# Table of Contents

## Adaptive Testing

A Learning Environment for English for Academic Purposes Based on Adaptive Tests and Task-Based Systems .......................... 1  
   *J.P. Gonçalves, S.M. Aluisio, L.H.M. de Oliveira, O.N. Oliveira, Jr.*

A Model for Student Knowledge Diagnosis Through Adaptive Testing ....................................... 12  
   *E. Guzmán, R. Conejo*

A Computer-Adaptive Test That Facilitates the Modification of Previously Entered Responses: An Empirical Study ..................... 22  
   *M. Lilley, T. Barker*

## Affect

An Autonomy-Oriented System Design for Enhancement of Learner’s Motivation in E-learning ................................. 34  
   *E. Blanchard, C. Frasson*

Inducing Optimal Emotional State for Learning in Intelligent Tutoring Systems ........................................ 45  
   *S. Chaffar, C. Frasson*

Evaluating a Probabilistic Model of Student Affect ............................ 55  
   *C. Conati, H. Maclare*

Politeness in Tutoring Dialogs: “Run the Factory, That’s What I’d Do” .......................... 67  
   *W.L. Johnson, P. Rizzo*

Providing Cognitive and Affective Scaffolding Through Teaching Strategies: Applying Linguistic Politeness to the Educational Context ... 77  
   *K. Porayska-Pomsta, H. Pain*

## Architectures for ITS

Knowledge Representation Requirements for Intelligent Tutoring Systems ................................. 87  
   *I. Hatzilygeroudis, J. Prentzas*

Coherence Compilation: Applying AIED Techniques to the Reuse of Educational TV Resources .................... 98  
   *R. Luckin, J. Underwood, B. du Boulay, J. Holmberg, H. Tunley*
Table of Contents

The Knowledge Like the Object of Interaction
in an Orthopaedic Surgery-Learning Environment ................. 108
V. Luengo, D. Mufti-Alchawafa, L. Vadcard

Towards Qualitative Accreditation with Cognitive Agents .......... 118
A. Minko, G. Gouardères

Integrating Intelligent Agents, User Models,
and Automatic Content Categorization in a Virtual Environment ..... 128
C. Trojahn dos Santos, F.S. Osório

Authoring Systems

EASE: Evolutional Authoring Support Environment ................. 140
L. Aroyo, A. Inaba, L. Soldatova, R. Mizoguchi

Selecting Theories in an Ontology-Based ITS Authoring Environment ... 150
J. Bourdeau, R. Mizoguchi, V. Psyché, R. Nkambou

Opening the Door to Non-programmers:
Authoring Intelligent Tutor Behavior by Demonstration .............. 162
K.R. Koedinger, V. Aleven, N. Heffernan, B. McLaren,
M. Hockenberry

Acquisition of the Domain Structure from Document Indexes
Using Heuristic Reasoning .............................................. 175
M. Larrañaga, U. Rueda, J.A. Elorriaga, A. Arruarte

Role-Based Specification of the Behaviour of an Agent
for the Interactive Resolution of Mathematical Problems ............. 187
M.A. Mora, R. Moriyón, F. Saiz

Lessons Learned from Authoring for Inquiry Learning:
A Tale of Authoring Tool Evolution ................................... 197
T. Murray, B. Woolf, D. Marshall

The Role of Domain Ontology in Knowledge Acquisition for ITSs .... 207
P. Suraweera, A. Mitrovic, B. Martin

Combining Heuristics and Formal Methods in a Tool
for Supporting Simulation-Based Discovery Learning .................. 217
K. Veermans, W.R. van Joolingen

Cognitive Modeling

Toward Tutoring Help Seeking
(Applying Cognitive Modeling to Meta-cognitive Skills) ............. 227
V. Aleven, B. McLaren, I. Roll, K. Koedinger
Why Are Algebra Word Problems Difficult?
Using Tutorial Log Files and the Power Law of Learning to Select
the Best Fitting Cognitive Model ................................. 240
  E.A. Croteau, N.T. Heffernan, K.R. Koedinger

