

TABLE OF CONTENTS

CHAPTER 1	Introduction	1
CHAPTER 2	Literature Review	6
2.1	Theoretical background of learning with media.....	6
2.2	3D computer graphics in computer-based educational system	7
2.3	Intelligent tutoring system and adaptive educational hypermedia.....	9
2.3.1.	Model- and procedure-based approaches for Web-based learning	10
2.3.2.	Methods and evaluation of methods in AH	11
2.3.3.	Difference between ITS and AEH	12
2.4	Spatial ability	13
2.5	Learning styles	14
CHAPTER 3	CooTutor System.....	17
3.1	System architecture	17
3.2	User interface with Interactive 3D Media	18
3.3	Adaptivity in CooTutor	20
3.3.1	Domain modeling.....	21
3.3.2	Student modeling.....	24
3.3.3	Concept sequencing.....	29
3.3.4	Material selection	30
3.3.5	Client-side tuning	37
CHAPTER 4	Evaluating the Effects of Media Representation.....	41
4.1	Design of the experiment.....	41
4.2	Learning materials with different representations.....	43
4.3	Measuring instrument.....	44
4.4	Data analysis	46
4.5	Experimental results.....	47
4.6	Discussion and implications	49
CHAPTER 5	Evaluating the Effects of Adaptation based on Learners' Traits.....	51
5.1	Walkthrough on how CooTutor works	52
5.2	Design of the experiment.....	57
5.3	Measuring instrument.....	60
5.4	Data analysis	61

5.5	Experimental Results	62
5.5.1	Result of spatial ability enhancement.....	64
5.5.2	Result of SGT achievement	64
5.5.3	Learners' attitude on CooTutor	65
5.5.4	Learners' usage behavior.....	66
5.6	Discussion	66
CHAPTER 6 Conclusion		70
REFERENCES		72
APPENDIX A.....		78
APPENDIX B.....		79

LIST OF FIGURES

FIGURE 1. 1: THE CONCEPT OF INTELLIGENT MEDIA FOR EFFECTIVE LEARNING	3
FIGURE 2. 1: CLASSIC PROCESS OF ADAPTATION IN ADAPTIVE SYSTEMS	9
FIGURE 2. 2: BRUSILOVSKY'S TAXONOMY OF AH TECHNOLOGIES (PARTIAL)	11
FIGURE 3. 1: COOTUTOR SYSTEM ARCHITECTURE.	18
FIGURE 3. 2: USER INTERFACE WITH 3D BLACKBOARD.	19
FIGURE 3. 3: DESCRIBING SPATIAL RELATIONS WITH 3D NAVIGATION.	19
FIGURE 3. 4: THE FLOW OF ADAPTIVITY IN COOTUTOR.	21
FIGURE 3. 5: ORGANIZING CONCEPTS AS A PREREQUISITE GRAPH (PARTIAL).	23
FIGURE 3. 6: LINKAGE BETWEEN THE DOMAIN MODEL AND LEARNING ITEMS,	23
FIGURE 3. 7: LEARNING ITEMS AS POINTS IN THE ATTRIBUTE SPACE (PARTIAL).	24
FIGURE 3. 8: THE ALGORITHM OF CONCEPT SEQUENCING	29
FIGURE 3. 9: THE PROCESS OF QUERY FORMULATION.	33
FIGURE 3. 10: A SNAPSHOT DEMONSTRATING THEORY REFINEMENT FROM USERS' RESPONSE.....	38
FIGURE 3. 11: THE STATIC CLASS DIAGRAM OF THE CLASS, ACTIVITIESBEAN (PARTIAL)	39
FIGURE 3. 12: THE EFFECT OF THE ADAPTIVE TECHNIQUE—STRETCH-TEXT	39
FIGURE 4. 1: THE PROCEDURE OF THE EXPERIMENT	43
FIGURE 4. 2: THE SCREENSHOTS OF LEARNING MATERIALS IN DIFFERENT REPRESENTATIONS.....	44
FIGURE 4. 3: A SAMPLE ITEM OF THE 20-ITEMS VERSION OF PVRT	45
FIGURE 4. 4.:THE SCREENSHOT OF WEB-BASED PVRT.....	45
FIGURE 4. 5: THE ADJUSTED MEAN OF POST-TEST SCORES WITH 95% C.I.	48
FIGURE 5. 1: MAJOR EVENTS THAT LEARNERS WILL MEET BY SETTING THE CONCEPT OF <i>ROTATION AROUND SINGLE AXIS</i> AS THE LEARNING GOAL.....	52
FIGURE 5. 2: ADAPTIVE NAVIGATION SUPPORT OFFERED BY COOTUTOR	54
FIGURE 5. 3: ACTIVITY LIST PRESENTED TO THE LEARNER SHOWING THE RECOMMENDATION.....	56
FIGURE 5. 4: THE DESIGN OF EXPERIMENT.....	58
FIGURE 5. 5: FACTORS UNDERLYING THE TEST SCORES OF THE EXPERIMENT	67

LIST OF TABLES

TABLE 3. 1: THE COMPARISON OF THREE TYPES OF LEARNER INFORMATION.....	26
TABLE 3. 2: FEATURES OF LEARNING MATERIALS.	31
TABLE 4. 1: DESCRIPTIVE STATISTICS OF PARTICIPANTS' PRE- AND POST-TEST SCORES.....	47
TABLE 4. 2: THE RESULTS OF ANCOVA BY USING THE POST-TEST SCORES AS DEPENDANT VARIABLE WITH PRE-TEST SCORES AS COVARIATE.....	47
TABLE 5. 1: LEARNING MATERIALS WITH FEATURE VALUES AND SIMILARITY MEASURES.....	53
TABLE 5. 2: FOUR VERSIONS OF COOTUTOR SYSTEM COMPARED IN THE EXPERIMENT	58
TABLE 5. 3: STATISTICS OF PARTICIPANTS' PRE- AND POST- PVRT SCORES ALONG WITH EFFECT SIZE	63
TABLE 5. 4:.. STATISTICS OF PARTICIPANTS' PRE- AND POST- ACHIEVEMENT TEST SCORES.....	63
TABLE 5. 5: STATISTICS OF PARTICIPANTS' RESPONSE ON THE ATTITUDE QUESTIONNAIRE.....	63
TABLE 5. 6: STATISTICS OF PARTICIPANTS' USAGE OF THE SYSTEM.....	65