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IFIP is the global non-profit federation of societies of ICT professionals that aims at achieving a worldwide professional and socially responsible development and application of information and communication technologies.

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The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is generally smaller and occasionally by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is also rigorous and papers are subjected to extensive group discussion.

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Don Passey · Rosa Bottino ·
Cathy Lewin · Eric Sanchez (Eds.)

Empowering Learners for Life in the Digital Age


IFIP TC 3 Open Conference on Computers in Education, OCCE 2018
Linz, Austria, June 24–28, 2018
Revised Selected Papers

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Preface

The IFIP TC3 Open Conference on Computers in Education (OCCE) 2018 was held in Linz, Austria, from June 25–28, 2018, with a doctoral consortium event held on June 24, 2018. Participation was truly international, with contributions from authors ranging from Armenia to the United Kingdom, from Botswana to Taiwan, from Colombia to South Africa, and from Kyrgyzstan to New Zealand. In total, lead authors came from 31 countries, across five continents.

In total, 63 papers were submitted to the conference (all subjected to double-blind review by two independent reviewers), 35 were submitted for consideration for this post-conference book (with 18 subjected to a second round of double-blind review by two independent reviewers), and, following these later reviews, 27 were selected and accepted. On average, with 162 reviews undertaken in total (independent of reviews by the editors), each of the 63 papers were subjected to 2.6 reviews, and each of the 27 selected papers were subjected to 6 reviews. We are delighted to present the outcomes of the research undertaken by these 27 authors and their collaborators in this volume.

The conference theme “Empowering Learners for Life in the Digital Age” drives our attention to the increasingly urgent need to allow each citizen to be able to face a society dramatically changed by technological evolution. Such a broad topic can be addressed in different ways and with different perspectives, which means that not only new skills and abilities are to be identified and addressed, but that the learning environment as a whole is to be reconsidered and questioned. In essence, the relationship among learners, digital tools, and knowledge is not simple and direct, and must be approached in a critical way with due consideration for the complexity of the underlying processes. The contributions that have been selected for this book discuss a number of key emerging topics and evolving practices in this area that have been divided into seven sections. These sections focus on: computational thinking; programming and computer science education; teachers’ education and professional development; games-based learning and gamification; learning in specific and disciplinary contexts; learning in social networking environments; and self-assessment, e-assessment, and e-examinations.

Section 1 - Computational Thinking. As a background to this topic, and from a thorough literature review, Bollin and Micheuz offer a debate on computational thinking from two complementary perspectives—that of an Austrian teacher and that of software engineer—each reflecting on their personal expertise. They conclude that computational thinking can be considered as a cultural technique, which leads to a refined working definition. Considering the relationship of computational thinking and problem-solving skills, Eickelmann, Labusch, and Vennemann describe how a large-scale study compares students’ competences in computational thinking (CT) with the underlying conditions of acquisition at an international level. The data are provided by the International Computer and Information Literacy Study 2018 (ICILS 2018), and they discuss how these competences will be compared with students’ problem-solving

skills through a German national extension to ICILS 2018. Considering another related skill area, Kadijevich, in a theoretical paper, examines how data modeling using interactive displays may cultivate CT practices across a range of school subjects. The author states that, while working with data is not explicitly mentioned in some CT definitions, such practices might enable a range of CT needs, such as abstraction, decomposition, and pattern recognition. In terms of students using computational thinking skills, Fluck, Chin, and Ranmuthugala report a study of students aged 12 years, who mastered computational thinking in mathematics (integral calculus) through use of multi-media learning materials and specialist mathematics software, demonstrating ability commensurate with university engineering students.

Section 2 - Programming and Computer Science Education. Programming and computer science education continue to be integrated into compulsory education in many countries. Kelter, Kramer, and Brinda have investigated teachers' perspectives about some popular learning and programming environments used in secondary computer science education in Germany. Contrary to outcomes reported in prior studies, they have showed that teachers do not see the editor as a key identifier of difference, while student-friendly debugging messages as well as a step-by-step execution of programs were identified as important features, with a clear favorite being BlueJ. Considering different ways that students might be assessed in terms of their computational thinking skills and practice, Matsuzawa, Murata, and Tani compared three testing methods (programming testing, traditional paper testing, and Bebras Challenges), finding that there was a clear correlation between outcomes assessed using the Bebras Challenge and actual programming. The development of programming and computer science across age ranges is also leading to the development of innovative methodological approaches. Djelil, Muller, and Sanchez investigated programmer behaviors when beginners interact with a programming microworld. They developed and used an innovative methodology that considered an analysis of learners' attitudes, rather than collecting learners' points of views or observing their score progression by means of knowledge tests or questionnaires. Also from a methodological perspective, Pasterk, Kesselbacher, and Bollin present a description of a semi-automated approach to categorize learning outcomes of computer science-related curricula into the two categories of computer science (CS) and digital literacy. Using this system, they showed high levels of match between learning outcomes classified by this approach and those classified by experts in the field.

