionary and Thesaurus*. Glasgow, HarperCollins.
- \_\_\_\_\_ (2000). *Hyperdictionary* Available at:  
<http://www.hyperdictionary.com/dictionary/multimedia>  
Accessed Date: 16 / 10 / 2003

---

(2002). "SPSS Tutorial -Quantitative Methods for Health Research." Available at:  
<http://www.unb.ca/courses/mhodgind/n6051/SPSS%20Tutorial%201.htm>  
Accessed Date: 03 / 05 / 2002.

---

(2002). "The Sims- Game Review."  
Available at <http://www.smartgirl.org/reviews/games/2074417.html>:  
Accessed Date: 01 / 01 / 02.

---

(2002). "The Sims - Game Reviewer."  
Available at <http://www.gamersunderground.net/VGamer.net>:  
Accessed Date: 01/01/02.

---

(2002). "The Game Critic Review of The Sims."  
Available at <http://www.game-critic.com/Reviews/PC/TheSims/review.htm>:  
Accessed Date: 01 / 01 / 02.

---

(2003). "The Sims."  
Available at <http://thesims.ea.com/us/international/index.html>:  
Accessed Date: 02 / 06 / 03.

---

(2004). "Sims Reviews."  
Available at <http://sacland.hypermart.net/subpages/reviews/sims.htm>:  
Accessed Date: 12 / 03 / 04.

---

(2004). "Sims Review."  
Available at <http://www.gamersright.com/PC/sims.htm>:  
Accessed Date: 12 / 03 / 2004.

---

(2004). "The Sims Preview."  
Available at [http://www.geocities.com/simsstash/preview\\_thesims.html](http://www.geocities.com/simsstash/preview_thesims.html):  
Accessed Date: 07 / 03 / 2004.

---

(2004). "The History of The Sims."  
Available at <http://www.geocities.com/simsstash/history.html>:  
Accessed Date: 07 / 03 / 2004.

---

(2004). "The Sims 2." Available at <http://www.co-uk-shopping.com/PC-and-Video-Games?PID-0YCCYZPLRN/The-Sims-2/>:  
Accessed Date: 07 / 03 / 2004.

---

(1983). *The Human Body*. Children Information Books. London,  
Jonathan Cape

---

(1988). *The Way Things Work*. Children Information  
Books London, Dorling Kindersley

\_\_\_\_\_ (1996). *The Ultimate Human Body*. Children Information Books. London, Dorling Kindersley

\_\_\_\_\_ (1997). *Human Body (Inside Guides Series)*. Children Information Books. London, Dorling Kindersley

\_\_\_\_\_ (1999). *Walking with Dinosaurs*. Children Information Books London, BBC Worldwide

\_\_\_\_\_ (1996) *The Ultimate Human Body* [CD-ROM] London, Dorling Kindersley

\_\_\_\_\_ (1997) *The New Way Things Work* [CD-ROM] London, Dorling Kindersley

\_\_\_\_\_ (1994) *Dinosaurs* [CD-ROM] London, Microsoft

\_\_\_\_\_ (1996) *The Magic School Bus – Dinosaur* [CD-ROM] London, Microsoft

\_\_\_\_\_ (2000) *Disney Activity Centre- Dinosaur* [CD-ROM] United Kingdom, Disney Interactive

\_\_\_\_\_ (2000) *The Sims – The People Simulator from the Creator of SimCity* [CD-ROM] US, Electronic Arts (Maxis)

**Statistical Results**

Chapter 7

Study 3 - Testing the Engaging Multimedia Design Model

(Kruskal-Wallis Tests)

**Descriptives<sup>a,b,c,d</sup>**

	Condition	Mean	Statistic
Rating 0-10 for Engagement at 5min	No Interaction	Mean	7.75
	Simuln Interaction	Mean	7.00
	Construct Interaction	Mean	8.38
Rating 0-10 for Engagement at 10min	No Interaction	Mean	6.75
	Simuln Interaction	Mean	8.00
	Construct Interaction	Mean	7.75
Rating 0-10 for Engagement at 15min	No Interaction	Mean	5.50
	Simuln Interaction	Mean	8.00
	Construct Interaction	Mean	8.25
Rating 0-10 for Engagement at 20min	No Interaction	Mean	4.75
	Simuln Interaction	Mean	9.38
	Construct Interaction	Mean	8.38
Rating 0-10 for Engagement at 25min	No Interaction	Mean	2.75
	Simuln Interaction	Mean	9.50
	Construct Interaction	Mean	9.25
Rating 0-10 for Engagement at 30min	No Interaction	Mean	2.50
	Simuln Interaction	Mean	9.75
	Construct Interaction	Mean	9.50
Rating 0-10 for	No Interaction	Mean	2.13
Rating 0-10 for	No Interaction	Mean	1.63

- a. Rating 0-10 for Engagement at 35min is constant when Condition = Simuln Interaction. It has been omitted.
- b. Rating 0-10 for Engagement at 35min is constant when Condition = Construct Interaction. It has been omitted.
- c. Rating 0-10 for Engagement at 40min is constant when Condition = Simuln Interaction. It has been omitted.
- d. Rating 0-10 for Engagement at 40min is constant when Condition = Construct Interaction. It has been omitted.

