SERIOUS GAMES AND LEARNING: AN ANNOTATED BIBLIOGRAPHY

Compiled by Dr Erica Southgate, Dr Shamus P. Smith, Ms Kathleen Smithers and Dr Janene Budd

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ABSTRACT

Over the last ten years gaming has become increasingly popular. This trend has been driven by mobile computer technology such as smartphones and tablets. The growing interest in the development of serious games for learning has been linked to the rapid take-up of mobile devices, which provide new opportunities for mobile learning (m-learning). This annotated bibliography is a compilation of abstracts of peer reviewed research on serious computer games with a focus on gamification and learning. It focuses on peer reviewed journal articles and conference papers that have primarily been published during the period 2005-2015.

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1. PURPOSE AND SCOPE OF REPORT

Background

Over the last ten years gaming has become increasingly popular. This trend has been driven by mobile computer technology such as smartphones and tablets (Ofcom, 2015) and social media use. Throughout this period, there has been increasing interest in the development of serious games for learning. The rapid take-up of mobile devices has provided new opportunities for mobile learning (m-learning) – learning anywhere and at any time (Corbeil & Valdes-Corbeil, 2007). Serious games are a key pedagogical tool for mobile learning. A recent systematic literature review found growing evidence that serious games can have a positive impact on knowledge and skills acquisition, and produce improvements in specific cognitive and perceptual outcomes for learners (Boyle et al, 2016).

Purpose

An annotated bibliography is a document that provides an overview of the available research on a given topic. This annotated bibliography is a compilation of abstracts from peer reviewed research on serious computer games and learning, published primarily during the period 2005-2015.

Method

An examination of journal articles and conference papers was conducted using Boolean search (and/or) with the terms serious games, gamification, computer games, video games learning, learning theory and educational games. Databases searched included Proquest, Inspec, ScienceDirect. A search with Google Scholar supplemented this. The search was primarily restricted to literature published within the period 2005-2015, with some OnlineFirst publications included. Books and book chapters were excluded from the search. Only peer reviewed literature has been included.

References

Boyle, E. A., Hainey, T., Connolly, T. M., Gray, G., Earp, J., Ott, M., Lim, T., Ninaus, Ribeiro, C., & Pereira, J. (2016). An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games. *Computers & Education*, *94*, 178-192.

Corbeil, J. R., & Valdes-Corbeil, M. E. (2007). Are you ready for mobile learning? *Educause Quarterly*, *30*(2). Retrieved from http://er.educause.edu/articles/2007/1/are-you-ready-for-mobile-learning

Ofcom (2015). Adults' media use and attitudes report. Technical report. http://stakeholders.ofcom.org.uk/binaries/research/media-literacy/media-lit-10years/2015_Adults_media_use_and_attitudes_report.pdf

2. ANNOTATED BIBLIOGRAPHY

Adamo-Villani, N., Oania, M., & Cooper, S. (2013). Using a serious game approach to teach secure coding in introductory programming: Development and initial finding. Journal of Educational Technology Systems, 41(2), 107-131. DOI: 10.2190/ET.41.2.b

Keywords: educational games; computer games; role-playing; computer security; computer sciences education; information security; programming; information security; novices; teaching methods; undergraduate students; formative evaluation; higher education

We report the development and initial evaluation of a serious game that, in conjunction with appropriately designed matching laboratory exercises, can be used to teach secure coding and Information Assurance (IA) concepts across a range of introductory computing courses. The IA Game is a role-playing serious game (RPG) in which the student travels through seven computer techno-inspired environments (IA concept rooms); in each environment he/she learns a different IA concept. After playing each level, the student completes a related CS educational module comprised of a theory lesson and a lab assignment. The game is being created with a user-centered iterative approach that includes two forms of evaluation: formative and summative. In this article we describe the design and development of the first four levels of the game, and report the findings of an initial formative evaluation of two game levels with a group of undergraduate students. (Abstract)

Adams, D. M., & Clark, D. B. (2014). Integrating self-explanation functionality into a complex game environment: Keeping gaming in motion. Computers & Education, 73, 149-159. DOI: 10.1016/j.compedu.2014.01.002