Towards Shared Understanding of Metacognitive Skill
and Facilitating Its Development ................................. 251
  M. Kayashima, A. Inaba, R. Mizoguchi

Collaborative Learning

Analyzing Discourse Structure to Coordinate Educational Forums ...... 262
  M.A. Gerosa, M.G. Pimentel, H. Fuks, C. Lucena

Intellectual Reputation to Find an Appropriate Person for a Role
in Creation and Inheritance of Organizational Intellect .............. 273
  Y. Hayashi, M. Ikeda

Learners’ Roles and Predictable Educational Benefits in
Collaborative Learning (An Ontological Approach to Support
Design and Analysis of CSCL) ....................................... 285
  A. Inaba, R. Mizoguchi

Redefining the Turn-Taking Notion in Mediated Communication
of Virtual Learning Communities ..................................... 295
  P. Reyes, P. Tchounikine

Harnessing P2P Power in the Classroom ................................ 305
  J. Vassileva

Analyzing Online Collaborative Dialogues:
The OXEnTCHÉ–Chat ................................................... 315
  A.C. Vieira, L. Teixeira, A. Timóteo, P. Tedesco, F. Barros

Natural Language Dialogue and Discourse

A Tool for Supporting Progressive Refinement
of Wizard-of-Oz Experiments in Natural Language .................. 325
  A. Fiedler, M. Gabsdil, H. Horacek

Tactical Language Training System: An Interim Report ............... 336
  W.L. Johnson, C. Beal, A. Fowles-Winkler, U. Lauper, S. Marsella,
  S. Narayanan, D. Papachristou, H. Vilhjálmsdóttir

Combining Competing Language Understanding Approaches
in an Intelligent Tutoring System .................................... 346
  P.W. Jordan, M. Makatchev, K. VanLehn
Evaluating Dialogue Schemata with the Wizard of Oz
Computer-Assisted Algebra Tutor .................................................. 358
    J.H. Kim, M. Glass

Spoken Versus Typed Human and Computer Dialogue Tutoring ......... 368
    D.J. Litman, C.P. Rosé, K. Forbes-Riley, K. VanLehn,
    D. Bhembe, S. Silliman

Linguistic Markers to Improve the Assessment of Students
in Mathematics: An Exploratory Study ........................................ 380
    S. Normand-Assadi, L. Coulange, É. Delozanne, B. Grugeon

Advantages of Spoken Language Interaction in Dialogue-Based
Intelligent Tutoring Systems ...................................................... 390
    H. Pon-Barry, B. Clark, K. Schultz, E.O. Bratt, S. Peters

CycleTalk: Toward a Dialogue Agent That Guides Design
with an Articulate Simulator ...................................................... 401
    C.P. Rosé, C. Torrey, V. Aleven, A. Robinson, C. Wu, K. Forbus

DReSDeN: Towards a Trainable Tutorial Dialogue Manager
to Support Negotiation Dialogues for Learning and Reflection ........... 412
    C.P. Rosé, C. Torrey

Combining Computational Models of Short Essay Grading
for Conceptual Physics Problems .................................................. 423
    M.J. Ventura, D.R. Franchescetti, P. Pennumatsa, A.C. Graesser,
    G.T. Jackson, X. Hu, Z. Cai, and the Tutoring Research Group

From Human to Automatic Summary Evaluation .............................. 432
    I. Zipitria, J.A. Elorriaga, A. Arruarte, A.D. de Ilarraza

Evaluation

Evaluating the Effectiveness of a Tutorial Dialogue System
for Self-Explanation ................................................................. 443
    V. Aleven, A. Ogan, O. Popescu, C. Torrey, K. Koedinger

Student Question-Asking Patterns in an Intelligent Algebra Tutor ...... 455

Web-Based Intelligent Multimedia Tutoring
for High Stakes Achievement Tests .............................................. 468
    I. Arroyo, C. Beal, T. Murray, R. Walles, B.P. Woolf

