




ICCE

Mumbai | India | 2016

THE 24th INTERNATIONAL CONFERENCE ON COMPUTERS IN EDUCATION
Nov. 28th - Dec. 2nd, 2016

“Think Global Act Local”

Early Career Workshop Proceedings

Sponsors from Govt. of India



Sponsors from Indian Industries



Copyright 2016 Asia-Pacific Society for Computers in Education

All rights reserved. No part of this book may be reproduced, stored in a retrieval system, transmitted, in any forms or any means, without the prior permission of the Asia-Pacific Society for Computers in Education.

ISBN 978-986-84735-6-0

Publisher

Asia-Pacific Society for Computers in Education

No.300, Jungda Road, Jhongli District, Taoyuan City 320, Taiwan

Editors

Lung-Hsiang WONG

Tanja MITROVIC

Hyo-Jeong SO

Weiqin CHEN

Jie-Chi YANG

Sahana MURTHY

Su Luan WONG

Sridhar IYER

PREFACE

Held in conjunction with the ICCE 2016, the inaugural Early Career Workshop (ECW) offers an opportunity for early career scholars in the learning technology field to discuss their research, early-career challenges and career directions with peers and senior advisors. The ECW aims to add value to the early-career participants in, but not limited to, the following aspects:

- To develop academic support networks among peers, between early career scholars and more senior scholars, and the connection between early career scholars and the APSCE Special Interest Groups (SIGs) related to their respective research interests
- To be engaged in negotiation and exchange, thereby developing greater awareness and appreciation, in acting strategically about one's academic career, including the development of a thriving research program, grant applications and journal publications, balancing multiple requirements (research, teaching, university/international services), building local and international relationships to maximize future career opportunities, getting promotion and tenure, etc.

In this ECW, three early-career scholars who are working in various research areas (Dr. Amali Weerasinghe: Intelligent Tutoring Systems for computer science education; Dr. Mas Nida Md. Khambari: meaningful gamified instructions for 21st century learners; Dr. Isabelle Savard: development of a method to consider cultural variables in the instructional design process) will discuss their early-career challenges and career directions with peers and senior advisors. For the first edition of ECW, it is our great honor to have invited three distinguished researchers, namely, Prof. Bruce McLaren, Prof. Nikol Rummel and Prof. Wenli Chen to share with the participants their wisdom and experiences in developing their illustrious academic careers. It is hoped that the ECW will become a platform to nurture and sustain a support network among early-career researchers and between them and the ICCE community for the participants' common goal of striving for a more eminent and fruitful academic life.

TABLE OF CONTENT

Paper Title	Authors	Page
Exploring the Effect of Metacognitive Support within the Context of Software System Modelling	<i>Amali WEERASINGHE</i>	1
Innovating a Meaningful Gamified Instruction: An Instructor's Quest to Fulfil the Demands of 21st Century Learners	<i>Mas Nida MD. KHAMBARI</i>	3
Using Design Based Research to Develop Strategies and Tools for Cultural Adaptation	<i>Isabelle SAVARD</i>	6

Exploring the Effect of Metacognitive Support within the Context of Software System Modelling

Amali WEERASINGHE

School of Computer Science, University of Adelaide, Australia
amali.weerasinghe@adelaide.edu.au

1. Overview

My overarching research goal is to advance our understanding about the complex interactions between learners and intelligent learning technologies while focusing on cognitive and metacognitive processes. My research is in the area of intelligent tutoring systems (ITS), which are complex software tools whose design is informed by cognitive theory and cognitive modelling. These systems are capable of adapting instruction to the needs of each learner using artificial intelligence (AI) techniques. In order to accomplish my goal, I conduct classroom and laboratory studies and collect fine-grained data to develop models of learners. These models enable me to build intelligent tutoring systems to foster conceptual change in learners through customized learning environments.