## Kruskal-Wallis Test

## Ranks

	Condition	N	Mean Rank
Rating 0-10 for Engagement at 5min	No Interaction	8	12.81
	Simuln Interaction	8	10.00
	Construct Interaction	8	14.69
	Total	24	
Rating 0-10 for Engagement at 10min	No Interaction	8	10.00
	Simuln Interaction	8	14.00
	Construct Interaction	8	13.50
	Total	24	
Rating 0-10 for Engagement at 15min	No Interaction	8	7.31
	Simuln Interaction	8	14.75
	Construct Interaction	8	15.44
	Total	24	
Rating 0-10 for Engagement at 20min	No Interaction	8	7.00
	Simuln Interaction	8	16.56
	Construct Interaction	8	13.94
	Total	24	
Rating 0-10 for Engagement at 25min	No Interaction	8	5.94
	Simuln Interaction	8	16.63
	Construct Interaction	8	14.94
	Total	24	
Rating 0-10 for Engagement at 30min	No Interaction	8	5.69
	Simuln Interaction	8	16.44
	Construct Interaction	8	15.38
	Total	24	
Rating 0-10 for Engagement at 35min	No Interaction	8	5.50
	Simuln Interaction	8	16.00
	Construct Interaction	8	16.00
	Total	24	
Rating 0-10 for Engagement at 40min	No Interaction	8	5.50
	Simuln Interaction	8	16.00
	Construct Interaction	8	16.00
	Total	24	



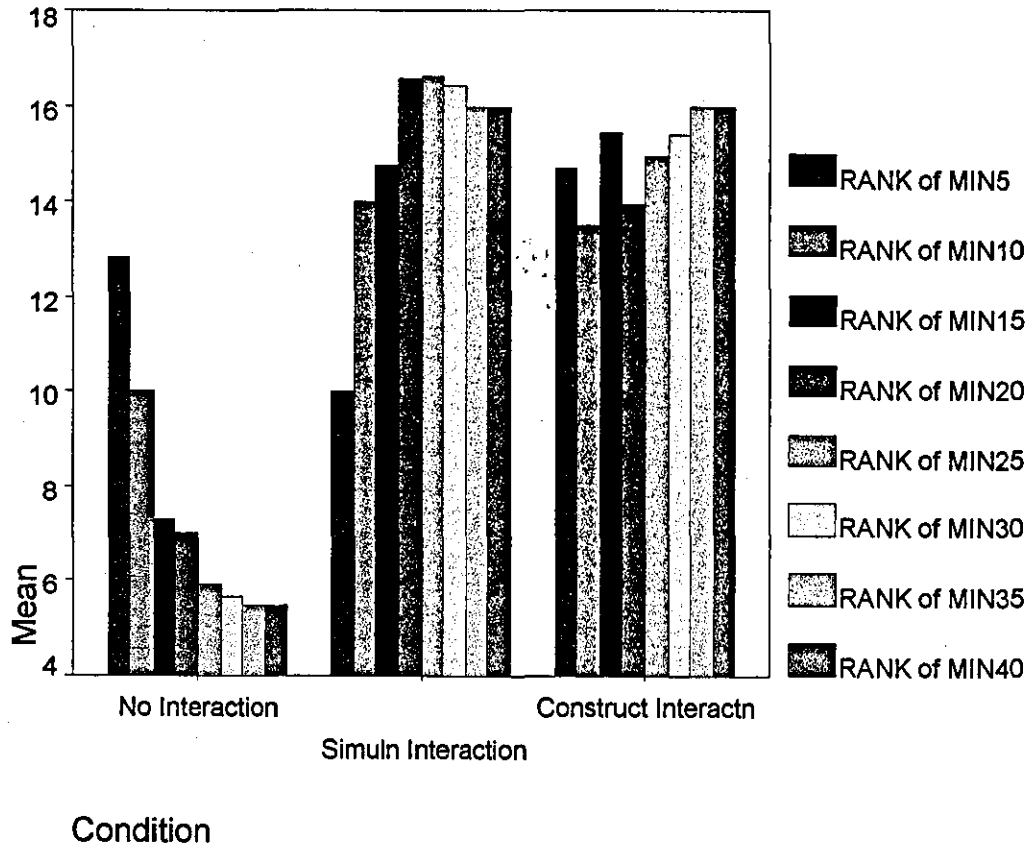
Test Statistics<sup>a,b</sup>

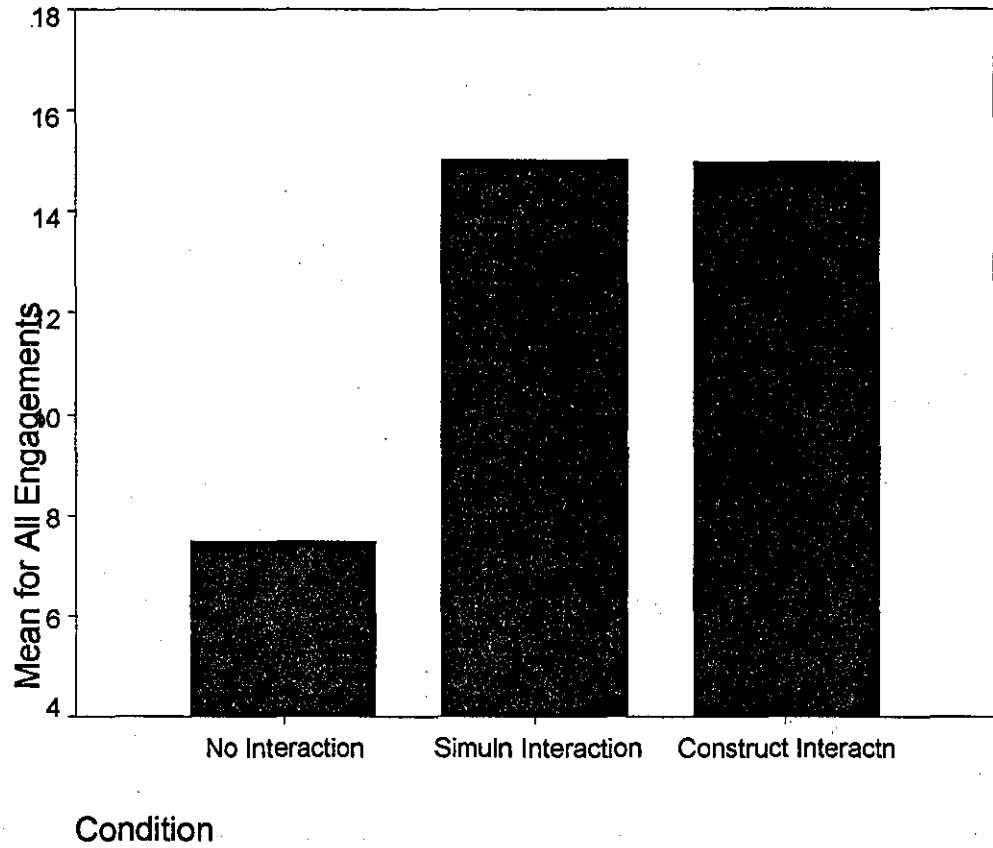
	Chi-Square	df	Asymp. Sig.
Rating 0-10 for Engagement at 5min	1.909	2	.385
Rating 0-10 for Engagement at 10min	1.559	2	.459
Rating 0-10 for Engagement at 15min	6.785	2	.034
Rating 0-10 for Engagement at 20min	8.256	2	.016
Rating 0-10 for Engagement at 25min	12.622	2	.002
Rating 0-10 for Engagement at 30min	14.113	2	.001
Rating 0-10 for Engagement at 35min	18.475	2	.000
Rating 0-10 for Engagement at 40min	18.667	2	.000

a. Kruskal Wallis Test

b. Grouping Variable: Condition

# Appendix A





Descriptives

		Condition	Statistic
Mean for All Engagement	No Interaction	Mean	7.4688
	Simuln Interaction	Mean	15.0469
	Construct Interaction	Mean	14.9844

**Statistical Results**

Chapter 8

Study 4 – A Study of Previous Experience

Sims WE Group Versus Sims WOE Group

---

(Analyse – General Linear Model - Related Measures – Game type –time – Sims WE and Sims WOE - )

**Within-Subjects Factors**

Measure: RANK

GM TYPE	TIME	Dependent Variable
1	1	RMIN5A
	2	RMIN10A
	3	RMIN15A
	4	RMIN20A
	5	RMIN25A
	6	RMIN30A
	7	RMIN35A
	8	RMIN40A
2	1	RMIN5B
	2	RMIN10B
	3	RMIN15B
	4	RMIN20B
	5	RMIN25B
	6	RMIN30B
	7	RMIN35B
	8	RMIN40B

**Between-Subjects Factors**

		Value Label	N
Sims Game	1	Sims WE	4
	2	Sims WOE	4

Profile Plots

GM\_TYPE \* Sims Game \* TIME