Keywords: self-explanation; educational games; feedback; physics learning

Previous research has shown that either asking students to explain their answers or providing explanatory feedback can be effective ways to increase learning from an educational game. This study focused on an educational physics game about Newton's 3 Laws of Motion called SURGE: The Fuzzy Chronicles. Eighty-six middle school students played one of three versions of the game: (1) the base version with no tips or questions, (2) the self-explanation version with self-explanation questions prompts, and (3) the explanatory feedback version with gameplay tips. There were no significant overall learning differences between the three groups, but students in the base version successfully answered more questions about Newton's second law than students in the self-explanation group. This may have been due to students in the base condition progressing significantly further through the game than students in the self-explanation group. The results suggest that the cognitive load for gameplay as well as game flow must be managed in order for students to take advantage of explanation functionality in educational tools designed to increase deeper, germane processing. (Abstract)

Ahmed, A. M., Mehid, Q. H., Moreton, R., & Elmaghraby, A. (2015). *Serious games providing opportunities to empower citizen engagement and participation in e-government services*. Paper presented at the 2015 Computer Games: AI, Animation, Mobile, Multimedia, Educational and Serious Games, Louisville, USA. DOI: 10.1109/CGames.2015.7272971

Keywords: government data processing; internet; serious games (computing); serious games; citizen engagement; citizen participation; e-government services; electronic government; technology; acceptance model; TAM; trustworthiness model; TM; internet; e-government initiatives

Serious games are electronic games designed not primarily for entertainment but for purposes such as education, training, health, military, politics, advertising and business. Communication between governments and citizens via electronic channels (i.e. e-government)to deliver services is difficult in developing countries due to limited IT knowledge, user experience and trust issues. Serious games can potentially improve citizen engagement in e-services by helping users expand their personal knowledge regarding services benefits, privacy and security. The main purpose of this paper is to investigate the extent to which an extended Technology Acceptance Model (TAM) and Trustworthiness Model (TM) facilitate the use of serious games in e-government services and empower citizen engagement and participation. In this research, the benefits of serious games are assayed in terms of perceived usefulness and perceived ease of use in TAM, as well as increased Internet and government trust in TM to form a conceptual model of factors that influence citizen adoption of e-government initiatives. The model provides a new way to assist governments in increasing citizens' engagement of their online services. (Abstract)

Ahrens, D. (2015). Serious games - A new perspective on workbased learning. *Procedia - Social and Behavioural Sciences, 204*, 277-281. DOI: 10.1016/j.sbspro.2015.08.152

Keywords: workbased learning; ICT; game-based learning

Since the foundation of the Serious Games Initiative of David Rejeski and Ben Sawyer in 2002 games from the genre of Serious Gaming have attracted increasingly special attention. Besides, it concerns (computer) games which do not serve excluding the entertainment, but contain such compelling elements. They serve primarily the mediation of information and education. In the area of vocational education and continuing education Serious Games are suited in particular when it is a matter of providing technical and standardized or difficult and complicated learning contents. By combining playful elements and requirements of the work process Serious Games promote the learning and achievement motivation. Furthermore, the interaction with the game generates procedural knowledge. How Serious Games can be done as an innovative way for workplace learning, is illustrated in the article on the basis of the first intermediate results of an empirical project on handling of heavy goods at the port. (Abstract)

Alberti, J. (2008). The game of reading and writing: How video games reframe our understanding of literacy. Computers and Composition, 25(3), 258-269. DOI:10.1016/j.compcom.2008.04.004

Keywords: game; gaming; digital; pedagogy; interactive; play; authority; visual

This essay focuses on how video games both highlight our traditional assumptions about reading and writing and suggest alternative paradigms that combine the new and the traditional:

• Play. Video games reveal how pleasure and desire are inherent to the reading and writing process. This dimension of gaming helps explain why video games can produce resistance in terms of

approaches to writing instruction grounded in maintaining the cultural distinction between play and work.