Can Automated Questions Scaffold
Children’s Reading Comprehension? ............................................ 478
    J.E. Beck, J. Mostow, J. Bey
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web-Based Evaluations Showing Differential Learning for Tutorial Strategies Employed by the Ms. Lindquist Tutor</td>
<td>491</td>
</tr>
<tr>
<td>N.T. Heffernan, E.A. Croteau</td>
<td></td>
</tr>
<tr>
<td>The Impact of Why/AutoTutor on Learning and Retention of Conceptual Physics</td>
<td>501</td>
</tr>
<tr>
<td>G.T. Jackson, M. Ventura, P. Chewle, A. Graesser, and the Tutoring Research Group</td>
<td></td>
</tr>
<tr>
<td>ITS Evaluation in Classroom: The Case of Ambre-AWP</td>
<td>511</td>
</tr>
<tr>
<td>S. Nogry, S. Jean-Daubias, N. Duclosson</td>
<td></td>
</tr>
<tr>
<td>Implicit Versus Explicit Learning of Strategies in a Non-procedural Cognitive Skill</td>
<td>521</td>
</tr>
<tr>
<td>Machine Learning in ITS</td>
<td></td>
</tr>
<tr>
<td>Detecting Student Misuse of Intelligent Tutoring Systems</td>
<td>531</td>
</tr>
<tr>
<td>Applying Machine Learning Techniques to Rule Generation in Intelligent Tutoring Systems</td>
<td>541</td>
</tr>
<tr>
<td>M.P. Jarvis, G. Nuzzo-Jones, N.T. Heffernan</td>
<td></td>
</tr>
<tr>
<td>A Category-Based Self-Improving Planning Module</td>
<td>554</td>
</tr>
<tr>
<td>R. Legaspi, R. Sison, M. Numao</td>
<td></td>
</tr>
<tr>
<td>AgentX: Using Reinforcement Learning to Improve the Effectiveness of Intelligent Tutoring Systems</td>
<td>564</td>
</tr>
<tr>
<td>K.N. Martin, I. Arroyo</td>
<td></td>
</tr>
<tr>
<td>An Intelligent Tutoring System Based on Self-Organizing Maps – Design, Implementation and Evaluation</td>
<td>573</td>
</tr>
<tr>
<td>W. Martins, S.D. de Carvalho</td>
<td></td>
</tr>
<tr>
<td>Modeling the Development of Problem Solving Skills in Chemistry with a Web-Based Tutor</td>
<td>580</td>
</tr>
<tr>
<td>R. Stevens, A. Soller, M. Cooper, M. Sprang</td>
<td></td>
</tr>
<tr>
<td>Pedagogical Agents</td>
<td></td>
</tr>
<tr>
<td>Pedagogical Agent Design: The Impact of Agent Realism, Gender, Ethnicity, and Instructional Role</td>
<td>592</td>
</tr>
<tr>
<td>A.L. Baylor, Y. Kim</td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Designing Empathic Agents: Adults Versus Kids</td>
<td>604</td>
</tr>
<tr>
<td>L. Hall, S. Woods, K. Dautenhahn, D. Sobral, A. Paiva,</td>
<td></td>
</tr>
<tr>
<td>D. Wolke, L. Newall</td>
<td></td>
</tr>
<tr>
<td>RMT: A Dialog-Based Research Methods Tutor</td>
<td>614</td>
</tr>
<tr>
<td>With or Without a Head</td>
<td></td>
</tr>
<tr>
<td>P. Wiemer-Hastings, D. Allbritton, E. Arnott</td>
<td></td>
</tr>
<tr>
<td>Student Modeling</td>
<td></td>
</tr>
<tr>
<td>Using Knowledge Tracing to Measure Student Reading Proficiencies</td>
<td>624</td>
</tr>
<tr>
<td>J.E. Beck, J. Sison</td>
<td></td>
</tr>
<tr>
<td>The Massive User Modelling System (MUMS)</td>
<td>635</td>
</tr>
<tr>
<td>C. Brooks, M. Winter, J. Greer, G. McCalla</td>
<td></td>
</tr>
<tr>
<td>An Open Learner Model for Children and Teachers:</td>
<td></td>
</tr>
<tr>
<td>Inspecting Knowledge Level of Individuals and Peers</td>
<td>646</td>
</tr>
<tr>
<td>S. Bull, M. McKay</td>
<td></td>
</tr>
<tr>
<td>Scaffolding Self-Explanation to Improve Learning</td>
<td>656</td>
</tr>
<tr>
<td>in Exploratory Learning Environments</td>
<td></td>
</tr>
<tr>
<td>A. Bunt, C. Conati, K. Muldner</td>
<td></td>
</tr>
<tr>
<td>Metacognition in Interactive Learning Environments:</td>
<td></td>
</tr>
<tr>
<td>The Reflection Assistant Model</td>
<td>668</td>
</tr>
<tr>
<td>C. Gama</td>
<td></td>
</tr>
<tr>
<td>Predicting Learning Characteristics</td>
<td>678</td>
</tr>
<tr>
<td>in a Multiple Intelligence Based Tutoring System</td>
<td></td>
</tr>
<tr>
<td>D. Kelly, B. Tangney</td>
<td></td>
</tr>
<tr>
<td>Alternative Views on Knowledge:</td>
<td></td>
</tr>
<tr>
<td>Presentation of Open Learner Models</td>
<td>689</td>
</tr>
<tr>
<td>A. Mabbott, S. Bull</td>
<td></td>
</tr>
<tr>
<td>Modeling Students’ Reasoning About Qualitative Physics:</td>
<td>699</td>
</tr>
<tr>
<td>Heuristics for Abductive Proof Search</td>
<td></td>
</tr>
<tr>
<td>M. Makatchev, P.W. Jordan, K. VanLehn</td>
<td></td>
</tr>
<tr>
<td>From Errors to Conceptions – An Approach to Student Diagnosis</td>
<td>710</td>
</tr>
<tr>
<td>C. Webber</td>
<td></td>
</tr>
<tr>
<td>Discovering Intelligent Agent:</td>
<td></td>
</tr>
<tr>
<td>A Tool for Helping Students Searching a Library</td>
<td>720</td>
</tr>
<tr>
<td>K. Yammine, M.A. Razek, E. Aimeur, C. Frasson</td>
<td></td>
</tr>
</tbody>
</table>
Teaching and Learning Strategies

