Multiple Perspectives on Problem Solving and Learning in the Digital Age
Multiple Perspectives on Problem Solving and Learning in the Digital Age
Research on problem solving and learning has a long tradition in both psychology and education. Cognitive psychologists agree that people have abilities that are essential for processing information and acting successfully in different environments. The nature of human problem solving and learning has been studied by educators and psychologists over the past hundred years. Accordingly, this interesting field of research was always linked with paradigm shifts, e.g. the cognitive revolution. The progress of computer technology has enabled researchers to develop more effective research methodologies and tools for the assessment of problem solving and learning.

This edited volume with selected expanded papers from the CELDA (Cognition and Exploratory Learning in the Digital Age) 2009 Conference (www.celda-conf.org) addresses the main issues concerned with problem solving, evolving learning processes, innovative pedagogies, and technology-based educational applications in the digital age. There have been advances in both cognitive psychology and computing that have affected the educational arena. The convergence of these two disciplines is increasing at a fast pace and affecting academia and professional practice in many ways. Paradigms (such as just-in-time learning, constructivism, student-centered learning and collaborative approaches) have emerged and are being supported by technological advancements such as simulations, virtual reality and multi-agent systems. These developments have created both opportunities and areas of serious concern. Hence, this volume aims to cover both technological as well as pedagogical issues related to these developments.

We organized the papers included in this volume around five themes: (a) instructional design perspectives, (b) cognitive perspectives, (c) assessment perspectives, (d) schooling and teaching perspectives, and (e) virtual environments perspectives. Each of the editors took lead responsibility for reviewing and editing the papers associated with one theme.

In Part I, instructional design perspectives are described and discussed. The authors show how information and communications technology (ICT) tools have completely altered the way museum curators design many of their exhibits and examine the human-computer interaction (HCI) which occurs when people access online museum exhibits (Alwi & McKay, Chapter 2). An ongoing challenge for
academics is the choice of which technologies to use and how to effectively integrate them into the curriculum. Accordingly, a framework for guiding the integration of technologies into curricula is introduced in the second chapter (Gosper, Chapter 3). Further, to support the learning process, the usability concept must be extended to include pedagogical considerations. The importance of pedagogical usability in education has been recognized, but not sufficiently researched. Therefore, the author shows how to foster pedagogically usable Web-based learning objects in school education (Hadjerrouit, Chapter 4). The lack of monitoring and expertise transfer tools involves important dysfunctions in the course organization and therefore dissatisfaction for tutors and students. The authors propose a personalized platform, which gives information to monitor activities and supports the acquisition and transfer of expertise (Michel & Lavoué, Chapter 5).

In Part II, chapters focus on cognitive perspectives of problem solving and learning in the digital age. The authors introduce a tool which basic aim is to construct a semantic knowledge base of concepts and relations among them, in order to analyze free text responses, assess concept maps and provide to users a semantic dictionary of concepts categorized according to the structures of that cognitive model (Blitsas, Grigoriadou, & Mitsis, Chapter 6). A new 1st person approach, singular and plural, to educational research and practice is introduced and compared with the traditional 2nd/3rd-person education (Iran-Nejad & Stewart, Chapter 7). A study which validates a theoretical framework for identifying social and cognitive regulation strategies employed by students during the process of joint construction of meaning in cooperative tasks in a university’s virtual learning environment is introduced next (López-Benavides & Alvarez Valdivia, Chapter 8). The last chapter of this part presents the new collaborative cognitive tools (CCT) for shared representations. The cognitive tools make a difference by providing a platform for collaborative construction of the school’s information strategy with a shared vision and practice-oriented goals supporting its implementation (Orava & Silander, Chapter 9).

In Part III, new assessment methodologies and tools are introduced. The authors present an attempt to validate a computerized tool as it is used to measure evidence of critical thinking for individual participants in discussion forums (Corich, Kinshuk, & Jeffery, Chapter 10). A new integrated framework for assessing complex problem solving in digital game-based learning in the context of a longitudinal design-based research study is introduced next (Eseryel, Ifenthaler, & Ge, Chapter 11). The concept map based adaptive intelligent knowledge assessment system is described which compares a teacher’s and a learner’s concept map on the basis of graph patterns and assigns score for a submitted solution (Grundspenkis, Chapter 12). Two case studies are presented which show how technologies support the assessment of complex learning in capstone units (McNeill, Chapter 13). Last, a graph-based approach to help learners with ongoing writing is introduced (Pirnay-Dummer & Ifenthaler, Chapter 14).

