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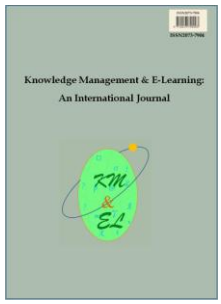

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Editorial: Digital systems supporting cognition and exploratory learning in 21st century

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Editorial: Digital systems supporting cognition and exploratory learning in 21st century

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Abstract: Digital systems and digital technologies are globally investigated for their potential to transform learning and teaching towards offering unique learning experiences to the 21st century learners. This Special Issue on Digital Systems supporting Cognition and Exploratory Learning in 21st Century aims to contribute to the dialogue between the educational technology and educational psychology research community and the educational practitioners on current issues towards large scale take-up of educational technology.

Keywords: Digital systems; Cognition; Exploratory learning

Biographical notes: Demetrios G. Sampson holds a Diploma in Electrical Engineering from the Democritus University of Thrace, Greece (1989) and a Ph.D. in Electronic Systems Engineering from the University of Essex, UK (1995). He is a Professor at the Department of Digital Systems, University of Piraeus, Greece and a Research Fellow at the Information Technologies Institute (ITI) of the Centre of Research and Technology Hellas (CERTH). He is the Founder and Director of the Advanced Digital Systems and Services for Education and Learning (ASK) since 1999. His main research interests are in

the area of Learning Technologies. He is the co-author of more than 327 publications in scientific books, journals and conferences with at least 1450 known citations (h-index: 21). He has received 7 times Best Paper Award in International Conferences on Advanced Learning Technologies. He is a Senior and Golden Core Member of IEEE and he was the elected Chair of the IEEE Computer Society Technical Committee on Learning Technologies (2008-2011). He is the recipient of the IEEE Computer Society Distinguished Service Award (July 2012). More details can be found at: http://www.ask4research.info/DS_CV.php.

Dirk Ifenthaler is the Director, Centre for Research in Digital Learning at Deakin University. Professor Ifenthaler was a 2012 Fulbright Scholar-in-Residence at the Jeannine Rainbolt College of Education, the University of Oklahoma, USA. Dirk's background is in cognitive psychology, educational technology, statistics, and teacher education. He developed automated and computer-based methodologies for the assessment, analysis, and feedback of graphical and natural language representations. His research outcomes include numerous co-authored books, book series, book chapters, journal articles, and international conference papers. Dirk is the Editor-in-Chief of Technology, Knowledge and Learning.

Pedro Isaias is an associate professor at Universidade Aberta (Portuguese Open University) in Lisbon, Portugal, responsible for several courses and director of the master degree program in Electronic Commerce and Internet since its start in 2003. He holds a PhD in Information Management (in the speciality of information and decision systems) from the New University of Lisbon. Author of several books, book chapters, papers and research reports, all in the information systems area, he has headed several conferences and workshops within the mentioned area. He has also been responsible for the scientific coordination of several EU funded research projects and has participated in various research projects. He is also a member of the editorial board of several journals and program committee member of several conferences and workshops. He is leading co-editor of the Interactive Technology and Smart Education (ITSE) Journal. At the moment, he is conducting research activity related to Information Systems in general, E-Learning, E-Commerce and WWW-related areas.

J. Michael Spector is a Professor and Former Chair of Learning Technologies at the University of North Texas. He was previously Professor of Educational Psychology and Instructional Technology, Doctoral Program Coordinator for the Learning, Design, and Technology Program, and a Research Scientist at the Learning and Performance Support Laboratory at the University of Georgia. Previously, he was Associate Director of the Learning Systems Institute, Professor of Instructional Systems, and Principal Investigator for the International Center for Learning, Education and Performance Systems at Florida State University. He served as Chair of Instructional Design, Development and Evaluation at Syracuse University and Director of the Educational Information Science and Technology Research Program at the University of Bergen. He earned a Ph.D. in Philosophy from The University of Texas at Austin. His research focuses on intelligent support for instructional design, assessing learning in complex domains, and technology integration in education. Dr. Spector served on the International Board of Standards for Training, Performance and Instruction (ibstpi) as Executive Vice President; he is a Past President of the Association for Educational and Communications Technology as well as a Past Chair of the Technology, Instruction, Cognition and Learning Special Interest Group of AERA; he is also an active member of AERA's Instructional Technology and Learning and Technology SIGs. He is

editor of Educational Technology Research & Development and serves on numerous other editorial boards. He edited the third and fourth editions of the Handbook of Research on Educational Communications and Technology, as well as the Encyclopedia of Educational Technology, and has more than 150 publications to his credit. More details can be found at: https://sites.google.com/site/jmspector007/Home/curriculum-vita.