Developing Learning by Teaching Environments That Support Self-Regulated Learning .............................. 730
  G. Biswas, K. Leelawong, K. Belynne, K. Viswanath, D. Schwartz, J. Davis

Adaptive Interface Methodology for Intelligent Tutoring Systems .......... 741
  G. Curilem S., F.M. de Azevedo, A.R. Barbosa

Implementing Analogies in an Electronic Tutoring System ............... 751
  E. Lulis, M. Evens, J. Michael

Towards Adaptive Generation of Faded Examples ....................... 762
  E. Melis, G. Goguadze

A Multi-dimensional Taxonomy for Automating Hinting .................. 772
  D. Tsovaltzi, A. Fiedler, H. Horacek

Poster Papers

Inferring Unobservable Learning Variables from Students’ Help Seeking Behavior ........................................ 782
  I. Arroyo, T. Murray, B.P. Woolf, C. Beal

The Social Role of Technical Personnel in the Deployment of Intelligent Tutoring Systems ................................. 785

Intelligent Tools for Cooperative Learning in the Internet ............. 788
  F. de Almeida Barros, F. Paraguaçu, A. Neves, C.J. Costa

A Plug-in Based Adaptive System: SAAW ................................ 791
  L. de Oliveira Brandão, S. Isotani, J.G. Moura

Helps and Hints for Learning with Web Based Learning Systems:
The Role of Instructions .................................................. 794
  A. Brunstein, J.F. Krems

Intelligent Learning Environment for Film Reading in Screening Mammography ........................................... 797
  J. Campos, P. Taylor, J. Soutter, R. Procter

Reuse of Collaborative Knowledge in Discussion Forums ................. 800
  W. Chen