In Part IV, schooling and teaching perspectives are described and discussed. The authors compare the impact of electronic performance support and web-based training (Klein & Nguyen, Chapter 15). Concepts and applications for moving beyond teaching and learning into a human development paradigm are introduced next.
Preparation, experiences, and roles in technology implementation for leaders for the 21st Century are critically reviewed in the following chapter (Schrum, Galizio, English, & Ledesma, Chapter 17). A project which examines the impact of an instruction based on the technology, pedagogy, and content knowledge framework on podcasting and vodcasting for preservice teachers in the United States is presented next (Yamamoto, Chapter 18).

In Part V, chapters focus on virtual environments perspectives. The authors explore the degree to which individual learning styles affect pre-simulation attitudes toward teamwork and post-simulation perceptions of the value of the simulation as a learning experience among third-semester university-level participants in a large-scale telematic simulation (Ekker & Sutherland, Chapter 19). Effects of an online social annotation tool which was implemented in the context of utilizing question-answering tasks with reading documents in order to foster students’ cognitive development with higher-order thinking, critical analysis, and development of sophisticated arguments in English writing are reported (Kim, Mendenhall, & Johnson, Chapter 20). The development of self-direction indicators for evaluating the e-learning course using students’ self reflections with social software are discussed next (Pata & Merisalo, Chapter 21). The next chapter explores the use of the Internet to connect university students in equivalent classes across international borders, completing collaborative assignments requiring student-student virtual dialog and cross-cultural reflection (Poindexter, Amtmann, & Ferrarini, Chapter 22). Last, the virtual campus project ViCaDiS is introduced which facilitates a shift from Institutional Learning Environments towards Personal Learning Environments (Vasiu & Andone, Chapter 23).

This is the second edited volume to result from a CELDA conference. We are convinced that this work covers the current state of research, methodology, assessment, and technology. When we have so many outstanding papers as were presented in Freiburg, Germany 2008 and Rome, Italy 2009, we will certainly seek to also have future edited volumes, as this benefits the entire professional community.
Acknowledgements

We would like to acknowledge the vital role played by the International Association for Development of the Information Society (http://www.iadis.org) and for its continuing sponsorship of CELDA conferences. In addition, we owe our thanks to the over 150 international CELDA committee members for providing thoughtful reviews for all papers submitted to the CELDA 2009 conference. Finally, we owe special thanks to Springer Science-Business Media (http://www.springer.com/) and Marie Sheldon for agreeing to publish the best papers from CELDA 2009 in this edited volume.

Freiburg, Germany
Athabasca, AB, Canada
Lisboa, Portugal
Piraeus, Greece
Athens, Georgia

Dirk Ifenthaler
Kinshuk
Pedro Isafas
Demetrios G. Sampson
J. Michael Spector
# Contents

1 Learning to Solve Problems in the Digital Age: Introduction . . . . 1
   J. Michael Spector and Kinshuk

Part I  Instructional Design Perspectives

2 Investigating an Online Museum’s Information System . . . . 11
   Asmidah Alwi and Elspeth McKay

3 MAPLET – A Framework for Matching Aims, Processes, Learner Expertise and Technologies . . . . . . . . . . . . . . . . . . . 23
   Maree Gosper

4 Web-Based Learning Objects in School Education . . . . . . . 37
   Said Hadjerrouit

5 KM and WEB 2.0 Methods for Project-Based Learning . . . . . 49
   Christine Michel and Élise Lavoué

Part II  Cognitive Perspectives

6 Semandix: Constructing a Knowledge Base According to a Text Comprehension Model . . . . . . . . . . . . . . . . . . . . . . . 67
   Panagiotis Blitsas, Maria Grigoriadou, and Christos Mitsis

7 First-Person Education and the Biofunctional Nature of Knowing, Understanding, and Affect . . . . . . . . . . . . . . . . . 89
   Asghar Iran-Nejad and William Stewart

8 Socio-cognitive Regulation Strategies in Cooperative Learning Tasks in Virtual Contexts . . . . . . . . . . . . . . . . . . . 111
   Denisse Margoth López-Benavides and Ibis Marlene Alvarez-Valdivia