• Authority. The interactivity of video games complicates questions of who authors and authorizes meaning in a discourse community. Video game players are simultaneously readers and writers whose gaming decisions are inscribed within a certain horizon of possibilities but not predictability. The video game is an inherently dialogic discursive space that problematizes the institutionalized distinction between "reading" and "writing"

• Return to the visual. The case of video games not only helps restore the understanding of writing as a visual form of communication but also challenges the apparent static quality of the printed text, emphasizing the temporal quality of all communication. In so doing, the study of video games promises to fundamentally rewrite the conceptual binary of process and product in composition pedagogy. (Abstract)

Alklind Taylor, A.-S., Backlund, P., & Niklasson, L. (2012). The coaching cycle: A coaching-by-gaming approach in serious games. *Simulation Gaming, 43*(5), 648-672. DOI: 10.1177/1046878112439442

Keywords: after action review; coaching by gaming; coaching cycle; debriefing; deliberate practice; experiential learning; formative feedback; game-based training; instructor roles; player-centered; puckstering; serious games; summative feedback; teacher player; teacher roles

Military organizations have a long history of using simulations, role-play, and games for training. This also encompasses good practices concerning how instructors utilize games and gaming behavior. Unfortunately, the work of instructors is rarely described explicitly in research relating to serious gaming. Decision makers also tend to have overconfidence in the pedagogical power of games and simulations, particularly where the instructor is taken out of the gaming loop. The authors propose a framework, the coaching cycle, that focuses on the roles of instructors. The roles include instructors acting as game players. The fact that the instructors take a more active part in all training activities will further improve learning. The coaching cycle integrates theories of experiential learning (where action precedes theory) and deliberate practice (where the trainee's skill is constantly challenged by a coach). Incorporating a coaching-by-gaming perspective complicates, but also strengthens, the player-centered design approach to game development in that we need to take into account two different types of players: trainees and instructor. Furthermore, the authors argue that the coaching cycle allows for a shift of focus to a more thorough debriefing, because it implies that learning of theoretical material before simulation/game playing is kept to a minimum. This shift will increase the transfer of knowledge. (Abstract)

All, A., Nuñez Castellar, E., & Van Looy, J. (2015). Towards a conceptual framework for assessing the effectiveness of digital game-based learning. *Computers & Education*, 88, 29-37. DOI: 10.1016/j.compedu.2015.04.012

Keywords: evaluation methodologies; interactive learning environments; media in education; interdisciplinary projects

In recent years, interest has grown in the systematic assessment of the effectiveness of digital game-based learning (DGBL). A conceptual framework describing what effectiveness means in the context

of DGBL and which are its subcomponents has hitherto been lacking however. Hence, the goal of this paper is to propose a conceptualization and operationalization of effectiveness rooted in social-cognitive theory. In order to identify desired outcomes and be able to operationalize effectiveness, focus groups were organized with three stakeholder groups following a user requirements analysis methodology. Results indicate that three categories of desired outcomes can be distinguished: learning, motivational and efficiency outcomes. For the different outcomes, different subcomponents can be extracted which can be organized hierarchically. Learning outcomes that are seen as relevant to the effectiveness of DGBL are 1) increased interest in the subject matter, 2) improvement in objective performance (e.g., in a test), and 3) transfer, referring to the player's ability to apply acquired knowledge or skills to real-world situations. Relevant motivational outcomes concern 1) enjoyment, the extent to which playing the game evoked an enjoyable experience, and 2) increased motivation to learn using DGBL. Efficiency outcomes relevant to DGBL effectiveness, finally, are related to 1) time management and 2) cost-effectiveness. Overall, it can be stated that a DGBL intervention is effective when it achieves similar or higher scores compared to other instructional methods in relation to any of the above mentioned outcomes without significantly (in the common, not the statistical sense) diminishing any of the others. (Abstract)

All, A., Nünez Castellar, E., & Van Looy, J. (2016). Assessing the effectiveness of digital game-based learning: Best practices. *Computers & Education*, 92-93, 90-103. DOI: 10.1016/j.compedu.2015.10.007

Keywords: digital game-based learning; evaluation methodologies; evaluation of CAL systems; interactive learning environments; media in education