A Module-Based Software Framework for E-learning over Internet Environment ............................................. 803
  S.-J. Cho, S. Lee
## Table of Contents

Improving Reuse and Flexibility in Multiagent Intelligent Tutoring System Development Based on the COMPOR Platform .......................... 806  
*E. de Barros Costa, H. Oliveira de Almeida, A. Perkusich*

Towards an Authoring Methodology in Large-Scale E-learning Environments on the Web .................................................. 809  
*E. de Barros Costa, R.J.R. dos Santos, A.C. Frey, G. Bittencourt*

ProPAT: A Programming ITS Based on Pedagogical Patterns .................. 812  
*K.V. Delgado, L.N. de Barros*

AMANDA: An ITS for Mediating Asynchronous Group Discussions .... 815  
*M.A. Eleuterio, F. Bortolozzi*

An E-learning Environment in Cardiology Domain .............................. 818  
*E. Ferneda, E. de Barros Costa, H. Oliveira de Almeida,  
L. Matos Brasil, A. Pereira Lima, Jr., G. Millaray Curilem*

Mining Data and Providing Explanation to Improve Learning in Geosimulation .................................................. 821  
*E.V. Filho, V. Pinheiro, V. Furtado*

A Web-Based Adaptive Educational System Where Adaptive Navigation Is Guided by Experience Reuse ........................................... 824  
*J.-M. Heraud*

Improving Knowledge Representation, Tutoring, and Authoring in a Component-Based ILE .................................................. 827  
*C. Hunn, M. Mavrikis*

A Novel Hybrid Intelligent Tutoring System and Its Use of Psychological Profiles and Learning Styles ................................. 830  
*W. Martins, F. Ramos de Melo, V. Meireles, L.E.G. Nalini*

Using the Web-Based Cooperative Music Prototyping Environment CODES in Learning Situations ............. 833  
*E.M. Miletto, M.S. Pimenta, L. Costalonga, R. Vicari*

A Multi-agent Approach to Providing Different Forms of Assessment in a Collaborative Learning Environment ......................... 836  
*M. Mirzarezaee, K. Badie, M. Dehghan, M. Kharrat*

The Overlaying Roles of Cognitive and Information Theories in the Design of Information Access Systems .............................. 839  
*C. Nakamura, S. Lajoie*

A Personalized Information Retrieval Service for an Educational Environment .................................................. 842  
*L. Nakayama, V. Nóbile de Almeida, R. Vicari*
Optimal Emotional Conditions for Learning with an Intelligent Tutoring System ........................................... 845  
*M. Ochs, C. Frasson*

FlexiTrainer: A Visual Authoring Framework for Case-Based Intelligent Tutoring Systems .......................... 848  
*S. Ramachandran, E. Remolina, D. Fu*

Tutorial Dialog in an Equation Solving Intelligent Tutoring System...... 851  
*L.M. Razzaq, N.T. Heffernan*

A Metacognitive ACT-R Model of Students’ Learning Strategies in Intelligent Tutoring Systems ............................ 854  
*I. Roll, R.S. Baker, V. Aleven, K.R. Koedinger*

Promoting Effective Help-Seeking Behavior Through Declarative Instruction .............................................. 857  
*I. Roll, V. Aleven, K. Koedinger*

Supporting Spatial Awareness in Training on a Telemanipulator in Space ..................................................... 860  
*J. Roy, R. Nkambou, F. Kabanza*

Validating DynMap as a Mechanism to Visualize the Student’s Evolution Through the Learning Process .......... 864  
*U. Rueda, M. Larrañaga, J.A. Elorriaga, A. Arruarte*

Qualitative Reasoning in Education of Deaf Students: Scientific Education and Acquisition of Portuguese as a Second Language....... 867  
*H. Salle, P. Salles, B. Bredeweg*

A Qualitative Model of Daniell Cell for Chemical Education ........... 870  
*P. Salles, R. Gauche, P. Virmond*

Student Representation Assisting Cognitive Analysis ......................... 873  
*A. Serguieva, T.M. Khan*