Section 3 - Teachers' Education and Professional Development. The integration of computer science and computational thinking into wide age ranges across education will clearly depend upon the development of skills and practices in the teaching workforce. McLeod and Carabott's study of pre-service teachers in an Australian university explored whether the information and communications technologies (ICT) content was appropriate in preparing them to implement the national curriculum. They found that it did not meet all their needs, challenging assumptions being made about digital competence, and recommended that universities review their expectations of digital competence and how to address these in teaching ICT in teaching degrees. In another country context, Tosato and Banzato's exploratory study investigated self-efficacy beliefs, intrinsic motivation and perceived efforts of a group of teachers from Italian schools who, on a voluntary basis, engaged in a 20-hour workshop on CS

teaching. They showed that there was a significant improvement in self-efficacy, despite the teachers' perceptions of needing to commit high levels of effort to master the subject content. Considering how teachers can develop and integrate ICT-based resources into their teaching, Yiannoutsou, Otero, Müller, Neofytou, Miltiadous, and Hadzilacos report their development of a decision-making system to support teachers in appropriating innovative scenarios that employ uses of ICT for teaching and learning. The system enables them to select, decompose, combine, enact, and revise different resources, and the authors' study investigated how teaching objectives can make use, or not, of the potential of digital technologies. In terms of teachers developing online courses, Haugsbakken and Langseth describe and conceptualize the outline features and processes of an infrastructure for organizing their production in continuous and further education. This consists of a network of employees with complementary competences (technical, pedagogical, and multimedia) to coach, mentor, and support educators through the entire online course production process, working in designated teams. Considering teaching, its development and its quality, Reçi and Bollin report how their study is considering teaching as a process, and how they are looking at existing approaches to assess teacher maturity. They introduce the idea of a teaching maturity model (TeaM) for school and university teachers, and offer the results of a pilot study testing its usability and acceptability with informatics lecturers in one university.

Section 4 - Games-Based Learning and Gamification. Games-based learning and games-based resources are both aspects that continue to emerge in the field, and they are being explored through a range of research perspectives. Holvikivi, Juurola, and Nuorteva describe an innovation platform development for the co-creation of serious games, offering modes of collaboration for schools, universities, citizens, and companies, based in three universities and two science centers in Finland. From their findings, they offer recommendations for best practices in universities to find efficient ways of implementation when developing serious games. In terms of using games within educational contexts, Sanchez, Paukovich, Müller, Kramar, and Widmer report an empirical study carried out during a museum school visit, aiming to understand the influence of a game on students' conduct in the museum. Their findings have led to the identification of different conducts and situations performed by students, depending on their gameplay. In terms of teachers using games, Bonvin, Sanchez, Champin, Casado, Guin, and Lefevre report a study of how a digital role-playing game allowed teachers to create teams. They assessed to what extent the game fostered students' engagement and showed that social engagement varied across time and gender, which seemed to be linked to specific features of the game and how it was played. Concerned with similar student interaction intentions, Ehlenz, Leonhardt, and Schroeder present a multi-touch learning game (MTLG) framework, designed to support cooperative, collaborative, and competitive interactions, and they show how a user-centered learning analytics data model could gather results, which led to the identification of challenges and lessons learned.

Section 5 - Learning in Specific and Disciplinary Contexts. Researchers continue to explore the ways in which existing and emerging technologies can be used to support learning in different contexts. In the context of English language learning in the United Arab Emirates, AIOkaily reports a case study exploring uses of a specific learning

environment, integrating a dubbing project designed and implemented in an English language listening and speaking course. Utilizing students' mobile devices for anywhere, anytime learning, students produced videos, which were entered in an internally organized competition; as a result, they demonstrated high levels of motivation, increased learning, confidence and sense of achievement, and pride in their resulting work. In the context of second language learning in Norway, De Caro-Barek studied the making of massive open online courses (MooCs) in a second language. Findings highlighted the need for course developers to critically look at how to build more innovative and interactive language MooCs within the framework of self-instructed courses using new convergent technologies such as Web real-time communication (WebRTC). In the context of school students aged 12–13 years learning biology in the UK, Webb, Tracey, Harwin, Tokatli, Hwang, Barrett, Jones, and Johnson report a study investigating whether the addition of haptics (virtual touch) to a three-dimensional (3D) virtual reality (VR) simulation would promote learning of key concepts. They concluded that there were significant knowledge gains, but no significant differences between the haptic and non-haptic condition. In the context of university students in Austria and Slovakia, Mujkanovic and Bollin report a study evaluating the extent to which it is possible to enhance student group outcomes by systematically reconstructing the groups of students. They found statistically significant improvements of outcomes for those groups that were systematically constructed.