In recent years, research into the effectiveness of digital game-based learning (DGBL) has increased. However, a large heterogeneity in methods for assessing the effectiveness of DGBL exist, leading to questions regarding reliability and validity of certain methods. This has resulted in the need for a scientific basis to conduct this type of research, providing procedures, frameworks and methods that can be validated. The present study is part of a larger systematic process towards the development of a standardized procedure for conducting DGBL effectiveness studies. In a first phase, the variety in methods that are used for sampling, implementation of the interventions, measures and data analysis were mapped in a systematic literature review using Cochrane guidelines. The present paper reflects the second stage, where this variety in elements are presented to experts in psychology and pedagogy by means of semi-structured interviews, in order to define preferred methods for conducting DGBL effectiveness studies. The interview was structured according to five dimensions that were used in the literature review: 1) participants (e.g., characteristics of the sample involved) 2) intervention (e.g., contents, format, timings and treatment lengths, intervention(s) in control group(s)) 3) methods (sampling, assignment of participants to conditions, number of testing moments) 4) outcome measures (e.g., instruments used to measure a certain outcome) and 5) data-analysis. The interviews were transcribed and analyzed using qualitative software package nVivo. Our results show that areas for improvement involve the intervention dimension and the methods dimension. The proposed improvements relate to implementation of the interventions in both the experimental and control group, determining which elements are preferably omitted during the intervention (such as guidance by the instructor, extra elements that consist of substantive information) and which elements would be aloud (e.g., procedural help, training session). Also,

variables on which similarity between experimental and control condition should be attained were determined (e.g., time exposed to intervention, instructor, day of the week). With regard to the methods dimension, proposed improvements relate to assignment of participants to conditions (e.g., variables to take into account when using blocked randomized design), general design (e.g. necessity of a pre-test and control group) test development (e.g., develop and pilot parallel tests) and testing moments (e.g., follow up after minimum 2 weeks). In sum, the present paper provides best practices that cover all aspects of the study design and consist of game specific elements. While several suggestions have been previously made regarding research design of DGBL effectiveness studies, these often do not cover all aspects of the research design. Hence, the results of this study can be seen as a base for a more systematic approach, which can be validated in the future in order to develop a standardized procedure for assessing the effectiveness of DGBL that can be applied flexibly across different contexts. (Abstract)

Almeida, F., Bolaert, H., Dowdall, S., Lourenço, J., & Milxzarksi, P. (2015). The walkabout framework for contextual learning through mobile serious games. *Education and Information Technologies, 20*(3), 415-428. DOI: 10.1007/s10639-013-9292-6

Keywords: contextual learning; mobile platforms; serious games; multimedia; multidisciplinary educational experience

Learning through games is increasingly gaining acceptance as a valuable training tool within the education and training community due to its simplicity, cost-effectiveness and essentially because most people prefer playing over learning. However, the use of games by students brings additional challenges regarding the design of games and their adoption in different learning, academic and interdisciplinary contexts, where issues such as planning, teachers and students participation have an important role in the success of contextual learning initiatives. This paper introduces a novel development framework and a learning process called WalkAbout for contextual learning mobile game systems that enables learners to practice and enhance 21st century skills, while generating and playing mobile contextual games. In our research, we investigate the main issues regarding the process of creating contextual mobile games and we detail the adopted methodology used in the design and implementation process of the WalkAbout framework. Finally, in order to preliminarily validate the platform and adopted methodology, we present and discuss the main results obtained after the games development, by looking at the potential of our design approach, the software framework and the learning experience that was offered to the students. (Abstract)

Alshammari, A., & Whittinghill, D. (2015). Multiplayer Kinect serious games: A review. *International Journal of Game-Based Learning, 5*(2), 45-61. DOI: 10.4018/IJGBL.2015070104

Keywords: multiplayer Kinect serious games; educational settings; educational users; learning experiences; educational contexts; physical safety; emotional safety; activity structure; e-learning; game-based learning

Single and multiplayer serious Kinect games have been used in many different areas, including education. Due to its relative newness as a technology, a dearth of literature exists concerning the requirements for the use of Kinect games in educational settings. A comprehensive review was conducted to include various perspectives in order to provide background information on the

existing research base that upholds the educational uses of these games. The review was built on empirical and theoretical studies conducted in the area of multiplayer Kinect games. A total of (748) articles were screened and (71) coded. While an abundance of convergent evidence from closely related domains has been produced on the subject, providing a set of recommendations for its proper usage; few studies have focused specifically on the role, development and effects of multiplayer Kinect games in educational settings. The potential for Kinect games to enhance learning experiences within educational contexts is promising; however, care must be taken to account for physical safety, emotional safety, and activity structure. Specific recommendations for addressing these important aspects of the use of multiplayer Kinect games are described in detail in the body of this manuscript. (Abstract)

Amenyo, J.-T. (2012). Playable serious games for studying and programming computational STEM and informatics applications of distributed and parallel computer architectures. *Journal of Educational Computing Research, 47*(4), 351-370. DOI: 10.2190/EC.47.4.a

Keywords: educational games; computer games; computer uses in education; programming; information science; computer sciences education; computer system design; stem education; professional personnel; instructional materials; educational strategies; computer simulation; college instruction

Carefully engineered playable games can serve as vehicles for students and practitioners to learn and explore the programming of advanced computer architectures to execute applications, such as high performance computing (HPC) and complex, inter-networked, distributed systems. The article presents families of playable games that are grounded in the concurrent, parallel, and distributed manipulations and processing of sequences. Some examples of such manipulations are games that involve pattern matching, recognition, alignment, transformation, and evolution of sequences. (Abstract)

Annetta, L., Lamb, R., Minogue, J., Folta, E., Holmes, S., Vallett, D., & Cheng, R. (2014). Safe science classrooms: Teacher training through serious educational games. *Information Sciences, 264*, 61-74. DOI: 10.1016/j.ins.2013.10.028

Keywords: serious education game; science teacher education; educational simulation; video game

STIMULATE (Science Training Immersive Modules for University Learning Around Teacher Education) is a Serious Educational Game (SEG) designed to advance science teacher preparation and development, by creating a laboratory safety module that immerse teachers in scenarios previously taught using only hypothetical case studies. This study employed a two-phase design based methodology. The first phase was a cognitive task analysis of a convenience sample (n = 10) of preservice and in-service science teachers in which they described their key issues and concerns regarding chemical laboratory safety planning, response, management plan, and assessment. Phase 2 examined the usability and effectiveness of STIMULATE's initial build on 31 preservice teachers. The t-test for equality of means demonstrates that there is a statistically significant difference between pretest and posttest scores, $t(30) = 14.79$, $p < .001$, $d = 2.56$ (large) Overall, results suggest positive learning gains from the preservice science teachers who engaged in STIMULATE program. (Abstract)

Annetta, L., Minogue, J., Holmes, S., & Cheng, M.-T. (2009). Investigating the impact of video games on high school students' engagement and learning about genetics. *Computers & Education, 53*(1), 74-85. DOI: 10.1016/j.compedu.2008.12.020

Keywords: applications in subject areas; interactive learning environments; pedagogical issues; secondary education; virtual reality

The popularity of video games has transcended entertainment crossing into the world of education. While the literature base on educational gaming is growing, there is still a lack of systematic study of this emerging technology's efficacy. This quasi-experimental study evaluated a teacher created video game on genetics in terms of its affective and cognitive impact on student users. While statistical results indicated no differences ($p > .05$) in student learning as measured by our instrument, there were significant differences ($p < .05$) found in the participants' level of engagement while interfacing with the video game. Implications on this emerging line of inquiry are discussed. (Abstract)

Annetta, L. A., Vallett, D., Fusareli, B., Lamb, R., Cheng, M.-T., Holmes, S., . . . Thurmond, B. (2014). Investigating science interest in a game-based learning project. *Journal of Computers in Mathematics and Science Teaching, 33*(4), 381-407.

Keywords: high schools; educational games; science instruction; student interests; learning activities; video games; science interests; student characteristics; computer software; technology uses in education; peer influences; informal education; teacher influence; student motivation

The purpose of this study was to examine the effect Serious Educational Games (SEGs) had on student interest in science in a federally funded game-based learning project. It can be argued that today's students are more likely to engage in video games than they are to interact in live, face-to-face learning environments. With a keen eye on motivating science students through SEGs, a cascading SEG development model was deployed. K-12 science teachers participated in summer workshops over three years where they learned to design and construct SEGs as teaching and learning tools, followed by student modification of teacher created games. Science interest was assessed through a mixed-method design, examining student responses to the Science Interest Survey (SIS) and through student voice from written blog prompts. Using chi-square and polytomous linear regression, results indicated that grade, age, gender and race were significant ($p<0.05$) predictors of science interest. Qualitative data from student blog responses indicate that science-based SEG creation positively influences student interest in science. Student voice blog responses indicated interest was boosted by successfully creating a working game of their own and as a result, students were inspired to do well in future science classes and had a new interest in pursuing STEM related careers. (Abstract)

Annetta, L. A., Murray, M. R., Laird, S. G., Bohr, S. C., & Park, J. C. (2006). Serious games: Incorporating video games in the classroom. *EDUCAUSE Quarterly, 29*(3), 16-22.

Keywords: graduate students; video games; distance education; science teachers; teaching methods; role-playing; synchronous communication; in-service teacher education

Technological advances in the new millennium may evoke disquiet among administrators and teachers taxed with understanding how to harness new capabilities and merge them with sound

pedagogy. To understand how gaming might bridge the gap between student interest and how lessons are taught, graduate students in science education at North Carolina State University (NCSU) took an online course that incorporated role-playing games. This article describes the creation of the NCSU course, which combined content and pedagogy with a multi-player educational gaming application (MEGA). The course design had two major goals: (1) Find a viable source for synchronous, online course delivery in a MEGA; and (2) Pilot a project for in-service teachers to design and create role-playing video games in a three-dimensional (3D) virtual environment as a supplement to science teacher instruction. (Abstract)

Antonaci, A., Dagnino, F., Ott, M., Bellotti, F., Berta, R., De Gloria, A., . . . Mayer, I. S. (2015). A gamified collaborative course in entrepreneurship: Focus on objectives and tools. *Computers in Human Behavior*, 51, 1276-1283. DOI: 10.1016/j.chb.2014.11.082

Keywords: technology enhanced learning; serious games; entrepreneurship education; gamification; higher education; collaboration

The paper deals with the hot issue of entrepreneurship education and describes the rationale behind the gamified and collaborative courses for university students conceived, developed and deployed in the framework of the eSG (stimulating entrepreneurship through Serious Games) project, funded under the EU lifelong learning (LLP) Programme. The project aims to help students becoming familiar, mainly through practice, with basic concepts of entrepreneurship and company management and to stimulate the emergence of their entrepreneurial attitudes. In the framework of the project specific courses mainly grounded on the concepts of gamification and collaboration were designed and carried out in three different partner countries: Italy, Spain and the Netherlands. The main objectives of the courses are presented in this paper and a theoretical model supporting the choice of Serious Games is shown which keeps into account usability, pedagogy and the entrepreneurship skills expressed by state of the art models. (Abstract)

Arnab, S., Berta, R., Earp, J., de Freitas, S., Popescue, M., Romero, M., . . . Usart, M. (2012). Framing the adoption of serious games in formal education. *Electronic Journal of e-Learning, 10*(2), 159-171.

Keywords: serious game; game-based learning; pedagogical issues; formal learning; teacher's role; collaboration

Nowadays formal education systems are under increasing pressure to respond and adapt to rapid technological innovation and associated changes in the way we work and live. As well as accommodation of technology in its ever-diversifying forms, there is a fundamental need to enhance learning processes through evolution in pedagogical approaches, so as to make learning in formal education more engaging and, it is hoped, more effective. One opportunity attracting particularly close attention is Serious Games (SG), which offer considerable potential for facilitating both informal and formal learning. SG appear to offer the chance to "hook" today's (largely) digital-native generation of young learners, who are at risk of falling into an ever-widening gap between "networked" lifestyles and the relative stagnant environment they experience in school and university. However, there are a number of inhibitors preventing wider SG take-up in mainstream education. This paper investigates SG in formal education, initially by concentrating on pedagogical

issues from two different but complementary perspectives, game design and game deployment. It then goes on to examine game based practice in formal settings and focuses on the pivotal role of the educator within the emerging panorama. This is followed by a brief look at some specific implementation strategies, collaboration and game building, which are opening up new possibilities. Finally some points for further consideration are offered. (Abstract)

Arnab, S., Brown, K., Clarke, S., Dunwell, I., Lim, T., