

**Abstracts  
and  
Conference Materials  
for the**

# **13th European Conference on Games Based Learning**

**The University of Southern Denmark  
Odense, Denmark**



**3 - 4 October 2019**

**Abstracts of Papers  
Presented at the**

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Based Learning  
ECGBL 2019**

**Hosted By  
University of Southern Denmark  
Odense, Denmark**

**3-4 October 2019**

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## ECGBL Preface

These proceedings represent the work of contributors to the 13th European Conference on Games Based Learning (ECGBL 2019), 3-4 October 2019, hosted by the Faculty of Engineering and Department of Sports Science and Clinical Biomechanics at the Faculty of Health Sciences, University of Southern Denmark in collaboration with the Maersk Mc-Kinney Moller Institute. The Conference Chair is Lars Elbæk and the Programme Chairs are Gunver Majgaard, Andrea Valente and Md. Saifuddin Khalid, all from University of Southern Denmark, Denmark.

The Maersk Mc-Kinney Moller Institute is an internationally recognized research organisation, which has maintained a leading position in robotics for more than two decades. The Institute focuses on game-based learning related research in robotics and embodied systems for learning, including mixed realities and the design of educational tools, digital didactical design and social responsibility.

The Department of Sports Science and Clinical Biomechanics at the University of Southern Denmark pursues research on innovation and scientific knowledge-based studies of the human body, sport, active living, health and digital design as well as human movement, sport and game-based learning as current fields of development.

At ECGBL this year the two departments are highlighting the themes of:

- Virtual reality and augmented reality for learning
- Game-based physical activity and health
- STEM pathways in educational practice
- Game based design

ECGBL is a well-established event on the academic research calendar and now in its 13th year the key aim remains the opportunity for participants to share ideas and meet the people who hold them. The scope of papers will ensure an interesting two days. The subjects covered illustrate the wide range of topics that fall into this important and ever-growing area of research.

The opening keynote presentation is given by Helle Marie Skovbjerg from the Design School Kolding, who will speak about Playful play-design – balancing between danger and safety in children full body play. On Thursday afternoon LEGO education will facilitate an interactive plenary session. The second day of the conference will open with an address by Simon Egenfeldt-Nielsen from

Serious Games Interactive who will talk about Social Gamification - Blended learning games.

With an initial submission of 205 abstracts, after the double blind, peer review process there are 93 Academic research papers, 15 PhD research papers, 4 Masters Research papers and 13 work-in-progress papers published in these Conference Proceedings. These papers represent research from Australia, Austria, Bulgaria, Canada, China, Croatia, Czech Republic, Denmark, Finland, Germany, Greece, Iran, Ireland, Italy, Malta, Mexico, The Netherlands, Norway, Portugal, Russia, Slovakia, South Africa, Spain, Sweden, Switzerland, Taiwan, the United Kingdom and the United States of America.

We hope you enjoy the conference.

**Lars Elbæk, Gunver Majgaard, Andrea Valente and Md. Saifuddin Khalid**

The University of Southern Denmark  
Odense, Denmark  
October 2019

## ECGBL Committee

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# Biographies

## Conference and Programme Chairs



**Lars Elbæk** is an Associate Professor at the Department of Sports Science and Clinical Biomechanics and the University of Southern Denmark and coordinator of the Sports Science Innovation and entrepreneurship program. He has worked with business innovation in the project "Play and Learning - Kids'n Tweens Lifestyle". He has through projects and through his Ph.D. training in-depth knowledge and experiences of doing interaction design and design research in sports, adapted physical activity, play approaches and pervasive computing. That in collaboration with both NGO's, public institutions and private companies and thereby experience in working in participatory innovative processes with external partners.



**Md. Saifuddin Khalid** is an Associate Professor in digital design and movement at University of Southern Denmark. He also works at the department of digitalization of Copenhagen Business School as an external lecturer. With a background in the fields of computer science (BSc & MSc), business informatics (BSc), human-centered communication and informatics (PhD), Khalid works on IT systems' development, integration, and adoption processes. His research contributes in the multi-disciplinary fields of interaction design, service design, educational technology, diffusion research, health informatics, and sports science. He received best teacher award 2016 at the Faculty of Humanities, Aalborg University, Denmark.



**Gunver Majgaard (PhD)** is Associate Professor at Embodied Systems for Robotics and Learning, Mærsk Mc-Kinney, University of Southern Denmark. She holds PhD in Robotics and Learning processes, which focused on design of educational tools and learning processes. The research focused on usage of physical-digital media and children as co-designers. Her research interests are technology in emerging technologies such as Mixed Reality; design of digital educational tools; game-based learning; participatory design processes; learning processes; didactical design; program and curriculum development. She has developed the engineering program Learning and Experience Technology.



**Andrea Valente** is Associate Professor and have a background in computer graphics from Torino University in Italy, and I worked with formal languages, code mobility and object-oriented type systems (during the PhD). I like mixing these subjects and this is why I am currently researching on educational tools for teaching Computer Science and other abstract concepts as early as elementary schools (e.g. the c-cards project and paper Turing machines). One of the goals of this research is to have simple toys (tangibles) that can be used to visualize and concretely operate with theoretical concepts like information or computation. Other areas of interest are e-learning especially in children education, real-time web systems and social media, formal methods and software engineering.

### Key Note Speakers



**Simon Egenfeldt-Nielsen** (PhD, Psychologist) is CEO of Serious Games Interactive , which he founded in 2006. Today it has around 15 employees. He has studied, researched and worked with computer games for +15 years. Over the years he has been involved in developing +150 games for different clients like Maersk, Metro, Opel, and World Bank. He has been involved in developing several award-winning series like Global Conflicts and Playing History. He has been involved in +10 primarily European research projects within game-based learning.



**Helle Marie Skovsbjerg** is the first Danish professor in play and employed at the Design School Kolding. Her research focusses on the mood perspectives of play. A concept created through empirical work with children. Thereby Helle Marie Skovsbjerg is investigating the unique Danish DNA for designing play and therefore contributing with knowledge of designing game-based learning.

### Mini Track Chairs



**Dr Panagiotis Fotaris** is Senior Lecturer and Course Leader for Digital Games Development and Computer Science for Games at the University of Brighton, UK. He is Senior Fellow of the Higher Education Academy and has previously held positions at the University of East London, University of West London, King's College London, Abertay University,

and University of Macedonia. Additionally, Panagiotis has spent a decade in the Creative Industries as graphic/UX designer, full-stack developer, radio producer/DJ/remixer, and music/videogames journalist. Due to his diverse background that combines computing with applied arts, games, music, and learning technologies, Panagiotis's current research interests focus on the pedagogic potential of escape rooms, immersive technology, virtual/augmented environments, and games in the context of computing and design education.



**Dr Bernadette Spieler** has a PhD in Engineering Sciences. She is a University Assistant/Lecturer at Graz University of Technology, Institute for Software Technology. Her work is focused on how to encourage female teenagers in particular with playful coding activities and Pocket Code (a tool developed at TU Graz). Moreover, her recent work is related to gender and diversity, gender-inclusive learning environments, gender sensitive (informatics)-didactics, game based/mobile learning, and constructionist gaming. During her research, she considered gender differences in interest, self-belonging, and self-efficacy towards coding and gaming. As a gender and diversity expert, she performs workshops and trainings on gender-related topics.

## Biographies of Contributing Authors

**Alexandra Alföldiová** is currently a PhD student of the Theory of Digital Games. She focuses on several topics, primary eco-innovations in the digital game environment aimed at raising public awareness of the possibilities of environmental protection and her dissertation thesis elaborates the issues of the incentives of gaming in the virtual environment

**Muriel Algayres** is a PhD fellow in the Department of Architecture Design and Media Technology at Aalborg University Copenhagen, Denmark. She holds a M.A in Educational science, and her research interest resides in technology-enhanced learning, active learning and game-based learning.

**Sahar Al-Sudani** Dr is a lecturer of computing at University of Kent, UK. She received her PhD in computer sciences from University of Technology-Baghdad in Collaboration with INRIA-France research centre in 2006. She is a member of a data science research group at the University and she served as a reviewer of Artificial Intelligence Review journal. She is a teaching fellow of Higher Education Academy in the UK. Her main research areas are Semantic Web, Knowledge Modelling and computing education.

**Ashish Amresh** As a Research Scientist at the Decision Theater, Dr. Amresh conducts research in the development of Serious Games and previously he led the Computer Gaming curriculum initiatives at Arizona State University, where he founded the Computer Gaming Certificate, Camp Game and UTBC summer programs. He was the founding program chair for the Simulation Science Games and Animation program at Embry Riddle Aeronautical University and his industry pursuits included working for Ronin Entertainment as a Graphics Software Engineer known for Star Wars: Force Commander and Bruce Lee Quest of the Dragon games. He is the author of Unreal Game Development, a popular book used for teaching game development skills for high school students. He has given numerous talks on using games in the class room for enhancing math and science learning. He is currently researching the development of software tools to improve game based learning outcomes.

**Sylvester Arnab** is a Professor of Game Science at Coventry University UK, where he forefronts the investigation into the application of playful and gameful approaches in teaching and learning. He co-founded the GameChangers initiative, which is being adopted and adapted in other countries, such as Malaysia.

**Archontoula Arvanitaki** is an in-service special education teacher and also a PhD candidate in Department of Preschool Education Sciences and Educational Design, University of the Aegean, Rhodes, Greece. Her main educational interests include game adjustments for blind children, implementation of new methods in teaching children with special needs and the construction of educational games.

**Dmitriy Babichenko** Professor of Practice, School of Computing and Information (SCI), University of Pittsburgh. Extensive industry experience in educational software design and development, IT project management, and web systems architecture design. Since joining SCI has taught undergraduate courses in programming and information systems analysis, design and implementation, databases, and games design. 2015- founded Learning Technologies Laboratory at School of Information Sciences, a lab dedicated to development of serious games, educational technologies, and undergraduate research.

**Kim Balnaves** is a doctoral student at Curtin University, Perth Western Australia. She lectures in teaching and learning technologies and works with Coder Dojo communities. Her main research areas are digital technologies and understanding how games can be built to develop and disrupt learning design.

**Vanessa Barbagiovanni Bugiacca** is a research associate at the University of Oldenburg. Her research interests are ‚cultures/ practices of resistance‘, E-Learning and digital humanities.

**Marina Bareicheva**, she is a 3rd year bachelor student at Ural Federal University. At the moment she has 8 published articles and 1 research work, participated in 7 international conferences. Research interests: effective development of territories, game practices in management. Actively helps to implement gaming methods for learning.

**Stephen Bezzina** is an Education Officer within the Ministry for Education and Employment in Malta. He holds a Master of Science degree in Digital Education (University of Edinburgh), specialising in games and assessment. He has been editorial board member on Press Start (University of Glasgow), a peer-reviewed student journal on Game Studies.

**Spyridon Blatsios** is a PhD candidate at the University of Macedonia, Thessaloniki, Greece. The topic of his thesis is on personalization and adaption of serious games. He is a judge on national conferences, and has been involved in Serious Games and Educational Robotics since 2005. His main research areas are Artificial Intelligence and data analytics. He is also an Ambassador for the Code Week initiative of the European Committee.

**Eelco Braad**, MSc, is a researcher at the User-Centered Design Group at Hanze University of Applied Sciences Groningen and a PhD-candidate at the Human Technology Interaction Group at Eindhoven University of Technology. His academic work focuses on how technology can be designed to improve the effectiveness, efficiency and enjoyability of studying in higher education.

**Sanna Brauer** received her PhD in Educational Sciences from University of Lapland in February 2019. Her doctoral dissertation is the first to address digital open badges and badge-driven learning in Europe. She currently works at University of Oulu, Faculty of Education and Oulu University of Applied Sciences, School of Professional Teacher Education, Finland.  
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**Louisa Bremner** is currently a PhD student at the University of Huddersfield. Her main research focus is looking at how game-based technology can be used to support learning for young children with Autism Spectrum Disorders. Her research interests include immersive technologies such as Virtual Reality and Augmented Reality, game-based learning and Human-Computer Interaction.

**Guido Bruinsma** Background in work and organizational psychology. After receiving PhD Guido on Serious Game proces and Serious Gaming as vehicle to foster organizational maturement: linking theory from behavioural and organizational sciences with Game Design. Employed at University of Twente, Saxion University of Applied Sciences (associate lector in 'digitalization in Human Resource Management'); has company (VierTwee) and is one of founders of gamelab Oost (foundation for applied gamedesign). Researches and practices serious game design and design based research.

**Tina Helene Bunæs** is an assistant professor at the Faculty of Computer Sciences at Østfold University College in Norway. Her main research area includes interaction design and game technologies, where she studies how virtual worlds can be used for training and learning in areas like health care and cultural heritage.

**Jeppe Bundsgaard** is professor in Subject Didactics and IT at Aarhus University. His research focuses on curriculum studies, innovative teaching and learning and educational use of computers. He has participated in a number of projects that developed and tested innovative digital teaching designs. His current research focuses on developing scenario-based standardized assessments measuring 21st Century Skills.

**Jackie Calderwood** Dr. Research Fellow at the Disruptive Media Learning Lab, Coventry University, UK, working on the European Horizon 2020 gamification project BEACONING to develop narrative artwork, build metagames and lead the UK pilot in education. Her research interests focus on pervasive media, Clean methodologies, co-creativity, community participation and eudaimonic engagement (inspired well-being).

**José Ramón Calvo-Ferrer** holds a PhD in Translation and Interpreting from the Universidad de Alicante, where he teaches different modules on Translation, English and teacher training since 2008. His research interests lie in ICT in general and video games in particular for second language learning and translator training. He has published various papers in top ranked specialised journals.

**Clayna Camacho** is a professor of marketing at Tecnologico de Monterrey (ITESM), Mexico. She received her MBA in 1993 and a Master degree in Marketing in 2000. She has worked for twenty years as a Business undergraduate teacher. She is also Brand Experience Designer for OCUS Brand Revelation, a Branding agency in Guadalajara, Mexico.



**Augusto Chiocciariello** After 4 years at the Educational Technology Centre, UC Irvine joined CNR-ITD in 1986. He was involved in the design and development of learning systems, he collaborated with Reggio Emilia infant schools, and coordinated CNR-ITD's participation in "Inspiring Science Education" EU project. He's currently coordinating the "Programming to Learn in Primary School" project.

**Peter Gissel Christensen** is 27 years old and has a bachelor's degree in Learning and Experience Technology and is currently study the master in Learning and Experience Technology at University of Southern Denmark in Odense. He is working in development of learning applications for children. And has experience in testing with children

**Gavin Clarke** earned a honours bachelor's degree in Computer games development from the Institute of Technology Carlow. Has an interest in video games and wanted to learn how to make them. He has worked in gameCORE before starting work on an MSc.

**Samantha Clarke** is a practical developer and researcher of game-based learning and gamification applications primarily focused on the role of games and play in the educational environment. Her research and practice interests are mainly in the area of curiosity, narrative and puzzle led games that include escape rooms, D&D, mystery boxes and choose your own adventure style games.

**Merijke Coenraad**, doctoral student, University of Maryland, College Park. Merijke researches the intersections of technology and equity, specifically broadening participation in computer science and promoting the voices of minoritized youth through rich media experiences. She received a B.S. in Elementary Education and Spanish & Hispanic Studies from Creighton University and an M.Ed. from Boston College.

**Luuk Collou** After completing my MSc. Business administration (specialization HRM) at the university Twente I started working for the university for applied Sciences Saxion and university Twente as a PhD researcher/lecturer. I am in the third year of my PhD and expect to graduate in May 2020.

**Conceição Costa** is a PhD in Communication Sciences - Media Studies from FCSH-UNL. She is a Full Researcher at CICANT-UHLT in Lisbon, Portugal. Currently she is the Principal Investigator of [GBL4deaf – Game-Based Learning For Deaf Students](#) and [MILT- Media Literacy for Living Together](#), funded by European Commission.

**Mária Čujdíková.** I am a PhD student at Comenius University in Bratislava. I am studying a programme Theory of Mathematics Education at the Faculty of Mathematics, Physics and Informatics. In my dissertation thesis I explore how video games develop mathematical thinking.

**Susanne Dau,** Ph.D. is a Program Manager and Docent at UCN. Her research interest is educational research and research in learning processes. She has been working with blended learning and professional development for several years

**Jason Davis** recently acquired his Phd in Economic Education in April 2018. He currently works as a lecturer in the Department of Public Management and Economics at the Durban University of Technology in South Africa. He sees educational gaming as a key component of an educators toolbox for 21<sup>st</sup> Century.

**Dr. Nick Degens** is the chair of the research group User-Centred Design at the Hanze University of Applied Sciences in Groningen. His background lies with the integration of education, interactive technology and artificial intelligence to develop innovative digital tools together with partners from the creative industry and public organisations.

**Amy Devine** is a Senior Research Manager at Cambridge Assessment English where she manages research on games-based assessments and digital learning tools. Amy has a PhD in Psychology from the University of Cambridge. Her research interests include gender differences and similarities, and the impact of test anxiety, self-beliefs, and motivation on learning.

**Stine Ejsing-Duun** is Associate professor of Games, design, technology and learning at Aalborg University, Copenhagen. She is Co-Director of The Center for Applied Game Research. Stine explores how to integrate design thinking and computational thinking into schools. Current research areas include: Design thinking, Computational thinking, creativity, aesthetics and learning, gender and technology.

**Sara Ekström** is a PhD candidate in Informatics with specialization in Work-Integrated Learning at the School of Business, Economics and IT at University West. In her research, she studies the interactions between a student and a social robot as they play a digital math game together. In addition, the teacher's role in this learning situation is studied.

**Chris Evans** is the Head of Technology Enhanced Learning at WMG, the University of Warwick. His research focuses on simulations for education, and in particular

the fields of ludology and narratology. He has an MSc in Digital Learning and is studying for a PhD in Games based learning, a subject area in which he also teaches.

**Carlo Fabricatore** Dr. is a human factors scholar, computer scientist and Associate Professor at the University of Huddersfield. Ever Since completing in 2000 his PhD in Industrial Engineering and Human-Computer Interaction, he has investigated how games and game design can promote engagement in complex sustainability problems, and foster capabilities and sensibilities required to tackle them.

**Gordon Fletcher** is currently Director of the Operations and Information Management in Salford Business School. Gordon's research is currently focused on strategic digital transformation but his interests reach more widely across all aspects of the influence of digital on business and culture. Gordon also actively engages with a range of businesses having recently completed work on the challenges facing directors of SMES and regularly working in collaboration with a range of organisations to delivery specialist knowledge exchange projects

**Jef Folkerts** is a lecturer/researcher at the Hanze University of Applied Sciences Groningen, The Netherlands. He holds a PhD in Cultural Sciences, for which he conducted research on imagination and cultural reflection through narrative and game mechanics in video games. His current work for the research group User Centered Design focusses on the use of (digital) technology for health related behaviour change.

**Panagiotis Fotaris:** Principal Lecturer and Course Leader for BSc (Hons) Digital Games Development & BSc (Hons) Computer Science for Games at the University of Brighton. He has a diverse background in computing, digital media, and e-learning, and demonstrates a deep understanding of the pedagogical, social and cultural issues affecting the adoption of new learning technologies. His research interests include Gamification, Augmented/Virtual Reality, Internet of Things, Technology Enhanced Learning, HCI and UX Design.

**Ivona Frankovic** is a PhD student at the University of Rijeka, Croatia. She earned a master's degree as a specialist in the Education of Informatics from the University of Rijeka, Department of Informatics in 2011. Her research interests are serious games, educational technologies (e-learning), game design, integration in classrooms, and learning programming at young age.

**Laura Freina** is a researcher at the Italian National Research Council. In the last two years, she has been involved in studies for the introduction of computational

thinking in all primary grades. In particular, in grades from 3 to 5 this is done through game making activities integrated with curricular objectives.

**Michael Fuchs** is a professor of software engineering at Wilhelm Büchner University in Darmstadt/Germany. He received his PhD in computer science from the university of Hagen/Germany in 2010.

**Sonja Gabriel** works as a professor for media literacy at University Teacher College Vienna/Krems (Austria). Her primary focus of research is on digital game-based learning and using serious games for teaching different subjects at school and university as well as evaluation of various projects for learning with games and game-design approaches.

**Alexander Gantikow** is an academic assistant in the Media Education and Visualization Group (University of Education Weingarten, Germany). He received his Bachelor's degree in Media and Education Management in 2015 and is currently enrolled in the consecutive Master's programme. His areas of interest are technology enhanced learning, human computer interaction and user experience design.

**Lanlan Gao** is an associate professor of computing at Fujian Educational College, China. She is a PhD student in computer informatics at Huddersfield University since 2017. She has published 30 papers and 3 books in China, involving main research areas which are information technology and educational games.

**Stefan Göbel** holds a PhD in computer science from TU Darmstadt and has long-term experience in Graphic Information Systems, Interactive Digital Storytelling, Edutainment applications and Serious Games. Dr. Göbel is academic councilor and lecturer at TU Darmstadt and heading the Serious Games group at the Multimedia Communications Lab.

**Johannetta Gordijn** is an educational advisor at Delft University of Technology, The Netherlands. She received her MA in Online and Distance Education from The Open University UK in 2015. She is involved in online education and coordinates teacher training at TUDelft.

**Mathias Gregersen**, 25 years old, has a bachelor's degree in Robotics and is currently studying for a master degree in Learning and Experience technology at the University of Southern Denmark. Mathias has previously worked with game creation in the Unity engine with a focus on networking and multiplayer games.

**Marianti Grizioti** is a Ph.D. student at National and Kapodistrian University of Athens, Greece. Her research is on computational thinking development through game design and modding. She is a member of Educational Technology Lab and has been involved in the development of ChoiCo game design tool and MaLT2 programmable geometry modeller.

**Natascha Denise Grønlie**, 24 years old, and has a bachelor's degree in Learning and Experience technology and is currently studying the master's degree at the University of Southern Denmark. Natascha has previously worked with integrating bio-input in games, and has experience in game design.

**Dimitar Gyaurov** is a PhD student and a game design teaching assistant at the University of Huddersfield. Dimitar's research is focussed on interaction, engagement and learning in games, and the use of computer games to promote the development of complex problem-solving skills and sustainability learning.

**Camilla Gyldehdahl** is lecturer at University College of Northern Denmark (UCN). She has been working with learning processes and game-based learning for several years. She is currently a Ph.D. student at Aalborg University at the Department of Education, Learning and Philosophy.

**Susanne Haake** is a postdoctoral research assistant in the Media Education and Visualization Group (University of Education Weingarten, Germany), an interdisciplinary research team. She holds a doctorate in media studies on narratives in media context (University of Trier). Her research focuses on game design, interactive storytelling, human computer interaction (HCI) and interface design.

**Thomas Hainey** Dr is the Programme Leader of Computer Games Development in the School of Computing, Engineering and Physical Sciences at the University of the West of Scotland. Thomas teaches a course on Serious Games which is his main research interest and has a large number of journal and conference publications in this area.

**Thorkild Hanghøj** is Professor of Games and Learning at Aalborg University, Copenhagen. Moreover, he is the Co-Director of The Center for Applied Game Research and currently heads the GBL21 project ([gbl21.aau.dk](http://gbl21.aau.dk)). Thorkild holds a PhD on playful knowledge in educational gaming. Current research areas include: games and design thinking, games and literacy and games and teacher roles.

**René Engelhardt Hansen** has a MSc in sports and health from the department of Sports and health at the University of Southern Denmark (SDU), with an interest in games, play, and the design and use of technology in the fields of human behavior and motivation, health promotion and learning.

**Tanja Heumoos** is a kindergarten pedagogue and attends the joint master program Early Childhood Studies of the universities of teacher education St. Gallen, Switzerland and Weingarten, Germany.

**Sara Hinterplattner** is a university assistant at the Institute for STEM Education at the Johannes Kepler University Linz. Her main research area is gifted education. In this role, she is involved in various talent development programs and leads the JKU Honors Program, a program for gifted students at the university.

**Dr. Pei-Chi Ho** is an associate professor teaching media design, e-learning, serious game, and communication technology in the Bachelor Program of Communication Arts, Da-Yeh University, Taiwan. Her many publications and research are focused on multi-media design.

**Tien-Yu Hsu** is a Researcher at National Museum of Natural Science in Taiwan. He is also an Associate Professor in Graduate Institute of Library and Information Science at National Chung Hsing University in Taiwan. His work and research interests are related to digital archives, digital museum, mobile learning, knowledge management, and unified content management.

**Suzaan Hughes** is a lecturer in the College of Business and Economics, at the University of Johannesburg. She has a keen interest in leveraging technology to enhance student learning and engagement. Suzaan initiated and continues to co-manage the longitudinal research project, “Increasing the impact of simulation based courses”.

**Nashwa Ismail** is a Research Career Development (RCD) lecturer in the Open University in the UK, leading RCD programme that coordinates training for post-doc and academic research activities to enable research student development. Technology-Enhanced Learning (TEL) and Games-Based Learning (GBL) are my research interests. I take part in different GBL research projects in in the UK and overseas countries

**Erik Ottar Jensen** is a Ph.D.-student at the *IT and Learning Design* lab at Aalborg University. He has worked as a teacher, and a mathematical and educational consultant on different levels of school administration. His main areas of research

are technology in mathematics education, game based learning and design thinking in public school.

**Nicklas Frisk Johansen** is a MSc student in Business Administration and E-Business at Copenhagen Business School. Nicklas' main research areas of interest are Service Design, digital work and the digital transformation of the public sector. After his studies Nicklas will be working as a technology consultant at EY.

**Michal Kabát** is a teacher and a researcher at FMK UCM in Trnava, Slovakia. He works in the Department of Digital Games Theory, where he teaches subjects related to design and development. He is specifically interested in subjects of artificial intelligence, virtual reality and transhumanism.

**Hannah Kaihovirta**, PhD, Lecturer at Aesthetic Didactics, the University of Helsinki. Research focus on contemporary art in education and multiliteracy learning. Her current research on aesthetic processes and gamification together with Matilda Ståhl and Minna Rimpilä got the award for best poster during ECGBL 2018 and they continue with a full paper presentation this year

**Bo Kampmann Walther** is Associate Professor at the Department of Media Studies, Institute of Cultural Sciences, at the University of Southern Denmark, DK. He has published and lectured widely on the topics of computer games, new media, IT and learning, ludification, new media philosophy, transmedia and literature, as well as sports (football) and media.

**Diane Jass Ketelhut**, Associate Professor University of Maryland. Diane's research centers on improving student science self-efficacy, learning/assessment through scientific inquiry experiences within virtual environments, and computational thinking in teacher education. Diane received a B.S. in Bio-Medical Sciences from Brown University, an M.Ed. from the University of Virginia, and her doctorate in Education from Harvard University.

**Zoi Karageorgiou**: PhD candidate of the School of Applied Arts (Hellenic Open University-HOU) and IT Professor at Vocational School. She studied Applied Informatics (University of Macedonia) and graduated the Master Program of Graphic Arts and Multimedia (HOU). She was awarded for "Best digital teaching scenario" by the Greek Ministry of Education, as Distinguished Member of the Scientific Association for the Promotion of Educational Innovation and took the 1st prize in a national creative writing competition. She deals with website management, teachers' training and eLearning courses. She is actively involved in national and international conferences, creative writing and narratives and participates in radio shows and in theater groups as an actor/animator.

**Nafisul Kiron** is a Ph.D. student at the University of Saskatchewan. He is a member of MADMUC Lab at the university. His main area of research is game based learning and testing. Previously he worked as a Software Engineer at Samsung R&D Institute Bangladesh in Solution Lab and Mobile Software Group.

**Thorsten Kodalle** LTC (General Staff) is lecture on security policy at the Command and Staff College of the German Armed Forces with a special focus on NATO, Critical Infrastructure and Cyber. He is a member of the NATO research task group “Gamification of Cyber Defense/Resilience”, an experienced facilitator of manual wargaming on the operational level for courses of action analysis, for operational analysis, operations research, serious gaming and especially for matrix wargaming.

**Amin Alinezhad Kordmahaleh** is a master student at the University of Tehran, Iran. He is studying entrepreneurship in online businesses. His research interests include E-commerce, Distance education, entrepreneurship, entrepreneurship education, Gamification, data science.

**Santeri Koivisto** is a classroom teacher (M.Ed.) from Finland that got side tracked to starting up a company during his studies. One of the startups he co-founded created MinecraftEdu. Currently he is working on a PhD at University of Tampere while working as Senior Advisor at Satakunta University of Applied Sciences. Main fields: digital games, education and entrepreneurship.

**Rameshnath Krishnasamy** is a Ph.D. candidate in Human-Computer Interaction at Aalborg University in Aalborg, Denmark. His qualifications are mostly in the fields of mobile, pervasive and ubiquitous computing technologies and game design. His main research area is designing digital exploration games for automated exhibition sites.

**Ekaterina Kubina**, she is a 3rd year bachelor student at Ural Federal University. At the moment she participated in 11 international conferences, has 7 published articles and 1 research work. Research interests: effective development of territories, game practices in management. Actively helps to implement gaming methods for learning.

**Annemari Kuhmonen**, M.A., is a senior lecturer of business administration (peer-to-peer, P2P) at Laurea University of Applied Sciences, Finland. Her areas of expertise include project management, international business and leadership. She has a long experience in international banking and entrepreneurship. Annemari is



enthusiastic about the gamification in business and development of collaborative learning environments.

**Bahar Kutun:** Since 05/2017: Ph. D. Student at the University of Rostock, Since 01/2016: Research assistant at Technische Hochschule Ingolstadt, 03/2014 – 09/2015: Studies in Business Information Systems at the University of Applied Sciences Nuremberg with the degree Master of Science. Award for the best total graduation, 10/2009 – 03/2014: Studies in Business Information Systems at the University of Applied Sciences Ingolstadt with the degree Bachelor of Science.

**Lasse Juel Larsen** is assistant professor at University of Southern Denmark at the Department for the Study of Culture. He received his PhD in learning, play, and computer games in 2013. Current teaching expands from the Department for the Study of Culture to the Faculty of Engineering. He has been the main driver in establishing the interdisciplinary Social Technology Lab. His current research focuses on game design and development, computer game aesthetics, playful interactions (transmedia worlds, wearables), play, and learning theory.

**Viorel Petrut Draghici** received the Diploma degree in System- and Computer Engineering from Politehnica University of Timisoara, Romania, and the Master of Science degree in Information Technology from University of Stuttgart, Germany. His main research interests at Fraunhofer IPA include Machine Learning, Robotics, Image Processing, Industry 4.0, Cloud Computing and Web services.

**HsinYi Liang** is a Project Assistance at National Museum of Natural Science in Taiwan. She is also studying PhD in the Graduate Institute of Applied Science and Technology at National Taiwan University of Science and Technology in Taiwan. Her work and research interests are related to digital museum, game-based learning, human factor, and interaction design.

**Sanne Lisborg** (cand.scient.soc.) is a PhD student at Aalborg University, department of Culture and learning, and University College Copenhagen. My PhD project is an ethnographic study of how virtual simulations are used in science teaching in the Danish lower secondary education.

**Maria Ximena López** is a psychologist and research fellow at the University of Huddersfield, UK. She received her PhD in innovation and evaluation in education from Roma Tre University, Italy, in 2010. Her research interest span across disciplines involving technologies for dementia, game-based learning, sustainable development and critical thinking.

**Patricia Lyk** is a PhD student in the Department of Embodied Systems for Robotics and Learning Unit at the University of Southern Denmark. She has a MSc in Engineering (Learning and Experience Technology) and is currently interested in Mixed reality for education.

**Frankie Lyons** is research masters student attending the Institute of Technology Carlow, working on a multi-discipline project for the institutes GameCORE and HealthCORE.

**Rikke Magnussen** is associate professor at Department of Communication, Aalborg University. Her main research interest is how digital learning design can open for new types of collaborative science practice and innovation processes to support community driven science in school. She has led several large projects within this field and currently leads the project Community Drive.

**Jonathan Marquez** is a PhD candidate in the School of Design at RMIT University, Melbourne, Australia. His qualifications mostly relate to creative media, teaching English as a second language (TESOL) and literacy education. His main research area is card game design for foreign language teaching specifically teaching English pragmatics.

**Melinda Mathe** is a doctoral candidate at the Department of Computer and Systems Sciences at Stockholm University, Stockholm, Sweden. She has an MSc in International and Comparative Education and also a background in Information Technology for Learning. Her research focuses on hybrid learning environments and the use of digital games and simulations in education.

**Asge Matthiesen (MSc)** upcoming PhD student at Embodied Systems for Robotics and Learning, Mærsk Mc-Kinney, University of Southern Denmark. MSc in Civil Engineering in Learning and Experience Technology. Finished Masters within Virtual Reality (VR) and article submitted, which focused upon VR as tool for treatment of patients with eating disorders combined with basic game elements in treatment process. Interests focus on user experience design, development of technology in different treatment processes and co-designing different projects with different user groups and involvement of different parties in a design process.

**Adam McGuire** is a Post Graduate Research student for gameCORE at the Institute of Technology Carlow. He received a BA in Art and Design in 2012 and in 2014; he graduated with a first class honours in Visual Communications and Design. His interests include playful human-computer interaction design.

**Heleen Meijburg**, MSc, is a researcher at the User-Centered Design Group at Hanze University of Applied Sciences Groningen. Her recent work focusses on how adaptive technologies can stimulate young children to adopt a physical active and healthy lifestyle.

**Andrey Melnikov** is a division head at Fund for Infrastructure and Educational Programs, Moscow. He received his Master of Education degree from The University of Manchester (taught in MHSES). Currently he is a PhD Student at Vytautas Magnus University, Lithuania. His main research areas are Information and communications technology in School, Educational Technologies in School.

**Larissa Müller** (female), is researcher at Fraunhofer INT, in the business unit for (Public) Technology- and Innovationplanning . She has a background in political science and sociology. In her current work her focus has been on innovation management, focusing on human-machine interfaces, technology assessment and societal factors. Larissa Müller was involved in research projects integrating the stakeholder groups and adequate methods of social research in innovation processes. Furthermore she led research projects regarding social and psychological effects of new concepts in road traffic and equality policy. As a former scientific employee of a member of the German parliament and parliamentary state secretary, Larissa Müller also has experience in scientific policy advice and political analysis.

**Peter Mozelius** is currently working as a PostDoc researcher at the Department of Computer and Systems Sciences at the Mid Sweden University in Östersund, Sweden. Research interests are in the areas of Blended learning, Game-based learning, Programming education and ICT4D.

**Brian Nelson** is a professor of education at Arizona State University. His research centers on the design and evaluation of virtual environments and games for STEM learning. Dr. Nelson is a Co-PI on the Port of Mars project investigating the use of games to explore the social aspects of human life in space.

**José Carlos Neves** has in Interaction Design his main focus of investigation, in particular in relation with the physical interface, interactive art and communication strategies for people with special needs. Holds a Ph.D in Communication Studies and teaches in the School of Arts, Architecture, Arts and Information Technologies at Lusófona University (Lisbon).

**Rune Kristian Lundedal Nielsen**, PhD, is a scholar of addiction, psychology, youth, and games. He is an Assistant Professor at the Center for Computer Games Research at IT University of Copenhagen.

**Josephine Plass-Nielsen** and **Oliver Bo Wolter Nielsen** have a bachelor's degree in Learning and Experience Technology from the Southern University of Denmark. Throughout their bachelor's degree, Josephine and Oliver have engaged in projects in the field of game development, game-based learning, human-computer interaction, and robotics. Josephine is currently studying a master's degree in Data Science, and Oliver is studying a master's degree in Learning and Experience Technology.

**John Nietfeld** is a Professor of Education Psychology at North Carolina State University. Dr. Nietfeld's teaching and research interests lie in self-regulated learning (SRL) and metacognition. He is currently examining how to create intelligent game-based learning environments that will facilitate and scaffold SRL skills for elementary and middle school students in science.

**Daire Ó Broin** holds a Ph.D. in Computer Science from Trinity College Dublin, which focused on approaches to developing the conditions of flow. He has been a lecturer at IT Carlow since 2008, where he teaches on the Computer Games Development programme. His research interests include increasing engagement and intrinsic motivation in games and learning.

**Jorge Oceja** teacher, ed. psychologist and M.A in instructional design by California State University (Fulbright Scholarship). PhD (2017) with thesis "Design of Game Experiences to Promote Civic Competence". Completed academic residencies at Engagement Lab at Universidade do Minho, Center for Applied Game Research at Aalborg University in Copenhagen, and Gamification Lab at Leuphana University in Luneburg. Taught in Elementary and Secondary in Spain, UK and USA and Adjunct Professor and researcher at University of Cantabria.

**Mette Ohlsen**, 25 years old, has a two-year education in multimedia design. She has a bachelor's degree in Learning and Experience technology and is currently studying the master's degree at the University of Southern Denmark. Mette has previously worked with integrating bio-input in games, and creating visuals for games.

**Jaime Palma** is a full time professor at Tecnológico de Monterrey, Mexico City Campus at the department of industrial and systems engineering. He holds an EngD (Doctor of Engineering) degree from the the University of Warwick. His

current research interests include, supply chain integration, small supply chain firms and SCOR model.

**Dimitra Panagouli** is a teacher in primary education for 16 years. She works in Athens College and has a Master's Degree in Mathematics Didactic. She is interested in Mathematics Didactic, Games Based Learning and Digital Games and History.

**Lena Pareto** is a full professor in informatics with specialization in work-integrated learning at University West, Sweden. Her main expertise is within design for learning, specializing in educational technology for mathematics, and studies of professional development and work-integrated learning in authentic settings. She has more than 20 years of experience as principal investigator from research projects in educational settings and has published more than 60 articles in the field.

**Veruschka Pelser-Carstens** is a Senior Lecturer at North West University (NWU), RSA. She received her Master's degree in Labour Relations Management from NWU in 2012. She is a PhD student in Computer Science at the University of Eastern Finland. Her main research areas are game based learning and teaching and learning with technology.

**Marianne Pickles** is the Head of Assessment Development at Cambridge Assessment English. Her current focus is on how games-based learning and assessment can help learners, as well as working on projects involving innovations in learning and assessment more broadly. She has a Master's in Language Testing from Lancaster University and has co-created and co-presented webinars about the communicative approach and immersive games. Marianne plays PS4 and likes LEGO.

**Lauri Pynnönen** is a second year PhD student at the University of Helsinki. His research focuses on digital game-based learning interventions in South Asia and Sub-Saharan Africa, where children learn basic literacy through educational games without a teacher at their own pace.

**Hadeel Ramadan** is an associate director of the Learning Interactive Visualization Experience lab (LIVE lab) and a faculty member in the Department of Visualization, College of Architecture at Texas A&M University. Mrs. Ramadan co-authored several educational games such as: ARTé Lumière, ARTé Hemut for Art History classes and Variant Prime (Calculus/ Derivatives) for Calculus classes.

**José Ramón Calvo-Ferrer** holds a PhD in Translation and Interpreting from the Universidad de Alicante, where he teaches different modules on Translation, English and teacher training since 2008. His research interests lie in ICT in general and video games in particular for second language learning and translator training. He has published various papers in top ranked specialised journals.

**Minna Rimpilä**, MEd, is working as a teacher in Basic Education at Vasa Övningsskola in Finland. Her current research on aesthetic processes and gamification together with Hannah Kaihoviirta and Matilda Ståhl got the award for best poster during ECGBL 2018 and they continue with a full paper presentation this year.

**Gretchen Caldwell Rinnert**, M.G.D. is an Associate Professor at Kent State University's School of Visual Communication Design. Her work focuses on learning tools for children. She has been working on a suite of iPad apps for preschoolers called Energetic Alpha, produced for the iPad through Lucy Junior, LLC.

**Henk Roelofs** Dr ( econometrics, social-geography) worked as senior-lecturer at NHLStenden University. Entrepreneur. CEO/Co-owner of LE-Network, a company specialized in role-game-simulations. Led several EU co-financed projects for start-ups. Founded international learning companies. Published articles on entrepreneurship/entrepreneurial learning using the experimental method in LEARN Games. In LEARN Games, LEGO is used to create positive playful emotions.

**Anna Rusmann** is a PhD student at Aalborg University. Her thesis concerns how to develop and validate a digital performance test of competences within design thinking.

**Rune Sætre** Since 2011 Rune has been working as associate professor at IDI, teaching the introductory computer science classes ITGK and Java OO Programming, the MSc class TDT-44 Semantic Web, and the PhD-level class DT8108 - Topics in Information Technology.

**Rune is currently a full-time associate professor (førstelektor) at NTNU, and leader of the NTNU Tekna union since january 2017, and the Akademikerne union since july 2017**

**Nancy B. Sardone** Ph.D. is an Associate Professor of Education at Georgian Court University, Lakewood, NJ. She teaches courses in social studies methods, instructional design, and educational technology. Topics of recently published

articles include game-based learning to promote civic literacy and 21st century skills and attitudes of teacher candidates toward game-based learning.

**Cornelia Schade** is a research associate at the Media Centre of Technische Universität Dresden. She received her M.Sc. in Management and Organisation Studies from Technische Universität Chemnitz in 2017. At the Media Centre she works in the department of Digital Learning and Teaching and her main research area is Game Based Learning and Serious Games.

**Nina Schiffeler** is a research assistant at the Cybernetics Lab IMA & IfU. She is part of the research group Digital Learning Environments and works on the use of digital media in (academic and professional) qualification contexts. Her special topic of expertise is the investigation of effects of Virtual and Augmented Reality on learning processes.

**Henrik Schoenau-Fog** is an associate professor at Aalborg University, Copenhagen. His research interests are motivational factors and assessment of engagement in games, learning and interactive media. He is working with interactive adaptive real-time storyworlds, purposive games and games for learning while teaching and supervising projects related to games, real-time virtual productions, emergent narratives, animation and media-technologies.

**Dr. Lauren Schrock** is a Teaching Fellow at WMG, University of Warwick. She is responsible for the delivery of Study Skills & Research Methodology. Her research interests include creative pedagogies, ethics of care, and critical management studies.

**Anna Seidel** is a designer and psychologist. She just finished the master degree at the University of Technology Dresden, Germany. In the Learn&Play project she engages in GBL, user research and evaluation.

**Souad Slyman** is an experienced educator & game researcher. She has 1<sup>st</sup> class degree in Mathematics and Computing (BSc), MA in Education, and currently conducting a PhD in Computer Science. Souad's research focuses on evaluating the impact of [games](#) that is purposefully designed to improve learning, attitudes and skills in a range of academic areas (Serious Games, HCI & Machine Learning).

**Christopher Sommer** is a research associate at the University of Oldenburg. He received his PhD at the University of Auckland in 2016. His research interests are military history, migration studies and E-Learning.

**Pia Spangenberg** studied economics in Cologne and New York. Her research is on sustainability, gender equality, and, digital games in the context of career choice. Currently, she is responsible for the research project “MARLA”, which aims at developing and evaluating a Mixed-Reality learning application with serious game elements for wind engine technology.

**Bernadette Spielerc** has a PhD in Engineering Sciences. She is a PostDoc at Graz University of Technology, Department for Software Technology. Her work is focused on how to encourage female teenagers with playful coding activities with Pocket Code. Moreover, her recent work is related to gender, game based/mobile learning and constructionist gaming. Please visit: <https://bernadette-spieler.com>

**Ton Spil** (1964) teaches Business Information Systems for MBA and Management of Risk Management and Business and IT. Track chair e-health in main conferences and published on ISI A level. Guest editor of JSIS and associate editor of several health journals. In 2017 main topics are adoption of IT, business modeling, serious gaming and digital strategies applied on (tele)health, music and banking. Creates digital strategies for (social) media & health. His new book is called “Digital Future” and appeared in May 2018.

**Matilda Ståhl**, MEd, doctoral student at Åbo Akademi University, Vasa, Finland. Research focus on video games, identity construction and visibility. Her current research on aesthetic processes and gamification together with Hannah Kaihovirta and Minna Rimpilä got the award for best poster during ECGBL 2018 and they continue with a full paper presentation this year.

**Natalia Stepanova**, Graduated Izhevsk Mechanical Institute, got her PhD degree from Leningrad Construction Engineering institute. Associate professor of the Ural Federal University (Ekaterinburg, Russia). Organizer of student R&D. Has more than 100 publications. Research interests: social responsibility, human resources management, development, urban environment and game-based management. Actively use gaming methods for learning.

**Joshua Streiff** is the Program Manager for the Internet of Things House and the Security and Privacy in Informatics, Computing, and Engineering Center at Indiana University. He develops and deploys secondary educational outreach programs and workshops.

**Anton Sukhov** is an associate professor at the Ural Federal University. In 2012 he create (first in Russia) electronic course on the game studies. **In 2016, he received the Award for the Best Presentation and special Crystal Plaque on the SGEM**



2016 conference. His research papers on game studies are in Top3% on Academia.edu

**Magdaléna Švecová**, PhD. focuses on media literacy and the development of senior digital skills. She works at the Faculty of Mass Media Communication of the University of Ss. Cyril and Methodius in Trnava at the Department of Digital Games.

**Rabail Tahir** is a PhD candidate and research fellow at Dept. of Computer and Information Science at the Norwegian University of Science and Technology (NTNU), Norway. Her research interests include game-based learning, educational technology, usability engineering, human computer interaction and user interface design.

**Philippe Tamla** is a PhD candidate at the university of Hagen/Germany. His research topic is on Information Retrieval for effective serious games development. Dr Michael Fuchs (co-author) is a professor of software engineering at Wilhelm Büchner University in Darmstadt/Germany. He received his PhD in computer science from the university of Hagen/Germany in 2010.

**Stavros Tsikinas MSc** is a PhD candidate of Applied Informatics at University of Macedonia, Greece. He received his MSc in game and media technology from Utrecht University in 2015. His main research areas are serious games, game development, game-based learning, and learning methods in special education.

**Daniela Tugarova** is an associated professor in the department of Informatics at South-West University, Bulgaria. She received her PhD in didactics in informatics from South West University in 2001. Her main research areas are didactics in informatics, ICT in education and usability of the e-learning content.

**Georgi Tugarov** is an associated professor of computer science at New Bulgarian University, Sofia, Bulgaria and also adjunct associated professor of computer science at American University in Bulgaria. He received his PhD from Technical University, Sofia, Bulgaria in 2004. His main research areas are information systems for e-learning, learning paths, e-portfolios, and object-oriented modelling.

**Andrea Valente** has a Computer Science master and PhD with specialization in computer graphics and formal methods (University of Torino, Italy). The PhD work was about formal languages and type systems for object-based programming

languages. I spent the past 10 years teaching IT, engineering and media students. Currently work on e-learning and knowledge management.

**Robby van Delden Dr.** assistant professor at Human Media Interaction (HMI) group of University of Twente. MSc degree in Human Media Interaction and also Industrial Design Engineering; PhD on his work on "(Steering) Interactive Play Behavior". Research concerns embodied interaction and entertainment computing for various domains of sports, play, health, and learning; he teaches in the Game Design, Interactive Media, and various user centered design courses.

**Laura Vawter** has a Masters in Linguistic Education and is a doctoral candidate in the Educational Psychology Institute in conjunction with the Computer Science Institute at the University of Rostock. Her current projects and research involve the design and implementation of language learning software within primary and secondary classrooms.

**Alf Inge Wang** is a professor in game technology the Norwegian University of Science and Technology. His main research focus is on using game technology for good and has published over 100 international peer-review publications. Wang is also inventor and co-founder of the global game-based learning platform Kahoot! and co-founder of PlayPulse.

**Jørn Weines** is a historian by training, with experience from indigenous studies and governance. He is currently a PhD Candidate at UiT The Arctic University of Norway, researching game-based learning as a method for increasing educational quality in interdisciplinary board games.

**Thomas Wernbacher** is a media psychologist at Danube University Krems. In his research he explores the use of playful approaches in various settings. His expertise includes behavioral theories in the form of gamification and nudging as well as emergent technologies in the form of virtual reality and blockchain.

**Mathias Manu Winnard** is a student at University of Southern Denmark studying Learning and Experience Technology at their Bachelor semester (6. semester).

**Spyridon Xanthopoulos** is a PhD Candidate since 2017, in the Department of Applied Informatics at the University of Macedonia (Greece). He received the BSc degree in the Department of Computer Engineering & Informatics from the University of Patras (Greece). His research is focused on Location-Based Serious Games.

**Ozan Yesilyurt** is a member of the group “IT Applications and Services for Production” at the Fraunhofer IPA. He is a software developer with a background in electrical engineering. His expertise lies in the databased production optimization and product smartification. His research field includes the implementation of cloud-based services and simulation games for production.

**Susann Zeiner-Fink** is a scientific staff member at Technische Universität Chemnitz. She is going to write her doctoral thesis about innovative creative methods and specialized in the field of business games. Thus, she is prospecting how business games could be implemented in further education or an enterprise environment to enhance learning processes.

# **Keynote Outlines**



## Keynote Outlines

The following are outlines for the Keynote Speeches which will take place at ECGBL 2019.

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### **Social Gamification - Blended learning games**

***Simon Egefeldt-Nielsen*** CEO, *Serious Games Interactive, Denmark*

Over the year's gamification have gone from golden boy to villain. Maybe the truth is more nuanced. In this keynote the potential of social gamification is explored – as an alternative to shallow gamification. Social gamification draws on resents trends in micro-learning, close-to-praxis and collaboration as a new blended format. Bringing back gamification to its roots and beyond pointification.

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### **Playful play-design – balancing between danger and safety in children full body play**

***Helle Marie Skovbjerg*** Design School Kolding, Denmark

The aim is to highlight the features of play design that enable children to explore the balance between danger and safety in their full body-play. The play design should support children enabling the extension of play practices, increasing competence, and even reducing danger while increasing risk-taking.

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### **Interactive session with LEGO Education in corporation with LEGO Foundation**

A short keynote presentation will inform the conference on the goals and impact of the LEGO LEAGUES through Games Based Learning. This with a focus on STEM and design for human movement and the LEGO Foundation's research on other similar projects. LEGO Education and the LEGO Foundation will present in a hands-on session, how FIRST LEGO League enables every student to succeed through a unique hands-on experience that facilitates learning through physical and digital creation.

*At the ECGBL 2019, we would like to highlight the themes designs for learning STEM, play, movement health, and creativity. The themes are reflected through, for instance, "The Microgravity Marathon" project case of the challenge guide for the FIRST LEGO LEAGUE 2018/2019*

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# **Research Paper Abstracts**





# The Impact of In-Class Mobile Learning on Students' Engagement and Performance

**Sahar Al-Sudani**

University of Kent, Medway, UK

DOI: 10.34160/GBL.19.141

**Abstract:** The work presented in this paper is related to the use of mobile learning to improve students' engagement and performance. It is part of the Student Success Project at the University of Kent. The project aims to reduce the attainment gap of various cohorts of students and enhance their academic performance. Initially, mobile learning was designed to target less well performing students in specific modules. Later on, it was noted that all students could benefit from incorporating in-class mobile learning during the delivery of a module. This paper presents the analysis and results obtained by applying mobile learning techniques in a stage-2 (second year undergraduate) computer science module entitled Software Engineering Process. Mobile learning has been used in various contexts in higher education and it has been suggested that effective learning can take place when students work collaboratively in class using mobile applications. This paper presents the experience of incorporating one particular mobile application named "Kahoot!" to engage students in a non-traditional question-and-answer learning mode. As we will see, students feel that this format is more dynamic and interactive than traditional lecturing methods. In fact, students effectively reflect on what they have learned during lecturers and classes while answering well-constructed Kahoot! tests. Initially, tailored weekly sessions were delivered to support students in applying the concepts learned during the past few weeks of study. In these sessions, the focus is to practice concepts learned in specific lectures with problem-solving, and engage students in a collaborative learning environment that promises higher levels of interaction. The outcome of Kahoot!-infused sessions is studied by analysing students' feedback in relation to Bloom's Taxonomy. In addition, students' performance in the assignments and examination of the targeted module have been recorded, analysed and contrasted with other cohorts. These initial findings show promising results, which encourage us to share the experience with other teaching staff to include using the tool in the delivery of their modules.

**Keywords:** in class mobile learning, Kahoot, student engagement, collaborative learning

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# Evaluating GameScapes and SimApps as Effective Classroom Teaching Tools

Ashish Amresh<sup>1</sup>, Vipin Verma<sup>1</sup>, Tyler Baron, Rahul Salla<sup>1</sup>, David Clarke<sup>2</sup> and Doug Beckwith<sup>2</sup>

<sup>1</sup>Arizona State University, USA

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DOI: 10.34190/GBL.19.151

**Abstract:** GameScapes and SimApps, are new narrative and game mechanic influenced tools for improving the classroom learning experience of students. In Fall 2015, GameScapes and SimApps were tested with 16 American colleges and universities and 26 members of their faculties to improve learning outcomes in first-year composition classes, many including English as secondary language students, specifically focusing on writing skills and grammar abilities. Several GameScapes and SimApps developed for the course were tested with over 1000 students. Faculty members could select at least two games from a set of 17 such games that would best align with their courses' learning objectives. Scores earned in student gameplay were converted to points that applied to students' grades in the courses. This paper presents a formative evaluation of the GameScapes and SimApps that were used by the teachers and students and discusses best practices, classroom observations, learning outcomes and future scalability of this methodology to other courses.

**Keywords:** game mechanics, assessment, evaluation, serious games

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## CreativeCulture: Can Teachers be Game Designers?

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**Abstract:** Games, which are more readily blended with existing educational techniques and practices, are more likely to be accepted by teachers as useful resources. Hence, it is worth ensuring the design of game-based learning resources might support such blending, which can range from pragmatic

considerations, such as how well an intended play session fits within a teaching schedule or homework arrangement, to pedagogical designs, which seek to address shortcomings in didactic instruction. To promote the sense of ownership and autonomy to break the barriers of adoption, not only that teachers should be part of the development process but they should also be empowered to create or co-create their games - removing the barriers to the development of game-based learning resources. In the CreativeCulture initiative, a project funded by the Newton Fund, teachers are empowered to create their games towards engaging learners with educational contents. Game making can be used to foster the development of transversal skills, such as 21st-century skills, where individuals can design and construct their games, often working in teams, allowing them to engage in a task that involves, and at the same time, fosters collaboration, problem solving and creativity. This case study extends the game design thinking process in proposing a solution for teachers in co-creating and developing their educational games. This process is examined through a study involving 43 teachers over two academic semesters. A total of eighteen game-based learning resources have been developed through the initiative, which has been tested in seven local primary schools in rural and semi-rural areas in Malaysia. This paper reflects on the lessons learnt and observations, which may provide insights on how game-based learning can remove barriers to the process of innovating the way we teach and learn.

**Keywords:** co-creativity, playful learning, game-based learning, game design, higher education

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## **Implementation and Assessment of Three Gamification Strategies Across Multiple Higher Education Disciplines**

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**Abstract:** Gamification is the use of game-like strategies and elements in a non-game setting. In educational disciplines, it is suggested to increase student engagement and motivation, potentially resulting in better learning outcomes. In this work, we examine students' grades and anonymously submitted end-of-semester surveys for a period prior-to and following the implementation of

distinct gamification strategies across courses from the University of Pittsburgh School of Computing and Information, School of Pharmacy, and School of Dental Medicine. This study aims to determine whether the introduction of gamification strategies into course curricula has positively affected students' perceptions of that course, and whether it enhanced performance, as measured by improvements in final grades. Survey responses were rated both by hand and via automated sentiment analysis software as positive, neutral, or negative in nature, quantifying the otherwise qualitative data. Results showed an increase in students' perceptions of all three courses after the respective gamification elements had been introduced. We did not see any evidence of improvement in students' performance in pre- and post-gamification course grades.

**Keywords:** gamification, alternate reality games, higher education, learning technologies

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## **Gamification in Higher Education: Implications to Improve Entrepreneurship Education**

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DOI:10.34190/GBL.19.062

**Abstract:** Last few decades have witnessed the rapid expansion of entrepreneurship education programs due to the critical impact of entrepreneurship on economic development, innovation and employment in both developed and developing countries. Despite applying technological advances in teaching different subjects in higher education, the majority of entrepreneurship education programs still use the traditional teaching methods. Game-based learning, simulation and gamification have recently been suggested as influential methods to improve students' engagement in and motivation for learning and consequently education programs' effectiveness. Yet, few studies have been conducted on such methods and entrepreneurship education. This paper aims to highlight these methods as to be effective in entrepreneurship education through a systematic review of the peer-reviewed published articles. We highlight the implications of the findings to improve higher education entrepreneurship programs.

**Keywords:** gamification, game-based learning, entrepreneurship education, serious games, simulation, higher education

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# Using Games to Develop Personal Skills Required for Strategic Decision Making

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DOI: 10.34190/GBL.19.028

**Abstract:** Games play an important role in education by submerging students within the process and making them feel as direct participants of an event with ability to affect the outcomes of a situation. Situation analysis, making and discussion of decisions, and interactions among the gamers, including formal interaction, collaboration or competition, help developing social and management skills of the participants. The paper describes use of dilemmas and table games during the short course of “Education gamification” with 50 students. Each of the dilemmas was a problem description related to the use of innovative technology. Teams were made, and each team member received a prompt card to assist in building the line of his or her behavior. The prompts were designed in a way to promote discussion. At the end the team was making a decision that considered interests of all stakeholders. During the course several most popular economy-related strategic games were used. These games allow students acting as professional economists that try to run their projects in timely and most efficient manner. Games develop abilities to make strategic decisions, improve management skills, force thinking and situation analysis. Authors collected statistics on management strategies used by the gamers, and on making final decisions. Erroneous actions and winning strategies are analyzed. Authors collected and reviewed feedback from the gamers, and developed recommendations regarding improvement of game organization process.

**Keywords:** skills, decision making, game-based learning

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# Games, Design and Assessment: How Game Designers are Doing it Right

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DOI: 10.34190/GBL.19.114

**Abstract:** The fixation of formal education to measure and certify academic attainment, continues to fuel the ubiquity of standardised assessment procedures. As such, educators are reluctant to embrace the same constructivist and novel stance adopted towards learning to the assessment domain and continue to favour summative over formative practices. On the other hand, literature on games in education, suggests that well-designed digital games support and enhance the positive interplay between the different forms and functions of assessment, which are inherent to the learning environment. This paper examines the principles of good game design in light of the constructive interaction that exists between learning and the different functions of assessment in games. For instance, levelling and collecting badges whilst climbing up the ladder of challenges found in games, can be considered as the outcome of a purely summative assessment of the player's progress, as the information collected during gameplay is solely used to judge and certify the player's performance. However and more importantly, both for the game designers and the players, the game is continuously producing immediate performance feedback in the form of, amongst others, both on-demand and just-in-time information, which informs the players' learning and allows them to adjust their actions, thus serving as a formative assessment of gameplay. On analysing the respective literature in the field of game studies and assessment, this paper discusses a number of game elements and core mechanics, under three broad themes, namely (i) adaptivity (ii) feedforward and (iii) distributed cognition, which game designers successfully deploy in good game designs. These are gradually and naturally extended towards the theoretical and practical underpinning of an assessment for learning pedagogy, thus potentially informing and transforming traditional assessment practices into a more playful experience.

**Keywords:** games, learning, assessment, adaptivity, feedforward, distributed cognition

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# Between “Fortnite” and “Civilization”: Digital Games and Historical-Cultural Education

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DOI: 10.34190/GBL.19.160

**Abstract:** Information and communication technologies (ICT), "new media" (NM), have brought significant social and educational changes. In the dynamic field of development, which is made up of institutions that promote modern, direct and effective information, the new era comes with entertainment and education ("edutainment"). Digital games (commercial games, online games, serious games etc.) create "cultural phenomena" with a large and ambiguous effect on the general public, as "Fortnite" recently did (Gallagher, 2019). The main goal of this study is primarily, the ambition to highlight contemporary findings and teaching efforts that link digital games and historical-cultural education. Moreover, on the other hand the objective is to review the results from a three-year teaching program called "History and video games" in order to use students' evaluations of digital games as basic tools in Historical-Cultural Education. This project, based in the framework of action research, took place in Athens College (P.C., Elementary School). The research hypothesis was that a video game could help students to learn history in a more fun and interactive way and we wanted to examine what digital games we can use for that purpose and how. The duration of the program was three years, from 2016 till 2019, it was optional to 5th and 6th graders for one-hour each week. The project analyzed the educational dimension of the digital games and focused on students' needs and attitudes towards the content and teaching methodology of historical and cultural education. Students experienced the evolution of digital games especially those with historical background. As they played real-time strategy games (placed in the Middle Ages and the 20th century) that offer the user the ability to choose between different cultures/ factions, they evaluated them, by recognizing their "strong" and "weak" points and exploring their relationship with the documented historical knowledge. Furthermore, they have created their own criteria to evaluate digital games. Finally, six focus groups were formed to gather students' opinions on the role of digital games in teaching history and culture. Organizing such a project related to digital games and history with students at that age brought very useful data that we want to take advantage to make history lesson more compelling.



**Keywords:** digital games, edutainment, action research, evaluation, history

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## **“I Know I Have Done This in School, but This is More fun!” The Development of the Motivating Learning Application, The World of Carl**

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DOI: 10.34190/GBL.19.083

**Abstract:** This paper describes and reflects upon the development process of the learning application The World of Carl intended for smartphones and tablets. The application was developed by Ordbogen.com together with three public schools aimed at first to third graders. The goal was to design a versatile app that motivated training and repetition of language skills. The overarching idea was to place the learner in the mindset of a player playing a game while solving tasks directly and openly associated with curriculum. The theoretical backdrop is inspired by Vygotsky’s concept of scaffolding, Bateson’s logical categories, Csikszentmihalyi’s ideas about flow including the concept of gamification as a design framework for tying together activity and rewards including possibilities for exploration, replayability and completion. The development approach used the scrum framework to organize the agile iterative process, cycling through several loops of idea generation, player test, evaluation, re-design, idea generation, etc. The application was playtested on 60+ users between 6 and 10 years. All reactions, suggestions and thoughts were seamlessly considered and taken into consideration in the continued development process. The key findings underscored the initial assumption and design goal that it is indeed possible to create an application consisting of motivating exercises done by carefully and well-thought-out content scaffolding and recombination of peripheral knowledge in order to support and enhance existing skills, knowledge and competences.

**Keywords:** learning, motivation, application, development, scrum, scaffolding, knowledge

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# MeCo: A Digital Card Game to Enhance Metacognitive Awareness

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**Abstract:** A key concept within 21st-century skills is knowing how to acquire new knowledge and skills. Metacognition is the knowledge a person has of their own learning combined with the skills to apply that knowledge to enable more efficient and effective learning. Game-based learning can stimulate motivation as well as learning, but while various reviews have pointed out the opportunity for digital games to promote metacognition, little is known about how games can be designed to accomplish this. If we want learners to become better at learning with games, we need to investigate how metacognition can be supported and trained through game-based learning. Previous research has identified generic principles for designing metacognitive training, while only a few principles specific to game-based learning have been suggested. We designed the mobile game MeCo based on these design principles. MeCo was inspired by the mobile game Reigns and replicates its mechanic of exploring a dynamically branching story through choice-making by swiping cards left or right. However, in MeCo the objective is to learn as much as possible about different planets and their inhabitants, by planning, performing, and evaluating space exploration missions. Two metacognitive interventions were added to promote the transfer of metacognition to real-world learning situations: metacognitive question prompts and metacognitive feedback. A preliminary evaluation of the game was conducted using questionnaires and focus groups. Players found the game motivating enough to engage with the story and to be willing to play the game in their free time. Furthermore, they found that their in-game choices mattered, although more linear parts were preferred over more dynamically branching parts of the game. However, the humour in the narrative interfered with the more serious nature of metacognitive questions, resulting in players not taking the questions seriously enough to have an impact on metacognitive awareness. The implications for designing motivating digital games to enhance metacognition are discussed.

**Keywords:** game-based learning, games for learning, metacognition, design-based research

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# Towards a Framework for Metacognition in Game-Based Learning

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DOI: 10.34190/GBL.19.067

**Abstract:** Game-based learning can motivate learners and help them to acquire new knowledge in an active way. However, it is not always clear for learners how to learn effectively and efficiently within game-based learning environments. As metacognition comprises the knowledge and skills that learners employ to plan, monitor, regulate, and evaluate their learning, it plays a key role in improving their learning in general. Thus, if we want learners to become better at learning through game-based learning, we need to investigate how metacognition can be integrated into the design of game-based learning environments. In this paper we introduce a framework that aids designers and researchers to formally specify the design of game-based learning environments encouraging metacognition. With a more formal specification of the metacognitive objectives and the way the training design and game design aims to achieve these goals, we can learn more through analysing and comparing different approaches. The framework consists of design dimensions regarding metacognitive outcomes, metacognitive training, and metacognitive game design. Each design dimension represents two opposing directions for the design of a game-based learning environment that are likely to affect the encouragement of metacognitive awareness within learners. As such, we introduce a formalised method to design, evaluate and compare games addressing metacognition, thus enabling both researchers and designers to create more effective games for learning in the future.

**Keywords:** game-based learning, games for learning, metacognition, design-based research

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# Digital Open Badge-Driven Learning: Gamified Progress and Inspiring Assessment

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DOI: 10.34190/GBL.19.015

**Abstract:** Digital open badges (e.g. Mozilla Open Badges) offer novel possibilities in identifying and recognising competences independent of how they were acquired. Digital open badge-driven learning suggests to enhance learning by promoting inspiring gamified competence-development. This paper offers a summary of the first European doctoral dissertation to represent an innovative application of competence-based approach and gamified learning process. The summary aims to address recent theoretical approaches to digital open badge-driven learning and principles for designing gamification with badges that could potentially support a competence-based approach in continuing professional development to meet the individual professional needs. The research aimed to explore vocational teachers' different ideas, views and experiences of the competence-based approach to professional development of digital pedagogical competences; it also sought to investigate the structure and process of digital open badge-driven learning. The data were collected from Finnish pre- and in-service vocational teachers (n=29) in 2016 via group online interviews (n=6) and via online questionnaires in 2017 (n=329). The study draws on descriptive mixed research methodologies: qualitative content analysis, phenomenography and a novel application of descriptive statistical methodology (constrained correspondence analysis) to the context of educational research. The results culminate in defining digital open badge-driven learning process grounded on the badge constellation of competences. This paper offers to summarise findings of different sub-studies emphasising gamification of competence-development. First, gamified criterion-based challenges arouse and maintain interest until the intended competence is achieved. Second, flexible study options support self-determined studying and prompt the desired learning action, allowing students to self-select the time and place of learning. Third, the option to customise studies represents another central principle: personalised study paths arouse interest and maintain students' motivation and engagement as their studies progress. Further, inspirational play through gamification encourages students to continue their studies after completing an initial task even towards the highest possible skills set level; this motivation is particularly apparent when they are given the option to personalise their study paths entirely. The triggers of the learning process appear more versatile than the triggers of gamification or online-learning alone. In terms

of digital open badge-driven learning, the prompting trigger for learning might be realised at different stages of the learning process in various forms, including community building and collaboration facilitated by gamification, scaffolding or criterion-based challenges.

**Keywords:** competence-based approach, digital open badge-driven learning, gamification, triggers of online learning, motivation, professional development

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## Using Single Player Virtual Simulations for Training on Collaborative Medical Practice

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DOI: 10.34190/GBL.19.095

**Abstract:** The development of safe, efficient and effective methods for training medical practitioners, using single player virtual simulations, has been undertaken by Østfold Hospital Trust (ØHT) in Norway. The hospital has developed and tested a prototype of a virtual thrombosis procedure, with the goal that a well-integrated training application will help increase patient survival rate by decreasing the treatment time. We have evaluated the prototype, focusing on the social and collaborative aspects of medical practice targeted by the simulation. As the thrombosis treatment is an example of collaborative work, we have used insights from Computer Supported Collaborative Work (CSCW), and how related concepts like situated action, contingency and awareness have been developed in this field. The study has combined observations, interviews and user testing. Through field studies at the hospital, we have observed the work practice and alternative training methods undertaken by hospital staff. The hospital management and the developers of the prototype have been interviewed, revealing the formal work descriptions of the thrombosis procedure and the design and development work undertaken to produce the prototype. We have also performed user evaluation of the prototype with the staff responsible for performing the procedure. This study has shed light on the highly situated and collaborative nature of thrombosis treatment at ØHT and we have found that the virtual simulation was a realistic representation of the work environment, the standardized procedure and the setup of the team responsible for the treatment. However, the medical staff reported that the simulation did not adequately represent the procedure as performed in practice. Further we suggest the following implications for designing virtual training applications targeting collaborative medical practice; 1) it is important that meaningful awareness

information is available to the user, 2) choosing the right level of abstraction is critical. To be able to represent the contingencies in collaborative medical practice by randomized scenarios in virtual training applications, this study indicate that highly realistic gameplay needs to be sacrificed.

**Keywords:** virtual simulations, serious games, collaborative work, medical practice, situated action, awareness

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## **‘Homeless Monopoly’: Co-Creative Community Engagement Model for Transmedia Educational Game Design**

**Jackie Calderwood**

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DOI: 10.34190/GBL.19.150

**Abstract:** This paper traces the research and development of a prototype transmedia game designed to raise awareness in young people of the issues surrounding homelessness. In Coventry the number of people in temporary accommodation has doubled in the 12 months up to March 2018 and those accepted as homeless has risen by over 50% to 964. Across the UK, homelessness is on the sharp increase and Shelter note a 59% increase in the number of homeless children in the past five years. This research project, positioned in relation to Coventry’s status as City of Culture 2021, addresses the question of how gamification and methodologies from artistic practice can provide capacity to intervene in the representational apparatus attached to those living on the margins of society and cast as ‘social objects’. From its inception during a workshop with students to address social issues via gamification, this transmedia research project innovates mechanisms by which to place the agency of target communities at the centre of the design and production process. Through a partnership instigated with local charity Coventry Cyrenians, creative focus groups were used to collect real-life testimonies from Coventry’s homeless and ex-homeless. Secondary school students engaged, via Cyrenian outreach, in the early stages of development and subsequently to user-test the prototype games. University students also made significant contributions to the project development. The author will discuss the nature of collaboration and the emergent forms of co-creative participation within the project, and how such engagement informed the game mechanics, components and strategies of play as well as providing content for the game. Findings will be presented from the initial testing of prototype board- game, evaluated via a mixed methods approach. The

model of engagement offers affordances for re-use as a transcontextual and transdisciplinary tool in games development. A concluding discussion will assess the impact to date and potential for future development as traditional board-game with educational resource pack, and hybrid forms of personal or group game that may be delivered via mobile or web-based technologies.

**Keywords:** gamification, board-game, homelessness, co-creativity, Cyrenians, monopoly

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## **Some Remarks on the Idiosyncrasy of Serious Games and its Effects on Research Results**

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DOI: 10.34190/GBL.19.137

**Abstract:** Due to their prominent position as tools for entertainment, video games have been steadily introduced in educational settings. Also, in an attempt to infuse pedagogy into gaming scenarios, there has been a growth in the design and implementation of video games for teaching and training. However, whereas several authors state that games are effective educational tools others indicate that claims concerning the educational effectiveness of games are merely based upon positive outcomes in relation to motivation rather than their effectiveness as standalone knowledge acquisition mechanisms. In connection with such claims, this study aims to outline the main traits of such games, known as ‘serious games.’ Specifically, it pays attention to the idiosyncrasy of games used in educational settings, and analyses both the types and characteristics which make these tools particular, especially when compared to traditional video games, and which may be the cause of the diverging opinions regarding the efficacy of using these technologies in the classroom.

**Keywords:** video games, serious games, DGBL, learning, training

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# Programming to Learn in Primary Schools: Including Scratch Activities in the Curriculum

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DOI: 10.34190/GBL.19.070

**Abstract:** The Italian Ministry of Education is promoting the introduction of coding and computational thinking in compulsory school. While it is still unclear how the Ministry will reform the current curriculum guidelines to introduce computing, Italian schools have anyway reached a record level of participation in events like the EU Code Week and the Hour of Code. “Programming to Learn in Primary School” is a project we are conducting following Papert’s claim that “children can learn to program and that learning to program can affect the way they learn everything else”. The project is in its second year and involves all primary school grades, from 1 to 5. The children in grade 1 and 2 work with programmable play kits with tangible interfaces. From grades 3 to 5 the online Scratch programming environment is used. To become proficient in a new language (the programming language here), children need time to learn how to use it expressively and become part of a social context where the language is practised. So the Scratch online community is a perfect match. Children love sharing their work and remixing, as well as the social features of Scratch for adding likes and commenting on each other’s projects. All the grade 3 to 5 children in the project attend a weekly computer lab class, playing with Scratch. In grades 4 and 5, they work on individual projects during the first half of the school year; in the second half, they work in small groups on a common theme that the teacher selects from those studied in class (the European Parliament, hydro-geological risk, etc.). The project aim is to develop and validate a vertical curriculum for the introduction of programming in primary schools as an expressive new language. In the lower grades the focus is on becoming fluent with the programming language, while integration with curricular disciplines is sought in the last two years.

**Keywords:** scratch programming, computational thinking, primary school, game making, coding

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# Where are all the Curious Students? Fostering a Love for Learning Through a Curiology box Approach

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DOI: 10.34190/GBL.19.004

**Abstract:** As British/UK Universities move towards more business oriented models of education, largely driven by financial goals, league tables and achievement metrics, students are increasingly relying on educators to hand-lead them through their assessments in Higher Education settings. This has been seen to be a particular issue since tuition fee increases, leading to a fee-entitlement approach to education exhibited by some students. This has also had a negative influence on how students approach their learning, leaning more towards a result driven focus with no room for development of discovery and exploration, a lack of curiosity-led learning motivation or an allowance for developing a love of learning. The authors therefore propose that there is a need to rekindle students love of learning in Higher Education by sparking their curiosity through playful methods. This paper explores the theory and background of the use of curiosity in education, presents 'Curiology' as an approach, and documents a playful example of how different types of curiosity can be developed through the theoretical 'making of' approach of an interactive 'Curiosity Box' designed to foster curiosity-led learning around the subject of women's roles at Bletchley Park in World War Two. A discussion of the design, method and pilot feedback of (n = 12) participants undertaking the curiosity box experience is presented alongside next stage considerations of future work.

**Keywords:** curiosity, curiology, playful learning, game-based learning, higher education

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# HRM Driven Organizational Change: Developing a Game Simulation Model for Strategic HRM

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DOI: 10.34190/GBL.19.044

**Abstract:** Deciding which HR-practices to select, and how to design them to be effective is challenging. Currently there is a lack of tools that aid HR-professionals in the design of effective HRM. A simulation model can fill this void. In this paper we present the design of, and first experiences with, a strategic HRM game-based simulation model that sets out to provide HR-professionals with insight into the quality of their selection of HR-practices while reflecting the complexity faced when designing HRM. The simulation model was built by specifying configurational HRM to a new level of detail using the competing values model and its suggested organizational change process as a framework. The game-based simulation model provides insight into the degree of alignment between strategy and HRM (vertical alignment), and between individual HR practices (horizontal alignment). Specifically, the model calculates how employee behavior changes over multiple years due to alterations in vertical and horizontal alignment. Results based on trial runs and application of the game-based simulation model in 31 serious game workshops (N= 423) show that the game-based simulation model is able to provide players (i.e. students, HR-professionals, general managers) with relevant insight into the vertical and horizontal alignment through fit scores. These fit scores enable players to tailor the HRM configuration to the organizational situation at hand. Furthermore, the game-based simulation model enables players to run the effects of HR practices on employee behavior over multiple (simulated) years. By doing so the model does not only represent a valuable tool to learn about HRM design, it presents a new level of detail in configurational HRM theory.

**Keywords:** game based simulation model, HRM, organizational change, employee behavior, strategic HR

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# Games for Education of Deaf Students: A Systematic Literature Review

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DOI: 10.34190/GBL.19.113

**Abstract:** Games have been applied in many educational contexts. Their potential in the learning process has been extensively documented, being able to be integrated into the educational process in several ways. For instance, game-based learning approaches reveal a significant and positive influence in several areas of cognition, resulting in improved performance in several areas of knowledge such as mathematics. In this paper, supported by a Systematic Literature Review (SLR), we argue that digital games for learning purposes need to be more documented in terms of the design and development process of game experience for deaf children and its correlation with learning outcomes. As preliminary results of this SLR on peer reviewed publications from 2013 to 2018 related with Game-based Learning approaches for deaf students, participant students in publications' sample are aged between 7 and 15 years old, were classified as deaf (eight) and deaf with cochlear implant (2). In our final sample, 12 publications, 12 digital games and one analogue (card game) were used in the studies. In what respects to digital games genre, seven studies mentioned it, being the Quiz the most frequent, which raises the question: are deaf students playing games with educational purposes or answering content questions not integrated with playability?

**Keywords:** game-based learning, deaf education, Systematic Literature Review (SLR)

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## Create Minecraft Fame, Save the World

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DOI: 10.34190/GBL.19.133

**Abstract:** This paper describes a small case study on using Minecraft during a course at Pacinotti-Archimede High School. This case study was based on the

observation of a game design course, an interview with Minecraft Global Mentor Marco Vigelini, and a long-term written communication with him. During the lesson we visited, the students created their own 3D games in Minecraft. It was not just about using a modern tool, but we could also see several principles of modern education. We discuss these in our study. The course merged two major topics of contemporary education - computational thinking and learning about sustainable development. Pupils in the course were enabled to unleash their creative potential as they become creators of a meaningful game and designers of a better world. Learning was based on collaboration. We could also observe an uncommon approach to teaching and feedback based evaluation. The case study presented may be an inspiration for similar use of Minecraft in formal or non-formal education.

**Keywords:** Minecraft, videogames, game design, sustainable development, principles of modern education

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## **GAF: From a Conceptual Framework to a Model of Learning in Educational Gaming**

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**Abstract:** There has been much debate in international literature on the effectiveness of educational games in student learning. In the field of Economics, there has been growing evidence that games are an effective teaching pedagogy in increasing motivation and the retention of knowledge. However, very little is written on 'how' and 'why' students learn from these Economics educational games. The Game Analysis Framework (GAF) was designed as a conceptual lens that would provide a method for mapping out 'how' and 'why' students learn from playing educational games. GAF was initially developed from three models of game design based on an experiential and constructivist theory of learning. However, from the results of the study, this model had to be revised as other factors such as motivation, engagement and emotions became the core drivers of learning. The study's results such as emotions necessitated a revision of the GAF model to include these new findings, highlighting the importance of non-cognitive factors in learning and how games harness these factors to create a deliberative learning environment. It also causes one to perhaps move beyond the constructivist and experiential learning paradigms of learning by doing to learning by enacting knowledge – an enactivist approach.

**Keywords:** educational gaming, constructivism, enactivism

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## **Design Thinking, Game Design, and School Subjects: What is the Connection?**

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DOI: 10.34190/GBL.19.143

**Abstract:** If you want to learn how to become more creative, better at collaboration, or want to develop your critical thinking skills playing games can be a powerful activity. If you want to be even surer, then build a game. This was the conclusion of a review performed by Qian and Clark (2016) on how Game-Based Learning can develop 21st Century Skills. Understanding relations between the broad categories of “learning”, “design”, and “games” is crucial in the research project Game-Based Learning in the 21st Century (GBL21.aau.dk), where we introduce game design activities through 24 teaching units for three subjects respectively Math, Science, and Danish. However, finding meaningful relations between design processes, game tools, and school subjects have proven to be a challenging task. In order to handle this challenge, our paper describes existing research on how to design games as a learning activity. The contribution of the paper is to provide a better understanding of the relations between the three domains of design thinking (DT), game tools/activities, and curriculum in order to develop, game design activities, which are relevant to teaching subjects. The contribution is an insight into research in game design as an approach to teaching; as well as, a review of relevant theories on designing as learning activity, and a discussion of how to implement these approaches in teaching.

**Keywords:** game design, design thinking, school subjects, learning goals, learning outcome

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# Aesthetic and Ethical Value Stances in Sport, Play and Movement-Games

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DOI: 10.34190/GBL.19.181

**Abstract:** Innovation in sport and movement has established itself as a multidisciplinary practice in which part of the innovations are various digital artefacts supporting physical activity, also termed movement games. In this empirical and philosophical study, we examine a multitude of value stances on an ethical-aesthetic continuum. Value stances are defined as philosophically embracing virtues, values, logics or lenses. We find that balancing the multitude of ethical-aesthetical value stances and with respect to “the purposefulness of no purpose” in doing sport, play, and physical movement, is vital in designing sustainable movement-games. Using artefacts such as heart rate monitors, GPS trackers, and other fitness trackers all acts for the quantifiable self. Similarly, mobile games, exergames, exertion-games, and play installations for physical activity have found their way into private and public spaces. These movement-games have a somewhat utilitarian user approach often designed mainly for health gains, not harvesting the full potential of seeing the users as social and physical moving human existences. This restricted user approach raises the question; what value stances may enhance the design of sustainable movement-games? The Danish existentialist philosopher Søren Kierkegaard stated that the aesthetic dimension denotes that humans strive to perform and feel well and to have pleasurable experiences. The ethical dimension refers to the human aspiration to do good based on interhuman normative standards. In our contemporary society we aim mainly at the aesthetic – pleasurable experiences – and perhaps too little “being” – “as an ethical dimension of life”. The analysis in this paper takes its point of departure in sport and health students’ reflections on their stances of doing movement and, further, their forming of value stances for five different proto-personas. The identified value stances that we merged into ten value stances unfolded in an ethical-aesthetic continuum. The identified value stances are; Fellowship, Empathy, Recognition, Play, Compete, Fun & Happiness, Mastery, Self-realisation, Health, and Immersion. The value stances are discussed by drawing on previous work on virtues and lenses in creating movement-games. In conclusion, we propose four distinct movement and design recommendations that we find valuable to include in the development of digital movement-games.

**Keywords:** human physical movement, digital design, virtues, stances, philosophy, sport services, digital movement games

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## **Game-Based Learning as a Meaning Making-Driven Activity Process: a Human Factors Perspective**

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DOI: 10.34190/GBL.19.177

**Abstract:** This article presents a human factors theoretical framework aimed at understanding learning in games as a meaning-making process. The framework models the gameplay activity as a process intrinsically driven by learning, conceptualizes game-based learning as a meaning-making process central to any type of game, and identifies aspects of a game system key to originate and influence such process. During gameplay, players continuously interpret changing scenarios, decide and plan action in order to pursue desired goals, execute planned actions, and evaluate results. Through this process, the gameplay experience unfolds as a holistic activity that integrates players' thinking, feeling and doing: players define their courses of actions based on the interplay of their perceptions, feelings and thoughts, which are in turn shaped by the outcomes of their actions and other relevant events unfolding in the game space. Through gameplay players explore the game space in order to make sense of the properties and relationships of game entities and events, their patterns of interaction, and the socio-cultural valorization that all this has within the game context. Accordingly, players learn continuously about what happens in the game, how and why, and, by extension, define what is meaningful to them, what they should do, how and why. Understanding the nature of this process and the key game elements that define it is crucial to identify learning potentialities offered by existing games, or design learning affordances for newly created products. We use an example to show how the framework can facilitate both the analysis and design of games from a learning perspective.

**Keywords:** human factors; meaning making; game-based learning; gameplay; game design framework

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# Ingress Rooms: Sustainable and Scalable Games for Learning

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DOI: 10.34190/GBL.19.166

**Abstract:** This paper introduces Ingress Room as a more scalable and sustainable hybrid game solution for education environments while still accessing the engaging benefits of Escape Rooms. A key challenge for institutions wanting to use escape rooms within an education environment is the highly controlled and physically restricted but safe space that is required to deploy the game. The Ingress Room reverses this situation by using the entire campus (or city) space as the platform for the game with the specific goal of locating and gaining access to a room in an unknown location. The challenges for the game are at specific locations but are only visible and have context through access to a website/app. Each game sets the participants off on a trail of puzzles that converge on an ingress room. Success is confirmed by entering a code displayed within the Ingress Room. As with Escape Rooms hints and tips are provided after unsuccessful attempts through the website/app. These tips are increasingly specific to avoid frustration among participants. The opportunities for learning are diverse and customisable depending on the skills level and the knowledge domain of the participants. There are opportunities to orient participants in their physical location, to encourage specific Inquiry Based Learning activities and to test existing knowledge. The game encourages generic skills including teamworking, communications and problem solving as well as domain specific understanding through tests of knowledge.

**Keywords:** escape rooms, higher education, games in education, inquiry based learning

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# Escape Rooms for Learning: A Systematic Review

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**Abstract:** Following the recent shift from traditional didactic classroom models to the adoption of active learning approaches, escape rooms and breakout games are increasingly being used in academia as a method for experiential, peer-group, game-based learning. Although they have the potential to enable new forms of teaching and transform the learning experience, escape rooms are a relatively new concept and there is not a substantial amount of work exploring their tendencies, affordances, and challenges on education. This paper addresses the lack of empirical evidence on the impact of escape rooms on educational settings by presenting a systematic review of 68 peer-reviewed studies published in scientific journals and conference proceedings between 2009 and April 2019. To analyse and critically appraise the current state of knowledge and practice in educational escape rooms, it considers aspects such as fields of education, target audience, game type and location, time limit, team size, and study results. The systematic review also highlights the advantages and challenges of these new learning activities, as well as their positive impact on student motivation and soft skills development. The analysis indicates that educational escape rooms can provide an enjoyable experience that immerses students as active participants in the learning environment. Additionally, they give learners the opportunity to engage in an activity that rewards teamwork, creativity, decision-making, leadership, communication, and critical thinking. Although instructional design for educational escape rooms is complex and time consuming, once the game has been developed it can be further applied in successive years. The results of this work aim to lay the groundwork for educators and other stakeholders by offering new insights with effective advice and recommendations for the successful incorporation of escape rooms into their teaching strategies.

**Keywords:** escape room, breakout game, game-based learning, systematic review, gamification

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# Game Making in Italian Primary Schools: The Neglected Actor

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DOI: 10.34190/GBL.19.068

**Abstract:** Students in primary schools engage in designing and developing games as a way to foster Computational Thinking (CT) skills through a constructionist approach. CT includes several 21st Century Skills such as critical thinking and problem-solving skills, it has positive effects on school results and is needed for a successful integration into our digital society. Focus is usually on STEM related subjects, suggesting that CT is fundamental for success in scientific areas; nevertheless, benefits from game making go well beyond this, including a much wider set of skills and school subjects. The process of game making and playing can be seen as a communication between three different actors: the developer, who is designing the game and coding the computer behaviour; the computer that interacts with the player; the player. The present paper, starting from the analysis of games created by grade 4 and 5 classes of an Italian primary school, as well as teacher training courses on coding in class and lessons organized by coding clubs, argues that while coding certainly is central to game making, little attention is paid to the human player. When the development of a game is carried out while keeping attention on the final player, several elements have to be considered: contents organization, player instructions, aesthetics, etc. The programming language becomes a means of communication, to be practiced within a social context including other developers and players, and widening the advantages of game making in schools. Language arts, visual communication skills and creativity are thus addressed, extending the range of basic skills for a successful integration in the 21st Century society. The paper reports a specific game making experience in primary schools, based in the online Scratch programming environment, which offers a rich context where projects can be shared, commented, and remixed: a perfect setting supporting communications. A preliminary analysis of the developed games is reported and suggestions to address the communicative aspects are given.

**Keywords:** computational thinking, problem solving, communication skills, game making, primary school education

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# Minecraft for Teaching Craft, Design and Technology in Primary School

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**Abstract:** Minecraft has been used for teaching various topics in primary and secondary school for quite some time, especially since 2016 when Minecraft education edition was offered. Research has shown that the game is useful for teaching problem solving, scientific and spatial concepts. This paper aims at investigating what pre-service primary teachers think about using Minecraft for teaching Craft, Design and Technology. All students were introduced to the game in a seminar and designed object which were 3D-printed afterwards. When analyzing the interviews, two groups of students could be identified: Those who would like to use Minecraft in their lessons basically see problems regarding didactics when working with games whereas the group of students who is against using Minecraft focuses more on missing equipment as major problem when working with games. Furthermore, the second group also doubts that children have enough skills to work with Minecraft and would like to have more lectures at university regarding how to use digital media in general. The methodology of digital game-based learning therefore needs to be taught at university colleges for teacher education to show future teachers how they should work with games and to experience themselves how to overcome obstacles like technical problems or under-equipped classrooms.

**Keywords:** Minecraft, pre-service teachers, primary school, teaching craft/design and technology, pre-conditions and success factors, digital literacy

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# SG4Mobility: Educational Game for Environment-Friendly Mobility Behaviour

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**Abstract:** SG4mobility is a science meets business research project funded by a regional agency for logistics and mobility in the state of Hesse, Germany. The project tackles the area of environment-friendly mobility behaviour. For that, an educational game is conceptualised using gamification mechanisms and the concept of sliced serious games with a game world and mini-games. The game world is the real physical space, mini-games are provided in form of location-based quizzes and physical exercises. Gamification elements (points, leaderboards) and scoring mechanisms are used to award environment-friendly mobility options (walking, bicycling, using public transport instead of private cars) and to encourage users to explore the urban environment (points of interest in the neighbourhood on their routes) via location-based games (quizzes, physical exercises). On the educational side, users learn about their individual mobility behaviour and get aware about the effects of using different mobility and transport modalities in terms of energy (CO<sub>2</sub> emission). This paper introduces the SG4Mobility approach, describes related work and presents the SG4Mobility app and its underlying concepts. Finally, the evaluation process for testing the app and results from first user studies are presented, the main results are summarised in a conclusion and next steps for further research and development investigations are outlined.

**Keywords:** SG4Mobility, educational game, gamification, mobility, modality detection, sliced serious game

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# Development of the Learning Game Tile war

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**Abstract:** This paper investigates the development of a learning game with focus on motivation and engagement. During the investigation a competitive learning game with the purpose of training addition through repetition, was developed. The game, Tile War, relies upon motivated play and continued engagement. Existing math games with focus on arithmetics are primarily designed from a structure where the player is progressing the games by solving equations. Typically, the narrative of the games does not include a direct connection to the equations being solved, creating dissonance between the two. State of the art competitive math games are often limited to beating other players' high scores providing little to no social interaction during play. This paper includes the development of a serious game that aims at integrating basic addition operations in a game structure, in such a way as to integrate the game mechanics tightly with the frame of the game, all to create a coherent player experience. The multiplayer competitive game structure is designed to include a social aspect thought to engage and motivate players. The working hypothesis is that such a design will present the player with a game that will increase player engagement and motivation, resulting in expanded playtime and increased skill of performing the basic arithmetic skill of addition. The development project used an agile and iterative design process where ideas and prototypes were developed and improved through player tests with 85 pupils in 5th, 6th and 7th grade, on three different private schools. The findings show the game was indeed motivating and engaging, however further development should consider adding dynamic difficulty adjustment (DDA) to support and expand a single and multiplayer modes together with a matchmaking system to make the multiplayer mode reach full maturity.

**Keywords:** competitive game, learning, motivation, arithmetic skill training, school children

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# Collaborative Modding of a Simulation Game: An Approach to the Development of Computational Thinking

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DOI: 10.34190/GBL.19.091

**Abstract:** The development of Computational Thinking is usually associated with solving closed coding exercises and quizzes. However, most of these approaches focus on teaching fragmented programming knowledge without enabling students to access and develop computational practices such as abstraction, pattern recognition and generalization, which are equally important for computational problem-solving. As a result, many students keep facing difficulties in describing and using these practices, even if they can successfully solve common programming tasks. This paper discusses game modification (modding) as a pedagogical approach to support students in exploring and expressing meanings about computational practices and concepts in an integrated context. In this approach, the game is seen as a complex system that incorporates powerful computational ideas and modding as a tool that makes these, otherwise complex, ideas accessible to students. The paper discusses the results of a design-based study with middle school students who played, evaluated and modified a simulation game in ChoiCo (Choices with Consequences) environment. The environment integrates three affordances for game design and modding: a) A map-based editor b) a database and c) block-based programming. The aim of the study was to investigate how construct meanings about computational thinking concepts and practices when they collaboratively modify the simulation game with the above affordances. The results indicate that game modding can provide a scaffold for students to gradually develop their understanding of computational practices and concepts. As students transformed from players to designers they discussed, changed and constructed increasingly complex modifications to the rules, the mechanics and the relations of the game system. During modding, they developed meanings about computational practices such as pattern recognition and abstraction and concepts such as conditionals and variables.

**Keywords:** game modding, computational thinking, simulation game, constructionist learning, block-based programming

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# Connecting People and Places: Countering ‘Nature Deficit Disorder’ With Location Based Games

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DOI: 10.34190/GBL.19.188

**Abstract:** This paper describes a project to implement location-based mobile games in a UK woodland, in collaboration with Forestry England, using a series of design guidelines developed through earlier research. The primary aim was to connect young people (aged 8-12) with rural environments, to counter the detachment younger generations have from our natural world. This study is part of a broader research undertaking and findings described here specifically relate to how affordances and signifiers in the physical environment can influence both the level of challenge and the will of the player to overcome such challenges. Co-designing with children helped to ensure playability and reveal properties that would appeal to their emotional needs. Working with wildlife experts at Forestry England and the Sussex Wildlife Trust also provided key information about real world activities suitable for children, facts about nature, habitats, landscapes and other content requirements. The design guidelines resulting from this project should be helpful to any researchers or developers that wish to develop games in future that encourage immersion across physical and virtual worlds, alongside an awareness of place.

**Keywords:** location based games; nature deficit disorder; emotional needs; young people; flow theory

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## A Serious Game to Teach Rudimentary Programming: Investigating Content Integration

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DOI: 10.34190/GBL.19.145

**Abstract:** Computer programming is a fundamental, transferable, rudimentary skill, which is an essential component across many University level programmes including Computer Games Development/Technology, Computer Science and Software Engineering. Programming has a reputation for being a difficult subject

requiring 10 years of education, study and training to transfer from novice to expert level with computer programming courses having a high dropout rate. This indicates that traditional teaching approaches may be insufficient in terms of engaging learners for a sufficient amount of time or may not prove to be educationally effective. Serious games have been empirically evaluated in a variety of educational and training areas and there are many examples of the application of serious games in programming education. It has however been noted by researchers that there is a lack of research performed in terms of how computer games are utilised in teaching with focus on acceptance by learners and the integration of the appropriate pedagogical content. This paper presents the first step in the development of a game to teach rudimentary programming concepts at Higher Education (HE) level. The paper will report on a survey of participants performed to investigate whether a computer game will be accepted by learners to teach rudimentary programming, what particular pedagogical content can be effectively incorporated into the game and what particular type of game is most preferred in terms of genre, graphical fidelity and format. The questionnaire will be utilised as a tool to produce a basic requirements specification for a computer game to teach programming concepts in a Computer Games Development/Technology programme in Higher Education at the University of the West of Scotland (UWS). Sixty-one participants in a Higher Education Computer Games Development/Technology programme completed the survey with some of the following interesting results: 75% of participants believed that a computer game to teach rudimentary programming would be a good idea. Participants stated that medium fidelity would be preferable and that it did not matter if the game was 2D or 3D. Some of the most difficult programming concepts were pointers and classes and a game could be most applicable in some of the following areas: objects, scope, functions, methods, conditional statements, while loops and switch statements.

**Keywords:** programming, games-based learning, survey, content

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# Developing Design Principles for Game-Related Design Thinking Activities

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**Abstract:** The aim of this paper is to identify emerging design principles when developing, piloting and implementing game-related Design Thinking activities for primary and lower secondary classrooms. The analyses are based on data from the large-scale intervention project GBL21 (Game-Based Learning in the 21st Century), which explores and measures how 1600 students working with game-related design activities in the subjects Danish, mathematics and science are able to develop design competencies such as being able to construct and communicate design solutions. In the paper, we focus on qualitative data from a pilot study on how two teachers adopt and enact one teaching unit in mathematics in grade 7. The challenge for the students is to design and construct a tangram game using the visual block-programming language Scratch with a set of agreed constraints (e.g. constructing pieces of a particular form). In our analysis, we identify design principles that support the enactment of the unit as exemplified by the two teachers. For our purpose, their teaching is interesting because they use quite different strategies when adopting the unit. One finding is that the material objects and close attention to dialogue are vital when coupling Design Thinking, game-like activities with subject matter (e.g. mathematics).

**Keywords:** design-based research, mathematics, dialogue, Scratch, Design Thinking, game design

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# Educating for the 21st Century With Role Play in Event Design

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DOI: 10.34190/GBL.19.117

**Abstract:** Society moves at an ever-increasing pace, and the importance for students to gain 21<sup>st</sup> century skills to prepare for post-education work life is an important topic. This is also evident in the education of bachelor-level students in Sports and Health in Denmark. The complexity of health issues and challenges with motivating healthy lifestyles is apparent and calls for education that prepares students for post-university work-life, especially due to the need for innovative practice and project-based work. Educating students for the 21<sup>st</sup> century requires a different teaching approach than traditional teaching domains targeting specific knowledge and academic skills, which challenges educational institutions and educators as their primary role is to increase employability of the students – especially at university level. *The aim* of this paper is to pinpoint the key learning outcomes regarding student acquisition of skills and competencies in a game-based event design course. The course was completed with 22 second-year bachelor students in Sports and Health at the University of Southern Denmark in 2019. Previous research show that a game-based learning approach can potentially increase student engagement and facilitate soft-skill acquisition. However, few empirical studies explore how role play can be applied at university level to simulate real-world scenarios and enable the acquisition of skills and competencies needed in cross-department projects. An action research approach was utilized to enable flexibility and improvement throughout the course. Inductive thematic analysis was applied to the qualitative data generated during the course, and the results are discussed drawing on concepts of 21<sup>st</sup> century skills and game-based learning. The results show that the course design created situations with the potential to improve Social Emotional Learning as a central element of 21<sup>st</sup> skills. Furthermore, the experience of working with a real-life project in a simulated project organization was educational for most of the students who were motivated by the course design and embraced the learning potential. The implications of this paper are especially relevant to educators who wish to develop teaching that prepare the students for 21<sup>st</sup> century work-life.

**Keywords:** game-based learning, role play, action research, 21<sup>st</sup> century skills, employability, university level education, university students

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# Beyond the Game: Exploring Winning Strategies With Gifted Students

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**Abstract:** This paper describes an experiment with gifted secondary school students from the 5th to 8th grade. The students were presented with a strategy game and challenged to solve different tasks together. This was done by having the students try out the game in different ways, model and print their own version of the game in 3D and develop a life-size game environment where the students became pieces in the game. These tasks have required interdisciplinary and out-of-the-box thinking and experimentation with the game. The focus of this the experiment is to evaluate the use of games as a catalyzer for independent development of gifted students' abilities. The students were observed and video recorded in order to analyze how they approached the task of finding winning strategies and which competences were trained during the experiment. The results show that the students' understanding of winning strategies evolved from an idea of finding a simple trick that always works to a concept of recognizing situations where a specific approach is advantageous. Their approach was simultaneously refined, going from a randomized testing to a systemized search for specific winning situations. The use of previous knowledge was clear as they simply tried to implement their former strategies, obtained by playing simpler versions of the game to the more advanced game, and modified these strategies as they were proven ineffective. They used their math skills to analyze the winning possibilities by describing the winning characteristics as binary outcomes and calculated the winning possibilities. During this work, the students trained not only their logical reasoning, problem-solving and argumentation skills, but also had to deal with social skills such as teamwork, engagement, decision-making, communication and organization as well. Creativity played a very important role and was shown by the students through their many different approaches. The analysis shows that working with games can motivate the students to develop their abilities independently by defining challenging questions and tasks themselves and solve them cooperatively or individually.

**Keywords:** game-based learning, gifted education, interdisciplinarity, winning strategies, modeling competence

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# Soundscape Design in an AR/VR Adventure Game

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**Abstract:** Players react to sound sources in a virtual reality (VR) game. Such sounds are linked to specific in-game objects, events, and environments. With new VR technology, researchers can develop interactive soundscapes for players to experience in their exploration of a surrounding virtual environment. To study such effects, we create an augmented reality/VR game. Its game development comprises two game constructions: (1) problem-solving scenario and (2) a first-person shooter, which lead to two set of operation rules and gamifications. To perform game experience assessment, we create a post-game experience interviewing questionnaire based on the Game Experience Questionnaire (GEQ, IJsselsteijn et al., 2008). This interview questionnaire assesses players' feelings and thoughts after they had stopped playing. This questionnaire includes components of the operational flow, perceptual feedback, interactive experience, immersive experience and cybersickness. The testing results: (1) A minimap to locate the player's position should be displayed. This keeps the player on track with the storyline. (2) Soundscapes facilitate the player's perception of distance and direction. A denser soundscape might make a game more interesting, but an abundance of sound sources is confusing for players isolated in a virtual environment. (3) A tutorial should be provided to familiarize players with the game's mechanics, objectives, and environment. Because reading is difficult in VR, cues on how to progress should rely more on auditory stimuli than NPC text. (4) Immersion is easily attained in a virtual environment. When focusing on missions, the player often loses track of time. (5) Gameplay design should exclude sideways motion to greatly reduce cybersickness.

**Keywords:** augmented reality/virtual reality game, soundscape, interactivity, immersion, cybersickness

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# Game-Based Learning for Competency Abilities in Blended Museum Contexts for Diverse Learners

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DOI: 10.34190/GBL.19.025

**Abstract:** In recent years, competency-based learning has attracted worldwide attention in the educating of lifelong learners who are capable of dealing with complex issues and addressing challenges arising in the future. Competency refers to a high-level ability to integrate learned knowledge, experiences and related skills in order to solve problems that require critical thinking, creativity, or social skills. However, most schools find it difficult to promote competency-based education due to a lack of interdisciplinary resources and professionals who can develop appropriate curriculums. While teachers are limited by what can be achieved in the classroom, museums can offer a lifelong edutainment environment with flexible choices for the public and also provide fruitful interdisciplinary learning resources to support competency-based education. However, the lack of proper scaffolding and supports in museums can negatively affect learner learning. Further, learners do not all have the same approach to learning and these differences need to be considered when considering the support to be offered. In this study, an innovative learning model to support competency education for lifelong learning in museums is proposed. A game-based learning service named CoboFun that offers various types of problem-solving activities was developed to facilitate learner interaction with exhibits and their peers in the museum. To examine the service design of CoboFun, learners' perceptions were evaluated and the differences in their cognitive styles were examined (Field Independent (FI) and Field Dependent (FD)). The results showed that both FI and FD learners enjoyed learning with CoboFun but that flexible learning tools needed to be provided to satisfy the different needs for the learners with different cognitive styles.

**Keywords:** competency-based learning, museum learning, game-based learning, virtual and physical, lifelong learning

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# Developing Teamwork Capabilities in a Simulation-Based Course: Student Perceptions

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**Abstract:** Teamwork is prevalent in simulation-based learning interventions. Many academics argue that simulations present a great opportunity to develop teamwork skills and capabilities. The purpose of this paper is to investigate students' perceptions and experiences regarding teamwork within two business simulation-based courses that were specifically designed, among other things, around learning objectives that stipulated the development of teamwork capabilities. Methodologically, the simulation-based courses in question not only required students to work in teams but also included a variety of team development activities, peer evaluations and reflections, as well as the educators' reflective diaries on initiatives implemented. Qualitative and quantitative data were collected as part of a broader multi-year (2015-2019), dual institution action research project. In this paper, the qualitative data about the development of teamwork capabilities was thematically analysed. The study findings demonstrate how students experience and perceive their development of teamwork capabilities in simulation-based courses. Themes detail students' perceived development of teamwork competencies, namely; developing communication skills, emotional management, increasing open mindedness, developing organisational skills and fine-tuning leadership capabilities. In terms of limitations, questionnaires and reflections completed by students are influenced by self-reporting bias. To counteract this, multiple qualitative data points were collected to ensure data triangulation. Researchers also mitigated this limitation by describing results clearly as perceptions of learners. The research offers a deeper understanding of students' perceptions of enhanced teamwork capabilities after working in a team while competing in a business simulation. The insights gained are useful to other educators utilizing serious games that require students to work in teams.

**Keywords:** simulation-based learning, serious games, teams, business simulation, management education

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# Math in Minecraft: Changes in Students' Mathematical Identities When Overcoming In-Game Challenges

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DOI: 10.34190/GBL.19.087

**Abstract:** This paper presents empirical findings from a qualitative study that uses *Minecraft* as a mathematical tool and learning environment. Even though *Minecraft* has been used for several years in classrooms all over the world, there is a lack of detailed empirical studies of what subject-related content students can learn by working with the game. The study is based on a teaching unit for 5th grade, which focused on using the coordinate system already embedded in *Minecraft* as a means of navigating and exploring the game in order to solve mathematical problems. Based on a design experiment with the teaching unit, we explore the following research question: How do 5th grade students experience a change in their mathematical identities when they participate in an inquiry-based teaching unit with *Minecraft*? A thematic analysis explore data from six group interviews. The theoretical perspectives used in the coding of data were based on domain theory and an interpretive framework for understanding students' mathematical identity. The key analytical findings regard the students' experience of the coordinate system as part of both the academic domain of mathematics and as a part of their everyday domain playing *Minecraft*, how students actively use the coordinate system to improve play in *Minecraft*, and how students experience new ways of participating in mathematics.

**Keywords:** *Minecraft*, mathematics education, student identity, domain theory, coordinate system

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## Virtual Reality Games and Environmental Awareness

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**Abstract:** The contribution deals with the importance of virtual reality (VR) within the contemporary world and its impact on essential human needs. Technological advances are expanding, they are less limiting, and so now, more so than ever

before, these new experiences allow people to gain attributes which help to develop their skills and personality as well. One of the primary objectives of the VR games is entertainment, but VR is used also beyond the realm of entertaining, and expands into other fields like art, various abilities' trainings, psychology, journalism and even complementing traditional education. Although, VR is not an entirely new technology, the genesis of which being a somewhat debatable topic that depends on its specific definition, what characterizes it and what fundamentally defines it both technologically and as an experience. In recent years considerable progress has been made on its technological side, making it currently more usable, reliable and affordable than ever before. The theoretical part of the study is devoted to the first technologies, which can be considered as the base of VR, defines key terms such as simulation, virtual worlds and virtual reality systems, specifies the essence of VR and its compatibility with different devices. In the research part, we focus on the education through VR games and the use of the VR technology to raise awareness in selected ecological issues. The objective is to introduce the possibilities of using VR games in the process of environmental education focusing on different target groups. We propose a solution through a specific game that has been already created to be compatible with virtual reality and focuses on separating waste with an aim to increase environmental knowledge, eco-innovation awareness and sustainability.

**Keywords:** eco-innovation, edutainment, environmental awareness, virtual reality, VR game

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## **Playing Against the Plot: Meta-Ethical Gameplay Disruption and Joyful Learning in *Grand Theft Auto IV***

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DOI: 10.34190/GBL.19.024

**Abstract:** This paper presents and discusses the findings and results of a series of tests carried out by the author in the Danish educational system among pupils and teachers using the game *Grand Theft Auto IV* (GTA IV) as a case study for investigating the problematic but also fruitful relation between gameplay and fiction, known as ludo-narrative dissonance. In analysing this dissonance, the paper further discusses the transcendental nature of play (Gadamer), the fact that play seems to play itself, and the delicate way in which the game insists on a meta-ethical theme while at the same time setting up utterly violent game rules and mechanics. As it turns out, this skirmish of fiction versus gameplay is exactly



the gravitational point zero of ‘ethics’ in the stigmatized game of GTA IV and thus a locus for joyful learning.

**Keywords:** didactics, ethics, ludo-narrative dissonance, gameplay, theory

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## Escape Room Design as a Game-Based Learning Process for STEAM Education

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DOI: 10.34190/GBL.19.190

**Abstract:** By combining elements of entertainment with creative writing, theater and technology, the increasingly popular live-action games escape rooms have the potential to improve the learning experience when used in academic settings. However, since educational escape rooms are still an emerging field, there is limited literature available about their use in STEAM education. The present paper addresses this issue by describing the methods followed by 39, 16 to 18-year-old, students and 10 teachers at a Vocational School of Greece to implement a STEAM-focused escape room activity using the Experiential Pyramid Model. The escape room was themed after the Spanish heist television series “La Casa de Papel” and incorporated creative writing, theatrical elements, and technology, such as Robotics, QR codes and Virtual Reality (VR), to promote communication, teamwork and peer learning. To make the experience more immersive, two team members had the roles of non-player characters (NPCs), and interacted with the players throughout the game, with a small script written during the design and evaluation phase. This collaborative activity was assessed via evaluation questionnaires, direct/participatory observation and interviews. The first results indicated that students were highly engaged and motivated especially at the design phase. They valued this pedagogical approach positively, since it facilitated the integration of contents of various subjects and enabled them to collaborate with their peers from different cohorts, thus promoting peer learning. This study aims to provide educators with an example of how they might develop and support non-traditional approaches to learning by immersing their students as active participants in the learning environment and allowing them to develop and apply knowledge, so to create a gameplay.

**Keywords:** escape room, theatre, technology, creative writing, education, STEAM

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# Method Cards for Movement-Based Design Activities: A Survey of Free Online Toolboxes

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DOI: 10.34190/GBL.19.049

**Abstract:** Card-based design tools have proven useful in both industry and academia in the fields of interaction design, human computer interaction (HCI), and the umbrella of fields overlapping user experience design. Wölfel and Merritt classified the design dimensions of physical card-based methods into five categories: 1) Intended Purpose & Scope, 2) Duration of use and placement in design process, 3) System or Methodology of use, 4) Customization, and 5) Formal Qualities. Furthermore, they identified three graduations of intended purpose & scope, ranging from very general to context specific: 1) General/repository card systems, 2) participatory design, and 3) context specific/agenda-driven. This paper draws attention to the methods involving human movement or movement-based methods, which constitute to one of the categories of agenda-driven methods. The design activities, particularly for the development of systems and services involving human movement, should build on movement-based methods for involving both designers and users for the increased emphasis on domain-specific human-centred design. We find that in the multi-disciplinary domains involving play, sport, fitness, games, and health, the movement-based method cards have become crucial in the new study programs and design projects involving innovation, creativity, and entrepreneurship. There are numerous articles on how cards are used in the design activities including examples of human movement-based methods. However, an overview of movement-based method cards has not been conducted and articulated. So, adopting an approach for systematic literature review, this paper identifies 20 free online resources resembling card-based design toolboxes from an organic Google search and discussion with colleagues in the HCI field. Studying the toolboxes containing 55-85 cards each and identified eighteen unique names for the movement-based design methods. The methods are mapped into Stanford D. school's five categories of design activities, empathize, define, ideate, prototype, and test. The methods grouped into each of the categories are presented briefly followed by discussion on practical implication due to similarities and differences. Four of the 20 card-based toolboxes were excluded as those do not contain any movement-based method. The paper concludes with the scope of further development of card-based design

tools particularly for movement-based methods for the human-computer interaction practitioners and education programs.

**Keywords:** method cards, design methods, design tools, movement-based design, bodystorming, embodied ideation

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## **Tower of Questions: A Peer-Quizzing Game to Engage Students in Question and Answer Posing**

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DOI: 10.34190/GBL.19.157

**Abstract:** Research has shown that educational games are effective in motivating students to learn. To contribute to ongoing research in the area of educational games, we developed and evaluated a peer-quizzing game called “Tower of Questions” which supports collaborative learning through asking and answering questions. The game uses the mechanics and dynamics found in tower defense games, a sub-genre of strategy games usually played in a massive online gathering. Our game is played in a class by students who use pseudonyms. Players can create virtual towers by asking questions, and other students conquer the towers by answering the questions. Students receive points for asking and answering questions in the game. To evaluate the effect of the game on student engagement and learning, we recruited 37 first-year university students in an introductory programming class who played the game regularly during the entire term, asking questions related to topics they learned in their course. The results of the analysis of the students’ activities indicate a strong correlation between the number of towers created and towers conquered, i.e. that students who actively posted questions also actively answered the questions of others. Students familiar with tower defense games engaged more in attacking other students’ towers (answering questions) than in creating new towers (asking questions). The post-survey data collected from the students shows that 82.14% of them found the game useful as a learning tool.

**Keywords:** gamification, game-based testing, peer-quizzing, incentives, engagement

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# Hosting a Matrix Wargame in a Slack Workspace

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DOI: 10.34190/GBL.19.184

**Abstract:** This article is a work in progress description of competence-based learning approaches at the Command and Staff College of the German Armed Forces (CSC) (specifically at the Faculty of Politics, Strategy and Social Science) and contains a best practice example for the successful implementation of a web 2.0 collaboration tool (slack) into a pen-and-paper tabletop exercise using a matrix wargame approach. It describes the terminological understanding of keywords like “Wargaming”, “Serious Gaming” and “Gamification” at the CSC and their relation to “Matrix Wargaming”. It shows how to use a free version of slack to create a holistic learning ecosystem that fosters self-driven learning, that is not restricted in time and space and enables global, synchronous and asynchronous contributions from students and subject matter experts (SMEs).

**Keywords:** competence-based learning, gamification, game-based learning, holistic learning ecosystem, matrix game, matrix wargame, wargaming, serious gaming, simulation-based learning, slack, slack workspace, table top exercise, web 2.0 collaboration

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## First Experience in Game Design for Students: Case Study

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DOI: 10.34190/GBL.19.029

**Abstract:** “If I am really making a game for players, and not in order to improve the number of site visitors, or conversion rate, or productivity, etc., what shall I do?” – is the key question for a game developer. What shall I do to make a game that is interesting for players, and reflects certain issues or demands. After experiencing games as add-ons for traditional education, the authors decided to implement their own ideas and projects of educational games. Several gaming

sessions were performed with people from different age groups with different requests and preferences concerning the games. Results include recommendations on organizing games for a large number of people, and methods for presenting data to players in condensed format to facilitate gaming process and make it transparent. The experience will be used to improve methods authors used to run educational games, correct revealed shortcomings, and gain additional support for new learning techniques.

**Keywords:** gamification, game developer, organization, education, generation Z

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## **Motivating Students to Learn law Through Co-Creation and Participation in Game Designing and Gameplay**

**Annemari Kuhmonen, Heikki Seppälä, Annamaija Anttila and Piia Rantanen**

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DOI: 10.34190/GBL.19.176

**Abstract:** The gaming industry has increased dramatically in a worldwide sense in recent years and this has brought significant importance to legal issues, such as intellectual property rights and contract law. This has meant for the continuous success of gaming companies that the understanding and use of IP instruments of protection is vitally important, however, it remains a challenge in many cases. Recently, the need to make the law more accessible to people and communicate legal information in a clear way has been recognized by legal designers, who are applying human-centred design to make legal services usable, useful and engaging. In our article we explore the co-creation process of an educational board game. Our research question is: How to facilitate 1. The learning of complex legal topics of the gaming business and 2. The training of soft skills by utilizing the principles of design thinking, service design, legal design and game design? We chose a board game as the presentation method of legal design, as the game environment is a context which is familiar to the game students. In addition, games enable the utilisation of different orders of legal design interventions, such as plain language, visual composition, interactive tools and creating a motivating learning environment. Learning by playing is an efficient way for learners to internalize the knowledge they have learnt. Our research approach was qualitative and we applied a design-based research method with which the educational game had been simultaneously developed and tested in practice. In this article we describe the collaborative game development process including the iterative development cycles with various stakeholders. In this

article we focus on the co-creation of the contents of the board game describing its design process utilising legal design. Our observations highlight the potential of the game development process and playing the game in improving the students' motivation to understand the legal topics and processes relevant to game businesses. As our intermediary result we present the 1st version of the "Game Law - Law Game" educational board game. Our innovative findings will be of interest for researchers, practitioners, and teachers in the field of educational games, legal design and pedagogy.

**Keywords:** legal design, game design, educational game, GDBL, soft skills

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## **Designing and Evaluating a Gamified Corporate eLearning Course**

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DOI: 10.34190/GBL.19.107

**Abstract:** In an increasing number of industries, employees are required to undertake online training courses which ostensibly provide them with essential job skills. However, these courses are often designed to rigid standards and generally focus on meeting minimum industry requirements rather than providing an engaging learning experience for employees. Consequently, much of these learning materials are soon forgotten and companies face a large loss in their investment. We propose that gamification, the use of game elements in non-game contexts, is a viable method of remedying learner disengagement in corporate e-learning. To this end, a user-centred design approach was used to gamify an existing corporate training course. Semi-structured interviews with a sample of corporate learners led to the selection of competitive game elements. A set of exemplary competitive elements were chosen from existing games and mockups were designed around these elements. User testing and refinement led to the final course design, consisting of confidence-graded questions, user challenges, and a leaderboard. A two treatment counterbalanced within subjects experiment was carried out using the non-gamified course as a control. In total, 15 participants completed both courses. For the purposes of the experiment, engagement was defined as "the outward manifestation of motivation," and was therefore measured using the Interest/Enjoyment subscale of the Intrinsic Motivation Inventory. Shapiro-Wilk testing on result sets showed normal distribution. Two-tailed paired t-testing showed a significant increase in intrinsic motivation in the gamified course ( $M = 4.344$ ,  $SD = 1.214$ ) over the non-gamified

course ( $M = 3.389$ ,  $SD = 1.358$ );  $t(13) = -3.533$ ;  $p = 0.003$ . Consequently, it was concluded that competitive game elements substantially increase intrinsic motivation in the e-learning course. Future work will focus on testing a wider range of game elements, as well as repeating this experiment with a larger sample group. The research is expected to benefit both corporate learners and their employers.

**Keywords:** gamification, motivation, user-centred design, self-determination theory, eLearning

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## Effects of Using Avatars in a Game-Based Learning Environment

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DOI:10.34190/GBL.19.051

**Abstract:** Peer reviewing is an approach often used in digital (higher) education as it represents a possibility to provide feedback to large student groups. However, especially in digital learning contexts, students feel being disconnected from the anonymous group of learners, leading to low-quality feedback. When feedback is open, and counterparts are known, this knowledge can lead to biases when commenting on each other's work. We developed a game-based learning environment called 'The Great Library' that we used to analyse the effect of avatars as game element to limit the effects of both fully anonymous and fully open feedback. Students and teachers using the new game-based learning environment were asked to provide feedback on their experiences with the learning environment and the use of avatars. The responses were compared to the same course provided without game elements. The qualitative data analysis reveals that the introduction of avatars still lacks acceptance on the side of the students, yet that they feel a sense of community in the GBL. Open and direct feedback is still used and appreciated by the students. The anonymity of the peer reviews resulting from the use of the avatars represents a challenge for the student-teacher interaction. The environment and set-up of the course in a whole still needs some adjustment in order to fully support the learning process of the students.

**Keywords:** game-based learning, avatar, gamification, peer feedback, peer review

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# Co-Designing an Immersive and Interactive Alcohol Resistance Training Tool Using 360-Degree Video

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**Abstract:** The presented design case gives an example of co-designing an interactive 360-degree simulation for alcohol prevention, where the user attends a party and creates her own experience through a number of choices. Overall, the application consists of 125 different movie sequences. The 360-degree simulation is experienced through VR glasses to provide an immersive and intense experience. As an example, the user can choose whether to drink alcohol or not, what type of alcohol and how often. The user is also faced with non-alcohol related choices such as the opportunity to help an intoxicated man, starting a fight or flirting with other guests. The alcohol intake among adolescents in Denmark is among the highest in Europe. Lately it has been found that peer pressure is the main reason why adolescents start drinking. The goal of the application is to give Danish adolescents (aged 15 to 17) a first-hand virtual experience with alcohol and some tools for recognizing and handling peer pressure, which they can use later in real life. The stakeholders in the co-design process consisted of 10 students (aged 18-28) studying film making and game design at Askov Højskole, Denmark, their teachers, alcohol experts from social services and researchers with expertise within health promotion, social marketing, virtual reality (VR), interaction design and game development. Additionally, 35 students from Askov Efterskole (aged 15-17) participated as actors and extras. This article describes the iterative design process of the application, containing exploration of key concepts, concepts design, prototype design and usability testing.

**Keywords:** virtual reality, 360-degree video, co-design, alcohol prevention

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# Increasing Engagement to Improve Wellness With Gamification

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**Abstract:** Athletes are at constant risk of sustaining preventable non-contact injuries due to factors such as spikes in training load, and physical fatigue. Research has shown that monitoring these factors allows for adjustments to players routines that can reduce their risk of injury. Past studies have reported that self-reporting methods are ineffective due to low rates of engagement and compliance. However if data could be gathered consistently, potential injury risk could be identified and the information utilised to prevent injury and enhance player wellness. A series of semi-structured interviews was carried out with players (n=10) from variety of team sports (Gaelic football, hurling, soccer, rugby) and Gaelic football coaches (n=5) in order to determine what features were most valuable to them when using mobile phone applications, and what features would be of most value to them hypothetically for monitoring their training / their teams training. The information gathered informed the design of an application with the purpose of replacing training load diaries currently being used in industry (forms and spreadsheets), which suffer from low rates of engagement and compliance. A pilot test was carried out with this non-gamified system with (n=21) student athletes. The pilot tests goal was to find and solve any usability issues before the creation of a gamified system. Secondary goals of the test were to gather information relevant to user engagement and compliance, before running a larger study. After the pilot test these student athletes were also surveyed (n=16) and interviews (n=6) about the value and effort they put in to training diaries and the developed app. The interviewees were also asked about the potential inclusion of game elements into the system, and how that may affect their usage, in order to inform the design and development of a gamified version. The usage data gathered in the non-gamified pilot tests showed an increase in usage time, interactions, and logins. More logs were made in total, however this was largely due to an increase of logging rest days, which outweighed the decline of logging users training activity and injury factors. When interviewed, users said they wanted a system that would help give them an advantage over other players, avoid injury, and track their progress. 5/6 users surveyed said gamification would make them willing to increase their effort in getting the information, 2/6 said it would make them willing to increase the time they spent on the app, 2/6 said it wouldn't increase their time. 1/6 was unsure how it would affect them. 1/6 did

not want game elements and wasn't willing to spend extra effort or time on a gamified system.

**Keywords:** sports, injury, gamification

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## **Knowledge Collaboration Between Professionals and Non-Professionals: A Systematic Mapping Review of Citizen Science, Crowd Sourcing and Community-driven Research**

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DOI: 10.34190/GBL19.185

**Abstract:** This paper presents a mapping review of statuses and trends in citizen science, crowdsourcing and community-driven research from 2013-2018. Understanding these fields is central in relation to the current trend of developing games for citizen science. The review focuses on identifying general themes, trends and gaps regarding knowledge collaboration and specific themes, trends and gaps regarding learning and education. This mapping is central in understanding and developing Citizen Science games, where gamers in science or other professions can collaborate. Two hundred and forty studies were identified through iterative searches and screening processes, and 11 themes were identified through grounded theory-inspired analysis. These themes are: 1. motivation, 2. evaluation, 3. education and learning, 4. man-machine collaboration, 5. participant experience, 6. impact on research, 7. CS technologies, 8. big data, 9. system or project design, 10. social media, and 11. participant development of research. Because our focus was on learning, we defined themes with a focus on traditional educational activity and new forms of learning in the field. The review reveals central discussions on both the potential of technology in citizen science learning and the application of new types of technology. Results related to citizen science learning showed that value is added into knowledge generation by the collective process of a crowd with multiple competences. Specifically, this occurs through two types of processes: social learning and learning from experience. These results indicate that it is important to focus on defining various groups of participant skills when designing citizen science systems, determining what processes users are able to participate in and what additional training or education is needed for participants to contribute to more

sophisticated processes. The review also reveals that technology will play an increasing role in crowd sourcing in both research and business. There are central discussions on whether the active input and participation of users will be transformed to more passive input with the involvement of passive sources of data generated by existing and new types of sensor technologies, bots, artificial intelligence and other types of technology. In the context of this review, the IoT development of 'the next generation of crowdsourcing' also raises a number of questions in relation to learning. With a focus on types of participation in learning and educational processes, 'active' versus 'passive' input becomes a challenge that must be addressed. The results presented in this paper are central as a background study regarding the involvement of technology in communities, such as the current trend of developing citizen science games.

**Keywords:** citizen science, knowledge collaboration, crowdsourcing, citizen science games

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## **Steering Forces in Learning and Role-Play: The Case of Occupational Therapy Education**

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DOI: 10.34190/GBL.19.074

**Abstract:** In this study, we adopt an ecological perspective (Nardi and O'Day, 1999) supported by language games theory (Wittgenstein, 1958) to explore how digital simulation-games could enrich existing forms of non-digital role-play in the Occupational Therapy education. Our goal is to understand: 1) How non-digital role-play is experienced by students and teachers, 2) Which intended learning is attributed to non-digital role-play, and lastly 3) How could digital simulations contribute to bridge theory and practice in educating healthcare professionals. Therefore, we have engaged in a participatory design process (Ehn, 1988) with Occupational Therapy educations and other partners from the relevant ecosystem in Copenhagen and Odense, Denmark. According to our data, non-digital role-play is an established practice within the education, however, teachers and students do not seem to agree on its learning value. This disagreement seems generated by a mismatch in the steering forces leading teachers' and students' perspectives on existing role-play practice and the students' learning hereof. In the teachers' view, academic knowledge and exams requirements are the primary steering forces of the students' learning outcome. Interpersonal and professional

skills appear instead as steering forces for the students, affecting how they relate to academic knowledge and exams requirements. In this respect, we find that existing role-play practices, which are used to train students to assess a patient's condition through clinical writing and reflection-in-action, exemplify the dilemma of balancing theory, practice, and relational skills in teaching and learning a profession (Schön, 1987). By clinical writing we mean a skilled note-taking practice (Bowman et al, 2015), resembling ethnography and used by occupational therapists to draft a profile of a patient to be shared with doctors and physiotherapists. In conclusion, we present new insights on the challenges of bridging theory and practice in profession studies, concluding with requirements and reflections on the design of a digital simulation.

**Keywords:** role-play, games, learning, occupational therapy, digitisation, participatory design and language games

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## Human Wrongs: Playing With Sensitive Matters Across Sandbox Games and Anthropomorphism

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DOI: 10.34190/GBL.19.037

**Abstract:** In this study we investigate the design of a playful digital simulation on human rights, targeting high school and university students, building on sociomateriality and simulation. Since human rights are a complex topic, emotionally and politically charged, with deep social and philosophical ramifications, we decided to recast the problem focusing on the connection between human rights and distribution of resources. The result is *Human Wrongs*, a sandbox game in which a single or a small group of players manages the shared resources of two populations. We wanted to avoid telling players what to think, letting them instead to uncover the dilemmas involved in securing equal access to the necessary goods, as to guarantee fundamental rights to life and freedom. As the name suggests, Human Wrongs can be used to see the effects of extreme inequality, providing the players with more opportunities for reflection, as in negative brainstorming. As it is argued that anthropomorphism in games affects players' emotional and cognitive responses, and we wanted to avoid issues with politically correctness or conflicts, our initial prototype represented two

populations of geometrical characters and food resources where visualized as spontaneously growing cupcakes. However, data from a participatory workshop conducted with a group of teenagers suggests a preference for more realistic situations and anthropomorphic characters, in which players can identify. To explore the impact of anthropomorphism on emotional responses and critical reflections we designed two new versions of our game, one with human-like characters and the other with funny-looking octopuses. Results from a qualitative evaluation with university students shows that even if the students found anthropomorphic game better suited to inspire critical reflections, they did enjoy playing the zoomorphic version and were more creative in exploring possible scenarios with it than with the human-themed version. Therefore, we propose a scenario where both versions are kept, to support more deep and nuanced reflections.

**Keywords:** sandbox games, human rights, collective good, anthropomorphism, identification

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## **GameLet: Fostering Oral Reading Fluency With a Gamified, Media-Based Approach**

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**Abstract:** In this paper, the design of a research and educational innovation project named GameLet (Gamified, media-based training of reading fluency), funded by Erasmus+ (2018-2021) is presented. The project aim is to develop a multilingual training program for reading fluency (RF) which aims at fostering learners' reading skills by improving their fluency through a gamified, media-based approach. More specifically, GameLet applies "meaningful" digital media-based gamification mechanisms to the development of learning scenarios and learning materials in order to increase pupils' motivation in self-directed,

individual and cooperative learning phases for RF training. The centrepiece of the developed concept is the story of a fictional radio play production, designed to encourage pupils to improve their reading and successfully record their role. The development of GameLet follows a Design-Based Research (DBR) approach. In close cooperation researchers and practitioners across three countries (Cyprus, Portugal, Germany), aim to generate methodological and pedagogical innovation through systematic design, testing and redesign while working within the school context. In addition to the design, the results of the first formative evaluation cycles carried out in one of the schools in spring 2019 are presented.

**Keywords:** oral reading fluency, mobile learning, gamification, game design, design based research

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## Digital Games-Based Teaching in Swedish Compulsory and Upper Secondary Schools

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DOI: 10.34190/GBL.19.079

**Abstract:** The interest in research around digital games in education has been significant; however, the integration of games in teaching and teachers' practice-based use is still somewhat an unexplored area. In this study, we investigate digital game implementation practices and challenges of teachers in Swedish compulsory and upper secondary schools and investigate how factors such as age, gender, and teaching-gaming background may influence digital game-based teaching practices. This study is the first to collect a comprehensive set of data in the Swedish context. Data were collected during March and April 2019 through an online survey consisting of 37 questions from 181 respondents. Our findings show that teachers in our sample apply gamification tools and a variety of digital games across different subject areas, typically to motivate student and practice knowledge. We find that slightly more females use gamification tools and educational games than males while males and young teachers are more likely to use entertainment games for teaching. Teachers report motivational and cognitive outcomes of digital games-based learning but perceive games as less effective for teaching communicative and analytical skills. The access to good quality resources applicable to the curriculum is a concern among all the teachers. However, teachers new to digital games-based teaching are mostly concerned about the integration of games and their unfamiliarity with game-related

technologies. Teachers with experience in the area are mostly concerned about game costs, access to good quality resources and preparation time. Future work will include a broader analysis of the data and results may be used to support the customization of game-based teaching tools and professional development programs to meet the needs of teachers.

