

Contents

1	Introduction	25
1.1	Aim of project	25
1.2	Justification	25
1.3	The two main domains of educational hypermedia	26
1.4	Problem areas	27
1.5	Approach	28
1.6	Research objective	30
2	Literature Review	31
2.1	Definition and history of e-learning	31
2.1.1	Definition	31
2.1.2	History	32
2.2	Forms of e-learning	34
2.2.1	Computer Based Training	34
2.2.2	Web Based Training	34
2.2.3	Hypermedia Authoring Tools (HATs)	35
2.2.4	Simulations	36
2.2.5	Video conferencing / Teleteaching	37
2.2.6	Learning Management Systems	38
2.2.7	Learning Content Management Systems	39
2.2.8	Game based learning	40
2.2.9	Blended learning	40
2.2.10	Web based collaboration	41
2.2.11	Microworlds	41
2.2.12	Visualisations	42

2.2.13	Learning communities and social learning	42
2.3	Advantages and disadvantages of e-learning	44
2.3.1	Advantages	44
2.3.2	Disadvantages	45
2.4	Pedagogical elements and approaches	46
2.4.1	Instructional design	46
2.4.2	Constructivism	47
2.4.3	Pedagogical perspectives	49
2.5	Educational research	51
2.5.1	Education and educational research	51
2.6	Teaching and learning strategies	53
2.6.1	Problems	53
2.6.2	Approaches	54
2.6.3	Non-computable teaching and learning strategies	56
2.6.4	Question and Answer	56
2.6.5	Lecturing	56
2.6.6	Case Study	57
2.6.7	Problem-Solving	57
2.7	E-learning and meta-data projects	58
2.8	Knowledge and learning objects	63
2.9	Project management and e-learning	65
2.10	Reuse of material	68
2.11	Adaptive Hypermedia System	70
2.11.1	Link adaptation	71
2.11.2	Content adaptation	71
2.11.3	User and knowledge management	72
2.12	Technology	74
2.12.1	Web 2.0 Technology	74
2.12.2	XML	75

2.12.3 XSL	75
2.12.4 SMIL	76
2.12.5 HTML and Dynamic HTML	76
2.12.6 Java and Java Script	76
2.13 Research objectives	78
2.13.1 Creation of a suitable framework for content separation . .	78
2.13.2 Evaluation of the framework	78
2.13.3 Evaluation of the authoring tool	79
3 EFTECS	81
3.1 Theoretical approach	81
3.2 EFTECS at EM-Layer	85
3.3 EFTECS at TLS-Layer	87
3.3.1 Question and Answer	87
3.3.2 Lecture	88
3.3.3 Case Study	89
3.3.4 Drill and Practice	91
3.4 EFTECS at EHP-Layer	92
3.4.1 Physical information	92
3.4.2 Domain information	93
3.4.3 Adaptation information	94
3.4.4 Additional information	94
3.5 Linking information	95
3.6 Common meta-information	96
3.7 Content space	97
3.8 The complete EFTECS	98
3.9 The eXtensible Educational Markup Language - XEML	100
3.10 Summary	100

4 HEAT	101
4.1 General approach	101
4.1.1 Technical aspects	102
4.1.2 Design aspects	103
4.2 EHP-Layer	105
4.2.1 Design aspects	105
4.2.2 Technical aspects	106
4.3 EHP-Information	108
4.3.1 Design aspects	108
4.3.2 Technical aspects	109
4.4 TLS-Layer	110
4.4.1 Design aspects	110
4.4.2 Technical aspects	111
4.5 EM-Layer	113
4.5.1 Design aspects	113
4.5.2 Technical aspects	114
4.6 Content space	115
4.7 Material delivery	117
4.8 Detailed example	119
4.9 Summary	133
5 Evaluation methodology	135
5.1 Analysis of alternative approaches	135
5.1.1 Group session vs. One-to-One session	135
5.1.2 Single session vs. Multiple sessions	135
5.1.3 Selected approach	136
5.2 Design of the interview evaluation	138
5.2.1 Basic design	138
5.2.2 Pilot study	138
5.2.3 Final design	140
5.3 Design of the practical evaluation	150
5.4 Summary	152

6 Interview evaluation	153
6.1 Analysis of the pre-test interview	153
6.1.1 Personal details	154
6.1.2 Educational task and level of teaching	154
6.1.3 Computing skills	155
6.1.4 Specific WWW knowledge	155
6.1.5 Thoughts about using the WWW as a tool for education .	156
6.1.6 Experience of authoring WWW based educational material	156
6.1.7 Intention to use the WWW for educational purposes . . .	157
6.1.8 External requirements to use the WWW for educational purposes	157
6.1.9 Educational markup projects	157
6.1.10 Summary of the pre-test interview	157
6.2 Analysis of the manual markup task	159
6.2.1 Provided material	159
6.2.2 EFTECS and 3-Layer-Model	159
6.2.3 Educational experts	159
6.2.4 Technical experts	160
6.3 Analysis of the mid-test interview	161
6.3.1 3-Layer-Model	161
6.3.2 Using the QA-TLS	162
6.3.3 Using the Lecture-TLS	162
6.3.4 Ease of QA material tagging	162
6.3.5 Ease of lecture material tagging	163
6.3.6 Additional comments	163
6.3.7 Summary of the mid-test interview	163
6.4 Analysis of the HEAT based markup task	165
6.4.1 HEAT	165
6.4.2 EFTECS and 3-Layer-Model	165
6.4.3 Educational experts	166

6.4.4	Technical experts	166
6.5	Analysis of the post-test interview	168
6.5.1	Using a QA-TLS in the HEAT	168
6.5.2	Using a Lecture-TLS in the HEAT	168
6.5.3	Linking of TLSs	168
6.5.4	Reuse of material from the content space	169
6.5.5	Processing the created material for the WWW	170
6.5.6	Quality of processed material	170
6.5.7	Manual markup vs. HEAT	170
6.5.8	Vision of practical application of the HEAT	171
6.5.9	Summary of the post-test interview	171
6.6	Summary	172
7	Practical evaluation	173
7.1	Design	173
7.1.1	Educational material	174
7.1.2	Aim of evaluation	174
7.2	Existing material	176
7.2.1	EHP-Layer	176
7.2.2	TLS-Layer	176
7.2.3	Linking of TLSs	177
7.2.4	EM-Layer	178
7.2.5	Presentation of the material	179
7.2.6	Ease of authoring	179
7.2.7	Author's expertise	180
7.3	New material	181
7.3.1	EHP-Layer	181
7.3.2	TLS-layer	181
7.3.3	Linking of TLSs	181
7.3.4	EM-Layer	182

7.3.5	Presentation of the material	183
7.3.6	Ease of authoring	183
7.3.7	Author's expertise	183
7.4	Summary	185
7.4.1	EHP-Layer	185
7.4.2	TLS-Layer	185
7.4.3	Linking of TLSs	186
7.4.4	EM-Layer	186
7.4.5	Presentation of the material	186
7.4.6	Ease of authoring	187
7.4.7	Author's expertise	187
8	Discussion	189
8.1	Review of the EFTECS	189
8.1.1	Design of the EFTECS	189
8.1.2	Content separation	190
8.1.3	Reusability of material	191
8.1.4	Presentation and communication	191
8.1.5	Extensibility of the EFTECS	192
8.2	Review of the HEAT	194
8.2.1	Conversion of the EFTECS into the HEAT	194
8.2.2	Basic functionality	195
8.2.3	Existing material	196
8.2.4	New material	197
8.2.5	Linking of TLSs and EMs	198
8.2.6	Content space	198
8.2.7	Quality of produced material	199
8.2.8	Additional functionalities	200
8.3	Critique of the study	201

9 Conclusions	203
9.1 Research objectives	203
9.1.1 Creation of a suitable framework for content separation . .	203
9.1.2 Evaluation of the framework	204
9.1.3 Evaluation of the authoring tool	205
9.2 Future work	207
9.2.1 Long term evaluation of the framework and the HEAT . .	207
9.2.2 Implementation of additional TLSs	207
9.2.3 Mass conversion of existing material	208
9.2.4 Improvement of the HEAT	209
9.3 Contribution to knowledge	213
References	215
A Appendices	235
A.1 Evaluation tasksheet	236
A.2 Evaluation Worksheet	252
A.3 Evaluation Interviews	254
A.4 Summary of interview results	257
A.4.1 Summary Pre-Test interview	257
A.4.2 Summary Mid-Test interview	260
A.4.3 Summary Post-Test Interview	263
A.5 XSL-Documents	267
A.5.1 Question and Answer - Multiple Choice	267
A.5.2 Lecture - Deductive	279
A.5.3 Drill and Practice - Drill and Practice	292
A.5.4 Case Study - Traditional	299
A.6 XEML - eXtensible Educational Markup Language	306
A.7 Contents of CD	309
A.7.1 The electronic format of the thesis	309
A.7.2 The transcripts of the interview evaluation	309

List of Figures

1	The three layers of the EFTECS	83
2	HEAT - Startup	119
3	HEAT - Startup - EM EHP-information	119
4	HEAT - Startup - Empty EM	120
5	HEAT - Add QA-TLS	121
6	HEAT - Inherit EHP-information	121
7	HEAT - QA-TLS	122
8	HEAT - QA-TLS Information	123
9	HEAT - QA-TLS Content	123
10	HEAT - Add Lecture-TLS	124
11	HEAT - Linking TLSs	125
12	HEAT - Linked TLSs	125
13	HEAT - Search Content Space	126
14	HEAT - Query Content Space	127
15	HEAT - Start XML processing	127
16	HEAT - XML creation information	128
17	HEAT - Created QA XML file	129
18	HEAT - Multiple-Choice-QA - XSL file	130
19	HEAT - Final view of a Lecture-TLS	131
20	HEAT - Final view of a QA-TLS	132
21	Lecture-TLS of existing material	177
22	Educational module with linked TLSs	178
23	Educational module with new material	182
24	Startup Screen	244
25	EHP-Information of the Educational Module	244
26	Empty HEAT	245
27	HEAT with QA-TLS	246
28	Content window of the QA-TLS	247