An Ontology-Based Planning Navigation in Problem-Solving Oriented Learning Processes ............................ 877  
*K. Seta, K. Tachibana, M. Umano, M. Ikeda*

A Formal and Computerized Modeling Method of Knowledge, User, and Strategy Models in PIModel-Tutor  .................... 880  
*J. Si*
SmartChat – An Intelligent Environment for Collaborative Discussions ........................................ 883
   S. de Albuquerque Siebra, C. da Rosa Christ, A.E.M. Queiroz, P.A. Tedesco, F. de Almeida Barros

Intelligent Learning Objects: An Agent Based Approach of Learning Objects ........................................ 886
   R.A. Silveira, E.R. Gomes, V.H. Pinto, R.M. Vicari

Using Simulated Students for Machine Learning ................... 889
   R. Stathacopoulou, M. Grigoriadou, M. Samarakou, G.D. Magoulas

Towards an Analysis of How Shared Representations Are Manipulated to Mediate Online Synchronous Collaboration .................. 892
   D.D. Suthers

A Methodology for the Construction of Learning Companions .......... 895
   P. Torreão, M. Aquino, P. Tedesco, J. Sá, A. Correia

Intelligent Learning Environment for Software Engineering Processes .... 898
   R. Yatchou, R. Nkambou, C. Tangha

Invited Presentations

Opportunities for Model-Based Learning Systems in the Human Exploration of Space ....................... 901
   B. Clancey

Toward Comprehensive Student Models:
Modeling Meta-cognitive Skills and Affective States in ITS .............. 902
   C. Conati

Having a Genuine Impact on Teaching and Learning –
Today and Tomorrow ......................................................... 903
   E. Soloway, C. Norris

Interactively Building a Knowledge Base for a Virtual Tutor ............. 904
   L. Tarouco

Ontological Engineering and ITS Research ............................. 905
   R. Mizoguchi

Agents Serving Human Learning ......................................... 906
   S.A. Cerri

Panels

Affect and Motivation ...................................................... 907
   W.L. Johnson, C. Conati, B. du Boulay, C. Frasson, H. Pain, K. Porayska-Pomsta
Inquiry Learning Environments: Where Is the Field and What Needs to Be Done Next? ........................................ 907
   B. MacLaren, L. Johnson, K. Koedinger, T. Murray, E. Soloway

Towards Encouraging a Learning Orientation Above a Performance Orientation .................................................. 907
   C.P. Rosé, L. Anthony, R. Baker, A. Corbett, H. Pain,
   K. Porayska-Pomsta, B. Woolf

Workshops

Workshop on Modeling Human Teaching Tactics and Strategies ............. 908
   F. Akhras, B. du Boulay

Workshop on Analyzing Student-Tutor Interaction Logs to Improve Educational Outcomes ........................................... 909
   J. Beck

Workshop on Grid Learning Services ........................................ 910
   G. Gouardères, R. Nkambou

Workshop on Distance Learning Environments for Digital Graphic Representation .................................................. 911
   R. Azambuja Silveira, A.B. Almeida da Silva

Workshop on Applications of Semantic Web Technologies for E-learning .................................................. 912
   L. Aroyo, D. Dicheva

Workshop on Social and Emotional Intelligence in Learning Environments .................................................. 913
   C. Frasson, K. Porayska-Pomsta

Workshop on Dialog-Based Intelligent Tutoring Systems: State of the Art and New Research Directions ..................... 914
   N. Heffernan, P. Wiemer-Hastings

Workshop on Designing Computational Models of Collaborative Learning Interaction ........................................ 915
   A. Soller, P. Jermann, M. Muehlenbrock, A. Martínez Moné

Author Index .......................................................... 917
Intelligent Tutoring Systems
7th International Conference, ITS 2004, Maceió, Alagoas, Brazil, August 30 - September 3, 2004,
Proceedings
Lester, J.C.; Vicari, R.M.; Paraguacu, F. (Eds.)
2004, XLII, 920 p., Softcover
ISBN: 978-3-540-22948-3