**Keywords:** educational games, games-based learning, gamification, digital games-based teaching in Sweden

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## **Fit for Play: Developing an Adaptive Exergame Platform to Motivate Inactive Children**

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DOI: 0.34190/GBL.19.045

**Abstract:** Sedentary behaviour in children, four years of age and older, has increased over the last decades. These children become physically less skilled, which demotivates them for regular sports activities. They become susceptible to health risks such as obesity and have a heightened chance to develop depression and a lower self-esteem. Sports professionals acknowledge that these children in time become unable to keep up with the sports education pace, leaving them prone to social exclusion as well. Exergames seem promising in their potential to increase the amount and quality of physical exercise in this group. Moreover, they offer strategies to motivate children to a more active and healthier lifestyle. However, some issues remain unclear regarding their applicability and individual fittingness. For one thing sports professionals have little to no experience using exergames in physical education, let alone understand which games could be appropriate to structurally activate said children. In addition, existing exergames regularly lack a suitable degree of adaptivity regarding what a child is physically capable of, which psychological needs should be addressed, and to what inactive children find appealing in terms of gameplay. The aim of our research project is to build a first prototype of an adaptive platform for exergames to motivate inactive children to structurally engage in physical exercise more, and better. The participative design method we used in our preliminary qualitative research led to a better understanding of the barriers to move and the psychological needs children have when it comes to physical exercise. We made a first global list of requirements for the adaptive platform and an overview of necessary design directions. Future pursuits in this project include a participative design research study amongst both children and sports professionals, and a thorough review of

the literature and state of the art knowledge. We will use this knowledge to create a first prototype of an adaptive platform in collaboration with a serious game company and an organisation of sport professionals. After user testing we will use the evaluation findings as a baseline for future measurements regarding the adaptation of suggested exergames and to formalize and disseminate found design guidelines.

**Keywords:** Exergames, inactive children, physical activity, sports professionals, adaptivity, gamification, motivation, behavioural change, design research, user-centered design

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## **A Game-Based Approach for Motoric Stroke Rehabilitation: Defining the Requirements**

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DOI: 10.34190/GBL.19.013

**Abstract:** The global phenomenon with an increased percentage of older adults is clearly identified in the Mid Sweden region. With a population that is older than the average, the need for medical care and rehabilitation is also higher. All diseases have their specialised treatments and rehabilitation requirements, and this study has a focus on defining requirements for game-based motoric stroke rehabilitation. The important research question to answer was: How might a game-based approach to motoric stroke rehabilitation support the idea of independent living? This study was carried out as a Requirement-Focused Design Science project, with the aim to define requirements for a stroke rehabilitation testbed. Requirements have been outlined with the Design science idea of asking the experts to explain their predictions of what they think will produce the effects. Eight domain experts with different professional roles were interviewed to obtain a multi-stakeholder perspective on technology enhanced and game-based stroke rehabilitation. Patterns and themes in the interview answers created categories in a thematic analysis. Furthermore, the concept was discussed with research colleagues with rich experience of e-health. All of the interviewed experts had a surprisingly positive attitude toward the game-based approach, but with the strong recommendation of an individualised rehabilitation schedule. There are large variations in both the rehabilitation needs and the stroke patients' digital skills. An interesting comment from one of the informants was to involve dancing activities, as a complement to the game-based rehabilitation. Out of the three discussed stroke rehabilitation categories: cognitive, motoric and speech



rehabilitation, motoric stroke rehabilitation seems to be the one with the highest potential for a game-based approach to support independent living. The outlined requirements could be an important part in the future implementation of a testbed for stroke rehabilitation

**Keywords:** game-based learning, game-based relearning, stroke rehabilitation, motoric stroke rehabilitation, game-based stroke rehabilitation

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## **‘Futuregame’: Creating a Game for Identifying Innovation Needs in Rural Areas**

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DOI: 10.34190/GBL.19.123

**Abstract:** For technology foresight it is important to find ways to enable persons to talk about their needs and wishes for the future, and to properly assess them. However, for non-tech savvy people it is especially hard to talk about technological needs. This can lead to experts creating technologies detached from actual needs, wishes and fears, for example in strategic planning concerning rural areas. It is important to involve the population early in the process of developing new technologies and the identification of technologies for their specific contexts. The project “Horizonte erweitern” (Broadening horizons)” deals with technology/innovation transfer and strengthening of rural areas as drivers of innovation. To integrate citizens of rural areas in the process, it is not sufficient to simply confront them with facts and possible technologies. Quite contrary, what is needed is a new form of participatory innovation. Only by using precise needs assessments it can be guaranteed that future developments are in line with what people actually want for themselves and their region, and don’t impose change on them. When asking citizens about their future needs, it is necessary to simplify information without distorting the facts. Ideas need to be represented in a realistic way, so that citizens can relate to them in their everyday life. Citizens need to be enabled to express their ideas, wishes and concerns about the future. They need to be supported in translating these into new visions for their future and the future of their region. To this end, the “Futuregame”, a social game, was created. It was used for workshops in three different rural areas throughout Germany. Within the Futuregame, citizens were given the possibility to discuss their ideas for their rural areas in a playful, cooperative way and translate them into rudimentary strategies. The game allowed researchers to methodically assess and analyze technological needs in order to identify the most promising

technological solutions for rural areas. This paper will discuss the process of technology foresight within the project, the development of the social gaming-format “Futuregame” as an important part of the foresight process and the results for the rural areas.

**Keywords:** future studies, technology foresight, social gaming, needs assessment, rural areas

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## eSports Skills are People Skills

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DOI: 10.34190/GBL.19.041

**Abstract:** Esports is the fastest growing sports industry globally, and esports research is becoming more prevalent. However, there is a lack of research on what 21<sup>st</sup> century skills esports players develop. This study examines the experiences of nine young *CS:GO* players and their coach enrolled in an esports program at a sports college in the greater Copenhagen area. Through observation and group interviews we try to identify the pedagogical goals of the coach and how these are understood and experienced by the players. Based on Gee’s notion of affinity space and Dialogical Self Theory, we explore how the players position themselves in relation to their esports activities as well as their perception of what it takes to be a competent player. The preliminary findings show that both the players and their coach emphasize healthy culture (‘sund spilkultur’) as a key aspect of the esports activities. Thus, players believe that being able to communicate well and in a respectful tone is a core competency on par with technical skills and understanding of the game. In summary, players report that their experience of better communication skills is an ongoing concern both inside and outside of the game. In addition, the players describe how their ‘people skills’ transfer to friends, family and school work as a result of esports training.

**Keywords:** Counter-Strike, esports, 21<sup>st</sup> century skills, communication, affinity space

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# Playing Emotions: Designing an Educational Resource That Promotes Emotional Education Through Independent Video Games

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DOI: 10.34190/GBL.19.032

**Abstract:** This work covers the first stages of a process for designing and implementing an educational resource that aims to promote social and emotional competences in secondary students through independent video games. We start reviewing different educational uses of games based on the main learning theories. Then we highlight the strengths of independent games, focusing on the possibilities that they offer for promoting variables such as self-esteem, empathy, identification of emotions, responsible decision making, and creativity. After explaining the peculiarities of design-based research, we define the problem that guides this work (the lack of resources for teachers), we show the first version of our proposal based on a sociocultural theoretical framework, and we present strategies for gathering information from teachers to improve the quality of the educational resource. We conclude by showing some of the teachers' first reactions after a face-to-face workshop where we presented the resource and the ways that their vision would impact future versions.

**Keywords:** design-based research, emotional competence, emotional education, independent video games

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## LOST: A Serious Game to Develop a Comprehensive Vision of Logistics

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DOI: 10.34190/GBL.19.036

**Abstract:** Due to the globalization of markets, logistics has acquired enormous importance; daily, all companies make decisions in this area. On the other hand, there is a very poor offer of educational software in logistics. In this paper, we review a business game with a focus in decision making in the area of supply

chain. Logistic Simulator (LOST, for short) is a serious game that allows students to develop and apply logistics concepts in a rapid and enjoyable manner. Thus permitting to understand the interfaces of different logistics topics. The game shows the participants the consequences of different decisions that are made through a number of key performance indicators, thus encouraging the identification of the main variables that must be assessed when making each decision. In summary, LOST represents a new way of developing and connecting logistics concepts. In addition, LOST triggers in students the motivation to investigate, develop and experiment with different strategies. The game has been used with undergraduate students from industrial engineering and business. The data obtained through surveys and the results obtained within the game, indicate that the motivation of students who have used this game increases significantly, and that they develop a better understanding of the issues related to operation management of companies. Accordingly, this article presents a description of the game and a number of relevant academic and motivational results.

**Keywords:** serious game, gamification, active learning, motivation, logistics, higher education

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## **Augmenting Game-Based Learning With a Robot Tutee**

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DOI:10.34190/GBL.19.138

**Abstract:** This paper presents the initial design of an educational setup where a humanoid robot is used as a game companion to a child while they play an educational arithmetic game together. Drawing on the learning-by-teaching paradigm, the robot's purpose is to act as the child's tutee and ask questions related to gameplay and the arithmetic content of the game. The original version of the game utilized a virtual teachable agent, which was shown to be effective for children's learning in previous studies. Here we replace the virtual agent with a social robot to explore if and how the embodiment and social-like behaviour of robots can augment game-based learning further. Our aim is to design a robot tutee that will enhance the game experience and stimulate elaboration of the game's learning material. So far we have conducted two design workshops with 81 schoolchildren in grades 2 and 4 where they experienced the robot and the

game in their classrooms. In this paper, we present the results of two post-workshop questionnaires, where the children were asked about desired behaviour for learning companions and their experiences with the robot as a game playing tutee. The first post-workshop questionnaire revealed that children would like to have a robot tutee that behaves as a kind and helpful human peer, but with improved capacities such as being kind to everyone, providing better explanations, and giving more compliments. The second post-workshop questionnaire revealed that the children accepted the tutor–tutee role-division and that a majority of children were able to hear, but less so, understand, the robot’s questions. Implications of these findings for design of the robot tutee are discussed.

**Keywords:** robot tutee, teachable agent, educational game, game-based learning, co-design

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## **Playing with Handwriting: Creating a Game-Based App for Learning Cursive**

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DOI: 10.34190/GBL.19.125

**Abstract:** Cursive has become a contentious curriculum issue. While cursive writing was once a focal point in language arts curriculum in the United States, the introduction of Common Core State Standards (CCSS 2019) omitted cursive writing, and caused many states to remove or downgrade cursive instruction. Internationally, countries such as Finland have replaced cursive with keyboarding skills (Russell 2015). However, even though cursive is difficult to instruct and time-consuming to learn, it offers great benefits as it increases neural activity and helps with keyboarding skills (Armstrong 2014; Jones 2017). More recently, cursive has gained renewed attention in the United States, with multiple states passing bills that make cursive instruction required, and provide teachers with resources for instruction (Heim 2016). Given this resurgence, our design team saw an opportunity to create an app that uses game-based learning to teach cursive. Since game-based learning has been found to increase students skills in an engaging way (Qian & Clarke 2016), we believe it can support cursive instruction while eliminating the tedious and frustrating aspects associated with it. This paper presents a case study of our child-centered co-design methods for designing a

cursive app for 8-to-11-year-olds. Our overarching research question is: how can our child-centered co-design methods be used to create an engaging cursive learning app? We conducted two focus groups with thirty-six third and fifth grade students, in a technology classroom on a university campus. Students were given a prompt, design materials, and were asked to contribute design ideas for the app. The results of our study will be used to design an app called Energetic Cursive. This work-in-progress illustrates the use of child-centered co-design methods (Martens, Rinnert & Andersen 2018) and how they can inform the game design process.

**Keywords:** play, gamified learning, cursive, rewards, child-centered co-design

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## **Action Learning Entrepreneurship Regulation Theory: Providing Answers and Imagination to (Self)Regulate Entrepreneurial-Learning**

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DOI: 10.34190/GBL.19.022

**Abstract:** The European Union (EU) has made entrepreneurship promotion a top priority and is encouraging countries to implement entrepreneurial learning across their education and training systems (European Commission 2010). However, there are few examples how to regulate the entrepreneurial learning process. The aim of this study is to present answers and imagination on how to (self)regulate entrepreneurial learning, based on testing Action Regulation Theory in a game-based learning environment. In total 406 persons were tested in 19 groups with at least 9 and on average 21 participants. Action Learning Entrepreneurship Regulation Theory or ALERT is a theory elaborated, using our LEGO-role-game-simulations, as a specification of Action Regulation Theory (ART). ART explains entrepreneurship from a psychological point of view: entrepreneurial actions that are mentally regulated. ALERT explains the game-based learning consequences for teaching entrepreneurship. Entrepreneurship learning actions are subject to regulation: rules and principles to control, direct, and manage the entrepreneurial learning processes. Like the Dutch regulated their rivers with dykes and canalisation. The aim of this paper is to provide answers and imagination, showing examples, on the questions on how to

(self)regulate entrepreneurship learning processes:- For a process characterized by sequenced phases of actions, to regulate by monitoring the development of creating added value in this sequence. - For a context characterized by self-starting, proactive and overcoming barriers, to regulate hierarchical levels of self-regulation in all phases of the sequence of actions. Teaching is different from learning: the process and the context have to evoke and challenge the entrepreneurial learning process. Because (self)regulation is different from telling how, like the Entrepreneurium-student on her entrepreneurial teaching context, 2018 AD said: "I can imagine by myself, and determine by myself"

**Keywords:** action learning entrepreneurship regulation theory, psychology of learning entrepreneurship, learning entrepreneurship LEGO-game (LEARN Game), entrepreneurial teaching context, the pilot in your plane

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## Developing a Test to Measure Design Thinking

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DOI: 10.34190/GBL.19.071

**Abstract:** Like other progressive learning approaches, game-based learning is expected to develop a number of advanced competences in students (Gee, 2007). These competences are often referred to as 21<sup>st</sup> century skills (Partnership for 21st Century Skills, 2002; Griffin and Care, 2015). Various frameworks of 21<sup>st</sup> century skills have been proposed, and what they typically have in common is the inclusion of competences such as collaboration, critical thinking and ICT skills. Two on-going Danish research projects, Game-Based Learning in the 21st Century and Community Drive, involve school-based interventions based on principles from design studies. Students learn to collaboratively investigate real-world problems, conceive ideas, build prototypes of solutions and present them to external parties. The aim is to develop students' design thinking skills, which can be seen as a subset or special category of 21<sup>st</sup> century skills. To measure the effects of the interventions, we have developed a computer-based test of design thinking. The test is a performance test, which means that, in addition to being asked to answer factual or procedural questions, students are given the opportunity to engage in activities such as building models, conceiving ideas and reflecting on ethical and social conflicts. To date, no other performance-based assessment of design skills

has been developed (Razzouk and Shute, 2012). Our test consists of four test modules. Within each module, students solve different types of tasks within a simulated, authentic narrative. The tasks measure various aspects of four design competences, which we argue are relevant for primary and lower secondary school students. The Rasch model is used to test the dimensionality of the data and scale the responses on the four dimensions. A number of tasks can be scored automatically, while others require human evaluation. In this paper, we present the test, the underlying design thinking theory, the design decisions and the statistical Rasch model used to scale the responses and validate the test. The principles behind the task scoring are also outlined, and the limitations of the test format are discussed in relation to the measurement of design thinking.

**Keywords:** competence measurement, design thinking, Rasch model, game-based learning, primary education, lower secondary education

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## Gaming Human Rights Education

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DOI: 10.34190/GBL.19.005

**Abstract:** All students need to possess world history and cultural knowledge to develop greater perspective in our increasingly globalized society to be prepared for the future. This paper discusses a two-tier approach toward acquisition of that knowledge. In the first tier, teacher candidates (n=73) conducted world history research on peacemakers and conflict makers. In the second tier, candidates worked alone or in small teams, applying their knowledge toward the development of a tabletop game (card or board game) designed for use by fourth through sixth grades students. Candidates also developed post-game play tasks aligned with content standards. Through game development, candidates recognized that games can be used as an introduction to a lesson, as the lesson itself, or as a review of material. The prototypes will be tested in 4-6 grade classrooms in the upcoming academic year. This article describes requirements of the game development task and provides a description of three prototypes developed by candidates.

**Keywords:** peace and conflict, human rights education, teacher candidates, tabletop games, methods of instruction

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# Between Learning Objectives and Learning Experience: Methods for the Development of Game Based Learning Scenarios

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DOI: 10.34190/GBL.19.096

**Abstract:** The huge range of learning opportunities makes educational offers for learners quickly (ex)changeable. An adequate Learning Experience Design (LXD) is the key to keep learners in an offer. LXD has strong intersections with concepts such as gamification and game-based learning (GBL). Within the two GBL projects presented in this paper, methods of the design thinking approach have been applied in the context of LXD. Both concepts share the idea of involving the user group in the design process in order to create a user-oriented solution to a specific problem. The first GBL project focussed on the development and testing of a serious game called "Stress-Rekord" (Engl. stress record) which aims at contributing to maintain the employability of nurses through effective prevention and health-promoting leadership behaviour. During the project, paper prototyping was used to test game mechanics and game aesthetics as well as usability. By using this method, concrete game scenarios and player behaviours could be explored before the digital integration. The second GBL project "gOPAL", aimed at the development of a study assistance course for first year students based on a gamified motivation design which is integrated into the learning management system (LMS) OPAL. During the development of the study assistance course, an idea factory was carried out in order to receive immediate feedback from the target group. The evaluation of both educational offers shows that the design methods had been successfully implemented, as users were satisfied and the drop-out rate was low. The paper describes the two methods paper prototyping and idea factory and shows how the balance between learning objectives and learning experiences had been mastered in two GBL projects.

**Keywords:** learning experience design, design thinking, game based learning, paper prototyping, idea factory

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# Escape (the Traditional Class-) Room: Gamification and Mixed Reality in Higher Education

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**Abstract:** In education, methods are constantly evolving and developing in order to increase learning outcomes and support the learning process. Several measures are undertaken to help learners concern themselves with e.g. abstract contents. Some of them are taken from commercial origins like Escape Rooms in order to increase the motivation or enjoyment of learning processes. Gamification and Mixed Reality are major trends in higher education deriving from such commercial origins. Gamification, on the methodological level, aims at making traditional classes, learning processes, and single exercises or learning contents more attractive. Mixed Reality (MR), on the technology level, displays a visual, interactive, and realistic way for conveying complex or abstract learning contents. Due to their high motivational potential to students, these two trends can be combined – in specific didactically reasonable contexts and ways – for modernising teaching and learning, especially in the field of engineering education. With the potential of gamification being highly motivating and MR being a visual technology (e.g. displaying abstract learning contents in a tangible manner), various use cases can be identified and tackled in engineering disciplines. One example is displayed in the paper available with a specific Escape Room scenario. However, the integration of these methods and technologies is often a challenge to university teachers due to limited resources (e.g. time, staff, money) or a lack of knowledge. Therefore, a workshop for lecturers is developed to increase acceptance and raise awareness and the capacity for a reasonable use of modern technologies and methods in education. The workshop aims at informing about current possibilities, the variety of methods and tools, practicing the use to qualify and enable lecturers as well as raising awareness for the possible impact of gamification and MR on the learning process. Based on David Kolb's experiential learning model, the workshop aims at presenting hands-on experiences of different methods and technologies in the scope of these two trends. Also, possibilities of combining Gamification and Mixed Reality are integrated. One especially important element is a specifically developed Escape Room-like scenario for consolidating and transferring knowledge from theoretical classes into a hands-on experience for students. This paper presents the underlying hypotheses and requirements of the scenario and its integration into the workshop for teachers. It aims at discussing the chances and challenges of

introducing Gamification and Mixed Reality into higher education classes as well as reflecting on the requirements and design criteria for the Escape Room-based scenario developed for the workshop.

**Keywords:** gamification, Mixed Reality, higher education, Escape Room, workshop

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## **Designing a Multi-Campus Game Development Course With Hybrid Synchronous and Asynchronous Learning Environments Using Video Conference Systems**

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DOI: 10.34190/GBL.19.140

**Abstract:** Using Video Conference Systems (VCS) when teaching courses with practical hands-on content in two campuses in parallel is a challenge for both teachers and students. Both parties have to learn how to teach and learn using VCS and this requires alternative pedagogical approaches from teachers and new learner strategies from students. Previous experiences from 2017 and 2018 at the multi-campus VCS course “Theory and Practice of Game Design and Development” (TaPoGaDaD) has shown that there is a potential for re-thinking the pedagogical design of courses based on theory, methods and practical hands-on game production. An essential intention of the Problem Based Learning (PBL) approach at Aalborg University is that students become motivated and active learners based on their work with solving real-life problems. We have thus been experimenting with new ways of designing multi-campus learning environments, which could support all the different aspect of learning, but focusing on the different learning environments which could support the course. In this study, we are describing our inspiration from the teachers’ and students’ experiences to design the learning environments suitable for the different stages and activities in the process of a practical game-development course using VCS and PBL. We will describe the concept and learning goals of the course as well as how we have used the problem-based learning concept and gamification as inspiration for developing the different learning environments and activities used in the course. Using a multi-method case study approach, we have explored how the new designed course have supported students’ engagement, participation and learning by various in-class surveys and feedback, an end-of-course student

survey and a narrative account of the course teachers' experiences enacting the new course design. The results of the continued development of the course offers a framework/guideline for staging a multi-campus practical game development course where students are actively participating and contributing.

**Keywords:** game development course, video conference system, problem based learning, hybrid synchronous and asynchronous learning environments

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## Investigating Regional Heritage Through the Development and Playing of AR Games

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DOI: 10.34190/GBL.19.030

**Abstract:** Virtual and augmented realities (VR and AR) have a rich potential to investigating and experiencing of various fields of knowledge by people of different ages but especially by young people. Serious AR and VR apps and games are a new attractive tool to acquire new knowledge and skills in an engaging way. This article presents a concept of AR games for investigating cultural and historical heritage by high school students in their study of local history. Each game is designed to study a group of cultural heritage sites (historical, architectural, geographical, etc.) located in a limited area of the region and selected as possible places that certain residents of the region may have visited in their time. For each game a certain historical person who actually lived at that time in the region is chosen and his biography and contribution to the development of the region is included in the game content. The route is displayed on the map of the region and the player must follow this route along with the selected historical person. In the places of location of the cultural object, the player must point his (or her) phone or tablet camera on the object in order to start investigating the object. Before he gets the information about this object he is asked whether he knows the historical purpose of the object; and if not he is suggested to search for any characteristic features of the object that could help him to answer the question. For organizing a dialogue with the user an Emotional Dialogue Tree (EDTree) model is used. A mobile game "One day in life of a

merchant Vasily Lapshin” is presented, which explores the architectural heritage of the late 19th century of Tsaritsyn (the historical name of Volgograd).

**Keywords:** educational games, augmented reality, cultural heritage study, investigating regional heritage

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## **Acumenous or Inquisitional? Towards a new Theoretical Lens Within Game-Based Learning**

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DOI: 10.34190/GBL.19.055

**Abstract:** While a body of research has examined the impacts of game-based learning on individuals psychologically and socially, there is little/no research examining the relationship between mathematics, programming and games learning. The kind of learning we can identify when games are used for learning mathematics and programming. To address these gaps, data were collected from two undergraduate courses in a series of focus-group interviews. Results show how interviewees’ successes to learn and play ‘*Acumenous Learning*’ whilst they struggle to play & understand ‘*Inquisitional Learning*’. However, evidence suggests that a change in maths educational games alone will not increase learning. A change in the way mathematics is integrated in the curriculum should be re-examined and not left unnoticed. This study proposes a new theoretical lens within games learning, ‘*Acumenous*’ and ‘*Inquisitional*’.

**Keywords:** game-based learning, educational games, mathematics, programming, acuminous

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# Development of e-Learning Applications Using HoloLens and Mixed Reality

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**Abstract:** Mixed Reality (MR) has become a more easily accessible technology to the general population. There are different types of MR: Virtual Reality (VR), commonly experienced through immersive VR headsets, and Augmented Reality (AR), commonly accessed through headsets and mobile phones. A new type of MR-technology is the HoloLens (Microsoft n.d.), which gives the user the ability to enhance their world with a superimposed virtual layer. The HoloLens can be interacted with through voice commands and hand gestures. This paper will analyse how the HoloLens can be used for educational purposes, and whether it can be used to improve learning and retention of knowledge (Klopfer 2008; Kolb 1984; Mayer 2016). This will be tested through the inclusion of the HoloLens applications SDU PACS and TwitterHolo, which are currently in early development. The main purpose of these applications is to use the AR-capabilities of the HoloLens to give students a new and better way to learn their curriculum, both individually and in groups. This is achieved by presenting information in a new way, as well as giving the students a portable work environment where they can visualize previously unseen relations inside the subjects they work with (Dunleavy 2014). The purpose of SDU PACS is to help the students easily recognize bone fractures in CT-scans by comparing scans and models, while TwitterHolo will visualize tweets from Danish politicians and make it possible to sort them using MR. The applications are meant for students only, as the HoloLens is not yet available to the public. To improve the user experience, as well as the learning and retention of knowledge, the application utilizes game elements such as MR-interaction with holograms, and multiplayer-collaboration centred around pre-defined learning objectives. This paper will discuss the usefulness as teaching materials of both the HoloLens and of the applications at their current point of development, as well as their shortcomings.

**Keywords:** mixed reality, augmented reality, Microsoft HoloLens, learning, retention

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# Developing a Serious Game for Girls: Design of Avatars and Non-Player Characters

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**Abstract:** Previous studies have examined gender differences in learning through digital games (Hayes & King, 2009; Joiner et al, 2011; Hartmann & Klimmt, 2016; Lawrence et al, 2018). Thus, specific preferences of girls should be considered when developing a serious game addressing a female target group. Especially, avatars and non-player characters present key features for game experience and learning objectives of a serious game (e.g., Lee & Hoadley, 2007). Based on a project in which a serious game for girls was developed, we will analyse the research question, which design and style elements of female avatars determine preferences especially for girls, and what kind of non-player characters (NPC) do girls prefer as feedback providers. Since the game was developed to be used at schools, we, additionally, analysed if girls' preferences on avatar and NPC design are acceptable for boys as well. We conducted two studies with girls and boys age 12 to 16 (N=116). In the first study, participants could decide on different female avatars (face and body) and style elements (haircut, glasses, makeup, skin colour, earrings, head shape, body weight, body height). In the second study, they could name preferences for non-player characters as feedback providers for a technical problem. Results showed differences for avatar choices and style elements: while girls preferred glasses, a little bit of makeup, and a more normal-weight-looking body, boys preferred thinner bodies and an avatar with even less makeup. Preferences of non-player characters also varied between boys and girls. While girls preferred male and female characters as feedback providers, boys mainly chose male feedback providers. The results are discussed on the background of game design. Furthermore, we will present how the results informed the design of the serious game *Serena Supergreen* and *The Broken Blade*.

**Keywords:** serious game, gender, design, avatars, non-player characters

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# Computer Science for all: Concepts to Engage Teenagers and Non-CS Students in Technology

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**Abstract:** Knowledge in Computer Science (CS) is essential, and companies have increased their demands for CS professionals. Despite this, many jobs remain unfilled. Furthermore, employees with computational thinking (CT) skills are required, even if they are not actual technicians. Moreover, the gender disparity in technology related fields is a serious problem. Even if companies want to hire women in technology, the number of women who enter these fields is remarkably low. In high schools, most teenagers acquire only low-level skills in CS. Thus, they may never understand the fundamental concepts of CS, have unrealistic expectations or preconceptions, and are influenced by stereotype-based expectations. Consequently, many teenagers exclude computing as a career path. In this research study, we present two promising concepts to overcome these challenges. First, we consider alternative paths to enter the field of CS. In 2018, a voluntary lecture “Design your own app” at the University of Graz for students of all degree programs was introduced. In total, 202 students participated. We applied a Game Development-Based Learning (GDBL) approach with the visual coding tool Pocket Code, a mobile app developed at Graz University of Technology. The students were supposed to create simple games directly on smartphones. The course received positive evaluations and led to our second concept; In January 2019, we started to design a MOOC (Massive Open Online Course) with the title “Get FIT in Computer Science”. The MOOC will be launched in August 2019 on the platform iMooX.at and will provide a general introduction to the field of CS. For exercises and the final submission, the students need to apply game design strategies by using Pocket Code. The MOOC has several target groups. First, this course can be used to encourage young women who have little to no previous knowledge in CS. Second, it should help all teenagers to get a more realistic picture of CS to its basic concepts. Third, teachers can use the course



materials to lead high school classes (Open Educational Resources). Finally, the MOOC can be accessed by everyone interested in this topic, thus students of other majors can acquire CS skills.

**Keywords:** computer science education, digital literacy, technology enhanced learning, MOOC, Pocket Code

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## Girls Create Games: Lessons Learned

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**Abstract:** Recent studies from all over the world show that more boys than girls play video games. The numbers are different for mobile gaming apps, where 65% of women are identified as gamers. Adapting game design activities for academic purposes is a widely applied approach at schools or off-school initiatives and seen as a promising opportunity for teenagers to learn to code in an entertaining way. These raises the questions if special girls' game-design patterns exist and what can we learn from them? This paper describes a girl-only intervention where girls were asked to create their own games. This "Girls' Coding Week" was designed as an off-school event and took place during summer 2018 with 13 girls between 11 to 14 years old. To explain the basic steps of programming and to create personalized games, the visual coding app Pocket Code, an app developed at Graz University of Technology, was used. The girls created their games with the help of a storyboard after receiving basic information about coding (through unplugged coding activities, challenges, introductions to game design principles). Qualitative and quantitative data was collected through interviews, created artefacts and surveys which refer to motivational aspects. The findings show that gaming elements female teenagers tend to like, create, and play, mostly follow stereotypical expectations. In contrast to our experiences in heterogeneous course settings, girls did not see this as something negative. Furthermore, the findings provided evidence for game-making environments for girls. Subsequently, the results contributed to the development of new featured games to be used in our app to inspire female users around the world to code their own games. The authors argue that by understanding these differences in game design, we can support girls so that they become game designers and thereby more interested in coding.

**Keywords:** game design, gendered design, design thinking, gender-inclusive GBL, digital artwork

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## **Gamifying Literature and Aesthetic Processes: A Student Perspective on an Interactive Play**

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**Abstract:** Gamification is often considered a motivational design by the use of points/badges/leaderboards (PBL) yet according to the definition provided by Deterding et al (2011, p. 9), gamification is “the use of game design elements in non-game contexts”. Further, Nacke and Deterding (2017) express a need for empirical research on the impact of gamification beyond PBL and with a broader definition of the game elements used in non-game contexts. This is the second part on a study on gamification within an interactive play and we previously noted three levels of gamification within a teacher perspective: structural, narrative and semiotic level (Ståhl, Kaihovirta and Rimpilä, n.d.). The aim of this paper is to explore gamification in the interactive play from a student perspective. We intend to reach this by answering the following research questions: 1. How are the three levels of gamification from the previous paper visible through a student perspective? 2. Are there further levels of gamification that emerge from a student perspective? The study was conducted in collaboration with a local primary school and local theatre in Finland in August to September 2018 and this paper focus on students in year 6 (12-13-year-old). The play was formed by the collaboration and was later offered to other schools within the concept of Theatre in Education, TIE. The study is based on Participatory Action Research, PAR, (Cohen, Manion and Morrison, 2000) and has an abductive approach. The primary data consists of video recordings and the researchers field notes while interviews with the students function as secondary data. The results indicate that the three levels that emerged in a teacher perspective is also visible within a student perspective. However, through a student perspective, two additional levels were identified: an environmental level as well as an interactional level.

**Keywords:** gamification, interactive play, student perspective

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# Obtaining Experience in Change Management Using Sprint Games

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**Abstract:** Brief life case-based games are referred to as sprint games. The short games strengthened with predefined gaming construct and gaming components are used under conditions of limited time. Gaming components can include, for example, competition and struggle for the prize. Introduction of these components into learning environment help bridging game with reality, creating business-like atmosphere of competition and maximizing gains within the game. Sprint games help forming efficient management skills. There are several types of sprint games that differ in terms of content and approaches taken. In our practice we use several types of short games depending on the tasks that we pursue. We are ready to share experience, but the key point is: the one that would understand potential clients better and faster, and present the product the customers are ready to pay for - wins. Such experience of change management is important and actual for a modern entrepreneur, helping to adopt company strategy with regard to internal and external challenges.

**Keywords:** sprint games, change management, consumers, targeting, skills

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## Ethical Issues of Simulation Video Games

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**Abstract:** Simulation video games (SVGs) are extremely wide category of modern video games, which provide innovative educational possibilities for personal and professional development. SVGs represent practically all forms of human activities, which in turn may raise sophisticated ethical issues. In terms of

methodology, most of the educational vehicle SVGs can be studied within the framework of ludology. The typological features of hybrid social SVGs can be investigated by means of narratological methodology and non-reductionist approach (I. Bogost). It is possible to identify two problematic ethical aspects of SVGs: “internal” and “external”. The “internal” aspect investigates ethical issues within the virtual worlds of SVGs. The “external” aspect focuses on the problem the use of SVGs experience for the violation of moral and legal norms in society. The main objective of the paper is to identify key educational possibilities of SVGs and reveal their ethical dimension. Civil vehicle SVGs (car, bus, truck, train, racing games) provide outstanding educational possibilities for training driver skills, but may provoke traffic offense. Flight SVGs allow training pilots of civil airlines, but can be used by terrorists. Military aviation, tank, navy and submarine SVGs train combat vehicles control and raise ethical issues of violence against virtual/real civilians. Sports SVGs allow skills training and actualize the problem of cheating/doping. More complicated social SVGs represent the models of social behaviour as well as the problems of deviant behavior and virtual harassment. Business simulators are relevant in the context of gamification, but raise the ethical issues of capitalist exploitation. Medical SVGs can help to rehearse a surgical operation and at the same time represent medical errors. Educational combat SVGs actualize the problems of the virtual violence and its influence on social behavior. Construction and management SVGs raise moral dilemmas in city management (“SimCity”). Government SVGs besides the educational aspects of public administration may represent the violation of legal norms. God games actualize the problems of moral choices in the discourse of religious ethics. The findings of the paper can be useful for the study of game based learning and modern ethical research.

**Keywords:** simulation video games, game studies, game based learning, ethics, computer games, education

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# Location-Based Games as a Teaching Method for Seniors in the Field of ICT

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**Abstract:** The concept of edutainment including the use of location-based games (LBG) as an educational method is gaining popularity as a form of teaching. What is important is that LBG as an educational method is aimed particularly at young learners and also the use of ICT is not implemented into the teaching process. This paper is dedicated to those who are interested in adult teaching with the help of experimental methods. The authors present the results of a research experiment named LoGaSET which is based on the comparison of two concepts: gamified edutainment with LBG characteristics and the traditional linear way in the classroom. During our research we conducted both trainings for seniors - gamified and linear - to compare which method is more effective in the field of ICT, mostly smartphones. We chose ten mobile applications (the same for both groups), to teach seniors basic smartphone skills and develop certain digital competences. The main difference between the methods is in the gamification aspect of the LBG model which includes the possibility of winning. The seniors in this group are divided into teams competing against each other for points. The learning process is modified into a game which has its own goals and story while didactics are hidden; seniors should not realise they are learning. Their attention is drawn-off by obstacles and motivation comes from game design and rules. For this kind of education, role play is a typical feature as well as students being in the centre of the educational process, the lecturers are only helpers. Students do not learn in the classroom but in public, moving around town. During training we also conducted research to evaluate both teaching and learning processes. We collected both quantitative and qualitative data. We measured seniors' pace and independence during learning and after it. We also used focus group interviews with seniors and educators to get feedback. In general, we discovered that both methods are equally effective but the best option is to link LBG and classroom methods together. Seniors will get the explanations they need as well as practice in real life.

**Keywords:** digital immigrants, education, location-based games, senior, smartphone

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## **How to Evaluate Educational Games With Refugee Children: Methodological Aspects and Lessons Learned From EduApp4syria**

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**Abstract:** Educational game evaluation is a multidimensional and complex phenomenon. The growing interest in game-based learning (GBL) results in an increasing need to evaluate the effects of this approach, which requires appropriate methods, techniques, and principles that can be applied by the GBL community. This paper reflects on the methodological aspects of evaluating educational games with refugee children drawing on practical experience and evaluation studies conducted in the EduApp4Syria project. The paper gives an overview of the project and presents three field studies conducted, including the GBL evaluation methods used in the context of refugee children. The methods used included quasi-experimental design, mixed-method approach, observation with/without checklist, questionnaires, interviews, pre/post-test (using EGRA), screen recording, game-logs, and expert evaluation. The evaluations illustrate the application and assessment of these methods. This paper presents the findings and pitfalls related to the applicability of evaluation methods in various phases of the game development life cycle and methodological and practical challenges in conducting research and eliciting data in the context of evaluating educational games with refugee children. This article provides an up-to-date examination of both methodological challenges common to GBL evaluation and those unique to the user group of refugee children, culminating in guidance for researchers on methods and critical issues that need to be considered when designing research studies involving educational games and children. The paper assists researchers to critically reflect on these methodological issues and methods they use as they will have implications on the data obtained.

**Keywords:** game-based learning, language-learning games, evaluation methods, methodological aspects, children, refugee children

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# Named Entity Recognition Supporting Serious Games Development in Stack Overflow Social Content

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**Abstract:** *Q&A sites for developers (like Stack Overflow) provide various types of game-specific social contents that can support the development of effective serious games – games that can really train, educate, and motivate players. These social contents include valuable information for effective serious games development, such as design principles and best practices, game-specific algorithms, game engines, API documentation and game libraries. However, existing techniques and tools for analysing social contents are mainly focusing on recognizing person, location, and organization, and thus are not designed to support the recent advance of entity-centric search systems, such as direct answers and knowledge-graph for serious games domain. In this research, we study the problem of NER to support the development of serious games. We address the challenges of recognizing game-specific named entities in social contents and develop a machine-learning based model that can recognize a broad category of named entities that game developers really care about. We conduct systematic experiments to evaluate our machine learning-based NER against a well-designed rule-based baseline system and to study the effectiveness of various NER techniques and features against the unique challenges of game-specific social contents.*

**Keywords:** named entity recognition, machine learning, social network, serious games development

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# Game-Based Course Design: A new Approach for Effective Online Teaching

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**Abstract:** The following short paper presents the methodology used to create a game-based course (GBC) with Variant: Limits™. The course used an educational game to make game-based learning the core of instruction in a calculus course to increase student engagement, motivation, knowledge gain and knowledge retention. Variant: Limits, an educational video, focuses on the conceptual understanding of complex calculus concepts. The GBC was a four-week, online course taught at Texas A&M University. While the game was the center of the course design, a game-based learning model was applied to integrate gameplay experience with real-world subject learning. Students were able to maximize the application of the game while learning calculus. At the conclusion of the GBC, the overall results show that students were engaged in the game and course, and gained a deeper understanding of the mathematical concepts presented within Variant: Limits.

**Keywords:** game-based learning, educational games, course design, engagement, distance education, online course

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# Designing a Serious Game for Independent Living Skills in Special Education

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**Abstract:** The transition from school life to independent living is an important and demanding step for every person. People with Intellectual Disability (ID) and people with Autism Spectrum Disorder (ASD) face more difficulties in this transition due to their limitations in daily living skills. Serious Games (SGs) are considered as a promising tool that can support the acquisition of such skills. The aim of this paper is to present the design of a new set of mini games that aim to support people with ID and ASD in acquiring skills for independent living, such as self-care, transportation and safety. Participatory design is considered important for designing serious games for the specific target group and in this sense it is our aim to incorporate anyone interested in the design process of the new game. The skills that we will try to incorporate in the game are examined in the context of the existing literature, a survey with special education professionals and teachers, as well as experts in the field. The proposed game is analyzed based on guidelines for designing SGs targeted to people with ID and ASD that were extracted in previous work based on a critical review of existing literature and SGs. Based on this previous work we concluded that although people with ID and ASD have differences, SGs that are targeted to them have many common features. Our hypothesis is that with a careful design and certain mechanisms for adapting the proposed SG to the special needs of people with ID and ASD, the same SG can be successfully used with both groups. The goal of the SG is to provide a personalized and entertaining experience to the players that would enhance the learning process of independent living skills, as well as providing an outline of a new design framework for SGs targeted to people with ID and ASD.

**Keywords:** serious games, game-based learning, intellectual disability, autism spectrum disorder, game design, independent living skills

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# Girls' and Boys' Viewpoint on Educational Computer Games

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**Abstract:** The focus of the paper is the attitude of boys and girls towards the use of educational computer games or game elements. For the study we design a questionnaire containing 54 variables divided in several subgroups: profile of the respondents; use of end user device; importance of game elements; application of games and game elements in different types of educational situations; preferences as to the type of educational games; usefulness of educational computer games and game elements regarding students' personal development; efficiency of the use of smart phones for educational activities in game environment. We obtained answers from 294 respondents - students of ages from 11 to 19, 54.4% of them girls. In the study we set main research questions regarding different attitude of girls and boys:

RQ1. Is there a difference between the preferences of boys and girls to the game features and elements?

RQ2. Is there a difference in gaming devices used by boys and girls?

RQ3. What are the games used by boys and girls and is there a statistically significant difference in the types of games used by boys and girls?

RQ4. Is there a statistically significant difference between boys and girls in terms of the benefit of using games and game elements through smartphones in learning activities such as acquiring educational content in the classroom, self-learning, knowledge assessment and self-assessment?

To obtain answers of the research questions we apply different types of descriptive and non-parametric statistical analysis. The answers to these questions give directions to developers of educational computer games how to

design usability and develop games that will be attractive and useful for girls or boys at different ages.

**Keywords:** computer game, user preferences, gender differences, analysis of requirements, usability of educational computer games

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## **How Serious is Serious Game Design? - Exploring Entertainment-Oriented and Goal-Oriented Gaming**

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**Abstract:** Game design is a trending multi-million business with an accompanying large body of research with almost 80.000 publications on Scopus. Based on serious games we and our students have created over the years we identified 4 different types of approaches to serious game design. In the current paper we present 4 exemplary games spanning two main game design approaches: a goal-oriented or context focused approach, and a more entertainment-oriented approach. Secondly, we looked at the technology was used in the game (e.g. either board or more oriented at computer games). Based on a structured literature search we furthermore made a selection of 7 papers on which the framework was mapped. In the seminal work we see a similar distinction in game design approaches emerging. In addition, we see opportunities for a more hybrid way of designing serious games. We see opportunities for a better mix of the goal-oriented and entertainment-oriented in order to reach a broader target audience. This paper adds a relevant view for the manner in which the field approaches the design of serious games. It allows to reflect on the merits of a more entertainment-oriented versus a more goal-oriented approach (e.g. a structured need-driven HCI approach). We postulate that this could have an impact on the way we educate and also how we can approach commercial projects.

**Keywords:** serious games, transformational games, educational games, game design, education

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# Jumble vs. Quiz: Evaluation of two Different Types of Games in Kahoot!

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**Abstract:** This article presents the results from a study evaluating two types of games in the game-based learning platform Kahoot! Quiz and Jumble. When playing the Quiz game, the goal for the students is to choose one out of four answers as quickly as possible, and the score is awarded for a correct answer and how fast the answer is given. When playing the Jumble game, the goal is to arrange four answers in a correct sequence, and the score is awarded for a correct sequence and the amount of time used to answer. The quasi-experiment was carried out in a software architecture course at the Norwegian University of Science and Technology with 59 participants. The experiment took place at the end of five 45-minute lectures on Software Quality attributes, where the two games were used to summarize the topic. Both the Quiz and the Jumble games were created in the same fashion where the goal was to map given statements to named software quality attributes. First, the students played through half of the summary questions using the Quiz game, and then they played through the remaining half using the Jumble game. The students were observed during both games and answered a survey after they had played both games (53 complete responses). The results presented are based on observations and a survey that includes both qualitative and quantitative data. The focus of the survey was on which of the two games the students perceived as most entertaining, most engaging, most motivating, required most concentration, and from which one they learned the most. They were also asked to give comments related to the experience. The results of the study show that both games were perceived to be equally fun, motivating, and provide the same perceived learning effect. However, the Jumble game was perceived to be more engaging and demanded higher concentration from the students. Several suggestions were also provided on how to improve the Jumble game.

**Keywords:** game-based learning, formative assessment, Kahoot!, game types, evaluation, student perceptions

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# Evaluation of Interactive and Gamified Approaches for Teaching ICT Theory: A Study of PowerPoint, Sembly and Kahoot!

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**Abstract:** This paper presents the experiences and results from an evaluation of using interactive and gamified approaches for teaching theory lectures in an ICT introductory course at the Norwegian University of Science and Technology. The course consists of two main parts: One part is an introduction to procedural programming, and the other part is a theoretical introduction to hardware, digital representation, network, and algorithms. The theory part is taught in one 45-minute lecture per week throughout the semester. Over the years, a significant challenge has been to keep the students' engagement, attention, and motivation high. In fall 2017, the five teachers in this course experimented with three different approaches for giving theory lectures to their respective groups of students. The first approach was traditional *PowerPoint* presentations and encouraging students to ask questions and interact verbally. The second approach was to use the classroom interaction-tool *Sembly*, where the teacher first gave a short introduction to the topic, the students then participated in a short warm-up quiz, and then they were asked to compose questions on their own using *Sembly* followed by a vote on which questions were the most important. Finally, the lecturer went through the slides for the lecture with the emphasis on answering the highest rated student questions. The third approach was to play a *Blind kahoot* (gamified approach), where the students played through several questions related to the topic using *Kahoot!* without any background knowledge, and the teacher provided explanations between the questions. The evaluation is based on data from observations in class, a survey where 469 students responded, a course evaluation with 363 respondents, and feedback on the *Blind kahoot*. The results indicate that most of the students prefer the gamified approach and that there was no difference in terms of gender. This study focuses on students' perception and not on the learning outcome of the three approaches.

**Keywords:** game-based learning, interactive learning, improving classroom teaching, evaluation, student perceptions, Kahoot!

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# Think!First: Inducing Behavioural Change Through Gamification, Persuasive Design Principles and Machine Learning

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**Abstract:** The importance of online trading is steadily increasing both nationally and internationally and will reach a market volume of 354 billion euros in 2020 for clothing alone. This rapid increase in parcel volume, but also the high number of returned goods - which account for up to 60% of deliveries - poses new challenges in the light of climate change, air pollution and traffic management (EHI Retail Institute 2015; Kristensen K. et al. 2013). Previous initiatives have aimed at the electrification of delivery cars or at the provision of central collection points, but have not used the biggest lever: human behaviour. What is needed are innovative approaches that broaden the scope of action for customers highlighting a more sustainable shopping experience. Within the Think!First project, a modular framework in terms of “level-up” for web shops was designed, developed and evaluated. With the help of gamification strategies, persuasive design principles and machine learning algorithms, users of our test shop were encouraged to behave in a more targeted and environmentally conscious manner while purchasing online goods. In order to measure the impact of our framework, we conducted a nationwide field test which showed that there are significant quantitative changes in interest and knowledge concerning sustainable shopping choices as well as a reduction of returned parcels in the test shop. Qualitative expert interviews showed that online retailers may implement customer-centric Think!First strategies in their own shops taking into account the increasing competition and ever more demanding efforts to satisfy customers. In retrospect our framework can be seen as crucial first step in improving the e-commerce sector on an ecological, a technological and a behavioural level.

**Keywords:** behavioural change, gamification, persuasive design, machine learning, e-commerce

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# Game-Based Learning to Support the Development From Lean Production to Digitalised Production

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DOI: 10.34190/GBL.19.031

**Abstract:** The developments of digitalisation, also referred to as the fourth industrial revolution, lead to a fundamental change in industrial production across all sectors. Industrial production is currently often organised using lean production methods. These methods are changing, and digital tools for production will increasingly be used in the future. The digital transformation of the production causes challenges in the manufacturing industry. Firstly, some companies have none or few competencies in this field and do not know the advantages for the company itself as well as for the employees caused by the digital transformation of production. Secondly, the role of employees in production is changing and they are often reluctant to adapt to these continuous changes. Simulation games are dynamic models for the game-based simulation of a system with the aim of better understanding, evaluating and designing systems. The artificial environment of a simulation game imitates the functions of a real environment and situation in which the players can gain experience and make decisions without pressure or real consequences. Therefore, simulation games are seen as an adequate approach to qualify employees in manufacturing industry. The simulation game developed by Fraunhofer IPA uses active learning methods to achieve higher learning outcomes than the comparatively passive conventional method of frontal teaching. Two production methods are implemented and combined in two different rounds of the simulation game. In the end, the advantages and disadvantages of the different types of production are discussed with the participants. The main goal of the simulation game is to understand the basic principles and backgrounds of lean production and digitalised production in general. The result of this work is the elaboration and implementation of a simulation game which meets the requirements and learning outcomes described above. In the context of the simulation game, three fields of action and directions of digitalisation in production are emphasized, namely efficiency, transparency and the generation of data.

**Keywords:** simulation game, digital transformation, lean production, digitalised production, game-based simulation

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# How Learning in Business Games can be Evaluated

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DOI: 10.34190/GBL.19.052

**Abstract:** Business games are useful tools for analysing communication, processes and correlations in business contexts by reducing the complexity of real companies' problems to substantial parts. They are usually used in further education for economical, production orientated or human resource related qualifications. Even though the benefits of learning with business games are well known and accepted among the scientific community, there are few approaches of making the results of business games measurable. This is due to the fact that it is difficult to evaluate game experiences, the behaviour of participants and to measure learning effects. Moreover, there are only few findings about general conditions that support learning and high quality results of business games. Thus, the paper provides first results of an experimental research about the design and evaluation of a self-developed learning game. Based on the analysis of questionnaires (N=230) and half-standard observations (N=69), participants' learning effects and game experiences were measured directly after the game and after a period of six months (N=29). The paper expounds first results of the analysis of the collected data, which provides insights of game-based learning and factors influencing game flow and atmosphere. One of the first and most important results of the analysis is that the learning of the participants is significantly connected with the game design. Additionally, gender and professional background of the participants and the impact of business game have been explored. Beyond that, it was possible to identify conditions and design elements that support learning outcome, participant perception and success of the business game. Based on the study, the paper emphasises which elements are important for designing and evaluating business games and which components improve learning in adult education.

**Keywords:** evaluation of business games, game-based learning, design elements of games, adult education

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# **PhD Research Papers**



# Combining Game-Based Learning and the Flipped Classroom: A Scoping Review

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DOI: 10.34190/GBL.19.059

**Abstract:** There is increasing pressure on educational institutions to make their students active learners. Both game-based learning and the flipped classroom approach can be seen as manifestations of that change in educational paradigm. Ample evidence exists of the efficiency of each of game-based learning and the flipped classroom methodology. Successful blending of the flipped classroom with other pedagogical models such as problem-based learning provides the framework through which the flipped classroom methodology can support other learning approaches. However, very little research so far has explored the use of game-based learning in the flipped classroom. This PhD project aims at examining to what extent game-based learning and the flipped classroom method can be used in conjunction to support students' motivation, engagement and learning outcomes. The PhD project is in its early stage of development and I will in this paper present findings based on a scoping review of research incorporating gaming elements in the flipped classroom. This review highlights the gradual shift from superficial elements of rewards-based gamification to fully incorporated serious games used as support for the flipped classroom. We will argue for the use of meaningful gamification to develop a holistic system, which incorporates gamification, storytelling, user-generated content through the development of bespoke games tailored to support the flipped classroom approach. We conclude that combination of game-based learning and the flipped classroom methodology has the potential to support better student engagement and motivation. We open on the potential for further research evaluating the impact of combining game-based learning and the flipped classroom on students' learning outcomes.

**Keywords:** flipped classroom, game-based learning, active learning, gamification

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# Educational Escape Room for Approaching the Concept of Length on Blind Students

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DOI: 10.34190/GBL.19.173

**Abstract:** The game can be included in the teaching curriculum of preschool children (4-7 years), as a framework suitable for supporting mathematical activities, but also as an autonomous activity, even for blind students. Escape rooms are live-action team-based games, where players are asked to solve puzzles to escape from a room. They are an educational tool, which in the long run can have learning benefits. Blind students have difficulty creating concepts about their body. Their mental map of the world and their place in it may be very limited. Concepts that are embedded in the perception of space, which, apart from its great importance to everyday life, have both educational and research significance, can be very difficult for them. However, they develop specific mechanisms and ways of perceiving concepts, and sometimes they perceive better some concepts, compared to the students with healthy vision. This paper devises and presents “the design of an ‘Escape Room’ game for the Mathematics Curriculum of the 3rd grade elementary school for students with visual impairment.” In addition, devises the monitoring protocol for observing five behavioral factors as the necessary factory for the design of the differentiated game, the student’s response to this type of game, the perception of the Museum's premises through the calculation and measurement of the length, the tactile and the socio-emotional players’ behavior.

**Keywords:** game design, escape room, blind students, the concept of length, monitoring protocol

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# Spawning in Concordia: A Tale of Digital Literacies in Virtual Worlds

**Kim Balnaves**

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DOI: 10.34190/GBL.19.006

**Abstract:** *It is Medieval times and you have spawned in Concordia a city of Harmony that has been turned to chaos- only a team of heroes can work together to save it.* Narrative, digital literacy, problem-solving and strategy have been identified as being necessary skills to develop in the 21<sup>st</sup> Century (Burnett & Merchant, 2016). These skills are an innate part of playing games in virtual online worlds (Gee, 2009). In this qualitative study, three groups of twenty 8-14 year old children in schools in Australia and Italy participated in an online virtual world together. In this world the children collaboratively solved six problems based around their culture and governance. The world is designed as a game based in a narrative story, in a virtual world, created in Minecraft. This research was developed to enhance the children's second language learning however there was also substantial growth noted in digital literacy skills (Dudeney, Hockly & Pegrum, 2013) development. This doctoral study uses the Digital Literacies Framework developed by Dudeney, Hockly and Pegrum (2013) to analyse and discuss the data generated within the game. The doctoral research is not yet complete so full results analysis are yet to be developed. This paper initially discusses how the game within the virtual world was designed in a way that allowed children to demonstrate and develop the literacies within the pre-developed digital literacy framework. The paper then elaborates upon this by discussing three of the game tasks; The Passport, Empathy Village and The Jewels Quest. In the preliminary analysis of data collected the way in which different children participate, even with language differences, highlights that digital literacies used in an authentic serious gaming context have the ability to enable students to collaborate cross-culturally.

**Keywords:** digital literacies, second language learning, Minecraft, virtual worlds, task based learning

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# Using Game Based Technology as a Mediating Function in Interventions to Develop Pretend Play Skills in Children With Autism Spectrum Disorder

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DOI: 10.34190/GBL.19.174

**Abstract:** Autism spectrum disorder (ASD) is a developmental disorder, relating to symptoms of lack of imaginary play. It is associated with poor outcomes in terms of independent living, educational attainment, employment, and social relationships. Pretend play is typically delayed in those with ASD diagnoses. Interventions using game-based technology are increasingly being used for children with autism with promising results. Learning from existing research could guide the design of future applications, and the use of technology to mediate pretend play interventions, leading to better outcomes for those with ASD. This paper reviews studies that have sought to improve pretend play interventions using technologies in children with ASD. Seven studies were included in the review after conducting a systemic database search. These were analysed for use of technology as a mediating function in the interventions. The results identify the relative impact of the interventions on the targeted skills of children and individuals with ASD. These show that using technologies as mediating functions had a positive impact in several areas of skill deficits that limit the success of children with ASD, not only in pretend play, but also with the associated skills, important for adult life and independence. This suggests that Game based technology shows good potential as a mediating function for enhancement of pretend play intervention for children with ASD.

**Keywords:** pretend play, game-based interventions, systematic synthesis, technology mediation

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# Game Features in Inquiry Game-Based Learning Strategies: A Systematic Synthesis

**Lanlan Gao, Carlo Fabricatore and Maria Ximena Lopez**

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DOI: 10.34190/GBL.19.170

**Abstract:** Educational games have been used to support Inquiry-based learning in the last ten years. Although many studies have shown game-based inquiry activities can help students develop problem solving abilities and understand scientific principles, little attention has been paid to understanding how game features have been used to support the inquiry processes, and how these may be related to impacts on achievement and engagement. This paper presents a review aimed at identifying game features used in games and gamified strategies designed to support IBL, and their impacts on students. Eleven studies were included in the review after conducting a systematic database search. The analysis revealed: a) the use of a wide variety of game elements including scoreboards, storylines, quests, contextualised feedback and non-linear exploration of information to support IBL; b) elements were mainly oriented at supporting three core characteristics of IBL: the hierarchical structure of learning processes, the creation of a meaningful environment framing the problem to solve, and the provision of progressive and contextualised guidance; c) positive impacts both in terms of conceptual learning and information seeking strategies, but there is mixed evidence regarding the impacts on engagement.

**Keywords:** inquiry-based learning, game features, systematic synthesis, game-based strategies

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## An Analysis Instrument for Gameplay Information Flows Supporting Sustainability Complex Problem-Solving

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DOI: 10.34190/GBL.19.171

**Abstract:** This article presents a game analysis instrument for the identification and evaluation of gameplay information flows which may promote the



development of complex problem-solving capabilities. Complex problem-solving is essential to foster the sustainable development of our global world, addressing our needs while at the same time ensuring that future generations will be able to address their own. Learning for sustainable development should be a central focus of contemporary education, and games can be valuable learning environments for the advancement of complex problem-solving capabilities. Players' engagement in complex problem-solving processes depends on contents, function, timeliness and amount of gameplay information available to them. Hence, the instrument presented in this article was developed to capture functionality and properties of gameplay information flows key to engage in and interpret complex problem-solving situations. The instrument is based on a model of gameplay as a contextualised activity process driven by meaning-making, developed integrating perspectives from complex problem-solving theory and constructivism learning theory. An exploratory test of the instrument was carried out through a case study based on the game *Stop Disasters*. Results suggest that the instrument allows to comprehensively evaluate suitability of gameplay information flows to engage players in complex problem-solving situations, and foster complex problem-solving capabilities. The instrument can support the analysis of existing games, as well as the design of new games. Hence, it can be a comprehensive and valuable tool for researchers, developers and educators involved in projects concerning sustainability and game-based learning.

**Keywords:** digital games, constructivist learning, complex problem-solving, sustainability, game analysis, gameplay information flows

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## A Framework for Game-Based Learning Design in Higher Education

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DOI: 10.34190/GBL.19.007

**Abstract:** Game-based learning in higher education has been challenged by critiques addressed concerning simplicity, lack of depth and a formalistic and systemic approach, which is in contradiction to higher education's demands for

critical thinking and exploration. There has been a tendency to focus on simple game structures that only feed the player with information, rather than encouraging curiosity and exploration. Difficulties are well known regarding the creation of a direct connection between educational content and the basic game structure. This paper will through an in-depth interview with World of Warcraft gamers and longitudinal educational design studies, develop a framework for a reconceptualisation of game principles in higher education. The methods include three gamers and 150 students from the technological educations program at University College of Northern Denmark. Based on qualitative empirical data a content analysis is conducted. The empirical findings reveal how the principles from game-based learning can support the students learning process and afford critical thinking and Exploration relevant for higher education. The framework for game-based learning, addressed in this paper, can contribute to the existing knowledge as it point towards *an idea of how to use gaming principles to challenge existing normativity within game-based learning and subsequently inspire further developments* for how academic topics, including critical thinking, can be learned in a much more exploratory way through games. Second, the article elaborates on the importance of the game-design supporting the intended learning processes. It is stressed that a holistic design strategy is needed to maintain the educational demands for critical thinking and exploration. However, further studies are suggested testing the evidence of academic learning in the use of game-based learning design in higher education. Primarily, studies addressing the effect of game-based learning in student critical thinking and exploration.

**Keywords:** game-based learning, World of Warcraft, higher education, critical thinking, exploration, learning design

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## Designing a Scalable Intervention for Studying the Impact of Teacher Facilitation With Digital Video Games

**Santeri Koivisto, Tiiu Marjoniemi and Mikael Uusi-Mäkelä**

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DOI: 10.34190/GBL.19.038

**Abstract:** Digital game-based learning has been researched widely but it often focuses only on the interaction between the learner and the game medium, leaving teachers' contribution largely unexplored. The aim of this design-based study is to describe the development of a scalable intervention and materials for studying chemistry that will leave teachers with more time to focus on facilitation.

Further, performance metrics were designed to measure the effectiveness of the intervention. The outcomes of this study are going to be utilized as a component in a larger research project that will explore the teacher's contribution and role in the learning process with games. In this paper, theoretical background of teachers' role in learning process with digital games is explored. Second, the design-based research as a method is described and its selection discussed briefly. Then, the initial design of the intervention itself is described in more detail, followed by observations from each iteration and conclusions to inform further iterations. The findings of this study show a notable increase in student attitudes towards studying chemistry and increase in retention of the materials studied. Key practices in lesson facilitation and questions for further research were identified.

**Keywords:** game-based learning, design research, digital video games, teacher position

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## Designing Digital Exploration Games for Automated Exhibition Sites

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DOI: 10.34190/GBL.019.048

**Abstract:** This paper presents a mixed-reality, location-based game for mobile devices, *Discover the Redoubt*, designed to support users in an automated, self-facilitated exhibition site - that is, a site where there are no personnel present, free admission, monitored through security cameras and time-locks to open/close the building. The game has been designed to accommodate an exhibition that has a combination of indoor and outdoor areas by utilizing Bluetooth beacons. The game is designed to investigate how museum communication can be mediated through an equilibration of 'fun' and 'facts' in an automated exhibition. Exhibition sites are widely regarded by scholars from multiple disciplines as environments where informal learning can take place and link educative and entertaining content. However, the challenge of balancing education and entertainment remains a debated topic in museum research. Users' expectations are often tempered by traditional museum communication that is reflected in exhibition design that uses glass displays with labels, signage, posters and looping audio and video content. Existing games in exhibitions, such as scavenger hunts and quizzes, provide a way of playing through an exhibition visit, which can support the users in a self-facilitated visit while providing active and interactive modus for the user.

However, the design of these games is relatively unexplored, when factoring in automation and self-facilitation. The design process here details user research, lab and field test which entails co-design with museum professionals and studying visitors in the exhibition. The aim is to support the user in automated sites by enabling exploratory behaviour through the gameplay.

**Keywords:** human-computer interaction, exhibition sites, gamification, constructive learning theory, exploration

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## **A Card Game Designed to Teach English Pragmatic Markers**

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DOI:10.34190/GBL.19.162

**Abstract:** In this paper, we describe the development of Mind You!, an educational card game currently in development to engage learners of English as a Second Language (ESL) to learn English pragmatic markers. Pragmatic markers, a study of pragmatics refer to individual words or phrases that provide the hearer context clues about the intended meaning of a speaker during conversation. Learners competent in the pragmatics of a foreign language can interpret intended meanings of native speakers thus developing cross-cultural understanding. Despite this, pragmatics has been given little attention in ESL classes due to lack of teacher training and suitable teaching materials. Mind You! is currently being developed as a supplement for teachers to use in ESL classes for teaching pragmatic markers. The development of Mind You! used a research through design approach which involved three case studies and three brainstorming workshops. The case studies examined how the rules, instructions and aesthetics of three existing card games engaged ESL learners in oral communication development. Thematic analysis involved determining common themes found in observations of learners playing the games and interviews with them about their learning experiences. Findings included providing equal opportunity for learners to practise the language during social interaction, card visual aesthetics containing relevant information for language learning and simple scoring system. The brainstorming workshops were conducted with game designers to conceptualise the rules, instructions and aesthetics of Mind You!. The three brainstorming workshops also informed three design iterations of the

card game. Each iteration consists of rules, instructions and aesthetics designed differently for learners to practise using pragmatic markers in sentences within social interaction and language play.

**Keywords:** card games, foreign language learning, game-based learning, pragmatics, design research, iterative design

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## ***Liike*: The Design and Development of a Serious Game for Accountancy Students**

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DOI: 10.34190/GBL.19.053

**Abstract:** Professional bodies regulating training for accountancy students posit that graduates lack certain professional competencies and skills in the workplace and it is evinced that there is a gap between the classroom and the boardroom. The South African Institute of Chartered Accountants (SAICA) call on lecturers to aid with the development of professional competencies and 21<sup>st</sup> century skills. Obtainment of these professional competencies and 21<sup>st</sup> century skills will prepare students to meet the challenges and opportunities of today's business world. A growing body of literature on teaching and learning indicates that lecturers should amend their teaching practices and pedagogical framework to include teaching and learning of competencies and skills. Teaching and learning research across disciplines suggests that the use of games in the classrooms can help students obtain these competencies and skills. A serious game dubbed *Liike* has been developed for undergraduate accountancy students to not only address the professional competencies and 21<sup>st</sup> century skills they require in the workplace but also to afford students an opportunity to apply theoretical concepts learned across different modules. This paper presents the detail of the design and development process of *Liike*. Furthermore, the paper highlights the *Liike* design-oriented research goal and methodology. Ultimately, the key characteristics that informed the design of *Liike* are presented as lessons learned. In conclusion it is suggested that not all design elements are created equally when it comes to imparting professional competencies and 21<sup>st</sup> century skills. Incorporating specific game design approaches and drivers are also needed to tie-up with the required professional competencies and 21<sup>st</sup> century skills.

**Keywords:** serious games, professional competencies, 21<sup>st</sup> century skills, game design, accountancy

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## **Digital Game-Based Learning for Early Childhood: Guardians' Attitudes in Pakistan and Bangladesh**

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DOI: 10.34190/GBL.19.163

**Abstract:** This paper explores guardians and facilitators attitudes towards digital game-based learning and their perceptions of a set of non-formal digital game-based learning interventions organized in South-Asia. These interventions lasted for 90 days and reached 278 children between the ages of 5 to 8 in Pakistan and Bangladesh. The children played digital learning games that focused on improving their literacy proficiency in English and on building their basic numeracy skills. The children did not participate in formal learning during the intervention, and each group of children was supported by a facilitator. In late 2017 41 legal guardians of students and 6 facilitators participated in focus group discussions, which form the basis of this article. The study identified positive attitudes from both guardians of the students and facilitators of the classes towards digital game-based learning and especially its perceived effect on children's motivation to participate in organized education. The study recognized the guardians' doubts towards transitioning from digital game-based learning to traditional learning. The discussions also showed the guardians' and facilitators' fear for the children's lack of exposure to skills they considered could only be achieved through traditional studying methods.

**Keywords:** digital game-based learning, literacy, early childhood, focus group discussions, South-Asia

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## **Task Analysis in CALL Software**

**Laura Vawter and Alke Martens**

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DOI: 10.34190/GBL.19.105

**Abstract:** Current research into Computer Assisted Language Learning (CALL) software design highlights a division between behaviorist and cognitivist

methodologies. The distinction of behaviorist and constructivist learning theories within CALL systems effect task creation. In language learning classrooms Task-Based Language Teaching (TBLT) is effective methodology in communicative language learning classroom. Some of the techniques for task creation within language classrooms are related to the Grammar Translation Method, Audiolingual Approach, and the Direct Method. This paper analyzes four current CALL software whose target users are young language learners. This paper breaks down tasks within these software system including the identification of these techniques. Furthermore, it examines the behaviorist and constructivist methodologies in this software through the measurement of user control, system feedback and system adaptation. Subsequently, this paper proposes that the identification of these techniques can move task creation in CALL software towards constructivist teaching methodologies. Additionally, this paper confirms that current CALL software follows behaviorist methodologies over constructivist.

**Keywords:** constructivist, behaviorist, micro-world, input, adaptability, user control

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## **Promoting 21st Century Skills With Game-Based Learning in Interdisciplinary Fisheries Education**

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DOI: 10.34190/GBL.19.153

**Abstract:** This conference paper presents the case of using a combination pre-made serious games and self-designed games at bachelor and master's programs at the Norwegian College of Fisheries Science to facilitate the integration of different disciplines and the development of practical skillsets that are necessary for success in the seafood industry after graduation. Furthermore, it explores the preliminary results of student surveys rating their experiences of game based learning in the bachelor in fisheries and aquaculture science program.

**Keywords:** game-based learning, interdisciplinary programs, fisheries science, student-active learning, constructive alignment

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# Investigating key Structural Elements in Location-Based Mobile Serious Games

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DOI: 10.34190/GBL.19.109

**Abstract:** Nowadays, the mobile industry is one of the most lucrative sectors with smartphone and tablet gaming growing year over year. In recent years, several commercial GPS-enabled AR location-aware mobile games have been presented that try to combine real world locations with in-game activities, such as Ingress or Geocaching. However, besides the obvious use of mobile games for entertainment purposes, games can disclose new opportunities for pedagogical activities when properly designed. Serious games use the motivational aspect of games for purposes other than entertainment. More specifically, location-based games have been used effectively in a number of domains. Location-based mobile serious games presented in the literature emphasize the interaction of players with the physical environment in a number of thematic domains such as promoting cultural heritage, place-based language learning in authentic settings, affecting human attitude and behavior towards environmental consciousness among other. However, such games pose extra challenges when it comes to game design and implementation due to the heterogeneity of technologies, scenarios and structural game elements involved. To this end, in this paper a number of location-based games developed for serious purposes presented by the research community in recent years is discussed. The aim of the article is to review such games from a structural perspective in order to put forward concepts and forms of gameplay that could facilitate the design of such games. Such an analysis has value for educational practitioners interested in implementing similar games. Furthermore, as educational practitioners are not expert game makers, game prototypes are implemented mainly with the use of authoring tools. Given that such tools are targeting generic location-based game experiences, there is a need for significant amount of research to be performed on ways that structural game elements and game mechanics can be framed within meaningful patterns and guidelines to create such type of games.

**Keywords:** Serious Games, location-based mobile games, game design

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# **Masters Papers**



# The Effects of Gamification on Third Level Intrinsic Motivation Towards Studying

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DOI: 10.34190/GBL.19.103

**Abstract:** Any activity, we choose to do, without an obvious sense of progression can cause people to become quite unmotivated and thus less likely to choose to partake. When we are talking about an activity like studying, an activity people do not often choose to do, the effect can be more extreme. Progression elements can be seen in almost all forms of digital life, social media to video games. When students get immediate feedback and a sense of progression they have a feeling of competence and relatedness, something that they do not have when progression cannot be felt. Students also choose to utilise methods of studying that are not of benefit to them. The questions this study aims to answer are: Will progression elements have a higher level of effect on student's motivation than non-progression? Will progression elements have a higher level of effect on student's rate of use than non-progression? We are using gamification, the use of game elements in non-game contexts, as a method of improving on existing studying methods. We are using progression elements to aid in student's motivation. Testing and discussion based questions can be of greater benefit to students than rote learning. Testing is a method of studying that has been known to have a greater effect on student's mastery of a subject for nearly 100 years. The app that has been developed utilises testing as its method of studying. Along with this, the app tries to promote discussion among the students. Discussion can be of benefit to students as they work together to answer the questions and correcting each other as they need. A pilot study was run testing the effects of the progression and non-progression approaches. We measured the effects on motivation using the Intrinsic motivation Inventory (IMI). The results of the IMI and average time spent per session were analysed to discover if there was a significant difference.

**Keywords:** gamification, progression, studying, motivation

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# Using Game-Based Training to Reduce Media Induced Anxiety in Young Children

**Tanja Heumos and Michael Kickmeier-Rust**

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DOI: 10.34190/GBL.19.159

**Abstract:** Digital games have been successfully applied for the treatment mental health problems such as stress disorders, traumatic disorders, or hyperactivity syndromes. Specifically the treatment of anxiety traits and anxiety disorders such as phobias have been in the focus of game-based treatments in the past. A societal challenge that is increasing in recent times is media-induced fears in young children. While tailored game-based treatments existing for school children, tailored and theoretically sound solutions for children below the age of eight are sparse and so is the available body of empirical research in this direction. With the present study, we look into the potential of digital games to support kindergarten children reducing (media-induced) anxieties. The present paper introduces the game we developed for helping children reducing anxiety tendencies and it introduces an experimental study that will be carried in May and June 2019. Moreover, the paper briefly presents and discusses the outcomes of a pre-study questionnaire focusing on media consumption and general anxieties of children.

**Keywords:** anxiety disorders, trait anxiety, game-based treatment, cognitive behavioral therapy, physiological measures

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# Development of a Virtual Reality Tool for Patients With Eating Disorder

**Asge Frederik Matthiesen, Else Teresa Møllebæk and Gunver Majgaard**

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DOI: 10.34190/GBL.19.152

**Abstract:** In Denmark alone, there is approximately 75.000 people living with an eating disorder. Patients who are suffering from the disorder show tendencies to overestimate their body image and the Danish health care system is still concerned with these issues. Virtual Reality (VR) has become a promising tool for

treating different forms of anxiety by exposing them to what they are afraid of in VR. Often patients with eating disorders experience problems regarding grocery shopping after they leave their treatment center. They should adjust their old habits and live without their difficulties, but it is easy to fall into old patterns, and therefore they need a tool for being able to work with their social anxiety, choice making and other related problems. The goal with this case study is to design and develop a virtual reality game-based learning tool in cooperation with patients and therapists at the department P50Ø at the University Hospital of Odense, Denmark and to examine how they experience the use of virtual reality in active skills training. Using virtual reality as a tool promotes immersion and presence which leads to an experience as close to real life as possible and makes the tool a combination of VR and exposure therapy. Game elements will be added to the application in terms of guiding the user through the mechanics, rewarding the patient and more. The methods behind this research are based upon an iterative design process coupled with qualitative and observational approach. The tool is developed in 3 iterations varying from different stages of low-fidelity prototyping to high-fidelity prototyping. The final product is being developed in Unity 3D and with the aid of a Garmin 360° camera, combined with 3D scans of groceries. The 3 iterations are being co-designed with 7 patients and an occupational therapist attached to department P50Ø and tested with a HTC vive. The results of the tests promising results regarding the use of VR in combination with therapy is still an area which is left for exploration, however it has shown great possibilities in using VR for treatment of patients with anorexia. The immersion and the game-based method are of great importance for creating a simulation in which treatment can be used. The possibility for repeating the simulation and using it for training is of great importance to the way of rethinking treatment in general.

**Keywords:** game-based learning, virtual reality, design, eating disorder, immersion, learning

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# Using a Game-Based System to Develop Student CV Writing Skills

**Adam McGuire and Daire OBroin**

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DOI: 10.34190/GBL.19.106

**Abstract:** Employability is an important skill for institutes to instil in their students and to ensure they are industry ready. Employability is the development of knowledge, skills and attributes that aid towards successful employment. This includes technical skills and disciplinary knowledge on which students currently focus over their college career. But it also includes their presentational skills like CV writing. This is a skill that students do not spend enough time developing. Instead they seek aid in CV writing techniques during their last few months of college due to a lack of awareness, motivation or scheduling. This can result in students feeling pressured to consider and develop their CV while they are focusing on their final year exams. Without seeking career guidance and developing their CV writing skills earlier in their college career, students may feel unprepared to apply for jobs. Existing resources include websites with templates for writing a CV but they lack feedback and the opportunity to practice. Practice is necessary to develop CV writing and the main purpose of this research is to explore the effect of using a game-based system compared to a standard approach in order to aid students to develop their employability. We hypothesised that a game-based approach would show a higher level of intrinsic motivation and value compared to a standard approach and formalised the following research question: *Can a game-based system demonstrate a higher level of intrinsic motivation for students to practice and develop their CV writing skills compared to a standard approach?* We developed a game-based system which includes structured CV exercise that involves students to critique CVs based on a checklist. Students are given feedback for critiquing CVs through rewards and progress bars. The standard approach involved a paper-based checklist where students would critique CVs against the checklist without the structure, rewards and feedback present in the game-based system. We carried out a study comparing a game-based system against a paper-based approach using a within-subjects design. Using the Intrinsic Motivation Inventory, we measured and compared the motivational effects of these two approaches.

**Keywords:** game based learning, employability, CV writing, gamification

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# **Work in Progress Papers**





# An Adaptation and Personalisation Methodology for Serious Games Design

**Spyridon Blatsios and Ioannis Refanidis**

University of Macedonia, Greece

DOI: 10.34190/GBL.19.122

**Abstract:** Serious games (SG) are considered to induce positive effects in the areas of learning motivation and learning gains. The use of SG in education is a large deviation from the common education standards, which usually are based on mass systems of instruction, assessment, grading and reporting students' knowledge and skills. SG encourage self-directness and independency of student, thus providing a framework for self-learning activities. But while SG can be engaging and motivating, and appealing to learners their contribution in education cannot be assessed. What is most interesting is that the assessment of the SG could help to create personalized educational material that provide the right balance between gaming and educational experience to each user. It has been suggested that SG can take advantage of Artificial Intelligence (AI) methods for automated adaptation to the learner. However, research still witnesses a lack of methodologies, guidelines and best practices on how to develop effective adaptive and personalised SG and how to integrate them in the actual learning and training processes. In previous work we proposed a framework on adaptive and personalised SG using AI methods based on user generated data. This work extends previous work by adding a methodology for an adaptive and personalised SG design. The so far developed methodologies are usually based on a linear approach. So the adaption is usually on micro level inside this linear game developing perspective. But a non-linear approach is more flexible and provides some space for macro adaptation, meaning adapting both the game development and the learning objectives to the user. In fact, a modular approach with multiple possible routes in game development is mostly suitable since it offers best opportunities for macro adaptation and set of different learning sequences. The development of a complex tutoring system like the one described above faces lots of challenges: Cold-start, co-adaptation and the fact that the Instructional Content adaptivity should be based on didactic models which should be based on learning theories. This paper will be used as a basis for further development of an adaptive and personalised SG.

**Keywords:** adaption, personalisation

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# Undertaking: A Business Game for 21<sup>st</sup>-Century Undergraduate Skills

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Tecnologico de Monterrey, Zapopan, Mexico

DOI: 10.34190/GBL.19.199

**Abstract:** The purpose of this research was to assess students' perceptions of learning effectiveness of a board game having synergy with a business simulator. The game teaches students how to integrate interdisciplinary knowledge while developing "21st-century skills" like collaboration, communication, information literacy, decision-making, and problem-solving. "Interactive cognitive complexity theory" suggests that interactive games are more effective than other instructional methods because they simultaneously engage students' affective and cognitive processes. (Tennyson & Jorczak, 2008). Board games are enjoyable and promote team collaboration and communication. On one hand, board game scenarios and premises are very dissimilar to business realities, on the other hand, business simulators are useful in developing decision-making, problem-solving, and information literacy skills, but their formats on computer screens may seem cold and distant. This project extracts the best features of both board games and business simulators to create an exciting learning experience in a new game called "Undertaking." Qualitative research was conducted using post-game interviews with 130 students. Then, a pre-game and post-game surveys were designed and tested based on validated scales for 21st-century skills (Chai et al., 2015; Cevik, 2019; Soh, Osman & Arsad, 2012). The quantitative data will be gathered with pre-game and post-game surveys applied to 150 students during November 2019. The participants of the research are business undergraduate freshmen students at the Guadalajara campus of Tecnologico de Monterrey (ITESM) in Mexico. The qualitative and first quantitative data demonstrated the positive impact of Undertaking on the students' perceptions of their 21st-century competencies. After the game, students reported a better understanding of how to solve problems, make decisions, communicate and, work collaboratively among others.

**Keywords:** game-based learning, 21st century skills, educational innovation, higher education, board games, business simulations

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# Supporting Learning Programming Using Educational Digital Games

**Ivona Frankovic, Natasa Hoic-Bozic, Martina Holenko Dlab and Marina Ivasic-Kos**

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DOI: 10.34190/GBL.19.094

**Abstract:** Contemporary education promotes the usage of digital games to support learning programming. Such games are not designed for entertainment, but specifically for educational purposes. Students start from a very early age to interact with computers through games and consequently, react positively on the educational digital games. When used for education, digital games have the potential to motivate students towards active participation and interaction. In addition, educational digital games make complex and abstract topics like programming more friendly. Games that support learning programming enable students to learn programming concepts using visual interfaces and interesting environments. In these games, younger students are usually expected to move the main character around the given path and perform a series of tasks (e.g. collect objects, skip the obstacles). Instead in a textual editor, students are coding through drag and drop interactions, and create programs that include basic programming concepts like sequence, variables, loops, and conditions. Furthermore, digital games are a good for visualizing the execution of algorithms that are often hard to understand. To make the game more interesting, the main character is often presented as an animated robot, animal or a cartoon character familiar to the students. The paper explores the possibilities of using existing digital games in learning basic programming skills, highlighting which programming concepts the game supports and for which it is recommended and appropriate to be used. This is the first step in the design of an educational game that is intended to develop within the “Coding4Girls” and “Digital games” projects. Future activities and plans for both projects are presented in the paper.

**Keywords:** learning programming, computational thinking, educational digital games, project Coding4Girls, project digital games

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# Stealing the Exams: Using Narrative Techniques in Designing an Escape Game in University Context

**Susanne Haake**

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DOI: 10.34190/GBL.19.186

**Abstract:** In this proposal the development of a narrative concept of the escape game "Stealing the exams" is presented. The game is based on NFC tags, which are distributed in the whole building of the university. By tagging them via smartphone the player acquires the next puzzle piece and eventually fulfills the mission. Particularly, according to game based learning escape rooms open up the chance to enhance communication between players, promote problem-solving skills, train time management while playing location based puzzles. An important research question goes around the challenge of connecting an exciting story with the different places and the puzzles that go with it. When designing the game, common methods of game design and design based researches were used. Part of the game balancing was to bring video-based story elements and tasks together into an appropriate balance in order to achieve an immersive gaming experience. During the whole process, the game play was repeatedly evaluated and discussed with the target group. In summary, our approach offers meaningful results of using storytelling both methodically and in terms of implementation, which we would like to make available to the research community as a best practice example.

**Keywords:** escape room, storytelling, game design, design based research, games based learning

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## BPMN Wheel: Board Game for Business Process Modelling

**Bahar Kutun and Werner Schmidt**

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DOI: 10.34190/GBL.19.012

**Abstract:** Gamification focuses on the integration of elements and mechanics, e.g., points, quests and leaderboards, from the field of gaming and game design

into a nongaming environment to engage and motivate people to achieve their goals. Learner's motivation difficulties are known as a problem in educational settings. Hence, we followed the idea of gamification to raise the motivation of learners in the field of knowledge acquisition and business process modelling. We developed a non-digital game, based on 14 typical game mechanics. The BPMN (Business Process Model and Notation) wheel as the chosen form of implementation is based on wheels of fortune, which are known to most people from television or trade fairs. The core of the board game is the BPMN wheel and another wheel for the collection of notation elements needed for process modelling. Additionally, the game includes game elements such as learning and control question cards. The basic idea of the BPMN wheel is that players learn basics about BPMN and these can apply practically. The game is played in teams. The teams develop a graphical process model based on a textual process description. The winner is the team with the best model quality. The prototype was tested and evaluated in the course 'Business Process Management' of the bachelor's program 'Digital Business' at the Technische Hochschule Ingolstadt. In order to be able to analyze the effects of the gamified solution on several aspects, we carried out knowledge tests (pre and post), modelling tests (pre and post) and further evaluations. This contribution should be considered as work in progress.

**Keywords:** gamification, game based learning, serious games, business process management, business process modelling, BPMN, knowledge transfer, knowledge acquisition, motivation

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## Increasing Awareness and Learning About Eco-Innovations Through Digital Games

**Zdenko Mago**

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DOI: 10.34190/GBL.19.078

**Abstract:** Digital games are still transcending into different areas of life, and their impact often becomes important, particularly in the present interactive era. Regarding global environmental problems (e.g. pollution, global warming, waste disposal, etc.), various forms of mitigation or even elimination of these issues are being sought. Eco-innovations represent a technological change that improves economic or environmental performance, organizational or social change aimed at increasing competitiveness or sustainability. Raising awareness about eco-innovations and learning about ecological opportunities currently seems to be

crucial. Many people, especially the young, often do not even know the meaning of the term eco-innovation and how to equate it with ecology in general. One of tools that could help to ecologize society and the environment are digital games as a popular means for people to spend their free time, have fun and learn something in an unusual way. The prospective benefit of using digital games for this lies in the fact that they can naturally generate possibilities and the accompanying processes even beyond simple engagement and reach e.g. via social networks. For digital games, participation that differentiates from engagement by the level of activity is typical. It means not only sharing posts and challenges with an aim to have as extensive a viral effect as possible, but also creative involvement within the process itself by editing existing and creating new content. The aim of the study is make a theoretical insight into eco-innovation learning issues, usable as preparation for later investigation – determination of the potential of mobile game-based learning concerning ecological habits and eco-innovations in order to reflect the potential for the possible utilization of mobile eco-games, and their further use within solutions to global environment problems.

**Keywords:** digital games, eco-innovation awareness, ecology, game-based learning, serious games

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## **"Allotrop:Reaction": An Example of Massively Multiplayer On-Line Role-Playing Game Construction for STEM Education in School**

**Andrey Melnikov<sup>1</sup>, Valentin Shuvalov<sup>2</sup>, Natalia Khodykina<sup>3</sup> and Marina Scherbakova<sup>4</sup>**

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<sup>3</sup>STEM-games, Moscow, Russia

<sup>4</sup>eNano, Moscow, Russia

DOI: 10.34190/GBL.19.128

**Abstract:** Currently 'game-based learning' is one of many promising approaches in education. Despite constant discussions of the benefits and negative effects of videogames, their leverage in school is becoming commonplace. One of the most promising videogame genres in terms of the breadth of learning goals and overall complexity is the massively multiplayer on-line role-playing game. In this paper, an example of designing a Massively Multiplayer Online Game (MMO) with

learning goals in the STEM area is presented. The game "Allotrop:Reaction" (under construction) combines "shooter", "crafting" and "game economy" and contains model engineering and science investigation tasks based on selected physics and chemistry concepts from 7<sup>th</sup>-8<sup>th</sup> grade Russian school curricula (13-14 year-old children).

**Keywords:** educational MMO development, serious games, game based learning

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## **Developing Pedagogical Videogames to Support Math Learning in Deaf Children: A Work in Progress (Phases 1-3).**

**José Carlos Neves and Carla Sousa**

Centre for Research in Communication, Information and Digital Culture –  
CICANT Lusófona University, Lisbon

DOI: 10.34190/GBL.19.169

**Abstract:** The shortage of pedagogical resources to support the teaching of deaf children is a reality in the context of teaching in Portuguese Sign Language (*Língua Gestual Portuguesa* - LGP). This problem is mainly due to the lack of technical resources in schools and the lack of dissemination of the existing resources, which decisively influences their technical and pedagogical quality and makes them highly dependent on each teacher's improvisation skills and motivation. *Educaçãoaccessível.pt* aims to contribute to the mitigation of such problems, with the production and distribution of free educational videogames for teaching mathematics to deaf students. Based on a collaboration, active since 2015, between a secondary school for deaf people and a bachelor's degree on Videogames, 21 mini games were already produced. The present poster is a work in progress that aims to systematizing the main pedagogical resources already developed, and to provide deaf-related particularities and constraints experienced during the production process, as well as data on classroom dynamics. At this stage of the project, some positive conclusions can be drawn: it's clear that it is possible to produce usable videogames for deaf students in a bachelor's degree class context, despite the complexity of the resources and partners involved. As for the results of the videogame application with deaf students, it has been observed that the students are motivated to use the games, which can contribute to the consolidation of math principles. About future work, project positive results and acquired expertise founded GBL4deaf (Game-Based Learning for Deaf Students), a larger and supported action-research project



aiming to study and document the impact of such pedagogical tools on deaf children's maths learning process.

**Keywords:** videogames, deaf, children, teaching, mathematics

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## How to Enhance Interest in Mathematics by Using Game-Based Learning

**Josephine Plass-Nielsen and Oliver Bo Wolter Nielsen**

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DOI: 10.34190/GBL.19.073

**Abstract:** Mathematics is a subject taught in school from very early on, but nonetheless, many students still find it difficult and frustrating to learn, even in higher education (Berggren, 2018). This frustration may lead the students to think that they are not smart enough which may cause a lack of interest in the subject. The hypothesis that students lack interest in mathematics has been tested by collecting and analyzing data about the students' attitude towards mathematics. Yet, according to Jo Boaler, every student should be able to learn math because "our brains have [an] enormous capacity to grow and change at any stage of life" (Duval, 2019), and this has been the main inspiration in the development of the game. The focus of this project has its emphasis on how to enhance the interest of learning mathematics for students in elementary school, more specifically fifth and sixth grade students. The final prototype is a video game, where the player is situated in a virtual house environment which resembles everyday situations that the students may encounter in their life. The core mechanic of the game is to solve puzzles disguised as normal house chores like "feeding the dog". To move through the virtual house, the students must solve the puzzles by using mathematical thinking, thus getting a greater understanding of an application of mathematics in an environment well-known to them. The goal of this project is to create a game that will introduce mathematical problems through game-based

**Keywords:** enhance mathematical thinking, game-based learning, video games as a medium for learning, mathematics, math brain, learning in a virtual world

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# The Impact of Game-Based Learning Design Features on Reading Comprehension and Interest

**John Nietfeld**

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DOI: 10.34190/GBL.19.088

**Abstract:** This study reports on the development of and first data collection for MISSIONS WITH MONTY, a game-based learning environment (GBLE) targeting metacomprehension skills for 5<sup>th</sup> graders on expository science texts. The project is in the first year of a three-year grant funded by the National Science Foundation, USA. The intent of the study is to 1) examine the effectiveness of the prototype of MISSIONS WITH MONTY, and 2) test the impact of sound effects on student interest and performance. MISSIONS WITH MONTY includes three key curricular units (ecosystems, Earth and human activity, from molecules to organisms) that align with state and national standards. In MISSIONS WITH MONTY the player fills the role of a promising young science professor traveling to work with Monty, a monitor lizard and world-renowned scientist known for his ability to solve real-life problems. Monty has created Wildlife University (WU) in a remote rainforest. The students and professors at WU are different animals focused on becoming more scientifically literate in order to save their natural habitats. Unfortunately, upon arrival at WU the player realizes that 1) Monty has gone missing and 2) WU has been recently closed due to animals getting sick. Thus, the player is provided with the challenge of undertaking a series of missions in order to save Monty to determine the cause of the sickness by developing skills for highlighting, summarization, metacognitive monitoring, and multiple-source comprehension. Players will visit a number of different animal scientists who lead research camps in the rainforest, ocean, and savanna and engage students in a series of mini-games clustered by content-related texts. Players eventually engage in two final mini-games that involve argumentation skills to solve the two overall primary dilemmas. Development of MISSIONS WITH MONTY is occurring through a collaborative process with participating students and teachers and the current data collection will focus only on the series of interactions from the first mini-game. Students will be randomly assigned to sound effects or no sound effects conditions. Data from group comparison will be the focus of the conference presentation.

**Keywords:** game-based learning, metacognition, science, metacomprehension, interest, self-regulated learning

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# **Learn&Play: Co-Designing a Game-Based Learning Scenario for Engineering Mechanics**

**Anna Seidel, Franziska Weidle, Claudia Börner, Lukas Flagmeier and Jonas Vossler**

Brandenburg University of Technology Cottbus-Senftenberg, Germany

DOI: 10.34190/GBL.19.098

**Abstract:** Despite the high number of enrolments in engineering courses at German universities up to 50% of students do not finish their bachelor degree (Heublein, Richter, Schmelzer & Simmer, 2014). A possible source for these high dropout rates could be found in engineering mechanics (EM) – a basic subject students seem to struggle with, as evidenced in weak test results. Since this subject plays such a fundamental role within many engineering courses, learning and comprehension problems may result in critical knowledge gaps as well as poor exam performance (Dammann, 2016). One possibility to tackle these issues is the adoption of a game-based learning (GBL) approach. GBL is a promising tool for mediating abstract content because of its motivating and cognitive effects. The research project *Learn&Play* utilizes a user-centred design approach to develop such a game-based learning scenario for EM. In order to do so, it examines the specific areas students struggle with, looks at the learning strategies in place and asks how students can be supported in their individual learning process. This paper presents some of the results obtained from a survey conducted with engineering students and discusses possible starting points and guidelines for the design of the scenario.

**Keywords:** engineering education, game-based-learning, engineering mechanics, user-centred design

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# X Marks the Spot: A Student-Developed Treasure-Hunt on the Digitization of Knowledge Production

**Christopher Sommer, Vanessa Barbagiovanni Bugiacca and Karen Ellwanger**

Carl von Ossietzky University, Oldenburg, Germany

DOI:10.34190/GBL19.047

**Abstract:** Smart devices enable university students to access a vast array of digital resources, more often than not of questionable quality or unknown provenance. In effect the standards of academic writing suffer and ‘soft’ forms of plagiarism are commonplace. The department of Material Culture at the Carl von Ossietzky University in Oldenburg explores a game-based solution to this challenge: side by side with undergraduate students a digital, interactive treasure-hunt using the app ‘Actionbound’ is developed. The app features location-based tasks that augment real-world environments. The goal is to equip first year students with digital literacy and promote proper academic conduct. Design principles and the development framework of this student-led project will be outlined.

**Keywords:** treasure-hunt, Actionbound, knowledge production, academic conduct, academic writing skills, digital literacy

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## A Mixed-Reality Learning Application to Experience Wind Engines for Beginner and Experts

**Pia Spangenberg<sup>1</sup>, Linda Kruse<sup>2</sup>, Matthias Rötting<sup>1</sup> and Felix Kapp<sup>1</sup>**

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DOI: 10.34190/GBL.19.063

**Abstract:** Mixed Reality (MR) Environments provide extensive possibilities for learning. MR technology can increase the quality of education by enabling learning in virtual spaces compared to real laboratories. It enables the merge of real and virtual worlds into new environments and visualizations, where physical and digital objects can coexist and interact in real time (Milgram & Kishino, 1994). Learners can experience and learn complex sequences of actions and relationships between components. Within the next three years, a

transdisciplinary team of educators, psychologists, game designers, engineers and practitioners will develop and evaluate a MR learning application for wind engines. The application will be used in Vocational Education Training (VET). Wind engines are complex systems that require the integration of electronical, constructional and metal-technical skills, and, are closely linked to environmental impacts (Spangenberg, Meyser & Schrader, 2019). To assemble, repair and maintain wind engines in Germany, professionals are required. However, trouble shooting on real wind engines is hardly possible during VET, especially in the case of risk scenarios. Therefore, expensive training gondolas are used in a laboratory situation on the ground. First scientific findings on the advantages of augmented and virtual learning (AR/VR) applications have shown, that besides the spatial presence and the flow experience (e.g., Krapp 2005), it can reduce the number of errors, and, thus, the likelihood of undesirable consequences in industrial training and assembly tasks (Gavish et al, 2015). The present work outlines the roadmap to the MR learning application. It presents as a first result two different MR learning scenarios.

**Keywords:** serious games, game-based-learning, wind engine, mixed-reality

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## Escaping to Cybersecurity Education: Using Manipulative Challenges to Engage and Educate

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DOI: 10.34190/GBL.19.183

**Abstract:** Early educational engagement is critical to the long-term development of cybersecurity abilities. Yet many schools have limited funds and expertise for cybersecurity education. Our center has been field testing project based, pedagogically sound, engaging educational experiences with the goal offering activities that can be taken to schools. Here we describe the design of an escape room challenge to teach technical skills in an easily, affordably scalable manner for grades 7 and up. Our initial observations indicate student engagement and learning is effective using our initial group-centered challenge activities. The piloted activities are being expanded and incorporated into a single portable game that can be taken to schools or used by other groups in workshops. Here we describe four of the activities in detail, offering lessons learned about engaging younger teens in computer security education. Physically manipulating objects creates an inherent physical connection to the challenges, and removes security concepts from a purely abstract domain. Furthermore, engaging with groups

offers shared learning. Framing these as an escape room offers a promise for engaging non-traditional students.

**Keywords:** escape room, hackathon, manipulative tools, cybersecurity, student development

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# **Abstracts Only**





# Trends in Cybersecurity Focused Games

**Merijke Coenraad, Diane Jass Ketelhut, Michel Cukier and Jandelyn Plane**

University of Maryland - College Park, USA

**Abstract:** By 2022, it is expected that there will be a 1.8 million worker shortage in cybersecurity fields (Center for Cyber Safety and Education, 2017). Within those fields, underrepresented minorities make up just 18% of the workforce while women make up 14% (Reed & Acosta-Rubio, 2017). Currently, cybersecurity topics are not introduced to students until high school or formally taught until upper level university courses, but it is believed that earlier access to cybersecurity concepts could increase interest in cybersecurity and diversity of the workforce. One potential manner of attracting youth to cybersecurity is through educational games. Games are used to teach a variety of concepts to learners of diverse ages due to their ability to motivate students and increase learning and self-efficacy (Clark, Tanner-Smith, & Killingsworth, 2016; Ketelhut and Tutwiler, 2018). Educational games allow players to learn concepts in a low stress environment by using the common gaming tactics of trial and error and the acceptance of failure within games to propel learning (Gee, 2005). Therefore, games could provide introductions to topics such as cybersecurity with a reputation as being not for all learners or extremely difficult. Our study seeks to answer the questions: how are games currently being used to teach cybersecurity and how are cybersecurity and cybersecurity professionals represented in current games? We systematically reviewed over 150 games available to users through the Apple App Store, Google Play Store, and the Internet and played each game to examine the content covered, game play, and game design. In this poster, we present preliminary results and trends within the cybersecurity games. These include a varying definition of cybersecurity and a propensity for games to focus on cyber hygiene and cyber safety topics. Early analysis shows a difference between the games available on the various platforms based on type of game, content, and role of the player. Games on mobile platforms are more likely to be from the perspective of a hacker, last for multiple sessions, and take a schematic form than are web-based games. Conversely, web-based games are more likely to be gamified quizzes or only tangentially related to cybersecurity.

**Keywords:** educational games, cybersecurity, review, mobile, web-based

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# Game Design for Engagement and Learning about Cybersecurity

**Merijke Coenraad, Diane Jass Ketelhut, David Weintrop and Michel Cukier**

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**Abstract:** While cybersecurity is becoming a growing concern affecting broad swaths of the population, those entering this field tend not to be representative of that population as a whole limiting the ability to develop diverse, innovative solutions. Changing this situation is considered important for increasing impact on personal, corporate and national security, but it has been far too slow. We know from science career interest research (Tai, Liu, Maltese & Fan, 2006) that children begin to narrow their career interests in the middle grades. Therefore, targeting this age group could be beneficial for increasing interest in cybersecurity. Cybersecurity is a topic that is not often taught until upper level courses because of the perceived reliance of cybersecurity on knowledge of computer science topics. We have taken a different approach by applying game-based learning theory and design to this problem. We are designing an educational game that strives to introduce educational concepts seamlessly in the gameplay to 10-14 year olds. Our in-development game is specifically designed to target youth who are generally not represented in the computer science workforce: girls who currently make up just 14% of the workforce and underrepresented minorities who make up 18% of the workforce (Reed & Acosta-Rubio, 2017). Because of this demographic and the typical assumptions made about who can be a cybersecurity professional, the game is designed to accentuate the gaming components and incorporate the educational components without overtly signaling that the game is about cybersecurity. Additionally, we are broadening the cybersecurity topics introduced in the game so basic concepts can be introduced earlier with a focus placed on the problem solving skills that will benefit the field. Therefore, we are attending carefully to both the game narrative and the embedded cybersecurity learning aspects. In this poster, we introduce our game and its first levels, focusing on what elements are included for engagement and/or for cybersecurity learning. In addition, we discuss our design goals, process, successes, and challenges through examples from our research experiences.

**Keywords:** cybersecurity, gaming, development, broadening participation

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# Diversity and Inclusion in Serious Games for Learning English

**Amy Devine, Marianne Pickles, Sarah Albrecht and Helen Kenyon**

Cambridge Assessment English, Cambridge, UK

**Abstract:** When it comes to creating educational games that have appeal across genders, developers are sometimes left in a quandary about how to do it. Unfortunately, there are some misconceptions about game preferences and gender which persist, and these present challenges when it comes to understanding the principles of diversity and inclusion. This presentation seeks to raise awareness among the educational games community about this topic, with a view to creating opportunities for a more constructive and informed discourse and approach. We will present some myths about gender alongside data that dispels these myths, and consider both helpful and unhelpful examples of how to talk about the topic. We will encourage you to take a critical eye towards claims such as “boys like games about shooting and killing things; girls like games about cooking and princess dresses” and “women don’t like shooters.” We have recently carried out several research projects into games-based learning and assessment for low level learners of English as a foreign language. In collaboration with Serious Games Interactive (SGI) we created an MVP of a game called The Lighthouse. Diversity and inclusion were central to our approach to designing the protagonist, and this presentation will outline the considerations we made and how we put them into practice. We have also partnered with a games developer called Wibbu to create educational support materials for their language learning game Ruby Rei. We will discuss the role that gender and inclusion has had in the qualitative and quantitative research we have carried out in relation to this product. This presentation will be of interest to anyone seeking to develop educational games, or to carry out research related to them, and those who would like to understand how to do this effectively from the perspective of diversity and inclusion, particularly in relation to gender.

**Keywords:** gender, diversity and inclusion in English language video games

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# Room2Educ8: A Conceptual Framework for Creating Educational Escape Rooms

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**Abstract:** Traditional entertainment-focused escape rooms are growing in popularity worldwide and have exploded from 2,800 rooms throughout the world in 2015 to over 7,200 in 2019. Escape rooms are live-action team-based games in which players work together to discover clues, solve puzzles, and accomplish tasks in one or more rooms in order to accomplish a specific goal. Increasingly escape rooms are now also being used within the academy as learning and research tools. Research findings have established that educational escape games can create immersion as they combine the strengths of storytelling and gameplay, therefore eliciting high motivation and engagement and so promoting successful learning. Yet evidence demonstrates that there is little consistency in the approaches adopted in this emerging field. To address this, we propose a conceptual framework (Room2Educ8) to operationalise the development of escape rooms into academic and educational practices. This framework provides a methodology for designing educational escape rooms for learning and behaviour change. It provides heuristics for goals, objectives and constraints, players, context, learning-based activities, briefing/debriefing, and evaluation. It delivers an easy to follow guideline to enable educators to embrace non-traditional learning techniques – thus escaping traditional classroom routine. We validate our concept through the use of two practice-based examples: one exploring the use of escape rooms in developing understanding of societal resilience to global challenges, such as climate change, and a second on the theme of cyber-security.

**Keywords:** escape room, breakout games, game-based learning, active learning, teamwork

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# Integration of Games-Based Learning Into sex Education Syllabus in Thailand

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**Abstract:** In Thailand, young people are particularly at risk of unsafe sexual behaviour. The teenage pregnancy rate in the country is the highest in South-East Asia; infection rates for sexually transmitted diseases are rising while the age of first sexual intercourse has decreased (Panyayong, 2010). It is well-documented that sex education can have beneficial effects on young people's sexual behaviour (UNICEF and Ministry of Education, 2016). However, many institutions teach about sexuality from a point of view that emphasizes the negative consequences of sexual intercourse and often do not explore the possibilities of Comprehensive Sex Education (CSE), such as offering a space for discussions and debates, or promoting students' analytic and critical-thinking skills as related to sexuality. CSE curriculum that is delivered to Grade 7 (age 12-14) secondary school students in Thailand does not promote students' analytic and critical-thinking skills related to sexuality. Findings of different projects about sex education concluded that there is need to propose new methods for teaching sexuality education that stimulate critical thinking and encourage discussions between students to raise awareness in CSE. A final recommendation by the UNICEF report (2016) is to create online learning materials such as games to provide alternative channels for learning about sexuality and related topics, both for students and for teacher training. Such online contents could not only provide accurate and up-to-date information about sexuality but could also help students change their attitudes to reduce misconceptions about sex and increase awareness of health and well-being as related to their sexual lives. Games-Based Learning (GBL) has become increasingly involved in teaching and learning, not only for children and younger students but also for the older workforce of today. This research project aims to investigate and evaluate year 7 secondary school students' experiences and views of integrating GBL in their learning about CSE. In the course of the study, we invited 1152 students to complete questionnaires and interviewed 12 secondary school teachers in focus groups in Chiang Mai in the north of Thailand. This paper found that GBL can serve students in their learning about CSE to gain understanding of their sexuality, develop skills including critical thinking skills, and interact with others (peers, teachers, etc.) in a safe environment.

**Keywords:** games-based learning, engagement, critical thinking, discussion

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## Children Learning Games: The Case of Customization

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**Abstract:** A frequent game design feature is partial customization of in-game content. This can be done, for example, by enabling the players to adjust elements of the game environment, including graphical assets. Does this feature, when present in educational games, enhance learning in case of primary school children? This has been examined by a seminal study by Cordova & Lepper in 1996 (J Edu Psy 88, pp. 715-730). That study showed medium to large effects in favor of the game version with customization possibilities: both in motivational and learning outcomes terms. However, that study used a very small sample (~12 per cell) and little attention has been paid to attempts at replicating these effects. In the present work-in-progress study, we investigate whether the possibility to partly customize the in-game set up enhances learning outcomes of children compared to the same game without customization possibilities. Children (3rd and 4th graders; planned N ~ 150) study about photosynthesis from the learning game for about 20 minutes. They study by “building” (i.e., controlling the growth of) their own plant. They are randomly assigned to one condition: with or without customization. In the former condition, they can select a plant which they will build, the environment in which they will build it, the animal which is supposed to be fed by the built plant; and they can name the animal. In the latter condition, they are assigned a particular plant, an animal, an environment; and they cannot name the animal. We measure motivational and learning outcome variables. We measure motivation by self-reports as well as behaviorally (i.e., free-choice). Learning outcomes are measured immediately after the treatment and two weeks later. So far, we have collected data of roughly 75 participants; the data collection should be completed in November 2019. This poster-only presentation will introduce the study and preliminary findings.

**Keywords:** educational games, children, customization, learning effects, motivation

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# Port of Mars: Exploring Social Systems and Practices for Sustaining Communities on Mars

**Brian Nelson, Lance Gharayi, Marco Janssen and Marty Anderies**

Arizona State University, Tempe, USA

**Abstract:** The toughest challenges in space exploration are not technological. They are social, political, and cultural. Through our Port of Mars project are exploring solutions by engaging the public in the scientific process through game play. When humans arrive on Mars, they will encounter resource, technological, psychological, and social challenges. Since the inhabitants will be entirely reliant on each other, they must work collectively to make decisions and take actions that will keep them alive and prospering. Local resources, such as buried ice deposits, will provide water. Habitats must provide protection from cosmic radiation. Despite these immense challenges, the social aspects of colonizing Mars might prove to be the greatest challenge of all: How do you sustain a healthy community in such a hazardous environment with severely limited resources? Port of Mars is a role-play and resource allocation card game that challenges players to manage individual goals against the conflicting needs of maintaining common infrastructure in the face of ongoing environmental, social, and technical challenges on Mars. The players represent members of Generation Zero: the first group of long-term residents to arrive on the Red Planet. Players experience Martian life and its challenges as early citizens of a Martian settlement. To survive, players must navigate their personal ambitions and the needs of the group. In this paper, we provide an overview of the Port of Mars project, goals, gameplay, and game elements. We highlight the design and rules of the game, focusing on our goal of providing players with a first-person, embodied experience to bolster personal engagement with both the surface-level challenges of their simulated life on Mars, and a tacit understanding of the underlying issues that influence their survival individually and collectively. Further, we describe our design process, user testing approach, and initial public implementations.

**Keywords:** social science games, space exploration, resource management

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# Implementation of Virtual Laboratories in Secondary School

**Sanne Lisborg**

Learning and culture, Aalborg University, Copenhagen, Danmark

**Abstract:** There is a political push for the use of virtual simulations in science teaching in the Danish education sector. The government has lanced a plan of action for integrating technology in education. A central focus area in this strategy is the use of virtual simulations as a supplement to traditional teaching. While simulations are increasingly being used at universities and in youth education, the experiences are relatively few in secondary education. Studies show that the use of virtual simulations has different learning advantages such as the possibility to preform experiments that are too dangerous or expensive to do in real-life. Research also conclude that the use of simulations as a supplement to traditional learning increases both motivation and learning outcome. The existing research addresses different potentials of implementing virtual simulation in education, but a deeper understanding of how virtual simulations are implemented in science teaching is missing. The PhD Project investigates how teachers and pupils use and experiences the implementation of virtual simulations. First part of the project is an ethnographic case study where I follow the implementing of virtual laboratories in a Danish secondary school. They use virtual laboratories developed by the Danish company Labster. These simulations have some gamification elements such a storyline build around a mission and moving around the laboratory doing small experiments. The case study raises questions such as; how to integrate the virtual laboratories as a part of the traditional teaching? What is the purpose of introducing the pupils to virtual laboratories? How do the pupils interact with the technology? Which potentials and challenges do the teacher and pupils experience? I will represent my findings from this case study.

**Keywords:** simulations, virtual laboratories, implementation, secondary education

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## ‘Get out of the Classroom!’: The Use of Escape Rooms as an Alternative Teaching Method in Engineering

**Lauren Schrock and Chris Evans**

WMG, Coventry, UK

**Abstract:** Escape rooms, or physical adventure games in which players work together to solve puzzles using hints, clues and a strategy to escape from a locked

room, have flourished in the last decade. Escape room puzzles involve the use of high-level analytical skills such as the analysis of given information and the solving of problems in new situations. This is one explanation for the increasing use of escape rooms in education and corporate training. However, published works have focused on their benefits to students' soft skills such as teamwork, communication and multitasking (Borrego et al., 2017; Clarke et al., 2017; Zhang et al., 2018), and on solidifying prior learning (Dietrich, 2018; Vörös & Sárközi, 2017), rather than their potential as a teaching and learning methodology with which to deliver coursework. This research builds upon growing evidence that recognises the motivational benefit of educational escape rooms. This is an activity for student engagement whilst evaluating their existing knowledge for the purpose of pitching class content at an appropriate level. Students, in five teams of five, will compete simultaneously to escape their respective, identical rooms. An identical equation given to each group will provide the first number to open the safe, and the value of the missing resistor the next. Each room will be monitored and further interactivity and narrative will be provided by a screen situated within each room. Consideration will be given to how to debrief students on their experience (Sanchez and Plumettaz-Sieber, 2018) in order to identify any pre-requisite knowledge that may be strong, weak, or absent. As this is a work in progress, qualitative findings from the study are not yet available. However, it is anticipated that it will demonstrate escape rooms are a pragmatic way to induct students into university curriculum. In addition, two themes to consider include: (1) the possibility of failure to escape the room, and how this translates into student experience and development; and (2) the use of escape rooms as an induction exercise for student interaction and integration. This study aims to contribute in two ways: first, as a way to gauge existing knowledge of students. Second, linking the escape room to university strategy of student experience, by reconceptualising failure and improving student interrelationships.

**Keywords:** Escape room, Induction, Engineering

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## **Developing an Evaluation Framework for an Educational Simulation Roleplay Game**

**Souad Slyman, Marco Gillies and John Jessel**

Goldsmiths, University of London, UK

**Abstract:** Despite the emergence of new methodologies for analysing and evaluating games using design frameworks and evaluation principles, there is still lack of inclusive game evaluation heuristics for educational simulation roleplay games (SRPGs). To address this gap, we develop a new SRPG evaluation

framework and examine the most important ingredients in game design choices for educational games that could affect the gaming experiences of different learners. Data were collected via a series of interviews and list of game reviews. Findings indicate that game design issues affect immensely players' experiences, since not all users had an enjoyable experience. This is due to lack of game usability heuristics, HCI principles and educational perspectives. The findings also demonstrate that important ingredients such as lack of engagement, entertainment, users' expectations & learning needs, feedback and assessment are some of the issues that inhibit today's learners from learning. On the basis of the data obtained, it is argued that the GADDIE (Game Analysis, Design, Development, Implementation and Evaluation) model could provide further guidance that leads on from previous research. Consequently, the framework could support the SRPG evaluation process more effectively and offers insights into a new way of employing these heuristics to meet users' expectations and learning needs, and thus increase their self-efficacy.

**Keywords:** game evaluation heuristics, users' learning needs, usability testing, game design, simulation roleplay game framework

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## **The Perspective of the Avatar: Reading Activities as Ludic Narratives in Gamified Literature Education**

**Stina Thunberg**

Luleå University of Technology, Sweden

**Abstract:** This paper presents the findings of what characterizes the ludic narrative created by the students participating in a gamified design for the upper secondary literature classroom. The learning potential of video games has been extensively discussed in theory, and researches has been pointing out the connection between reading fiction and playing a video game (Ryan & Thon 2014). Although there is a lack of studies addressing the implementation of gaming design in the classrooms (Ortiz, Chiliza, & Valcke, 2017). The study is an educational design project with a qualitative, explorative approach doing research on the intervention (McKenney & Reeves, 2018). A design for the upper secondary literature classroom has been created, addressing young people in the new media landscape. In the game design, the students are supposed to act as player characters in the classical novel *Herr Arnes Penningar* by Selma Lagerlöf, in the form of a digital avatar. The gamified design use game element such as avatars, quests and experience points. The design assumptions made are gamified reading as a creative, explorative and participatory activity. The aim of this paper is to contribute with new knowledge about the reading activity in a gamified

design for literature education. The design was implemented during spring 2018 in both the mother tongue and the second language classroom in the upper secondary school. The material is 167 avatar texts and 68 avatar films made by 48 students. Twenty-two students and four teachers were also interviewed, semi-structured. The material is analysed by thematic coding (Mason, 1996), and theoretical perspectives (Kania 2017) The preliminary results are that the students in the shape of the avatar take different positions in their ludo-narratives in relation to the original story. They mostly position themselves as helpers of the subject in the story, but there are also students taking the position of an opponent. Through their position, they create their ludo-narratives and at the same time as they explore the original story, reinterpreting characters and events, a movement between a game situation and an aesthetic situation (Kania 2017).

**Keywords:** literature, gamification, reading, writing

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## Time to Walk

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<sup>3</sup>Karl-Franzens-Universität Graz, Austria

**Abstract:** In recent decades, a stagnation or even a decline in pedestrian traffic has been observed in many cities, despite the ambitious efforts of national and international action plans, strategies and initiatives. Our project "Walk Your City" addresses this problem by designing, developing and evaluating an innovative, behavioural-based pedestrian initiative with a focus on the nudging method. The applied nudging framework includes gamification as well as crowdsourcing elements and aims to decisively improve the quality of life in cities by promoting walking as an active and health-enhancing activity. The core of our approach is represented by nudges which are triggered via an app as well as offline campaigns. The story refers to a not so distant dystopian future where the pilot city Graz suffers from pollution, traffic chaos as well as climate change. Via regular walking as well as visiting places such as parks or viewpoints users of the app are rewarded with tokens. Following the idea of crowdsourcing these tokens can be invested into wishes for improvement such as parking benches or zebra crossings. Through this unique combination of technological innovations, playful approaches, behavioural concepts and creative campaigns, participants are motivated to explore and experience the city on foot. Walking should be perceived as a genuine and healthy alternative for short distances and anchored

as first choice when covering small distances. The nudging-method will be iteratively optimized in terms of acceptance, functionality and usability using focus groups, internal lab tests and expert workshops. This strategy will be a practice-oriented project implementation that is tailored to the needs of different target groups such as students, commuters as well as tourists. The mobility and health data obtained during the pilot test will be used to evaluate the suitability and impact of the nudging method in course of an academic paper. As the empirical data will be collected in early autumn 2019, important insights into whether and how the nudging framework is suitable for behavioural change can be presented at the conference.

**Keywords:** walking, nudging, gamification, exergames, health games

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# **International Educational Games Competition**



# Concordia

**Kim Balnaves**

Curtin University, Australia

## Games Description

"Help us find kindness, empathy,  
knowledge and morality to bring peace to

Concordia once again!"

This game built in a Minecraft World aims to create a virtual world which children can participate in through collaborative teamwork. The activities are based on curriculum outcomes that allow children to explore culture whilst authentically interacting with students from another country. Students will be able to participate in a games-based authentic context that allows them to develop all aspects of the second language curriculum as well as the general competencies within the intercultural understanding and digital literacies framework (Dudeney, Hockly & Pegrum, 2013). The study behind the game investigates whether LOTE understandings, Intercultural Understandings and digital literacies can be developed more successfully with under-performing students through the use of "serious games". Students co-develop the narrative of the game (which is housed on a private server for security purposes) as they participate within the virtual world. This enables them to have ownership of the world and to develop friendships, empathy and communication strategies with other students- both in their class and half way across the world, equally. The students need to communicate to build team strategy to complete the missions creatively and collaboratively. They also look at their own cultural identity and co-create the story and the products within the game through re-designing their environment collectively.

"Join your friends around the world as you solve the  
puzzles of the four treasures of Concordia."

## Learning Outcomes

This game has been developed to enhance second language learning skills through the use of and development of digital literacy skills (Dudeney, Hockly & Pegrum, 2013) development. This game uses the Digital Literacies Framework (Dudeney, Hockly and Pegrum, 2013) to analyse and build the puzzles generated



within the game, alongside the core elements of LOTE (Language other than English SCSA/International Baccalaureate curriculum). This is a link to the different learning outcomes to be achieved during each section of the game: [https://docs.google.com/document/d/1S2Yh0VBfcL7RZQzkqth9\\_UWCzxdjFwrBRzbD-TBvjUA/edit](https://docs.google.com/document/d/1S2Yh0VBfcL7RZQzkqth9_UWCzxdjFwrBRzbD-TBvjUA/edit)

### **What makes your game different to those already available?**

This is currently the only Minecraft education game that can be played across countries. The game itself is housed on a private server so the data is protected and set up in such a way that children can participate both nationally and internationally. Also, this game is based on the Australian Curriculum and the International Baccalaureate so it is relevant as addressing curriculum in Australia and in international schools.

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## **VRkeer (in English 'traffic', notice pun with capitals VR))**

**Carl Boel**

Ghent University and Odisee University College, Belgium

### **Games Description**

We are developing a virtual reality serious game teaching children how to ride a bicycle safely. The game is being developed for Oculus Quest. The pupils are set in a traffic situation (e.g. pass by a car double parked, turn left...), they have to ride the bike (via controllers) and they have to make the right decision. Based on their decision they succeed or fail (and collide). The pupils get feedback when they end a level. They can watch the replay of their own performance (even from the perspective of the other traffic participant) and actually see what they did. In the feedback they also get a short movie modelling how to perform successfully. When they failed they can retry. In total there are 21 levels, 7 skills they have to master in 3 difficulty levels. Some gamification elements are added: personalisation of bike and avatar and when completing a level they get rewards. These rewards can be used to buy a different helmet, better gear... in the shop. An actual steering wheel with 'holsters' for the controllers is added. Boxes with 10 VR glasses and a full didactical worksheet will be provided (for free!) through one of the project's partners. The game has won the public's prize in the Smart Belgium Awards last week!

## **Learning Outcomes**

Learning outcomes have not yet been studied, but will be starting from September. In the research design AB-testing is included, using a pretest, a posttest, a longitudinal (6 months) test and a transfer test. Judging from similar (but not the same) experiments, we highly believe better learning outcomes will be delivered.

## **What makes your game different to those already available?**

First, this game will be distributed freely for everyone. Second, this game is the result of a co-creation with pupils and teachers in every step of the design process including visual design, gameplay, traffic situations, feedback system... We also worked with teachers asking them what they found hard in using the game and the equipment. We then adapted or explicitly explained in the didactical guide. Third, the development of this game is a good example of the T-Pack model, since we combined the expertise of teachers, instructional designers and developers. Last, we developed this game, using evidence-based principles, both on a macro-level (4C/ID: Van Merriënboer & Kirschner), meso-level (Educational Design Research: McKenney & Nieveen, T-Pack: Mishra & Koehler) and micro-level (multimedialearning Clark & Mayer). None of the known existing games (Beat the Street, WegWijsVR) are being developed in the same way.

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## **Homeless 'Monopoly'**

**Jackie Calderwood**

Disruptive Media Learning Lab, Coventry University, UK

### **Games Description**

'Homeless Monopoly' is an educational board-game juxtaposing references to the traditional property-acquisition game with real-life scenarios and testimonies gathered from Coventry's rapidly rising homeless population. The game is targeted at young people aged 11-18 and is also relevant for an adult audience. As players travel backwards and forwards around the board, they encounter Opportunities and Choices whereby they will ask each other for advice, make decisions that affect their future, and learn about the scenarios that can lead to homelessness and the support available for those affected by homelessness. With a trading system of resource tokens as well as coins, players are encouraged to collaborate and support other players. Global events create change for all players, whilst daily encounters affect individual players. Access to utilities and the

changing weather impact players as they move between the iconic locations of Coventry, support services, and the visible and ‘invisible’ sites of homelessness in the city represented on the board. Players experience scenarios that will challenge them to debate what they would do or advise in a specific situation, with repercussions on their progress through the game. Ultimately a key to your own home is the goal – which can be achieved alone or, with forward planning, in collaboration with another player.

The board game is part of a transmedia research project and collaboration between researchers at the Coventry University’s Disruptive Media Learning Lab, the University of Warwick, and local charity Coventry Cyrenians. As Coventry celebrates its status as City of Culture 2021, the project aims to give voice to people suffering from homelessness and to raise awareness of the complexity of scenarios that can cause a person to find themselves without a home to live in. The development of the game questions how gamification and participatory arts methodologies can provide capacity to intervene in the representational apparatus attached to those living on the margins of society and cast as ‘social objects’. From its inception during a workshop with students to address social issues via gamification, the project has innovated mechanisms by which to place the agency of target communities at the centre of the design and production process. Creative focus groups were used to collect testimonies and input from Coventry’s homeless and ex-homeless. Secondary school students engaged, via Cyrenian outreach, in the early stages of development and subsequently to user-test the prototype games. University and Higher Education College students made significant contributions to the project development, contributing ideas and testing the prototype game. Three illustration undergraduates worked on the colourful design and thought-provoking artwork for the game tokens, cards, board, and player pieces, also contributing their ideas for game mechanics and scenario content. Further developments in process include a giant board game and adapted play for public engagement (eg city installation) and a prototype AR version of the game, with plans to create an educational resource pack to accompany the game for use in local schools and youth settings.

### **Learning Outcomes**

1. Increased awareness of the issues faced by the rapidly growing homeless population in Coventry.
2. Understanding of the complexity of real-life scenarios that can lead to homelessness, to counteract stereotyping and increase empathy.

3. Increased awareness of the support services available for those at risk of or affected by homelessness.
4. Experience of the benefits of open discussion in decision-making and of collaboration in overcoming challenges.

### **What makes your game different to those already available?**

This is an innovative game to raise awareness and promote social change. Using real-life testimonies gathered from homeless and ex-homeless people through our partnership with local homelessness charity Coventry Cyrenians, this game brings a collaborative and educational approach to consider the issues faced by local homeless people, in a juxtaposition of contrasted values and affordances to that of the traditional property-ownership board game.

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## **Solar Race**

**Michael Callaghan**

Ulster University, UK

### **Games Description**

Solar Race uses a hybrid approach which combines a physical board game with a voice driven, virtual assistant to create a family focussed, educational game where you explore the Solar System, learning fascinating facts about the planets and their moons. The game is educational in nature and curriculum aligned for ages 10 – 11 years upwards. Amazon Alexa acts as the quizmaster and guide for two opposing teams (Astronauts versus the Cosmonauts) as they compete in a race to the end, dice driven, space trivia game where players answer different question types and collect points while encountering and avoiding space hazards, meteor showers, solar storms and a black hole in an attempt to make it home to Earth safely. The physical board layout maintains the relative placement, scale, size and position(s) of the planets/moons from the Sun. There are 38 locations to visit along a circular route through the solar system which includes planets, moons, space stations, refuelling stations, observatories and a range of hazards and boosts e.g. space sickness, black hole, meteor shower, solar storm, Voyager and Hailey's Comet. On arrival and departure from each of the stops, players are provided with random interesting facts and trivia about their location(s) and answer questions about their current location. The game provides interesting, strategic and engaging choices for player with the use of card decks where individual cards can be used at opportune moments to negate hazards, change

questions, warp around the board or hinder the other team. The game has a high level of replayability as the questions and related facts/trivia are pulled dynamically from a database. The conversational virtual assistant aspect of the game is built on Amazon web services using Amazon Alexa skills kit, S3 storage and the DynamoDB database. This backend architecture allows a personalised player experience tied to their Amazon account which manages all aspects of game state e.g. start a new game, pause the game, resume the last game, request help, request current score/status, range of multiple-choice question types and exit/quit the game. The game has two modes, the daily question mode and the full game mode.

Game overview and playthrough video

<https://youtu.be/9BfoHoC1qhk>

Solar Race Amazon Alexa game website

<https://www.solarracegame.com/>

### **Learning Outcomes**

The game is roughly aligned to the educational curriculum for age 10 - 11 upwards (USA Grade level 5-6, UK key stage 2 -3, ISCED level 2/lower secondary school) related to the solar system. The main purpose of the game is to explore our solar system and familiarize students with the planets and associated moons and their features e.g. relative size, placement, location, orbits, composition and timeline for discovery. From this they will be able to recognise planets and moons by their unique characteristics and understand the origin and meanings of their names. The game is designed for competing two teams, typically composed of parents and children and can help alleviate parents' concerns about excessive screen time as it adds a physical and collaborative element to gameplay. The design of the game mechanics allows interesting decisions/choices to be made at different stages of the game facilitating strategic thinking and planning.

### **What makes your game different to those already available?**

The game explores the practicalities, challenges and opportunities of using conversational, voice driven, virtual assistants as a quizmaster in the design of physical, educational board games. The virtual assistant manages opposing teams of players, guiding them through the entire game from start to finish, asking questions, keeping score, providing guidance and timely feedback when required

while maintaining and managing game state without any physical connection to the board game. The design and optimisation of the conversation flow (with associated game mechanics) to reduce the frustrations usually associated with use of voice assistants to engage a diverse range of users was also explored.

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## **Subtitle Legends**

**José Ramón Calvo-Ferrer**

University of Alicante, Spain

### **Games Description**

Subtitle Legends is a video game for educational purposes based on error detection. Specifically, it simulates an audiovisual translation context in which players need to watch short animated videos and identify any discrepancies between what is heard (in any given language) and the subtitles (in a different language). Mistakes in game subtitles involve typical translation mistakes such as incorrect use of grammar and vocabulary, and other having to do specifically with subtitles, such as excessive length or improper segmentation. Although this game has to do with translation, no typing is required. When a discrepancy is detected, it may be solved by clicking on the most adequate resource (a bilingual dictionary if a word has been mistranslated, a grammar reference for a subject-verb inaccuracy, etc.). By correctly doing so, players may thrive in the audiovisual translation industry and generate more earnings, which gives them the possibility to invest in equipment such as better dictionaries, computers, offices, etc. The game comes with an editor so that educators may create their own game contents, including characters, scenarios, audios, subtitles, errors, etc.

### **Learning Outcomes**

The purpose of Subtitle Legends is twofold: First, it has been designed to assess language proficiency by using game data. Video games have been successfully used as data mining tools to identify patterns and predict outcomes in education. In this regard, the univocal correspondence between errors and resources provide useful insight into whether players have understood what has been heard in the video clips and read in the subtitles, and how that corresponds with their language skills. Secondly, players may learn the basic concepts of subtitling such as how to break long sentences into different lines, style issues and the need to reduce sentence length to provide readable subtitles. Also, since educators may use the game editor to create their own contents, Subtitle Legends provides adaptive, purposeful user-oriented training.

### **What makes your game different to those already available?**

Subtitle Legends provides specific translator training, measures language proficiency and provides a tool for educational content creation.

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## **Tile War**

**Peter Christensen, Mathias Gregersen, Natascha Grønlie and Mette Ohlsen**

South Danish University, Denmark

### **Games Description**

The game is a 2 player competitive game (sharing the same keyboard) about summing up numbers, reaching a predefined target. Creating a sum that is equal to the target, you get points and hinder the opponent in doing the same. Each game takes 2 minutes and the winner will be the one who collects the most points.

### **Learning Outcomes**

Better arithmetic for children

### **What makes your game different to those already available?**

Intergration of the game mechanics and the math.

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## **Book Runner: A Library Information & Services Digital Game**

**Samantha Clarke**

Disruptive Media Learning Lab, Coventry University, UK

### **Games Description**

Book Runner is a sci-fi themed, video role-playing game designed to facilitate basic information literacy and library orientation in a fun, scalable and accessible way. Our understanding of space in a library setting is rapidly shifting, so there must also be an equal effort to ensure that learning activities, resources, content and services that are on offer, reflect this change. The game was designed to maximise the range of learning contexts in which it could be played and to ensure a high level of scalability. It is playable via a browser window and thus accessible

via any internet-enabled device without any additional software required. Playtime is approximately 45 minutes allowing the game to be easily incorporated into teaching interventions either as a standalone activity or as part of a larger lesson plan. Links to the game have also been included on all Coventry University LibGuides and shared via social media allowing students to play it independently. The game was designed using a Serious Game (SG) methodology (Arnab & Clarke 2015) wherein gameplay directly delivers on learning outcomes. Based on retro role-playing games, the game features a virtual representation of Coventry University's Lanchester Library and a plot involving a maniacal library catalogue (Locate) that has become self aware and taken over all library systems and software. During the game the player battles through the library completing tasks and challenges to rescue the captive library staff, master their knowledge of library-use and ultimately defeat and tame Locate. This game uses narrative, humour and the ideals of 'want to experience' to bring a unique look at how we can deliver library information through a game-based learning approach which is wholly scalable and accessible anywhere.

Lastly we have provided the game files as an open source resource, so that other institutions and game designers can use and adapt for their own purposes, ensuring that the game provides a best practice approach to open discussions on serious games design and development.

### **Learning Outcomes**

The learning outcomes directly relate to library and information services that are outlined below:

*Orientation: Sigma (Find sigma office, complete sigma tasks).*

*Orientation: Group Study Rooms (Follow character to group study room).*

*Orientation: Rovers Podium (Speak to character at Rover Podium).*

*Orientation: 2nd Floor Enquiry Desk (Speak to character at Enquiry Desk).*

*Orientation: Subject Librarian Office (Player to find librarian office in game).*

*Orientation: Mobile Shelving (Puzzle - player to move the shelving to get to a book).*

\* Online Orientation: Libguides (Player to enter code in game after visiting Libguides).

\* Online Orientation: Referencing Guide (Player to visit Referencing guide and complete task).

\* Library Skills: Construct a reference in CU Harvard (Player to input correct date of reference into game).



- \* Library Skills: Find a book in the library (Find a book in the game's bookcases using Dewey Decimal system navigation).
- \* Library Skills: Find an eBook (Player to locate an eBook on Locate and enter code in game).
- \* Library Skills: Find an article on Locate (Player to locate an article on Locate and enter code in game).
- \* Library Skills: Reserve a book (Player to find reserved book).
- \* Knowledge: Loan limit is 20 items (Player to choose in quiz form).
- \* Knowledge: Books can be borrowed for one or three weeks (Player to choose in quiz form).
- Knowledge: Fines (Player to choose in quiz form).
- \* Orientation: Self-issue machines (Player task to find and use the machines)
- \* Online Orientation: Accessing databases (Player to complete task in Locate, leading to in game fight with database characters).
- \* Knowledge: Support offered by subject librarians (Interaction with in-game librarian characters).
- \* Knowledge: Support offered at service desk and enquiry desk  
(Interaction with in-game characters (If you get stuck in the game you can always go to the enquiry desk)).
- \* Knowledge: Support offered by Rovers  
Interaction with in-game characters. If you get stuck in the game you can always find a Rover).

### **What makes your game different to those already available?**

A number of University libraries have adopted game-based learning teaching activities, however, these tend to demand onsite attendance from the students and are generally not scalable for large numbers and/or accessible to online/distance learners. Book Runner allows students to play/learn online at their own pace and is entirely independent, encouraging self-directed learning. It provides an engaging alternative to 'traditional' chalk and talk induction and allows more staff time to be spent on teaching higher level information literacy skills rather than basic support and information service. The development of the game is unique as a multi-disciplined working collaboration between several departments at Coventry University, bringing together wide-ranging expertise to deliver the game. It was developed using evidence informed practice of SG development and teaching practice, guided by the Trans-Disciplinary Model for SG Design (Arnab & Clarke, 2015). We also adopted a participatory design approach in which Coventry University students were asked to play test and feedback to enhance and be part of the design process. This we felt really helped to understand what the students thought and felt about how we were delivering the information. The use of RPG Maker MV and this type of RPG serious game used in

this context is a completely innovative approach and has not been developed or trialled previously in any other Higher Education context to the best of our knowledge. Both Qualitative and Quantitative data from the evaluation of the game shows significant evidence in positive confidence gain to knowledge and orientation tasks and positive reception from the students who have said the following about the game:

"Original, motivating, funny and it teaches you a lot!"

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## **Unsung**

**Samantha Clarke**

Disruptive Media Learning Lab, UK

### **Games Description**

'Unsung' is a prototype curiosity box that was built to build awareness around women's roles at Bletchley park during World War 2. It draws attention, particularly to Margaret Rock, one of Bletchley's prominent female decoders that helped to crack the German ENIGMA. The box is a team activity in which players are invited to find out as much about the 'real' artefacts as possible. Drawing on similar escape room principles using puzzles, narrative and exploration, but 'Unsung' draws on the concepts of perceptual curiosity to inspire players to piece together the story through multiple stimuli. Players will need to flex their research skills and complex problem solving in order to uncover the boxes secrets.

### **Learning Outcomes**

The main learning outcomes of Unsung are to raise awareness of the women who were working in Bletchley Park during WW2. To start discussions and conversations about the role women had in helping to decipher ENIGMA and to be used as a way to inspire primary and secondary school age girls/women to think seriously about Maths, Technology and Science led careers by highlighting that women have long been involved and integral in these STEM based roles. As a general experience, it also highlights Bletchley's role in the war, examples of cryptography and provides a closer look at British history.

### **What makes your game different to those already available?**

There are no (to my knowledge) other educational versions of curiosity boxes being trialled and utilised as ways to inspire curiosity in students for a variety of educational purposes. This physical, interactive narrative experience puts real World War 2 artefacts (gas mask) into players hands and gives them a chance to reflect on what they are learning are they progress and piece together the story.

This is a real hands on experience for anyone who enjoys puzzle-solving, stories and a touch of theatre!

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## **JAMP/Jigsaw Algebra Magnet Puzzle/HAREZMI**

**Banu Omur Colasan**

Educational Ministry Of Turkey/ Istanbul Education Directorate, Turkey

### **Games Description**

First I distribute every students an x square, they touch and see it, and I tell about calculating the squares area, if the edge is x unit as they hold their hands, that means that square's name is  $x^2$ . Then 2 pieces of rectangular, short edge is 1 unit and the long edge is x unit. I tell about calculating the rectangulars area, long edge and the short edge are multiplied, 1 times x is equal to x, that means the rectangular tile which they touch is a concrete model of x. And the square which edge is 1 unit, 1 times 1 is equal to 1, I say when you are modelling 5, you will use 5 pieces 1 square. Now all the students have one piece x square, one piece 1 square and 2 pieces x rectangular. Then I explain the most important rule, they will choose a question card, and for 1st level cards, there are quadratic 3 terms algebraic expressions, of course I don't tell them. For first level cards when they see 3 terms, they must take the tiles And I ask them to model  $x^2+2x+1$ , all the tiles are on their hands, and the most important rule is they have to model a big square or a rectangular with the tiles. It cant be L shaped, or segmented, indented. Combining the puzzle X next to x, 1 next to 1 can come in length. Now its time to model the expression, miraculously many of them build the model. Now look at the big squares edges and in 2 brackets, write the area formula. All the tiles have the edge unit. Many of them easily find the result.  $(x+1).(x+1)$  Now its time to combine the question with the result,  $x^2+2x+1=(x+1).(x+1)$  We turn the other side of question card, YES IT IS TRUE, CONGRATULATIONS !!! You have factori-zed a quadratic 3-term algebraic expression without any action. 2nd level questioncards, there are multiplied 2 brackets algebraic 2 terms expressions. this time you will consider the edge units. For example  $(2x + 2). (3x + 5)$  This time you will create your model by looking at the edge lengths of the puzzles you have. If we are going to use X, we use x squared If we are going to use 1 we use rectangles with 1 unit First parenthesis is created.  $(2x + 2)$ ; 2 pieces x squared and 2 pieces rectangular rows.  $(3x + 5)$  for 3 pieces x squared and 5 rectangles next to each other. An L-shaped polygon was formed, According to the previous rules are filled with puzzle pieces in consideration and completed into a rectangle. Now write the sum of the fields of the rectangle you have created 6 times  $x^2$  +13 times x + 10 times 1 squared model So  $(2x + 2). (3x + 5) = 6x^2 + 13x + 10$  CONGRATULATIONS!!!

Without multiplication, you found the multiplication of algebraic expressions by simply building the puzzle (ie modeling).

### **Learning Outcomes**

We teach our students quadratic algebraic expressions in the 7th and 8th classes. As many of the students, they are afraid of math and have many prejudice. I have been teaching the task as a game for 3 years. All the math teacher use algebraic tiles. I used to make them from colourful papers, have cut and applied the students on their posters. They used to enjoy the lesson but something was missing according to me. I was drawing the tiles on the board and it wasn't tangible. Then I searched for a material and found out the magnetic sheets. I have magnet algebraic tiles made and started to use in the class. At the beginning of the lesson, I don't talk about the task because when I say "today you will learn quadratic algebraic expressions multiplying and factorizing" they are terrified and paralyzed. So that I tell them, let's play a game today, we will make puzzles, They are exciting about games and be relax and they don't realize but all of them learn the game easily. On the first level students factorize a quadratic 3-term algebraic expression without any action. On the second level Without multiplication, they find the multiplication of algebraic expressions by simply building the puzzle (ie modeling). And as a teacher I experienced that students whom are labeled as lazy, careless etc, they attend the lesson with enthusiasm. They can't answer other questions but answer the algebraic expressions. With my game permanent learning takes place.

### **What makes your game different to those already available?**

I have been teaching the task quadratic algebraic expressions as a game for 3 years. All the math teacher use algebraic tiles. I used to make them from colourful papers, have cut and applied the students on their posters. They used to enjoy the lesson but something was missing according to me. I was drawing the tiles on the board and it wasn't tangible. Then I searched for a material and found out the magnetic sheets. I have magnet algebraic tiles made and started to use in the class and whiteboard. At the beginning of the lesson, I don't talk about the task because when I say "today you will learn quadratic algebraic expressions multiplying and factorizing" they are terrified and paralyzed. So that I tell them, today I don't want to teach math, let's play a game today, we will make puzzles, They are exciting about games and be relax and they don't realize but all of them learn the game easily. This year I create the game as a board game in a box. When children or adults don't feel learning stress, they learn, my game managed that, I tested on many age groups. Teachers can use the game in the class, or a student can play by himself/herself or 2 and more students can play like a competition, they all work. and as a Turkish math teacher I work on the STEM project of

Istanbul Education Directorate. Project's name is HAREZMİ. Harezmi is a Turkish mathematician, and also study on geography and astronomy, explorer of zero, and he is known as the father of algebra, algorithm which means information processing steps that we try to teach our children today. Harezmi is a symbol of holistic science and learning as his times science people, because he is a Turk from Turkmenistan, as a respect his name is given to the Turkey's STEM project. Inspiring from the father of algebra I gave the game his name. HAREZMI as a subtitle. On the cover of gamebox and the questioncards there will be stylized portrait of Harezmi.

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## The Lord of the Numbers

**Bilgen Demirdağ**

Cakir Schools, Turkey

### Games Description

The mathematical topics, fractions, decimals and percentages are subjects that students tend to struggle or generally find boring. I designed this game in order to teach these difficulty bearing subjects, in a fun way, inspired by Solitaire.

- Firstly, players will randomly select one card to complete their task, the tasks are based on the places that are on the Unesco World Heritage List in Turkey.
- Each card is defined on the basis of information and legends specific to the selected place. The tasks that determine the purpose of the game takes place.
- The task cards give the game a real purpose and provide learning while having fun.
- After you select the task card, it's time to put the game tokens in place.
  - o The guide includes examples of token layouts. The tokens are arranged according to a preferred layout example.
  - o When sequencing the tokens, the numbers on the tokens will be facing upwards, and the tokens are positioned side by side and on top of each other.
  - o Once the tokens are mixed, they are randomly arranged according to the preferred pattern.
  - o Among the two players, the youngest player in the game will begin.
  - o The aim of the players is to find and collect pairs of tokens with a fraction, a decimal and a percentage representation equivalent to each other.
- Rule to take a token;
- o In order to take a token, there must not be any other token that is aligned with one or both of the long sides of that token. It is not important whether there are tokens that touch the other edges.

- Each player has 1 minute to find a pair. If a pair is not available in the given time, a turn is passed over rule will be applied.
- Turn passing rule;
  - o This rule applies if the pair has no double or the player has not seen the pair (s) in the given time. One of the token on the top is taken, placed on a short edge of the column where it touches the bottom. The turn is passed to the other player.
  - o The players repeat the same process in sequence until a pair is found.
- When all the tokens on the bottom are finished, the player who gets the most tokens wins the game.
- Players usually complete the game with a close-call result, which keeps the suspense and excitement going until the last minute.

### **Learning Outcomes**

The fraction, decimal and percentage representations representing the same magnitude transform and match each other. Whilst achieving mathematical goals your also increasing and reinforcing the awareness of local and universal values.

### **What makes your game different to those already available?**

In addition to measuring the gains of the subject with the excitement of the game, the game also aims to raise awareness of local values. Therefore it is an interdisciplinary game.

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## **Maths Duel**

### **Pierpaolo Dondio**

Technological University Dublin, Ireland

### **Games Description**

Maths Duel is a card game (both digital and non-digital) stimulating numerical, strategical and problem-solving skills, including basic maths operations, tables, multiplies, inequalities, ordering, measures, rounding, currencies, algebra, conversions and fractions. It is an educational game designed for pupils aged 7 - 13, and it is aligned with the Maths Irish curriculum of 2nd to 6th class primary school and 1st year secondary school. Besides its educational purpose, Maths Duel has been proved to be a highly enjoyable game that can be played by a broader audience of young and adults. The core idea of the game is that players have a deck of cards containing number cards and spell cards, which are special cards modifying the value and abilities of number cards. Aim of the game is to capture the other player's number cards using their maths abilities and be the first to reach a target amount of points. The basic rule of the game is that a

number captures a number with the same value. Some number cards have special abilities that allow them to capture a group of numbers in one move, or capture numbers with a value different from their own. Spell cards can also modify the value of number cards, and also capture, create or give extra abilities to them. There are more than 100 spells for millions of different combinations, tricks and strategies! Each card is mapped to a maths concept. For instance, the card “capture all numbers in the table of” helps the player applying the notion of multiples. By introducing different number and spell cards in the deck, it is possible to map different maths curriculum components. For instance, to practice fractions, number cards representing fractions or decimal numbers can be used. A player could use a card “1.5” to capture the fraction card “ $1\frac{1}{2}$ ”. Units of measurement can be added to cards to teach conversions, length, capacity or currencies. For instance, a player can multiply by two its “50 cents” card to obtain “100 cents” and capture an opponent’s “1 euro” card. The above card-based mechanism represents an advantage of Maths Duel over current games since it makes the game flexible and able to cover a large set of curriculum content. This flexibility makes the game a valuable tool for classroom learning as well, as the teacher can adapt it to the content required. Players have also the possibility to build their own deck of cards and implement their personal strategies. Maths Duel has been designed to stimulate strategic thinking, collaboration and creativity rather than repetition. The electronic version of the game logs every move players are doing, data that could be used to support, monitor, adapt and personalize the game experience. A match of Maths Duel is about 5 to 10 minutes long, depending on the game mode and rules, and it can be played versus a computer player or another human player. In the tournament mode, a single tournament can accommodate up to 128 players.

### **Learning Outcomes**

By including different cards in the game it is possible to address different curriculum concepts. Referring to the Irish primary school curriculum from 2nd to 6th class (8-12 year old pupils) [1], currently we designed card to support the following learning outcomes:

- Four basic operations: plus, minus, division and multiplication
- Odd and Even numbers
- Inequalities and number comparison
- Ordering, greatest, smallest
- Intervals
- Multiples and Tables
- Prime Numbers
- Capacity
- Currencies

- Distances
- Power of a number
- Unit conversions (litre, meter, grams, euro).
- Fractions (concept of fractions, four operations with fractions, proper and improper fractions, conversion between fractions and decimals)
- Operations and comparison with decimals
- Rounding
- Algebraic Operations

### **What makes your game different to those already available?**

We designed Maths Duel with unique features to overcome the limitations of today educational games for Maths. Our published research based on a survey of more than 800 teachers [1] provides a fairly detailed and disappointing picture of the use of Maths serious games in the teaching practice. Games are said to be usually very engaging, but also too simple and poorly designed from an educational point of view, with little value for teachers. The perceived poor pedagogical design of current games was the second most-frequent reason mentioned by teachers not to use games. Our survey showed how 87% of games used by teachers and pupils have little pedagogy behind them and they follow a behaviourist approach, based on exercise repetition. Only 18% of games support multi-player and 12% of them have some adaptability or monitor student's progress and 8% are collaborative. Mostly, today educational games replicate paper exercises approach, offering puzzles in which the player has to answer questions repetitively until finding the right answer. Often mathematics is delivered via puzzle-like activities added to a visually appealing videogame. These games result engaging but with limited lifespan and impact on learning. Maths Duel aims to provide a highly engaging game with a solid design compared to the state-of-the-art. In Maths Duel, mathematics is diluted in the game mechanic, it is the essential component of the game. Student or player will have fun while playing without realizing the amount of logical and problem-solving skills they are applying. Maths Duel has been designed following the Constructivism learning paradigm, where strategical thinking and creativity are promoted rather than repetition. Players can even build their decks of card to implement their own game strategy. The game is fast to be deployed for classroom usage, it can cover much more curriculum content than other games due to its flexible game mechanic. It is therefore a tool for classroom learning as the teacher can adapt it to the content required. It logs every moves players do, data that could be used by the teacher to monitor students' progress, or to adapt and personalize the game experience. [1] Rocha M, Tangney B, Dondio P. Play and Learn: Teachers' Perceptions About Classroom Video Games. In European Conference on Games



## **Ways2Sort**

**Simon Egenfeldt-Nielsen**

Serious Games Interactive, Denmark

### **Games Description**

Can waste sorting really be fun? With Ways2Sort it can! Test your waste sorting knowledge and your ability to learn and remember which waste items belong where. Work on your high score by being faster and more accurate. The game is a small action puzzle game, where you need to internalise the sorting categories to be able to win.

### **Learning Outcomes**

Ways2Sort educate children on the importance of waste sorting and how to sort waste correctly. The game incorporates factual waste sorting data and methods from different municipalities, which makes it highly customisable and relevant for each individual municipality. In the game, different waste items are presented to the player, who has to figure out which waste bin to put the items into. The player is introduced to different sorting types, e.g. residual waste, glass, biowaste etc., and different environments, e.g. kitchen, garden and kid's room.

### **What makes your game different to those already available?**

The game has a very close relation between the game and learning mechanics that is quite rare. It also take quite care to reinforce errors at the end of the levels. The most important difference is that the game is made so it can easily be modified to the specific sorting categories in an area, and the game will be fitted to this. The game can also be tied to specific waste patterns in eg. a municipality so players will get to play and learn the most important things based on real-life data from that municipality.

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# **Hunt for Human Rights**

**Stephen Farley, Jaia Alexandra Kavanagh, Laura Ann-Marie Masterson, Molly Carolanne Egan, Ellen Kearney, Willemijn, Bosschaert, Lucy Edgeworth and Eve Ellen Mathews**

Trocaire/Loreto Secondary School Balbriggan, Ireland

## **Games Description**

Hunt for Human Rights was developed by seven students in Loreto Secondary School, Balbriggan in Dublin as an entry into the Trocaire Game Changers competition in Ireland. The challenge of this competition is to create a game to help younger students learn about a global justice issue. The game has to be either a board, card or digital game in order to qualify. Hunt for human rights is currently in board game format, with the potential to be developed into a digital version in the future. The game has two main objectives, to help young people become familiar with our basic human rights as laid out in the Universal Declaration of Human Rights (UDHR), and to understand different ways that these rights can be denied through the actions of others. A set of scenarios have been developed that use case studies from both the global north and the global south that examine how different rights have been taken away. These scenarios include exploration of gender inequality, the impact of climate change, conflict, discrimination, and being forced to leave home and become an asylum seeker or refugee. The game is loosely linked to a number of subject specifications in Ireland, including Civil Social and Political Education (CSPE), and Politics and Society.

## **Learning Outcomes**

Learn about our basic human rights Learn about how rights can be denied Learn about what actions can be taken to protect human rights

## **What makes your game different to those already available?**

There are educational games out there in Ireland, but none that specifically explore the denial of human rights globally.

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# Enchanted Crystals

**David Farrell**

Glasgow Caledonian University, UK

## Games Description

Enchanted Crystals is the result of an intense two year project that has brought together game developers, teachers, and researchers from all over Europe to try to help improve maths education in young people. Generously supported by an Erasmus+ grant from the British National Agency, we investigated curricula and best practice across Germany, Greece, Portugal and the UK. We spoke with teachers who told us that pupils who struggled with fundamental mental mathematics have real difficulty in understanding more advanced concepts, and we looked to literature and science to underpin the way we developed Enchanted Crystals as a helpful aide in for teachers. The primary pedagogical purpose of the game is to support the practice of mental mathematics so that players use their fast recall memory system for such answers rather than having to use slower working memory to “work out” the answer step by step. Evidence supports that by improving mental maths basics, pupils may perform better at higher levels of mathematics education. As a mental maths game, it doesn’t teach the fundamentals, but rather is a companion tool that can help in revision, homework, or simply to practice and automate the process for pupils who already know how to do mental maths, but who are slow. The game sees players trying to save their school of wizardry from an evil wizard teacher. Players control two pupils at the school who have to learn and cast spells to overcome obstacles. Spells are cast by drawing an appropriate shape on the screen of the touch device using a finger. These shapes are the shapes of numbers and each of the spells corresponds to a particular answer of a mental arithmetic problem. At any given time, there are numbers inside crystals of varying colours. The player decides which spell they wish to cast, carries out the appropriate exercise of mental arithmetic, using the numbers inside the coloured crystals and then casts their spell by drawing the answer on screen. If the player is in a dark spaces and wishes to light all of the torches, she may cast the light spell by drawing on screen the answer to the yellow crystal number plus the red crystal number. If the player wishes to make a staircase appear to reach a higher level, she must cast the answer to the yellow crystal multiplied by the red crystal. Level design is used to progressively increase the difficulty level and to introduce the player to more game mechanics and more advanced spells throughout the game. Lesson packs are included in the game handbook for teachers including a focus on pupils with special needs. A ‘print at home’ non-digital variation on the game is included that teachers can use to support less able pupils. The game has some features to

support pupils who have physical or mental difficulties playing, including the ability to control the speed of the game that the game operates at as well as the difficulty of the numbers used for the operations.

### **Learning Outcomes**

The game supports the practice of mental maths skills such as those found in 4th - 6th grade primary education. Addition, subtraction, multiplication and division and order of operations.

### **What makes your game different to those already available?**

The game is playable on pupils' own phones instead of an in-class computer. The game focuses on practising an existing skill to make it faster rather than in teaching itself. The game comes with extensive lesson plans including a focus on those with special needs. It's playable in German, Portuguese, Greek, and English

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## **Earth Remembers**

### **David Farrell**

Glasgow Caledonian University, UK

### **Games Description**

Earth Remembers is a transmedia game that combines digital simulation, human-driven storytelling elements, board-game elements, and video clips to help professional climate negotiators understand the way that their national commitment decisions impact the planet. The game is the result of a collaboration between undergraduates and academics from the Purdue Climate Change Research Centre, Glasgow Caledonian University, and Utrecht University. The game mirrors the real-world UN Conference of Party conference negotiations where diplomats meet every six months to make decisions on how to implement the Paris Agreement. In the game, up to thirty players (representing governments) decide how to commit their national budgets to categories such as investment in green technology, climate adaptation, climate mitigation or their own economy. Once players have made their commitments, they are submitted to a host server that uses an IPCC climate model to simulate the effects of each decision on carbon emissions, national GDP and the global temperature. Each turn skips forward five years, enabling players to “live” through the plausible future scenarios of 2033, 2038, 2043 and onwards out to 2118 to see how their decisions affect the world. The game also models the relationship between global temperature and so called ‘Tipping Points’. These Tipping Points are events that may trigger within certain temperature ranges that cannot easily be undone by reducing global temperature to a pre-industrial level. For example, if one of the

Tipping Points - the West Antarctic Ice Sheet Collapse, is triggered, it would mean a sea level rise globally that displaces entire island states and would impact coastlines globally. Other Tipping Points include losing the Coral Reefs or the Boreal Forest, altering weather systems such as the Indian Summer Monsoon, or further ice melts such as the Greenland Ice-Sheet. Because the effects of triggering these Tipping Points can lag behind the moment that they are triggered, it can be difficult for people to feel urgent call to action as we approach possible trigger thresholds. By simulating the game in five year increments, we were able have players 'live through' the moment where the tipping point was triggered and then use human-centred future scenario exploration and storytelling to help make concrete the world created by decisions of our players. The game was played by delegates and other attendees at the UN FCCC Climate Change conference in Katowice and in Bonn last year and feedback from attendees suggests that it is a powerful experience that can help make these far away, abstract realities more concrete and emotionally real for players.

### **Learning Outcomes**

The game's primary learning outcomes are centred around the concept of Tipping Points - that there are key temperature thresholds that can trigger effects with large, long term impacts that are not easily undone.

### **What makes your game different to those already available?**

The game is aimed at an atypical audience - policy makers and aims to impact their understanding of climate tipping points, which is directly relevant to their roles in international negotiations. The game also mirrors real-world negotiations in a way that few games attempt. The game mixes many forms of media in order to harness the best features of each. For example whilst the computer simulation is clearly the most efficient way to model the effects of decisions on temperature increase, having creative people facilitate the collaborative storytelling aspects of the game takes advantage of individuals' ability to synthesise disparate pieces of information in order to make the 'possible future' created by the players more believable.

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## **SumWOrdZ**

**Gareth Kerry Rees**

GKR Games, UK

### **Games Description**

SumWOrdZ (apple app store only) is aimed at all ages from Secondary school upwards for those wanting to improve their basic maths or those that are more

able at maths and want a challenge. It is a word/number game where players not only get better at arithmetic but also improve their spelling and general knowledge. For those wanting to see how their skills compare against others or simply want to see how they are improving there is a Leaderboard showing their ranking in terms of lollipops, medals, shield, trophies and highest scores!!! Its designed to be a fun way of improving players basic maths skills and still be challenging where players are not afraid to make mistakes as they learn! There are 4 words making up a game, each word has a number under each of the letters. The words are chosen by the player from a Theme of interest at the start of the game. The player also gets to choose which Dice Combination helps them calculate the number value on each letter also at the start of the game. When the first word appears the player presses each dice in the selected combination as many times as necessary to compute the number on any letter they wish to calculate first. The dice values then change for the next letter in the word. There is a time limit for each word and if completed a score is shown as well as a reward in the form of a medal if the players scores above a set target or a lollipop if they do not. When all 4 words are completed a grand total of the score and medals and/or lollipops which are posted on a Leaderboard for others to see if the player wishes. Some of the themes like Capitals it says which Country it is the capital of on a Knowledge Board shown after completing each word as well as a medal or lollipop. There are 3 levels Easy, Medium or Hard and players can choose to enter all 3 or simply play the level they feel comfortable at to improve at their own pace. Each level corresponds to the award of a Bronze, Silver or Gold medal if each word target is achieved. So, players can be the highest scorer or have the highest medal count at any one or all 3 levels. Or else, simply play for themselves at the level they are comfortable and learn by their mistakes and improve at their own pace. There are other player statistics which allows them to see how and where they have got their scores and also their highest scores to help them choose possibly other dice combinations or themes to improve their scores further. Link to SumWOrdZ as follows:

<https://itunes.apple.com/gb/app/sumw0rdz/id1120636829?mt=8>

### **Learning Outcomes**

There are many Themes on Topics that appeal to a wide range of ages to which I am adding all the time, many in the future will be aimed at the school curriculum in a general way to engage with secondary school age pupils. In addition, there are themes that cover topics of current as well as academic interest to also engage the parents of the same pupils. So, SumWOrdZ can become a family affair with parents and pupils sharing or competing against each other if they wish! Playing the game regularly will definitely improve players of all ages arithmetical

skills and familiarity with the words will improve their spelling and also their general knowledge. Not many games can make that claim.

### **What makes your game different to those already available?**

My game is simple in its construct combining dice combos the player chooses to maximize their calculating skills and a broad range of topical themes that interests them. The dual approach enables players of all ages to engage with improving their arithmetical skills and their knowledge and spelling at the same time. It is at the same time fun and challenging with many rewards and players can learn from their mistakes and see how they can improve on the Leaderboards. The game is split into Easy Medium and Hard levels so players can be the best or getting better at some level. The game is also easily scaleable in the future with many more levels and dice combos and themes that can be added - I do not believe many games can make that claim.

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## **The Kingdom of the Blossoming Rose**

**David Kristan**

Faculty of Education, University of Ljubljana, Slovenia

### **Games Description**

The Kingdom of the Blossoming Rose is a strategic single player videogame. It was designed by three students from Faculty of Education in cooperation with three students from NTF (University of Ljubljana). What about the story? It starts in the Kingdom of the Blossoming Rose, which is threatened by a group of corrupted enemies called Niobians. These evil forces are approaching »the Roses«, who doesn't have an army strong enough to defend itself against the powerful Niobians. Therefore, the prince heads to the allied kingdoms to call for aid. The paths to those kingdoms are complicated and therefore the player's task is to write an algorithm, which brings the prince to the kingdom in the best possible way. In the home kingdom prince is given as many soldiers as he can get, but this amounts only to 1000 soldiers as there are not many men capable of battling on the front. Every move is expensive as it costs you 5 soldiers per step, due to exhaustion. Luckily there are crystals, that have healing properties and can bring 15 soldiers back to life. Now why is this game educational? The paths must be carefully chosen and calculated. Wrong path could mean a loss of many soldiers! The player writes an algorithm that takes him on the best path (brings to the end as many soldiers as possible). The game includes 3 learning objectives, that are to be found in Slovenian primary school curriculum. Pupils learn to represent a simple task with an algorithm, follow algorithm, that was written by someone else and divide problem in to minor problems and solve them.

### **Learning Outcomes**

Learning objectives progress from first to the last level, according to Bloom's taxonomy. Therefore, in the first level pupils learn to follow algorithm, that was written by someone else, on second level they learn to translate written commands into symbol commands, on the third level they choose the best path by themselves, on the fourth level analyse which path is the best from the given options, on the fifth level correct a mistake and on the final level they must divide a larger path in to smaller paths. So, the first stage is remembering, second understanding, third applying, fourth analysing, fifth evaluating and the last is devising. Final accomplishment depends on number of the soldiers brought to battle. The game can be used for testing pupils knowledge or for grading their knowledge, based on the number of soldiers brought to the end.

### **What makes your game different to those already available?**

The game can be used for grading, because it keeps track of the score and progresses from level to level (Bloom's taxonomy). The game has an interesting story, which can give additional motivation to the pupil.

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## **BPMN wheel**

### **Bahar Kutun**

Technische Hochschule Hochschule Ingolstadt, Germany

### **Games Description**

The basic idea of the game is that participants can learn basics about BPMN (Business Process Model and Notation) and apply them in practice. The BPMN wheel as the chosen form of implementation is based on wheels of fortune, which are known to most people from trade fairs or from television. The core of the board game is the BPMN wheel and another wheel for the collection of notation elements needed for process modeling. The BPMN wheel contains 14 fields consisting of four types called "learning card", "question", "teamwork" and "notation wheel". The notation wheel itself has 14 fields (different number of activity, event, gateway, artifacts, and Lane). The game includes the following elements designed for knowledge transfer.

- learning cards

The theoretical contents required for the acquisition of the modelling language are placed on the front of 40 cards of the same color. The learning cards were labeled with headings such as "events" or "artifacts", provided to give the



students a structure for the teaching content and to help them in learning and retention.

- question cards

Not only to query what has been learned but also to support the learning process, 20 question cards of the same color have been developed. On the front side of the cards are placed questions of different types, e.g. open or closed questions. Students can find the answer of the question by turning the card. The question cards have circles in the colors yellow, orange and blue. These show the color of the coin, which can be collected by answering the question correctly. Collected coins can then be exchanged for (missing) notation elements again.

- notation elements

Per game set there were created moderation cards for activities, events, gateways, data objects and lanes. These can be collected during the game and applied to moderation sheet when modeling the process. The gameplay looks like this: Students organize themselves in teams of 2-5 people. One by one, the players turn the BPMN wheel and execute the instruction corresponding to the "twisted" field. If the "question" field is turned, a question card is drawn. The team can decide for themselves whether the question should be answered by the player in the row or in the team. For the correct answer the team receives a coin of the color yellow, orange or blue. If the pointer points to the field "learning card", a learning card is drawn and read aloud. All drawn cards are returned to their piles. Players can model the business process based on a textual process description. To do this, the players have to land on the "notation wheel" field and then collect the necessary notation elements with the wheel. In addition, players can exchange their collected coins for notation items. If a player then lands on the "teamwork" field, the team has three minutes to model the process based on the textual description with the collected notation elements. The winner is the team that first modeled the process without errors. The game lasts about 70 minutes with 3 people and modelling a process that is not too difficult to model.

### **Learning Outcomes**

Players can acquire knowledge of the notation language, as well as practice the acquired knowledge in team.

### **What makes your game different to those already available?**

By playing business processes can be modeled

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# **FUNERGY**

**Sergio Luis Herrera Gonzalez**

Politecnico di Milano, Italy

## **Games Description**

FUNERGY is a simple and engaging card game, paired with a mobile app, designed to inform children and their families about the European Energy Scale and to improve their awareness about energy and sustainable consumption. The game comprises two components. A card game can be played without prior knowledge about energy conservation, but introduces concepts such as positive energy attitudes, good consumption habits, shared responsibility, etc.; these hints are embedded both in the game mechanics itself and in the card illustrations. A digital quiz game provides energy saving information in a concise and entertaining way, without interrupting the ongoing card gameplay. The card game and the mobile app interact during the play and the rules reward the acquired knowledge and the cooperation-competition strategy. Indeed, the game promotes not only competition, but also collaboration, to convey the principle that energy saving is a collective and societal effort. The gameplay consists of seven rounds, corresponding EU Energy Scale levels. Seven decks of cards with the letters and colours of the Energy Scale are placed on the table, as score points. The game starts from the G level and finishes when the players reach level A. Every player receives seven cards from the playing deck and the remaining cards make the drawing deck; the objective is to collect cards numbered from 1 to 7, discarding as soon as possible all the “negative” cards (representing old appliances) and exploiting wild cards. The player in turn draws from the deck and exchanges a card with another player, to complete the hand. If she completes the combination from 1 to 7, she closes the round, shows her cards, picks up the scale cards of the current level, keeps the card with the highest score, and distributes the other cards, with lower values, to the other players. When the player closes the round using wildcards, she uses the mobile app to answer an energy quiz; she scans the QR code on the card and receives a quiz with 2 possible answers; she makes her choice and the app gives feedback and displays a brief, yet informative, explanation of the quiz topic. If the answer is correct, the player keeps the card for herself; otherwise, she must “donate” it to another player. The game ends when the level A round is closed: all players sum up their Energy Scale Cards and add 3 points for every wild card. The player with the highest score wins.

## **Learning Outcomes**

At the end of the game, the children are aware of the existence of the Energy Scale, learn that a higher level on the scale means a higher saving, apprehend

useful behaviour to save energy (cards are illustrated to show such behaviours), and, by answering the questions of the app, improve their knowledge about a broad variety of energy topics, no matter if their answer was right or wrong. Funergy is part of an experiment involving 89 classes of 10 primary and first intermediate schools in Italy and Switzerland. A total of 1500 children, from 6 to 14 years old, are involved with their families; 480 children more participate as a control group. The experiment settings consist of 3 stages:

-On the first stage, the children and their parents are asked to fill out a questionnaire, which assesses their knowledge and attitude towards energy saving.

-The second stage consists of an activity at the school, where project representatives present the objective of the game and explain the rules; then a game session of 30 to 45 min takes place. After the intervention, a copy of the game is given to each pupil and they are encouraged to play with their family and friends to increase the game effect and reach.

-The final stage is the evaluation of the game impact; a second questionnaire is provided to the children and their parents, so to measure the changes in the family attitude towards energy saving due to the experience with the game.

The evaluation stage is ongoing and a significant increase in energy awareness in children and families is expected. At the time of writing, around 70% of the pupils downloaded the app autonomously, to continue playing at home.

### **What makes your game different to those already available?**

Funergy has a different impact than other games as its mechanics create an immediate interaction between the players around the table and introduces specific ways to communicate. While having a learning purpose, the game is still perceived as fun and the learning elements are not invasive and stimulating. Funergy uses a technology that is available for everyone, a smartphone, and even without it, the card game can be played and it is fun.

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# Grow Planet

**Kristian Lundquist**

Gro Play, Sweden

## Games Description

Grow Planet is an immersive learning world designed for K-3 and their teachers. Grow Planet could briefly be described as a plug and play version of a mix of Minecraft, Kahn Academy and Super Mario Odyssey, complemented with a full stack dashboard for the teacher to plan and supervise the students' progress and pace according to the national curriculum and local educational plans.

## Learning Outcomes

The students / players learn about STEAM and Sustainable Development in an holistic context through phenomenon-based education where student control, problem solving and experimenting plays an important role.

## What makes your game different to those already available?

From the beginning Grow Planet is designed for the younger ages (K-3) and has proved being really easy to use for both students and teachers compared to other learning games in this category. Also Grow Planet drives engagement through real-life problem solving based on a comprehensive collection of Sustainable Development topics that students really care about. Through these engaging stories students dig into all the STEAM knowledge and ability training available in the game environment. Grow Planet is a easy-to-use, plug and play game environment for multi-platform use (both web and app) which enables an holistic and flexible learning environment.

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# Liquid Marx

**Christoph Lüerig**

University of Applied Science Trier, Germany

## Games Description

Karl Marx, his theory and its social impacts are a highly political and emotional subject matter. Game mechanics compared to stories have the characteristic of de emotionalizing subject matters. Liquid Marx is a serious VR game whose core game mechanic is constructed upon the quantitative economic theory of Karl Marx and uses glasses with liquids as metaphors for the different quantities. The game mechanics are split into two main layers. On the strategic layer the game is about maximizing one of those quantities over a certain period of time. On an

operational layer the game is about mixing and managing the glasses and their fluids representing the different quantities of that theory. The role of the operational layer is to lure the player into the game and give him some immediate feedback. It is also the part that is portrayed in the gameplay videos mentioned below. Playing the strategic layer successfully requires understanding of the basic concepts of Marx's economic theory as it involves planning of steps to maximize one of the different quantities of Marx's theory. Balancing this part of the game has been done with a brute force optimizer to avoid the pitfall of dominant strategies. Also the strategic layer has been play tested with 2D prototype beforehand. As a third additional component the game contains a series of exhibits which are photogrammetric reconstructions of Karl Marx related objects that can be found in Trier. Some of them can be found in the Karl-Marx-Haus which is a museum run by the Friedrich-Ebert-Stiftung. This provides an explorative component to the game. Virtual Reality (VR) often brings itself the problem of cyber sickness. On the positive side it provides a far better spatial impression of the simulated scene and allows for different interaction mechanics usually evolving around the controllers and the improved spatial impression. Liquid Marx minimizes cyber sickness by putting the player more or less stationary into the center of a round table where all interaction relevant objects are placed on. The technical focus of this VR implementation is placed on the glass and fluid interaction. The fluid simulation is physically motivated but not accurate. On one hand this makes the simulation believable. On the other hand it avoids usability problems like swapping or spilling of the fluid.

Further information, screenshots and download:

<https://www.hochschule-trier.de/go/liquid-marx/>

### **Learning Outcomes**

The game has two desired learning outcomes. First there is the basic understanding that a big part of Karl-Marx work is a theory and just a theory. So it is not automatically linked to all the political and emotional baggage it is often associated with. The second objective is to provide an understanding of the basic terms of Marx's economic theory and its interdependencies.

### **What makes your game different to those already available?**

A lot of educational games fall into one of two categories. There are either more of a simulation than a game or they are a game where the core game mechanics is more or less unrelated to the subject matter. This is only reflected in the aesthetics layer of the game or in the story. Liquid Marx has a more playful approach than a simulation by simplifying parts of the theory and using the

metaphorical approach with the liquids. On the other hand maximizing an economic quantity directly roots the subject matter into the game mechanics. For the VR side of gaming most of the VR games available also fall into two categories. They are either relatively complex games but they are ports from non VR games. As such they are often only superficially adjusted to that format. On the other hand there are VR games that only consist of one atomic VR optimized game mechanic like shooting arrows. Liquid Marx picks VR optimized game mechanics like the pouring of liquids but places them in a larger strategic context.

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## **Spirits of St.Catherines**

**Niall Mc Shane**

Ulster University, UK

### **Games Description**

‘Spirits of St.Catherines’ is a room-scale VR experience for immersive learning in next generation museum and heritage exhibitions. The game features a detailed, historically accurate virtual reconstruction of a 15th century church and graveyard in the north-west of Ireland that has been built using real-world archaeological data collection and heritage archive information. The environment is used to present a historical narrative that provides an understanding of the intangible attributes of the time period and allows players to experience the folklore, traditions, knowledge and natural heritage. Upon entering the experience, players are presented with a portal into the game’s hub area and virtual museum. Within the virtual museum players can view and interact with a series of curated digitised historical artefacts and documents. The virtual museum area is used to enhance the players knowledge of cultural heritage in 15th century Ireland but also demonstrate the process of mapping, data collection and curation within a heritage project. From the hub area players can enter portals to step into the past to and experience the heritage environment is a multitude of ways. ‘Narrative mode’ allows players to explore the environment using a teleportation mechanic to collect the fragmented story resources. Upon collection players are able to piece together the narrative and assign each part to its location on the map so they can reveal the full chronology of the story. Catch a spirit mode transports players to the church graveyard in a atmospheric night-time setting to play a motion based challenge where they must track down and capture the spirits that roam the environment. Players are given a net that they control with the VR motion controllers to catch the spirits that roam the graveyard. By capturing the spirits you will uncover the resting places of prominent figures in the graves and map how they are linked to the game’s historical narrative.

### **Learning Outcomes**

Spirits of St.Catherines is designed to provide an immersive learning experience for intangible heritage through comprehension and problem solving within a narrative framework. Memory is tested through recall of facts and concepts supported by narrative. Knowledge and understanding are required to collate the historical narrative into a single coherent piece. Analysis of information is performed as players map the connections between ideas within the game story into locations and chronology of narrative. Skills in problem solving and spacial awareness are required as players navigate the environment and complete the spacial motion challenge of capturing the graveyard spirits.

### **What makes your game different to those already available?**

Spirits of St.Catherines has unique narrative mechanics that require players to explore a historical reconstruction of a real-world environment and connect elements of story within the environment in order to reveal and understand the full chronological history. This is an innovative approach to narrative comprehension that requires detective work, problem solving and understanding of the text to make connections between the environment and story. The game also has a unique net mechanic with fully modeled rod bending physics. This makes the experience of capturing the spirits fun and physical but also linked to the historical narrative.

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## **Finity**

### **Tony Mullen**

Northeastern University, USA

### **Games Description**

Station2Station is an abstract strategy game based on pattern matching with finite state machines (FSMs). FSMs are a foundational concept in computer science, and underlie many diverse and important CS topics, including regular expressions, the TCP networking protocol, Turing machines, hidden Markov models, and many others. In Station2Station, players build paths between "stations" (analogous to states in an FSM) in a way that fosters algorithmic thinking and develops deep intuitions about how FSMs work. Thanks to the simple and intuitive game-play, sophisticated concepts become accessible to players with no knowledge of algorithms or computer science. Children as young as 8 years old have played, enjoyed, and won the game, even while dealing directly with the very same concepts that CS undergraduates would encounter in a course on automaton theory or formal language theory. During game-play, black and white arrows (analogous to labeled transitions) are positioned from

station to station to follow a pattern of eight black and white indicators which have been selected at random at the beginning of the game. Throughout the game, players build up the equivalent of an FSM to match this binary sequence bit by bit, yielding a remarkably low-level view of algorithmic processes in a non-digital tabletop game. Colored markers (rings and a starting post) are used to determine which stations a player's path passes through. With each turn, players choose between several possible moves: placing or moving markers, placing or moving arrows, or placing their "blocker" piece to restrict the moves of their opponents. A handful of rules govern which moves may be played under what circumstances. The game can be explained in a few minutes and the rules can be mastered in a game or two. The strategic component of the game lies in building a legal path to match the black and white sequence laid out at the beginning of the game, while preventing one's opponents from doing so first. The black and white arrows are shared resources, so beneficial moves for one player may also benefit opponents, and setbacks may similarly be shared among several players. Legal paths are built up incrementally, and if a player's path is disrupted by an opponent's move, the player's rings may be rendered "orphans" and removed from the board, a setback for that player. The game can involve surprising reversals, and short-term self-sacrifice is sometimes necessary in the pursuit of longer-term strategic goals. Aside from the educational benefits, Station2Station is designed to be a challenging and entertaining strategy game. It can be played by 2, 3, or 4 people (with experimental variants proposed for more players or teams). The game is complex enough to enable deep strategic play for adults, but can be enjoyed by kids and casual players as well.

### **Learning Outcomes**

Station2Station is intended to foster algorithmic thinking and intuitions about pattern matching with finite state machines. These are enormously important habits of thought for anyone in computer science or programming, and they must be cultivated by actual practice. The benefits of playing Station2Station do not depend on players being aware of what they are learning, or even that the game is intended to be educational at all. In the same way that card games are perennial reference points for the study of probability, Station2Station is intended to help lay the foundations of understanding to ease the path when algorithmic concepts are studied directly. For kids, it is a great way to build up intuitions that will be helpful in coding and computer science without screen time. At the same time, when played competitively by skilled players, the game is cognitively demanding even for those with a good understanding of the underlying principles. It can be incorporated in interesting ways directly into a university-level course on automaton theory and as the basis of algorithmic analysis and coding projects.



### **What makes your game different to those already available?**

The underlying mechanisms of FSMs are important to many video games; any game that behaves a certain way based upon player input and the current game state can be said to operate according to the principles of an FSM. To a much more limited extent, the broad idea of a changing game state is sometimes found in tabletop games. However, to my knowledge no game has ever incorporated the concepts of FSMs so simply and explicitly, or in a form so close to their conventional graph-based visualization in computer science. Also, although path-creation and maze games are common, the mechanism of building a path to match a shared pattern which changes from game-to-game is to my knowledge unique as well. The game is visually distinctive, with pieces designed specifically for its unique game play. There are no written components to the game board or pieces, so the game is fully international out of the box, aside from the instructions. Game pieces are easy to see and to hold, and can be manufactured in color-blind friendly colors.

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## **Port of Mars**

**Brian Nelson**

Arizona State University, USA

### **Games Description**

The idea of a human colony on Mars captivates dreamers, yet grounds them in reality. When humans do arrive on Mars, they will encounter resource, technological, psychological, and social challenges. Since the inhabitants will be entirely reliant on each other, they must work collectively to make decisions and take actions that will keep them alive and prospering. Local resources, such as buried ice deposits, will provide water. Habitats must provide protection from cosmic radiation. In spite of these immense challenges, the social aspects of colonizing Mars might prove to be the greatest challenge of all: How do you sustain a healthy community in such a hazardous environment with severely limited resources? Port of Mars (PoM) is a resource allocation card game requiring players to manage individual goals against the conflicting needs of maintaining common infrastructure in the face of ongoing environmental, social, and technical challenges. In short, the game explores factors impacting Human Sustainability on Earth through a Mars lens. Currently the game is used in a formal experimental study to investigate the factors leading to success of groups of undergraduate student players to manage their habitat. The players represent members of Generation Zero: the first group of long-term residents to arrive on the Red Planet. People experience Martian life and its challenges as early citizens of a Martian settlement. To survive, players must navigate their personal

ambitions and the needs of the group. There are five characters in the game, Entertainer, Pioneer, Scientists, Politician, and Entrepreneur, who will have their own cards of ambitions during the game. In each round of the game, the players receive a number of time blocks. They can invest their time blocks in the shared Upkeep of the colony or invest the time blocks to pursue their personal ambitions. A minimum level of the shared infrastructure is needed for the game to continue. As such, the game experience provides a fundamental social dilemma where there are tensions between individuals goals and collective goals. Each character comes with cards that defines how they can earn Influence cards, as well as a unique deck of Opportunity cards. Each character has one influence topic they are good at earning, two influence topics they can earn, and two influence topics they can't earn at all. Time blocks are spent to derive Influence cards (Entertainment, Legacy, Science, Politics and Finance). To derive Opportunity cards, the player needs to have the right combination of Influence cards. Opportunity cards lead to victory points, and the player who earns the most victory points wins the game, as long as the shared infrastructure is still operational. In each round the players have an opportunity to trade influence cards. Each round also experiences surprise events (Event cards), which could lead to a reduction of the shared infrastructure (for example, dust storms).

### **Learning Outcomes**

Through the first-person, embodied experience gained through gameplay, players gain a stronger personal engagement with both the surface-level challenges of their simulated life on Mars, and a tacit understanding of the underlying issues that influence their survival individually and collectively. The data derived from player choices and behaviors during gameplay provide invaluable information on the pressing Earth-bound issue of Human Sustainability.

### **What makes your game different to those already available?**

The game serves dual purposes of engaging the public in a learning activity designed to help them understand the complex topic of resource management and sustainability on earth through a fictionalized Mars narrative. At the same time, the data collected provides insights on how to prepare people to cope with challenges of climate change and dwindling resources on earth.

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# Ficha Tripla

**José Carlos Neves and Yoao Frade**

Universidade Lusófona (ULHT), Portugal

## Games Description

Is intended for teaching mathematics to deaf students and hearing people, with a tutorial in Sign Language. It seeks to develop the speed of reasoning at the level of algebraic operations involving multiplication, addition and subtraction. This is a variant of a typical racing game, where two electrical plugs (or one in single player mode) go through tunnels avoiding meteorites as obstacles and seeking portals with questions and answers. Each player chooses an electrical plug that will have to pass through the answers. It will gain speed if it hits the right option and will slow down on a wrong answer hit. The videogame integrates a question editor that allows to change and create questions according to the pedagogical needs of the teacher or the interests of the player. Other subjects besides mathematics are already included. Regarding the interfaces, it can be played on a keyboard or a controller that was designed by students using 3D printing and Arduino. It has the shape of a rounded rectangle and contains a joystick on the left side and two push buttons on the right.

## Learning Outcomes

Is intended for teaching mathematics to deaf students and hearing people, including game tutorials and mathematical concepts in Portuguese Sign Language, as well as a questions editor that allows teachers to create their own themes and questions. In the current version, it seeks to develop the reasoning speed at the level of multiplication, addition and subtraction.

## What makes your game different to those already available?

Ficha Tripla condenses only needed visual information in the right places. Besides, subtle visual effects also make it suitable for deaf people. Teaching Math and everything with a built-in question editor, this is a game for learning but also to have fun with. This way, we invite everyone - no exclusions - to join our journey throughout planets in space, aboard different plugs at light speed.

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# ReMat

**José Carlos Neves and David Patrao**

Universidade Lusófona (ULHT), Portugal

**Games Description:** ReMat is a educational mini-game for teaching mathematics to deaf students and hearing people, developed by 3 students of the bachelor degree on videogames of University Lusófona (Lisbon), in partnership with a school specialized in teaching the deaf. It consists of a variant of a football game in which two players, represented by a blue circle and a red circle, are confronted with math questions while playing football. The match takes place in a hexagonal arena with six goals, which correspond to six possible answers in rounds with a question for each player. To correctly answer the questions players will have to put the ball in the goal with the right answer, which is different for each of the players. Players can choose the duration of the game and the player with the most goals accumulated at the end of the game wins. The Video Game can be played by keyboard or controller that was designed by students using 3D printing and Arduino. It has a circular shape in association with a ball, and contains a joystick on the right side and one push button on the left side.

## **Learning Outcomes**

Is intended for teaching mathematics to deaf students and hearing people, with a tutorial in Sign Language. It seeks to develop the speed of reasoning at the level of algebraic operations involving multiplication, addition and subtraction.

## **What makes your game different to those already available?**

The distinctive six goals shape of the arena implies a gaming dynamic completely different from the traditional football game, as it combines technical and precise gameplay with the capacity of fast thinking of the player. This means that one must be as good playing the game as in solving math questions quickly.

Other distinctive characteristic is the defensive strategy: the player is rewarded for knowing his opponent's answer so he can adopt a defensive play style while figuring out his own answer; if the player already knows both answers he will have the knowledge of which goal the opponent is trying to score.

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# Liike

## Veruschka Pelser-Carstens

North West University, South Africa

### Games Description

#### *Why create the game?*

Few tabletop serious games have surfaced from South African creators to address teaching and learning needs in accountancy education. Aside from Liike being developed as part of V Pelser-Carstens PhD study, the game also tries to fill the gap between university and the workplace as a tabletop game for learning.

#### *Where does the game take place?*

Liike takes place in a fictional business world. Not much world building has been done in order to allow players to conjure up their own ideas for what this place looks and feels like.

#### *What do I control?*

Players take control of miniatures to move around the board in the process planning their own career path and accumulating points and money by answering game cards.

#### *How many characters do I control?*

Players may choose from one of five possible player characters for a single game. What is the main focus?

Players learn, in a fun way, how to apply their knowledge and in the process of gameplay they will obtain pervasive skills. Both knowledge application and obtaining of 21st century skills fill the gap between university and the business world.

#### *Objectives:*

Fight Corruption

Build a career path

Be the selfless mentor

Play the Wild Tiles

#### *Round 1*

No money is awarded in round one. Each player starts with a blank slate.

Play-order: Highest dice-roll is player one, thereafter player play clockwise.

Each player has in front of him/her a career path (bricks), pen and paper and an avatar. Player one moves to an adjacent vertex and places a path block (brick) to indicate path on the edge of the tile (rule-book).

Strategically choose one of the 3 tiles on the board to move from vertex to vertex, creating a career path. Move from vertex to vertex when answering game card question correctly. Three question cards are drawn. One card from the cards marked as Corruption and two cards from the game cards (indicated by color). Three cards are drawn, in turn, by each player. Player (whose turn it is to play on the board) answers one card, 2nd card is answered by another player as chosen and corruption answers the 3rd card.

The player in play has the option to risk their own score to answer Corruptions question // 'This is seen as whistle blowing (free move to any place on the board, when answered correctly). Player then needs to strategically think of move and career path and can block other players. Each player (clockwise) continues with play and collects awards (indicated by either game cards, tiles or bricks).

#### *Round 2 onward*

Corruption starts to play and moves from vertex to vertex. Restriction however in place as Corruption can only move on one tile and not from vertex to vertex.

#### *Risk*

Question card answered correctly: Receive money from bank in the amount indicated on the card. Question card answered incorrect: Corruption receives money from the bank in the amount indicated on the card. Answer question on behalf of Corruption correctly: Receive money from bank in the amount indicated on the card and move to any place on the board building career path as well.

Answer question on behalf of Corruption incorrect: Money is paid to Corruption from own account.

#### *End of game*

Game lasts for 10 rounds.

Money is tallied, player with the most money: Score 10 points

Career paths as indicated bricks, player with the longest path: Score 5 points

Record Keeping - The selfless mentor: Score 5 points

Record Keeping – Corruption has the most money: Corruption wins.

### **Learning Outcomes**

Liike is a tabletop serious game intended to have players implicitly learn 21st century skills and also give the players an opportunity to apply content knowledge (accountancy education).

### **What makes your game different to those already available?**

Games in accountancy education usually only focus on one main subject/module: Accounting. For Liike five modules are included in the design of the game: Law, Tax, Auditing, Financial Management and Accounting. Also the game is developed as a tabletop game but the playing card can be played with an App as well (in the process of development). This feature can be used by lectures to track or assess students play and knowledge.

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## **Energetic Alpha**

**Gretchen Rinnert**

Kent State University, USA

### **Games Description**

Technology is synonymous with speed, efficiency, and rapid response, especially when associated with innovation. Learning language and letterforms is not a simple activity, but one that takes a child many years of repetitive practice. Children often struggle with stroke order, precision, and control. Our design team asked the following question; what if technology can slow learning down and create reflective and rewarded practice? Handwriting ability has been linked to student writing skills. “If children cannot form letters—or cannot form them with reasonable legibility and speed—they cannot translate the language in their minds into written text. Struggling with handwriting can lead to a self-fulfilling prophecy in which students avoid writing, come to think of themselves as not being able to write, and fall further and further behind their peers.” (Graham, 2010). Many preschoolers flip and confuse similar letters, and write letters in reverse. Handwriting instruction focuses on teaching students quick, legible writing techniques so that they can focus on their ideas. (Graham, 2010). Most children need to practice letter writing to correct these mistakes. Our researchers developed an iPad alphabet app called Energetic Alpha that uses interaction and motion to slow down a child’s movement and instructs children how to write using proper stroke order. The app tracks a child’s successful attempts and rewards them with animations that feature a corresponding verb. All 26 letters are represented in unique animations. The design team merged basic gamification with traditional letter writing activity by including elements like goals, rules, challenges, and rewards to engage young users. Energetic Alpha connects to the

internet to stream videos as the child plays, but can be used offline without the video content when needed. No in-app purchases are required to play the game. Energetic Alpha is for children learning to write, between 3 and 6 years of age, who are learning language and letterforms. Both upper and lowercase letterforms are available for writing practice. Energetic Alpha was developed by parents, university professors, teachers, and children using co-design methodology. The best ideas were used to make a fun and playful writing experience.

## Reference

Graham, S. (2010). Want to Improve Children's Writing? Don't Neglect Their Handwriting. AMERICAN EDUCATOR, V76(N1), 49-55.  
doi:<http://www.aft.org/sites/default/files/periodicals/graham.pdf>

## Learning Outcomes

Energetic Alpha was designed around early literacy skills. We have identified 4 learning outcomes as our focus in designing Energetic Alpha:

1. Increase letter shape recognition
2. Increase letter sound recognition
3. Improve verb vocabulary acquisition
4. Write letters using proper stroke order (English alphabet)

## What makes your game different to those already available?

Many preschool games focus on letter writing, and many alphabet books focus on alphabet recognition through noun association. Energetic Alpha is the first game that brings together letter recognition, sound, writing and verb vocabulary. Using animated sequences we engage preschoolers in rewards that aims to expand verb vocabulary and broaden their language experience.

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# Once Upon a Maths

## Mariana Rocha

Technological University Dublin, Ireland

## Games Description

"Once Upon of Maths" is a point-and-click adventure game developed for Mathematics education in the primary school. The game follows the design principles of situated learning environments, focusing on the development of activities that show how knowledge can solve real-life problems. The narrative of the game is based on the history of Mathematics, and focuses on a protagonist



character (the player), who wants to become a master explorer of Mathematics. To do that, s/he has to use Maths knowledge to solve problems from different times in the human history. Storytelling and exploration are essential elements of this type of game, and it involves a lot of puzzle solving and conceptual challenges. The game is divided in phases. In each one, the player meets a character that tells how Mathematics was used on his/her time to overcome daily life problems. Then, the character invites the player to solve a challenge using the concepts learned. For instance, the player can visit Nebamun, a sculptor from the Ancient Egyptian, and learn how his people used parts of the human body as units of measurement. Later, Nebamun invites the player to use the Ancient Egyptian measurement system and check the height of a number of decorative vases. After measuring the vases and registering the results, the player is invited to order the vases by size. If the player succeeds, Nebamun promises to give one of the vases as a reward, besides an amount of coins. Both vase and coins can be used by the player in future game activities. Both problem and solution are integrated to the narrative provided by the character, and the student must reflect about it instead of delivering a memorized answer. The novelty of Once Upon of Maths is to show the player that mathematics concepts are used to solve everyday life problems since Ancient societies. This strategy is an attempt to overcome the massive amount of drill and practice videogames that leads the player to memorize Maths content without reflecting about them. The game development is based on stakeholders needs emerged from our previous researches, besides situated learning guidelines suggested in the literature. Once Upon of Maths is a web-based game, designed using tools such as HTML, CSS, JavaScript, PHP and MySQL. Students at the end of primary school (11-12 years old) are the target audience of the early prototype of this game.

### **Learning Outcomes**

- 1) Comprehend the importance and application of Mathematics as a solution to daily life problems
- 2) Use mathematical concepts to solve problems proposed in the game, not only recalling memorized contents, but actually reflecting about what is the best way of applying those.

### **What makes your game different to those already available?**

A significant amount of Maths games use drill-and-practice as a teaching approach. Once Upon a Maths innovates offering an environment where the player learns in a situated context, making it easier to comprehend the concepts and showing that Mathematics is constantly being developed to solve daily life challenges.

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# Minimum learning energy memory games

**Henk Roelofs**

NHLStenden university Emmen, The Netherlands

## Games Description

We developed a sequence of specific memory games to activate unconscious learning of foreign languages, accompanied by an extra reflection phase using a specific Kahoot. The teaching idea is to minimize learning energy by revealing in a foreign language what you already know without knowing you do. This by teaching and learning “identical words”, so a very basic vocabulary of a foreign language can be taught and learned. Transforming unconscious knowledge into activated conscious knowledge. For example: ordering “2 cappuccino” with two fingers in the air makes it possible for a European to communicate in Chinese and for a Chinese to communicate in Europe. Both in China and in Europe you will get two cappuccino. An application is to use this identically characteristic of words in a foreign language to learn the Cyrillic alphabet, the Arab alphabet, the Hindi alphabet, etc., in an “unconscious” way. No Chinese alphabet of course, because this doesn’t exist. For example: the Russian alphabet which has 33 capital letters, while the ISO basic Latin (and English) alphabet consists of 26 capital letters, that is codified in various national and international standards and used widely in international communication.

We apply a sequence of 3 types of memory games for Russian:

1. Image, Cyrillic Russian text, English text (or Dutch): keep the cards when two are the same

Image of a professor	ПРОФÉССОР	Professor
Image of a restaurant	РЕСТОРÁН	Restaurant
Image of lemonade	ЛИМОНÁД	Lemonade
Image of football play	ФУТБÓЛ	Football
Image of a salad	САЛÁТ	Salad
Image of jam	ДЖЕМ	Jam
Image of a douche	ДУШ	Douche
Image of a tractor	РА́КТОР	Tractor
Image of a massage	МАССÁЖ	Massage]

2. Image, Cyrillic Russian text: keep the cards when two are the same and the word is pronounced correct

Image of a professor	ПРОФÉССОР
Image of a restaurant	РЕСТОРÁН
Image of lemonade	ЛИМОНÁД
Image of football play	ФУТБÓЛ
Image of a salad	САЛÁТ
Image of jam	ДЖЕМ
Image of a douche	ДУШ
Image of a tractor	РÁКТОР
Image of a massage	МАССÁЖ

3. Cyrillic Russian text: keep the cards when two are the same and the word is pronounced correct

ПРОФÉССОР

РЕСТОРÁН

ЛИМОНÁД

ФУТБÓЛ

САЛÁТ

ДЖЕМ

ДУШ

РÁКТОР

МАССÁЖ

The Kahoot is an extra competitive element: the word is shown in Cyrillic, after a few seconds pronounced in Russian. Then the competition to be the fastest right answer –standard Kahoot- is used. Another application is to use this system to solve dyslexics problems in writing, by identical words in Dutch and English to create the two ‘dispositional representations’ of the word (see Damasio) which are written just the same but pronounced a little bit different.

### **Learning Outcomes**

The teaching idea is to minimize learning energy by revealing in a foreign language what you already know without knowing you do. This by teaching and learning “identical words”, so a very basic vocabulary of a foreign language can be taught and learned. Transforming unconscious knowledge into activated conscious knowledge. An application is to use this identically characteristic of words in a foreign language to learn the Cyrillic alphabet, the Arab alphabet, the Hindi alphabet, etc., in an “unconscious” way. No Chinese alphabet of course, because this doesn’t exist.

### **What makes your game different to those already available?**

The content and the specific sequence

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# LEARN Game: serious entrepreneurial learning

## Henk Roelofs

NHLStenden university, The Netherlands

### Games Description

The simulation-role-game LEARN Game, is an entrepreneurial context using LEGO to teach and learn in a playful manner. Participants ( at least 9, on average 25) interact as independent entrepreneurs: buying and selling LEGO parts for producing LEGO towers, and trade them. We apply LEARN games for:

- teaching/learning entrepreneurship
- teaching/learning in an entrepreneurial way a basic vocabulary of a foreign language (Arab, Russian, Hindi, Chinese, German etc)

The essence of the simulation game LEARN Game lies in the conflict of interests among the different market players. The objective is learning, but there is also a competitive element: the one, who scores the most 'profit', wins. During the game, there is continuously exposure to market changes and risks. The dynamics of 'real' uncertain market situations, pressures of scarcity of resources, money, time, competitors create experiences to learn. LEGO contributes to a playful setting, in which positive emotions can support learning processes.

*The rules of LEARN Game are:*

- Everybody is entrepreneur in his/her role: Trader, Producer or Supplier
- Several markets are created, where two types of LEGO products are traded: mono-coloured towers (sold by Producers & Traders) and multi-coloured towers (sold only by Traders)
- All participants are limited in their resources, have a (small) competitive advantage in their LEGO-stock and have the same starting capital: € 2500 in cash and in kind.
- The added value is created by trading the raw materials, bought at the Market Raw Materials and finished products sold at the Market Finished products.

o In the foreign language LEARN Games, this foreign language is used in buying/selling , where native speakers at the Market Raw Materials and the Market Finished products, creating pull learning: No 'foreign language', no money! In Chinese: 没中文 : 没钱 méi zhōng wén : méi qián

- More complex versions have: a tax authority, export markets , foreign currency

### *Teaching and learning results of LEARN Game*

② LEARN Game teaches to enlarge your view, participants learn to identify opportunities that 'others done see', to take such opportunities. Positive emotions in experiencing successful transactions support the learning by doing process. Success drives success.

② LEARN Game teaches to engage in entrepreneurial activities: creating added value, being exposed to competition, experience risk taking, identifying opportunities and deciding fast, organize administrative processes (VAT!), develop negotiation skills, cope with uncertainty because availability and prices of LEGO bricks and plates change.

The experiences provide confidence to participants to address uncertainty caused by the necessity of creating added value while being exposed to competition. Participants learn a more entrepreneurial behavior-style.

o LEARN Game teaches to learn an basic vocabulary in a foreign language in an entrepreneurial way

② LEARN Games teaches to learn playful by using LEGO (Danish for "toy") with connotations: youth sentiment, it keeps the kid alive, joy, cheerfulness, enthusiasm. Playing with LEGO is a "meme": a unit of cultural transfer.

② LEARN Games measures performances: transactions of participants (smart-phones, QR-codes) increasing seriousness of serious game based learning.

### **Learning Outcomes**

#### Teaching and learning results of LEARN Game

② LEARN Game teaches to enlarge your view, participants learn to identify opportunities that 'others done see', to take such opportunities. Positive

emotions in experiencing successful transactions support the learning by doing process. Success drives success.

❑ LEARN Game teaches to engage in entrepreneurial activities: creating added value, being exposed to competition, experience risk taking, identifying opportunities and deciding fast, organize administrative processes (VAT!), develop negotiation skills, cope with uncertainty because availability and prices of LEGO bricks and plates change.

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❑ LEARN Games measures performances: transactions of participants (smart-phones, QR-codes) increasing seriousness of serious game based learning.

### **What makes your game different to those already available?**

It is developed in over 20 years experience (played in NL,D, F, Fin, P, B) now added smart phones to measure performances. These 20 we were already different, now we are "extra" different.

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## **Battle for Cattle**

### **Markus Schmidt and Camillo Meinhart**

Biofaction KG, Austria

#### **Games Description**

Battle for Cattle is the world's first science vaccine game, which is modeled after a real-world synthetic biology vaccine research project for farm animals. The game allows its players to master the same challenges as the scientists from the EC-H2020 funded project Mycosynvac, who work on the development of a mycoplasma vaccine chassis using a synthetic biology approach. In the game, the player is confronted with sick farm animals and the problem of antibiotics overuse. The player experiences an increase in antibiotic resistance and learns

about the importance and principle of vaccines. The player has to save the lives of cows on a farm and take control over the design of a synthetic biology vaccine. During the game, the player develops a strategy regarding when to use antibiotics, and when not. Game players also need to find out how viruses differ from bacteria, and finally how to transform a pathogen into a vaccine chassis that can harbor several immune stimulating epitopes - surface proteins triggering the immune response - that together work as a vaccine. During the game, the player goes back and forth between a farm environment and a laboratory, where the vaccines are designed. Battle for Cattle has been produced in close collaboration with scientists and game developers. It enables its players to understand the role of pathogens, antibiotics and vaccines by becoming the vaccine developer themselves.

*Game duration:* ±30 minutes

*Development state:* finished 1st of July

*Device:* phone, tablet, computer.

*Target Audience:* High school students.

### **Learning Outcomes**

The player learns that bacterial infections can be treated with antibiotics.

The player learns that viral infections cannot be treated.

The player learns that one can be protected from viral & bacterial infections by vaccination.

The player learns that antigens and a harmless host are important for a synthetic biology vaccine.

The player learns that a synthetic biology vaccine is created by 'removing' unnecessary DNA from a bacterial host - creating a chassis - and inserting DNA coding for epitopes of the pathogen.

The player learns that bacteria can grow resistant to antibiotics.

### **What makes your game different to those already available?**

This game describes the process of the research done in Mycosynvac. It is the first and only game covering this EC-H2020 funded project. Furthermore, it is the first serious video game that covers the treatment of farm animals with antibiotics and viruses on this scientific level.

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# World Rescue

**Robin Sharma**

UNESCO MGIEP, India

## Games Description

World Rescue is a narrative, research-based video-game inspired by the Sustainable Development Goals (SDGs) of the United Nations. Through fast-paced gameplay set in Kenya, Norway, Brazil, India, and China, players meet five young heroes and help them solve global problems—such as displacement, disease, deforestation, drought, and pollution—at the community level. After all, it's young global citizens who have the power to lead us to a more sustainable world! Players interact with the game using 'drag and drop' feature. The complete game has over fifty activities/mini-games that form part of the complete story. These mini-games are divided into ten levels and two acts. The players are introduced to the idea of 'three pillars of sustainability'. These 'pillars' focus on maintaining a balance among 'environmental', 'social', and 'economic' sustainability of the planet in order to achieve overall sustainability. Players actions in various mini-games determine their score on each pillar. They can choose to act in a certain way that they score higher on one pillar and not so much on the other one depending upon their priorities. But, at the same time players only advance to the next level by achieving a threshold score on each of the 'three pillars'. This is implemented to address the fact that overall sustainability is important for the health of the planet and we cannot just focus on one of the many aspects of society for holistic progress. The game places the player in shoes of characters from five countries and the players help them tackle and solve these local problems that they are facing. These five characters are Salim, who is an 18-year-old Somali who came to Kenya as a refugee and lives in a refugee camp, Hana who is a corporate lawyer and a single mom balancing her professional and personal life in Norway, Ama who is a 13-year-old indigenous girl growing up in the Amazon rainforest in Brazil, Sanya who is a young agricultural scientist working with farming community from India, and Liang who is an automobile engineer and factory manager in China. Player's objective in the game is to help the characters by make judicious decisions for them which are also helpful for the health of the planet and its sustainability. In the game, players also learn about the seventeen SDGs and various indicators and trivia associated with each SDG. In the quiz mode, players also take quizzes associated with the SDGs to up their scores and earn superpowers.

## Learning Outcomes

The game address the following learning outcome:



- a. To spread awareness about the Sustainable Development Goals of the United Nations;
- b. To make players aware about global issues like climate change, deforestation, and impacts of industrialization on sustainability;
- c. To promote feelings of empathy, compassion and global citizenship among players.

### **What makes**

### **your game different to those already available?**

The unique feature of World Rescue is that it is a digital, educational game on the Sustainable Development Goals. It weaves storytelling, empathy and problem-solving into a single narrative sensitizing its players of the global issues and helping regular characters from around the world solve global problems in local context. It promotes and educates the player about what can be done at individual level to contribute towards solving global issues and ensuring overall sustainability of the planet.

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## **ecoCEO - It's your business!**

### **Anse Smeets**

VITO NV, Belgium

### **Games Description**

ecoCEO aims to increase awareness and transfer knowledge about circular economy strategies and circular business models to students in secondary education. It is a card game, that can be played with 3 or 4 players (12+), either individually or in teams of 2 players. The game itself takes 50 minutes to play. Including introduction, explanation of game rules, game setup and debriefing, a time slot of 90-100 minutes is recommended. During the game, players run a company that produces electronic products, such as microchips, smartphones and e-bikes. Their mission is to develop a thriving business. They need to take decisions about their investment strategy, worker allocation and materials management. By combining different investments, they can diversify their product portfolio, improve their production efficiency, respond to regulatory challenges and try new business models to maximise their company's performance and profitability. The game consists of 2 stages. During stage I, players learn about the production and sales processes in a linear economy, based on the traditional take-make-sell-dispose pattern. They learn about how efficiency measures and resource substitution strategies can optimise this system in response to resource constraints. Stage II introduces the concept of a circular economy, in which new business models can help overcoming resource constraints, including recycling, take-back systems, reuse, repair and product-

service systems. Across the game, day-to-day business is interrupted by events. The game ends after 50 minutes of play. Each company's success is measured in victory points, that can be gained through strategic investments, awards and the accumulation of financial capital. The player or team with the most victory points wins the game. ecoCEO shows the impacts linear and circular business strategies have on the performance of a company, and on its resilience against external events such as policy measures, market disruptions and availability of resources. It teaches students about the relevance and the opportunities of circular strategies such as recycling, take-back systems, reuse and repair activities and product-service systems. During and after gameplay, students are stimulated to engage in discussions about sustainable entrepreneurship, consumption patterns, resource scarcity and waste management.

### **Learning Outcomes**

Knowledge-related objectives: During the game, players learn:

- The basic principles of entrepreneurship and company management.
- The difference between linear and circular economy business models.
- The basic concepts and strategies of a circular economy, such as recycling, take-back, reuse, design-for-repair, product-service systems.
- The impacts that resource scarcity, market dynamics and regulations can have on a company.

Skills-related objectives: During the game, players learn:

- To manage resources, personnel, investments and capital in a simplified company context.
- To translate circular economy concepts, such as efficiency, recycling, reuse and repair to business practices, and their own consumption and purchasing habits.
- To discuss sustainable entrepreneurship and make trade-offs between short term and long term business strategies.

### **What makes your game different to those already available?**

The game combines principles of entrepreneurship and business with sustainability topics, such as resource efficiency, waste recycling and reuse. This makes it a multidisciplinary game, cutting across different subjects (science, technology, economics, ethics). The game can be used in a typical class-setting (economics, geography), but it can also be integrated in thematic school projects on business management or sustainable lifestyles.

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# Thumb-allegiance: The force of fellowship

**Stina Thunberg**

Luleå University of Technology, Sweden

## Games Description

Thumb-allegiance - The Force of Friendship

Descending in the classical story of Thumbelina, challenged by the concept of the avatar, quests and experience point, second language students gain engagement for reading and writing fiction

The learning goals are:

- Stimulate creativity and engagement
- Interpretation of a literary text through creative processes
- Creating and making text and film and publish them online
- Developing reading and writing skills.

The game is part of an educational design research project combining the reading of classical literary texts, in this case a picture book, with gaming elements to stimulate creativity and engagement (Gee 2007: Lazar 2015) for reading and writing fiction in the second language classroom. The target group for the design are newly arrived students in the ages of 7-18 years old and has been tested in a class of newly arrived students with a little or no formal schooling in the ages of 16-17, preparing for upper secondary school. The story of Thumbelina written by H.C Andersen illustrated by Elsa Beskow is considered to engage and challenge the students with classical themes and richness of nature descriptions in both text and pictures. The gaming elements used are avatars, quests and experience points. The students get access to the story by first discussing the pictures, and after that read the text. After reading seven pages the students get their first quest to make a presentation movie of their avatar with the tool Plotagon, and publish the movie their blog, made with the same name as their avatar. In the test design, some of the students named their avatars: Littlesandra, Bravelypeter, Cütececilia, and Smartlena. All the quests are published in the blogs that are connected to the teacher's blog with the teacher's avatar. The next quest is descending in the story making friends with the lonely Thumbelina: "All summer long, poor Thumbelina lived all alone in the woods." (Thumbelina). This is a writing assignment, and the students are instructed to imagine through the avatar senses, sight, hearing, touch, smell and taste. The third quest is to react to the forced marriage between Thumbelina and the mole by speaking at the forest

council, a film making assignment. The final quest is retelling the end of the story, from the avatar's perspective, combining film making and writing. The student gets experience points according to curriculum standards for fulfilling the quests and the quality of language, literary composition, and figuration. The results from testing the design show that the students were highly engaged and invested in their avatar. The experience point was a motivational factor in the beginning of the design, but later the students got more motivated by taking part in the story an avatar of their own creation, becoming empowered learners by co-design, customize, identity and manipulation (Gee 2005). The students either created an avatar very similar to their own person, or the opposite, quite different from themselves. Several boys created a female avatar, and shy students' avatar becomes more talkative.

### **Learning Outcomes**

Engagement for reading and writing fiction. Development of reading and writing skills.

### **What makes your game different to those already available?**

The game design is combining analogue reading with the digital avatar. The purpose with the avatar is to put the passage through the classroom into the fiction in focus, the between the reality and the narrative. Entering the fictional world is theoretically stimulated through the avatar and its quests. The avatar is a tool for the creation of meaning in the world projected by reading, and the avatar is playing a key-roll. Through the avatar the reader acts and the reading becomes a performative act through creative writing. The avatar as a metaphor and as a didactic tool makes the students passage into the story visible, by an active descending into the fictional world. The avatar is a kind of scaffolding for the imagination of the story or as a way of telling a story in the creation of a bi-medial novel. The gap between the student and the avatar descending in the story makes possibilities for an aesthetic game situation, and creative reading and writing. This is a new way of meeting different kinds of students, that might have problems with reading engagement.

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# Virtual Reality Escape Room for Teaching Computer Science

**John Vos, Panagotis Fotaris, Ross Jones, James Shaw, and Jack Whitchurch**

Univeristy of Brighton, UK

## **Games Description**

The game is a VR escape room aimed at Key Stage 3 students (11 to 14-year olds) who study programming languages as part of their computing curriculum. It makes use of simple code blocks to teach key concepts of Java programming. The background story of the game is that the player is a scientist working on a spaceship. At some point s/he receives a communication that an enemy is on its way to attack the spaceship and destroy the player's scientific research by corrupting his/her code which is stored in the spaceships data banks. The player has 1 hour to complete 3 puzzles to activate a shield and protect the ship. In order to do so, s/he will have to apply different programming concepts, such as IF statements, loops and variables. Throughout the game there is an AI voice from another scientist that acts as the Game Master and provides guidance and hints to the player. As the game is still considered under-development, there are 3 rooms to explore, with each one containing puzzles that teach a different key concept of programming. However, the final version of the game will contain more rooms that cover additional programming concepts for multiple programming languages, such as Python, JavaScript, and C/C++.

**Learning outcomes:** On successful completion of this game, students will be able to demonstrate an understanding of basic programming concepts including conditional statements, variables, and iteration in Java.

## **What makes your game different to those already available?**

Although there are several games teaching computer programming, our game is original as it blends the Virtual Reality environment and the fairly new concept of educational escape rooms. The game engages learners in an activity that rewards teamwork, creativity, decision-making, leadership, communication, and critical thinking.

---

# **Additional Materials**



# The importance of paper citations and Google Scholar

As an academic researcher you will know the importance of having access to the work of other researchers in your field as well as making your own work available to others. In the area of academic publishing this is achieved through citation indexing. There are a number of bodies that undertake this task including Thompson ISI, Elsevier Scopus and Google Scholar – to name just a few.

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However, it is also important for you, the author, to make sure that you have made your work available for citation – particularly with organizations such as Google Scholar. We are providing you here with the simple steps you need to take to do this and we would ask you to take the time to upload your paper as soon as you can.

Step one: Extract your paper from the full proceedings that you have downloaded from the Dropbox link provided to you.

Step two: Upload your paper to your own website, e.g.,

[www.university.edu/~professor/jpdr2009.pdf](http://www.university.edu/~professor/jpdr2009.pdf) ; and add a link to it on your publications page, such as [www.university.edu/~professor/publications.html](http://www.university.edu/~professor/publications.html).

Make sure that the full text of your paper is in a PDF file that ends with ".pdf",

The Google Scholar search robots should normally find your paper and include it in Google Scholar within several weeks. If this doesn't work, you could check if your local institutional repository is already configured for indexing in Google Scholar, and upload your papers there.

More information is available from  
<http://scholar.google.com.au/intl/en/scholar/inclusion.html>



We will separately upload the proceedings to Google Books which is also searched – but evidence has shown that individual upload results in quicker indexing by Google Scholar.

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## **ACPIL's conference activities**

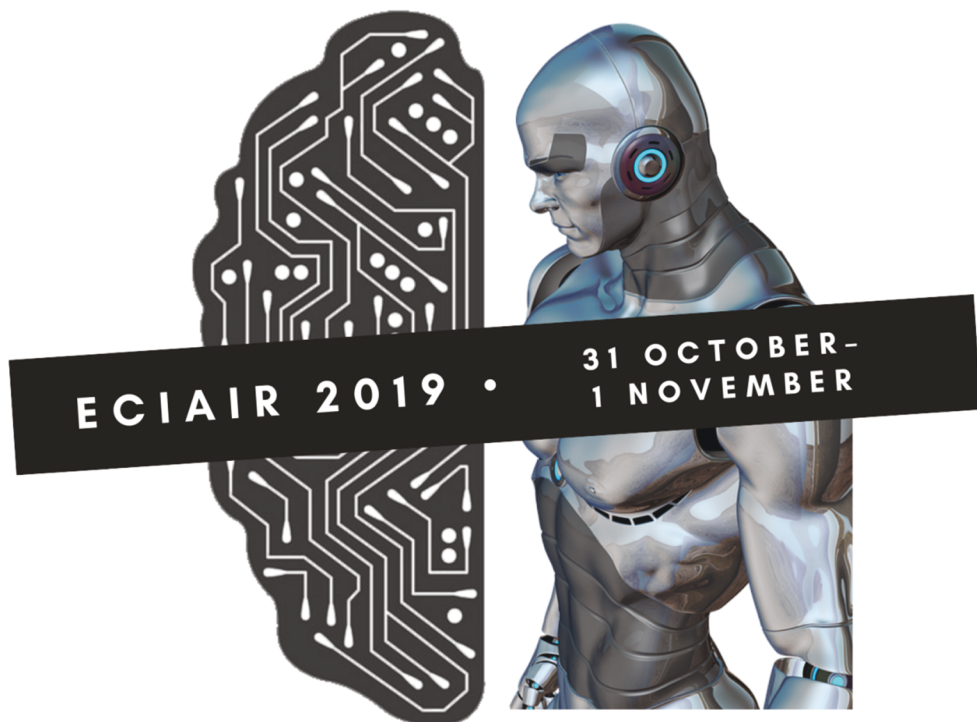
For over 20 years we have facilitated conferences globally. Originally our focus was only on ICT. Over the years we have broadened the scope, but there is still a strong leaning towards ICT. Currently there are 16 conferences run in various parts of the world which are attended by approximately 1,500 conference participants annually. Global reach is one of the dimensions that differentiates us. At any given conference there are regularly participants from 30 or more countries. Some of the conferences are accompanied by master classes in their associated field which are run on the day before the conference.

Seven conferences are associated with Excellence Awards for which we appoint judges, accept nominations, conduct evaluations and award prizes. The Games Based Learning Conference runs an established annual competition. Details of these events are contained in our website at [www.academic-conferences.org](http://www.academic-conferences.org)

## **Contact information**

If you would like to host a conference, facilitate a workshop or have a book published please contact [louise@academic-conferences.org](mailto:louise@academic-conferences.org)

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# ICGR 2020

## 3rd International Conference on Gender Research

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Despite some advances in the area, topics related to gender research remain pertinent & are gaining momentum in a changing society. It is important to empower and develop research on specific gender topics, in order to acquire a clearer understanding & to obtain important insights. Now in its third year the **International Conference on Gender Research** was established to be a multi-disciplinary event for everyone researching in this area to present their work & discuss the key topics with the scientific community.

*Key Topics include: Gender in the workplace; Gender and law; Gender and English literature, fiction and writing; Gender economics; Feminist studies; Men and masculinities; Gender equality; Gender and Education*

## 2-3 APRIL 2020

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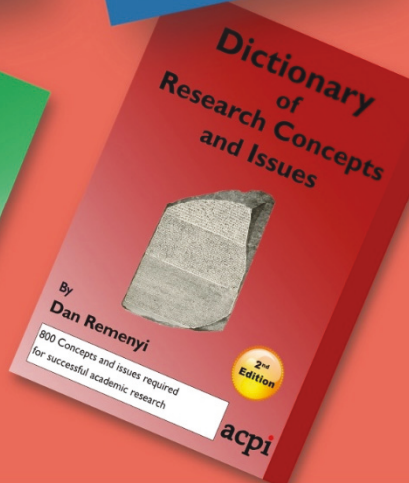
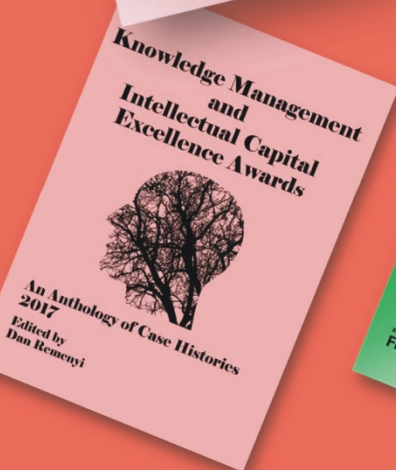
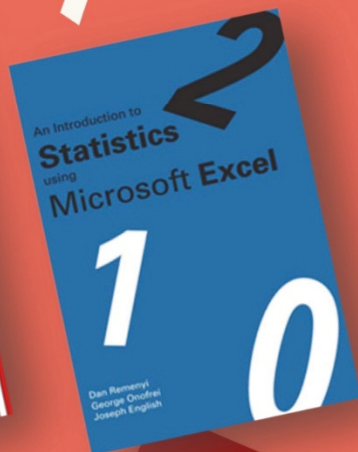
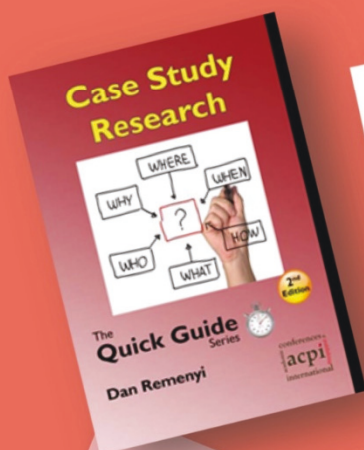
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# Research Jotter

Research ideas can happen at any time –  
catch them in writing when they first occur

