9 Collaborative Cognitive Tools for Shared Representations . . . . 127
   Jukka Orava and Pasi Silander
Part III  Assessment Perspectives

10 Automating the Measurement of Critical Thinking for Individuals Participating in Discussion Forums
Stephen Corich, Kinshuk, and Lynn Jeffrey

11 Alternative Assessment Strategies for Complex Problem Solving in Game-Based Learning Environments
Deniz Eseryel, Dirk Ifenthaler, and Xun Ge

12 Concept Map Based Intelligent Knowledge Assessment System: Experience of Development and Practical Use
Janis Grundspenkis

13 Technologies to Support the Assessment of Complex Learning in Capstone Units: Two Case Studies
Margot McNeill

14 Text-Guided Automated Self Assessment
Pablo Pirnay-Dummer and Dirk Ifenthaler

Part IV  Schooling and Teaching Perspectives

15 Comparing the Impact of Electronic Performance Support and Web-Based Training
James D. Klein and Frank Nguyen

16 Moving Beyond Teaching and Learning into a Human Development Paradigm
Sandra Reeb-Gruber, Michael K. McCuddy, Xavier Parisot, and David Rossi

17 Leaders for the Twenty-First Century: Preparation, Experiences, and Roles in Technology Implementation
Lynne Schrum, Lyndsie M. Galizio, Mary C. English, and Patrick Ledesma

18 Pedagogy and Content Knowledge Based Podcasting Project for Preservice Teachers
Junko Yamamoto

Part V  Virtual Environments Perspectives

19 Simulation-Games as a Learning Experience: An Analysis of Learning Style and Attitude
Janet Lynn Sutherland and Knut Ekker

20 Implementation of an Online Social Annotation Tool in a College English Course
Anne Mendenhall, Chanmin Kim, and Tristan E. Johnson
21 Self-Direction Indicators for Evaluating the Design-Based Elearning Course with Social Software ................................. 325
Kai Pata and Sonja Merisalo

22 Employing Virtual Collaborative Exchanges to Expand Global Awareness ................................................................. 343
Sandra Poindexter, Ray Amtmann, and Tawni Ferrarini

23 Ideas and Concepts of ViCaDiS – A Virtual Learning Environment for Digital Students ........................................ 359
Radu Vasiu and Diana Andone

Index ............................................................................................................................................... 377
Contributors

**Ibis Marlene Alvarez-Valdivia** Universitat Autònoma de Barcelona, Barcelona, Spain, ibismarlene.alvarez@uab.cat

**Asmidah Alwi** School of Business IT and Logistics RMIT University, Melbourne 3000, VIC, Australia, asmidah.alwi@rmit.edu.au

**Ray Amtmann** Northern Michigan University, Marquette, MI, USA, ramtmann@nmu.edu

**Diana Andone** “Politehnica” University of Timisoara, Timisoara, Romania, diana.andone@cm.upt.ro

**Panagiotis Blitsas** I.P.G.S. in Basic & Applied Cognitive Science, National & Kapodistrian University of Athens, Panepistimiopolis, Athens, Greece, pblitsas@di.uoa.gr

**Stephen Corich** Eastern Institute of Technology Hawke’s Bay, Napier, Taradale, New Zealand, scorich@eit.ac.nz

**Knut Ekker** Information Technology, Nord-Trondelag University College, Steinkjer, Norway, knut.ekker@hint.no

**Mary C. English** George Mason University, Fairfax, VA, USA, menglis2@gmu.edu

**Deniz Eseryel** College of Education, University of Oklahoma, Norman, OK, USA, eseryel@ou.edu

**Tawni Ferrarini** Northern Michigan University, Marquette, MI, USA, tferrari@nmu.edu

**Lyndsie M. Galizio** George Mason University, Fairfax, VA, USA, lgalizio@gmu.edu

**Xun Ge** University of Oklahoma, Norman, OK, USA, xge@ou.edu

**Maree Gosper** Learning and Teaching Centre, Macquarie University, Sydney, NSW, Australia, maree.gosper@mq.edu.au
Maria Grigoriadou I.P.G.S. in Basic & Applied Cognitive Science, National & Kapodistrian University of Athens, Panepistimiopolis, Athens, Greece, gregor@di.uoa.gr