Section 6 - Learning in Social Networking Environments. Learning using social networking environments continues to be an area of research study. Considering different social networks that might be used, Katz reports a study where three similar groups of students were enrolled in an 'Introduction to Ethics' course, exposed to either Facebook-based, WhatsApp-based, or Twitter-based delivery of ethical concepts on their smartphones. The author found that the WhatsApp, and to a lesser extent, Facebook students, were associated with higher enhanced achievement and positive feelings toward their delivery platforms compared with Twitter students. In terms of knowledge sharing using a social networking environment, Haugsbakken reports a case study of how a county authority in a Nordic country implemented an enterprise social media platform. The author found that when a group of employees tried to make sense of the practice of sharing by reflection-on-action, they interpreted sharing as an informing practice, resulting in information-overload and disengaged users.

Section 7 - Self-Assessment, e-Assessment, and e-Examinations. An emerging area of practice development and research study concerns uses of technologies for self-assessment, e-assessment, and e-examinations. In the context of developing an ICT-based method for the self-assessment of ICT skills, Voňková, Černochová, Selcuk, Hrabák, and Králová report a pilot study exploring uses of anchoring vignettes in the analysis of Czech upper secondary school students' self-assessment of ICT skills. They conclude that the enhanced research method they used, based on anchoring vignettes, could be used for further studies, as they found high variability of the use of scale by respondents in their self-assessments. In terms of using technologies for e-examination, Hillier and Lyon report a study investigating students' perceptions of a bring-your-own (BYO) laptop-based e-examination system trialed in an Australian pre-university college in geography and globalization. They found that many of the typists were taking a computerized supervised test for the first time and concluded that there is a

need to ensure adequate support for students who might not be all equally prepared for the computerization of high-stakes examinations. In a follow-up paper, they report students' expressed strategies, habits, and preferences with respect to responding to supervised text-based assessments. They conclude that there was significant alignment between preferred writing strategies and choice of text production method, but that grades achieved between typists and hand-writers did not differ significantly. In terms of student perceptions of e-assessment, Küppers and Schroeder report findings from a survey, with evidence gathered from several higher education institutes. They found that students seemed to be open-minded regarding e-assessment, but that there was a need to completely convince the students of opportunities offered by e-assessment that would go beyond those offered through uses of more traditional media.

The varied mix of papers presented in this book shows some of the many perspectives and addressed topics that characterize educational computing research. These trends can give an idea of the opportunities offered by ICT to improve teaching and learning processes but also highlight how the integration of ICT in education is neither straightforward nor simple, as it leads to increasing organizational and management complexity. This raises the question of how innovative experiences and studies can be transferred on a wide scale and which systemic changes not only in educational practices but also in educational policies can support effective innovation.

Last but not least, we would like to thank the organizers and Program Committee members of this conference for enabling this range of important contributions to become accessible to us, and the reviewers for their thorough and insightful comments that have enhanced the quality of the papers. Primarily, of course, we thank the authors for their commitment and dedication, in providing us with a wide range of complementary perspectives that brings knowledge in this field to our attention, and highlights the contributions that researchers are making in this field.

May 2019

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Contents

Computational Thinking

Computational Thinking on the Way to a Cultural Technique: A Debate on Lords and Servants	3
<i>Andreas Bollin and Peter Micheuz</i>	
Computational Thinking and Problem-Solving in the Context of IEA-ICILS 2018	14
<i>Birgit Eickelmann, Amelie Labusch, and Mario Vennemann</i>	
Cultivating Computational Thinking Through Data Practice	24
<i>Djordje M. Kadijevich</i>	
Transformative Computational Thinking in Mathematics: A Comparison by Student Age.	34
<i>Andrew E. Fluck, C. K. H. Chin, and Dev Ranmuthugala</i>	

Programming and Computer Science Education

Teachers' Perspectives on Learning and Programming Environments for Secondary Education	47
<i>Riko Kelter, Matthias Kramer, and Torsten Brinda</i>	
Multivocal Challenge Toward Measuring Computational Thinking: Bebras Challenge Versus Computer Programming	56
<i>Yoshiaki Matsuzawa, Kazuyoshi Murata, and Seiichi Tani</i>	
Investigating Learners' Behaviours When Interacting with a Programming Microworld: An Empirical Study Based on Playing Analytics.	67
<i>Fahima Djelil, Pierre-Alain Muller, and Eric Sanchez</i>	
A Semi-automated Approach to Categorise Learning Outcomes into Digital Literacy or Computer Science.	77
<i>Stefan Pasterk, Max Kesselbacher, and Andreas Bollin</i>	

Teachers' Education and Professional Development

Who's Teaching the Teachers? Viewing the ICT Content of a Teaching Degree Through the Eyes of Pre-service Teachers.	91
<i>Amber McLeod and Kelly Carabott</i>	

Exploratory Study on the Effort Perceived by In-service K-12 Teachers from Subject Areas not Specialising in Computer Science Who Are Complete CS Novices	101
<i>Paolo Tosato and Monica Banzato</i>	
Hanging Pictures or Searching the Web: Informing the Design of a Decision-Making System that Empowers Teachers to Appropriate Educational Resources to Their School’s Infrastructure	112
<i>N. Yiannoutsou, N. Otero, W. Müller, C. Neofytou, M. Miliadous, and T. Hadzilacos</i>	
Designing an Educational Action Task Force for MOOCs and Online Course Production.	122
<i>Halvdan Haugsbakken and Inger Langseth</i>	
A Teaching Process Oriented Model for Quality Assurance in Education - Usability and Acceptability.	128
<i>Elisa Reçi and Andreas Bollin</i>	
Games-Based Learning and Gamification	
Collaboration Platform for Public and Private Actors in Educational Games Development	141
<i>Jaana Holvikivi, Leenu Juurola, and Maija Nuorteva</i>	
Students’ Conducts During a Digital Game-Based Museum School Visit	151
<i>Eric Sanchez, Elsa Paukovics, Sylvia Müller, Nicolas Kramar, and Antoine Widmer</i>	
Assessing Social Engagement in a Digital Role-Playing Game: Changes over Time and Gender Differences	161
<i>Guillaume Bonvin, Eric Sanchez, Pierre-Antoine Champin, Rémi Casado, Nathalie Guin, and Marie Lefevre</i>	
A Learning Analytics Approach in Web-Based Multi-user Learning Games. . . .	167
<i>Matthias Ehlenz, Thiemo Leonhardt, and Ulrik Schroeder</i>	
Learning in Specific and Disciplinary Contexts	
The Role of Audiovisual Translation in Mediating Foreign Language Learning: Activity Theory Perspective	175
<i>Rasha AlOkaily</i>	
Innovation in Language Teaching and Learning: What Do We Need to Make a Massive Open Online Course (MooC) for Language Learning Genuinely Innovative?	187
<i>Veruska De Caro-Barek</i>	

An Investigation of the Impact of Haptics for Promoting Understanding of Difficult Concepts in Cell Biology	197
<i>Mary Webb, Megan Tracey, William Harwin, Ozan Tokatli, Faustina Hwang, Natasha Barrett, Chris Jones, and Ros Johnson</i>	
Personality-Based Group Formation: A Large-Scale Study on the Role of Skills and Personality in Software Engineering Education	207
<i>Amir Mujkanovic and Andreas Bollin</i>	
Learning in Social Networking Environments	
Social Networks as Learning Delivery Platforms: Academic Achievement and Attitudes of Students	221
<i>Yaacov J. Katz</i>	
Learning to Share by Reflection-on-Action on an Enterprise Social Media Platform	231
<i>Halvdan Haugsbakken</i>	
Self-Assessment, e-Assessment and e-Examinations	
The Application of Anchoring Vignettes in the Analysis of Self-assessment of ICT Skills: A Pilot Study Among Czech Secondary School Students.	243
<i>Hana Voňková, Miroslava Černochová, Hasan Selcuk, Jan Hrabák, and Kateřina Králová</i>	
Student Experiences with a Bring Your Own Laptop e-Exam System in Pre-university College	253
<i>Mathew Hillier and Nathaniel Lyon</i>	
Writing e-Exams in Pre-University College	264
<i>Mathew Hillier and Nathaniel Lyon</i>	
Students' Perceptions of e-Assessment: A Case Study from Germany	275
<i>Bastian Küppers and Ulrik Schroeder</i>	
Author Index	285