2. Research Agenda

The global move towards ‘knowledge-intensive economies’ requires a population with higher-order thinking skills. This necessitates exploring ways to support the development of higher-order thinking skills. Thus overall goal of my research is to explore ways of utilising intelligent tutoring systems to foster higher-order thinking skills particularly metacognitive skills of learners. These skills enable learners to set goals, plan their learning, monitor their progress, and respond appropriately to difficulties and errors. Such skills are vital to become independent problem-solvers who can achieve competency quickly in new domains. Bransford et al. (2000) suggest metacognition as one of three principles that should be applied to educational research and design. Numerous tutoring systems include metacognitive support to improve domain-level learning. For example, self-explanation has been shown to support deep learning in Database Modelling (Mitrovic, 2012), Physics (Conati & VanLehn, 2000) and Geometry (Aleven & Koedinger, 2002). However, very few systems actually attempt to help students to acquire or improve the metacognitive skills themselves (and not only the domain-level knowledge). These systems include Help Tutor (Roll, et al., 2010), Betty’s Brain (Wagster, et al., 2007) and MetaTutor (Azevedo et al., 2011). However, a lot remains to be known about how intelligent tutoring systems can support the acquisition of metacognitive skills. Modelling, tutoring, and evaluation of metacognitive skills and knowledge pose a number of challenges. For example, how can metacognitive knowledge be represented? What is the relationship between domain-level support and metacognitive support? How can metacognitive behaviour be measured over extended periods of time or changing contexts?

My research focuses on exploring these challenges within UML-IT, an ITS that helps students learn Unified Modelling Language (UML) modelling. Modelling software systems is a core skill expected by a software engineer (Sommerville, 2011). Thus this is a core topic in a majority of undergraduate software engineering programmes. UML consists of multiple graphical notations, which captures different aspects of a software system including static

structures, component behaviours and component interactions. These graphical notations enable software engineers to capture multiple perspectives of a single system. The modelling process starts with a Use Case diagram, which enables to specify the boundary of the system being modeled. Outside the boundary, we specify other systems, organizations or people that either provide information to the target system or consume information from the system. Inside the boundary we model a set of use cases, which is a high-level view of the system requirements. Upon completion of the Use case diagram, the class diagram is designed. This provides the structure of the system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects. After the Class diagram, a set of sequence diagrams, one for each Use Case is created. A sequence diagram represents objects and classes involved in each Use Case and the sequence of messages exchanged between the objects needed to carry out the functionality of the Use Case. While Class diagrams represent a static view of the system, Sequence diagrams provide a dynamic view of the system. Even though there are many other types of diagrams available in UML, we will limit our discussion to these three types of diagrams (Use case diagrams, Class diagrams and Sequence diagrams) to stay within the scope of the paper.

The need to capture multiple perspectives of a single system through multiple modelling tasks provides an opportunity to explore the effect of metacognitive support in inter-related, open-ended tasks for a single software system. Even though metacognitive support has been provided for open-ended tasks, the effect of such support has not been explored within the context of inter-related open-ended tasks. Furthermore, intelligent learning support provided to learn UML modelling has been limited to a single type of diagrams i.e. class diagrams (Baghaei and Mitrovic, 2007). In contrast, my research agenda focuses on exploring the effect of metacognitive support for inter-related open-ended tasks within the context of system modelling using UML.

References

- Aleven, V., Koedinger, K. R. (2002), An effective meta-cognitive strategy: learning by doing and explaining with a computer-based Cognitive Tutor. *Cognitive Science*, 26(2), 147-179.
- Azevedo, R., Johnson, A., & Chauncey, A. & Graesser, A. (2011). Use of hypermedia to convey and assess self-regulated learning. In Schunk, D. H. & Zimmerman, B. (Eds.), *Handbook of self-regulation of learning and performance* (pp 102-121), New York: Routledge,
- Baghaei, N.m & Mitrovic, A. (2007). From Modelling Domain knowledge to Metacognitive Skills: Extending a Constraint-based Tutoring System to Support Collaboration. *Proceedings of the 11th International Conference on User Modeling* (pp.217-227), Corfu, Greece,
- Bransford, J. (2000). *How people learn: brain, mind, experience*. Washington D.C.: National Academy Press.
- Conati C., & VanLehn, K. (2000). Toward Computer-Based Support of Meta-Cognitive Skills: a Computational Framework to Coach Self-Explanation. *International Journal of Artificial Intelligence in Education*, 11, 389-415.
- Mitrovic, A. (2012). Fifteen years of constraint-based tutors: What we have achieved and where we are going. *User Modeling and User-Adapted Interaction*, 22(1-2), 39-75
- Roll, I., Aleven, V., McLaren, B. M., & Koedinger, K. R. (2010), Improving students' help seeking skills using metacognitive feedback in an intelligent tutoring system. *Learning and Instruction*, 21(2), 267-280.
- Sommerville, I. (2011). *Software Engineering*, Boston, Massachusetts: Pearson Education.
- Wagster, J., Tan, J., Wu, Y., Biswas, G., & Schwartz, D. (2007). Do learning by teaching environments with metacognitive support help students develop better learning behaviors?. *Proceedings of the 29th Annual Meeting of the Cognitive Science Society* (pp. 695-700), Nashville, TN.

Innovating a Meaningful Gamified Instruction: An Instructor's Quest to Fulfil the Demands of 21st Century Learners

Mas Nida MD. KHAMBARI
Universiti Putra Malaysia, Malaysia
*khamasnida@upm.edu.my

Abstract: In the quest to fulfill the demands of 21st Century Learners who are digital citizens, this study aims to explore the gamified instruction approach in the context of higher education institution and how it could impact learning and instruction. The dynamic and adaptive nature of today learners calls for a new mode of instruction—bringing new challenges to instructors. This study is deemed timely in the transformation age of instructional system. It also echoes the Malaysian Education Ministry aspirations to become world's leading education system that actively pursue technologies and innovations that fulfil 21st Century learners' needs and enables greater personalization of learning experience.

Keywords: Innovation, gamified instruction, gamification, game elements, 21st Century education, higher education

1. Introduction

Today's students are 21st Century learners. They are digital citizens growing up with rapid developments of technologies and advanced gadgets. They are dynamic and adaptive to new things. Because of this, the practice on teaching and learning has taken a different quest from what it used to be not so long ago. The challenges in getting learners to be engaged, participative, and motivated in lessons have increased. More often than not, learners are not keen to attend instructions which are carried out in a teacher-centred mode. Debates aroused. Why was this not a problem before? Why are learners today different from those from a decade ago? The Malaysian Education Ministry, in the Malaysian Education Blueprint 2015-2025 (Higher Education), has charted waves of transformation to accelerate improvements in Higher Education instructions so as to create new generation of Malaysian students to excel globally in a competitive environment (Ministry of Education Malaysia, 2015). With such aspiration, a change of mode of instruction at the higher education institution level is of a crucial need.

2. Research Background and Literature Reviews

The dynamic nature of 21st Century learners calls for a new mode of instruction. Of late, gamification has become an emerging phenomenon in the field of education. Gamification in classroom instruction is defined as an approach whereby an instructor uses game elements in non-game context (Deterding, Khaled, Nacke, & Dixon, 2011), namely in teaching, to create a fun and engaging learning atmosphere (Amir & Ralph, 2014). It employs the elements of point-giving; playing for a specific goal to achieve in a specific structure (Nicholson, 2012) as a means to engage and immerse students in the teaching and learning process. Other elements include the use of such as badges, leaderboards, progress bars, performance graphs, quests, meaningful stories, avatars, and profile developments (Sailer, Hense, Mandl, & Klevers, 2013). Basically, gamification in instruction uses the motivational power of games but in the context of education to enhance and diversify the teaching approach and foster self-driving behavior.

In the past, scholars had discussed on the gamification's effect on students' motivation. It is seen as an innovative approach to foster motivation (Sailer et al., 2013) as it allows the freedom for trial-and-error and encourages "exploration, collaboration, and the exchange of ideas while removing unwanted pressures that can interfere with students' abilities" (Cohen, 2011, p. 17). When gamification is employed, users or students who played the game, should feel that the activity is important to them and thereby will be self-motivated to perform it. Thus, learning can happen in an almost continuous basis. However, Deci, Koestner and Ryan (2011) warned that facilitating people's understanding of the importance of the games activities to themselves is a challenge. Nicholson (2012) suggests removing the scoring elements of a gamification to encourage a focus on the integration of play; thus yielding a meaningful game-based experience.

However, very limited empirical research has investigated how or why gamification or game-based instruction works especially in the higher-education institution context. Therefore, it is against this background that this study is undertaken.

3. Research Questions

This study aims to answer these questions:

1. What game elements in the instructional system that work or do not work for undergraduate students?
2. What are the feedbacks of undergraduate students who have experienced gamified learning/instruction?
3. How has the gamified learning/instruction impacted the undergraduate students' learning experiences?

4. Significance of the Research

This research will also shed an insight into the scholarship of teaching and learning, especially in helping instructors to identify ways to increase students' motivation and engagement in instructions by using the gamification approach. It is deemed timely in the transformation age of the instructional system.

5. Research Methodology

This study will employ a qualitative research methods. The participants will be all of the undergraduate students (approximately 30 students) who are currently enrolled in the researcher's course FCE3400 Educational Technology at the Faculty of Educational Studies, Universiti Putra Malaysia in the September 2016 semester. Data will be collected in the form of auto-ethnography of the course instructor, documents, survey forms, video recordings of critical events, and audio recordings of focus group interviews. An interview protocol and observation rubric will be developed prior to the September 2016 semester's commencement. A systematic grounded theory analysis will be carried out; utilizing open coding method (Strauss & Corbin, 2008; Charmaz, 2006) and categorizing them according to themes. The audio-recorded interviews and video-recorded critical events will be transcribed, and the transcripts will be read and re-read to ensure familiarization and enhance the accuracy of the findings.

6. Expected Results and Benefit

The researchers anticipate to find the types of game elements in the instructional system that work for the undergraduate students enrolled in the course FCE3400 Educational Technology at the Faculty of Educational Studies, Universiti Putra Malaysia. These game elements should be able to enhance students' engagement and motivation in classroom participation and improve their learning experiences. The researchers also theorize that there will be challenges and drawbacks of using

gamification as an instructional approach and ways to overcome them. This research will pave a way for future research studies on the scholarship of teaching and learning specifically in the use of gamification in instruction; proposing models of learning through games that could support Malaysia's aspiration to become the world's leading education system that fulfils the 21st Century demands.

References:

- Amir, B. & Ralph, P. (2014). Proposing a theory of gamification effectiveness. *ICSE'14*. Hyderabad, India.
- Deci, E., Koestner, R., & Ryan, R. (2001). Extrinsic rewards and intrinsic motivations in education: reconsidered onve again. *Review of Educational Research*, 71(1), 1-27.
- Deterding, S., Khaled, R., Nacke, L., & Dixon, D. (2011). Gamification: Towards a definition. *Proceedings of the 2011 annual conference extended abstracts on human factors in computing systems*, ACM.
- Ministry of Education Malaysia (2015). *Executive Summary Malaysia Education Blueprint 2015-2025 (Higher Education)*. Retrieved from www.moe.gov.my
- Sailer, M., Hense, J., Mandl, H., & Klevers, M. (2013). Psychological Perspectives on Motivation through Gamification. *IXD&A*, 19, 28-37
- Cohen, A. M. (2011). The gamification of education. *The Futurist*, 45(5), 16-17. Retrieved from <http://search.proquest.com/docview/884627174?accountid=27932>
- Charmaz, K. (2006). *Constructing Grounded Theory: A practical guide through qualitative analysis*. London: Sage.
- Strauss, A. L. & Corbin, J. M. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory (3rd Ed.)*. California: Sage.

Using Design Based Research to Develop Strategies and Tools for Cultural Adaptation

Isabelle SAVARD*

LICEF Research Center, TÉLUQ, Canada / Laval University, Canada

*isabelle.savard@fmed.ulaval.ca

1. Introduction

The internationalization of education has placed the need for cultural adaptation at the heart of present-day concerns in educational technology. We (Savard, I., 2014, Savard, I., Paquette, G. et Bourdeau, J. (2014) and Savard, I., Bourdeau, J., Paquette, G., 2010, 2013) have proposed a method to consider cultural variables in the instructional design process, and an advisor system that accompanies the instructional designer in his or her cultural adaptation activities. To do so, we have defined the notion of Culture, identified cultural variables in pedagogical practices and proposed an ontology of cultural variables. Using this ontology as a basis, we have created a “Cultural Diversity” knowledge base that brings together knowledge about pedagogical practices in five different national cultures: Belgium, Mauritius, France, Gabon and Quebec. Our advisor system uses this knowledge to advise the instructional designer who wishes to adapt to a new culture.

The research methodology used is Design-based Research (Bell, 2004), into which we have integrated the Unified Process (Larman, 2004). Design-based Research (DBR) is a systematic and flexible methodology with the goal to improve educational practices through iterative analyses, design, development and implementation in real contexts so as to establish theoretical principles and proposals (Wang and Hannafin, 2005). According to Reeves (2000), the goal of this type of developmental research is to solve real and present-day problems while building design principles that may be useful in future decision making. Three main characteristics of DBR may be highlighted: its dual purpose, which consists in understanding the phenomena studied and adjusting the design (interventionist); its adaptability, which makes it possible to modify the protocol and the design during experimentation; and its openness, on the basis of which a DBR protocol is able to bring together quantitative and qualitative methods and techniques.

In accordance with this iterative process, our research began with semi-structured interviews at the University of Mauritius, where we analyzed local pedagogical practices, as well as practical problems relating to cultural adaptation. These interviews confirmed the need to take cultural variables into consideration in the instructional design process, and in the cultural adaptation of learning objects for reuse in a new culture. We then developed: 1) the method for treating cultural variables, 2) the knowledge base and 3) the advisor system, by consulting designers in the field, particularly via a web questionnaire. Our work made it possible for us to target nineteen variables that we grouped into three main categories: values, common practices and human interactions. It is on the basis of these variables that we consolidated the knowledge used by the advisor system about the five cultures represented. Five iterations in the DBR process made it possible to develop these solutions.

In 2015-2016, postdoctoral research conducted at the Japan Advanced Institute of Science and Technology (JAIST) in Japan led to the addition of one iteration to this research and to the refinement of the tools developed. We (Savard, I., Mizoguchi, R., 2016) have developed an upper-level ontology of Culture that may be used to develop ontologies for any identified sub-culture and/or in order to analyze or compare cultures. We have also reworked the ontology of cultural variables to tie it to the ontology of education (OMNIBUS) developed by Hayachi, Y., Bourdeau, J., Mizoguchi, R. (2009). We thus believe to have elaborated the basis for the development of a computerized system that could advise the instructional designer, the teacher and also the learner by using the knowledge modeled about theories of Culture (MAUOC, Blanchard, E., Mizoguchi, R., 2014), theories of education (OMNIBUS, Hayachi,

Y., Bourdeau, J., Mizoguchi, R., 2009) and the cultural variables identified in pedagogical practices (Savard, I., 2014). This system could take the form of a web module that would provide a framework for planning the learner's pedagogical path, for example in accordance with the philosophy of personal pedagogies (Maina, M., Garcia, I., 2016). The user (Instructional Designer, Teacher or Learner) could find information and/or advice both on cultural adaptation and variables and on strategic pedagogical practices based on theories of education. A forthcoming iteration will also make it possible to develop the "Asian branch" of the "Cultural Diversity" knowledge base. Indeed, we plan to increase the knowledge about pedagogical practices in China, Japan and Thailand.

Design-based Research was not standard practice when this research was undertaken (in 2005), and few models existed at the time. We have developed one such model that could be discussed at the Early Career Workshop. We believe that it could prove to be a useful contribution to the advancement of knowledge in the field of educational technology.

References

- Bell, P. (2004). "On the Theoretical Breadth of Design-Based Research in Education", *Educational Psychologist*, volume 39, pages 243 to 253.
- Blanchard, E. G. and Mizoguchi, R. (2014). Designing culturally-aware tutoring systems with MAUOC, the more advanced upper ontology of culture. *Research and Practice in Technology Enhanced Learning*, 9(1), 41-69.
- Larman, G. (2004). *Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development (3rd Edition)*. Massachusetts, Prentice Hall, 702 pages.
- Maina, M. F., & González, I. G. (2016). Articulating personal pedagogies through learning ecologies. In *The Future of Ubiquitous Learning* (pp. 73-94). Springer Berlin Heidelberg.
- Reeves, T. (2000). Enhancing the worth of instructional technology research through "design experiments" and other developmental strategies. *International perspectives on instructional technology research for the 21st century*, New Orleans, LA, USA.
- Savard, I., Mizoguchi, R. (in progress, in 2016). *Ontology of Culture: A Procedural Approach for Cultural Adaptation in ITSs*.
- Savard, I. (2014). *Modélisation des connaissances pour un design pédagogique intégrant les variables culturelles*. (Doctoral Thesis), TÉLUQ-UQAM, Montreal, Canada. Retrieved from: <http://r-libre.telug.ca/362/>.
- Savard, I., Paquette, G. et Bourdeau, J. (2014). An Advisor System for Cultural Adaptation in Instructional Design. In *Fifth International Workshop on Culturally-Aware Tutoring Systems (CATS2014)* (p. 15). Retrieved from: <http://cats-ws.org/wp-content/uploads/2014/05/Proceedings-CATS2014.pdf#page=15>
- Savard, I., Bourdeau, J., Paquette, G. (2013). "An Ontology and a Method to Support Instructional Design Integrating Cultural Variables". *Proceedings of Culturally-aware technology-enhanced learning (CulTEL)*. Paphos, Cyprus, September 17th 2013. Retrieved from: http://www.macs.hw.ac.uk/CulTEL/submissions/cultel2013_submission_3.pdf
- Savard, I., Bourdeau, J., et Paquette, G. (2010). Modélisation des connaissances pour un environnement de conception pédagogique conscient des variables culturelles. In *Les cahiers de l'ISC*, 1, 49-58. Retrieved from: https://isc.uqam.ca/upload/files/CahiersISC/ACTES_Final-pourMiseEnLigne.pdf#page=49 (May 24th, 2016)
- Wang, F. and Hannafin, M.J. (2005). "Design-based research and technology-enhanced learning environments", *Educational Technology Research & Development*, vol. 53, no. 4, pages 5 to 23.