Janis Grundspenksis Department of Systems Theory and Design, Faculty of Computer Science and Information Technology, Riga Technical University, Riga, Latvia, janis.grundspenksis@cs.rtu.lv

Said Hadjerrouit University of Agder, Kristiansand, Norway, said.hadjerrouit@uia.no

Dirk Ifenthaler Albert-Ludwigs-University Freiburg, Freiburg, Germany, ifenthaler@ezw.uni-freiburg.de

Asghar Iran-Nejad The University of Alabama, Tuscaloosa, AL, USA, airannej@bamaed.ua.edu

Pedro Isaías Universidade Aberta, Lisboa, Portugal, pisaias@univ-ab.pt

Lynn Jeffrey Massey University, New Zealand, I.m.jeffrey@massey.ac.nz

Tristan E. Johnson Florida State University, Gainesville, FL, USA, tristanjohnson@gmail.com

Chanmin Kim University of Georgia, Athens, GA, USA, chanmin@uga.edu

Kinshuk University of Athabasca, Athabasca, AB, Canada, kinshuk@ieee.org

James D. Klein Arizona State University, Tempe, AZ, USA, james.klein@asu.edu

Élise Lavoué Equipe de recherche MAGELLAN, Université Jean Moulin Lyon 3, Lyon, Cedex 08, France, elise.lavoue@univ-lyon3.fr

Patrick Ledesma George Mason University, Fairfax, VA, USA, pledesml1@gmu.edu

Denisse Margoth López-Benavides Universitat Oberta de Catalunya, Barcelona, Catalonia, Spain, dlopezben@uoc.edu

Elspeth McKay School of Business IT and Logistics RMIT University, Melbourne 3000, VIC, Australia, elspeth.mckay@rmit.edu.au

Michael K. McCuddy Valparaiso University, Valparaiso, IN, USA, mike.mccuddy@valpo.edu

Margot McNeill Macquarie University, Sydney, NSW, Australia, margot.mcneill@mq.edu.au

Anne Mendenhall Department of Educational Psychology Learning System, Florida State University, Gainesville, FL, USA, anne.mendenhall@gmail.com

Sonja Merisalo Helsinki Metropolia University of Applied Sciences, Oulu, Finland, sonja.merisalo@metropolia.fi
Christine Michel Laboratoire LIESP, INSA-Lyon, Villeurbanne, France, christine.michel@insa-lyon.fr

Christos Mitsis University of Piraeus, Piraeus, Greece, msp09006@students.cs.unipi.gr

Frank Nguyen American Express, USA, frank@frankn.net

Jukka Orava Department of Education, Medical Center, Helsinki, Finland, jukka.orava@hel.fi

Xavier Parisot Champagne Graduate School of Management, Troyes, France, xavier.parisot@groupe-esc-troyes.com

Kai Pata Institute of Informatics, Tallinn University, Tallinn, Estonia, kpata@tlu.ee

Pablo Pirnay-Dummer Albert-Ludwigs-University Freiburg, Freiburg, Germany, pablo.dummer@ezw.uni-freiburg.de

Sandra Poindexter College of Business, Northern Michigan University, Marquette, MI, USA, spoindex@nmu.edu

Sandra Reeb-Gruber INHolland University of Applied Sciences, HB Hoofddorp, The Netherlands, sandra.reebgruber@inholland.nl

David Rossi Reims Champagne Ardenne University, Reims, France, david.rossi@univ-reims.fr

Demetrios G. Sampson Department of Technology in Education and Digital Systems, University of Piraeus, Piraeus, Greece, sampson@unipi.gr

Lynne Schrum George Mason University, Fairfax, VA, USA, lschrum@gmu.edu

Pasi Silander Department of Education, Medical Center, Helsinki, Finland, pasi.silander@hel.fi

J. Michael Spector University of Georgia, Athens, GA, USA, mspector@uga.edu

William Stewart The University of Alabama, Tuscaloosa, AL, USA, airannej@bamaed.ua.edu

Janet Lynn Sutherland English-Speaking Cultures, Languages and Literatures Faculty, University of Bremen, Bremen, Germany, jsuther@uni-bremen.de

Radu Vasiu “Politehnica” University of Timisoara, Timisoara, Romania, radu.vasiu@cm.upt.ro

Junko Yamamoto Slippery Rock University of Pennsylvania, Slippery Rock, PA, USA, junko.yamamoto@sr.edu