Introduction

The Cognition and Exploratory Learning in the Digital Age (CELDA) conference is a unique international research conference that aims to bring together educational technology and educational psychology researchers, as well as educational practitioners in fostering the dialogue between these communities that often appear to act in isolation. This fragmented research and practice environment worldwide results to sporadic efforts that reduce the transformative potential of digital technologies in learning and teaching, exactly when this is most needed in response to global societal demand for technology-supported quality education. To this end, CELDA has created, since its 1st edition in 2004, a community that actively contributes to this dialogue and has contributed to outcomes that influence academia and professional practice in many ways (Ifenthaler, Isaias, Spector, Kinshuk, & Sampson, 2011; Isaias, Ifenthaler, Kinshuk, Sampson, & Spector, 2012; Sampson, Isaias, Ifenthaler, & Spector, 2013; Spector, Ifenthaler, Isaias, Kinshuk, & Sampson, 2010; Sampson, Ifenthaler, Spector, & Isaias, 2014).

This special issue is yet another outcome of this long lasting process (Ifenthaler, Spector, Sampson, & Isaias, 2014; Ifenthaler, Sampson, Spector, & Isaias, 2012; Ifenthaler, Isaias, Kinshuk, Sampson & Spector, 2012; Kinshuk, Ifenthaler, Spector, Sampson & Isaias, 2010; Ifenthaler, Isaias, Spector, Kinshuk, & Sampson, 2009; Spector, Sampson, Kinshuk, & Isaias, 2009; Kinshuk, Spector, & Sampson, 2008; Kinshuk, Sampson, Isaias, Spector, & Schrum, 2007; Kinshuk & Sampson, 2006). It is created from the extended versions of best papers from the 2013 International Conference on Cognition and Exploratory Learning in the Digital Age (CELDA; see http://www.celda-conf.org) that was held in Fort Worth, Texas, USA in October 2013 hosted by the Department of Learning Technologies of the University of North Texas. Each contribution reports an original research work in the theme of this special issue, namely, Digital Systems supporting Cognition and Exploratory Learning in 21st Century.

The special issue starts with an *Longitudinal analysis of cognitive constructs fostered by STEM activities for middle school students* by Rhonda Christensen, Gerald Knezek, Tandra Tyler-Wood (University of North Texas, USA) and David Gibson (Curtin University, Western Australia). In this article, the authors report from their Middle Schoolers Out to Save the World (MSOSW) project funded from the Innovative Technology Experiences for Students and Teachers (ITEST) program of the U.S. National Science Foundation (NSF). The main goal of the MSOSW project, entering its sixth year at the time of publication of this special issue, is to foster STEM content and career interest in order to prepare middle school students to participate in the science, technology, engineering and mathematics (STEM) workforce of the future. The major findings shared in this article are: (1) higher-order STEM-related constructs established during the treatment year tended to persist two years later, even as component dispositions varied, and (2) gender differences in level of persistence emerged in only one of the four higher-order constructs identified.

Next, Kuo-Hung Chao (National Taiwan Normal University, Taiwan), Chung-Hsien Lan (Taoyuan Innovation Institute of Technology, Taiwan), Kinshuk (Athabasca University, Canada), Kuo-En Chang (National Taiwan Normal University, Taiwan) and Yao-Ting Sung (National Taiwan Normal University, Taiwan) present the *Implementation of a mobile peer assessment system with augmented reality and its deployment in a fundamental design course*. This article proposes a framework that incorporates mobile peer assessment and augmented reality (AR) technology to enhance interaction and learning effectiveness. Based on this framework, a mobile AR peer assessment system has been developed to facilitate students to improve work interpretation, frequently interact with peers, represent their thinking and reflect upon their own works anytime anywhere. Furthermore, the mobile AR technology provides personalized and location-based adaptive contents that enable individual students to interact with the mixed reality environment and observe how works are possibly applied to the real world in the future. The system, then, was used in a fundamental design course, where students used the system to acquire sufficient information in indoor and outdoor situations and mark peers' work accurately based on appropriate assessment criteria. The experimental results demonstrate that the system assisted students in acquiring useful information, proposing their viewpoints, and further fostering critical thinking skills and reflection.

Then, Michael Eisenberg and Antranig Basman (University of Colorado, USA) and Sherry Hsi (Lawrence Hall of Science, USA) present a software system, *Math on a Sphere* (MoS), that opens up access to the Science on a Sphere (SoS), a compelling educational display installed at numerous museums and planetariums around the world, by providing a simple programming interface to the public, over the World Wide Web. Their system allows anyone to write programs for spherical graphics patterns, and then to upload those programs at a planetarium or museum site and see the result on the giant sphere. The authors describe the implementation of the MoS system; sketch a sample project; and conclude with a wide-ranging discussion of their user testing so far, as well as strategies for empowering children and students with greater control of public displays.

This special issue concludes with a contribution by Panagiotis Zervas, Charalampos Alifragkis and Demetrios Sampson (University of Piraeus and the Centre for Research and Technology – Hellas, Greece). In this article, the authors offer A *quantitative analysis of learning object repositories (LORs) as knowledge management systems*. More specifically, the authors present a quantitative analysis of the functionalities of forty-nine (49) major LORs, so as (a) to measure the adoption level of the LORs' functionalities master list, and (b) to identify whether this level influences LORs' growth as indicated by the development over time of the number of the LOs and the number of registered users that these LORs include.

Overall, the four selected papers in this special issue demonstrate the different perspectives on the transformative potential of digital technologies and digital systems in learning and teaching, contributing to the current public discourse on educational technology.

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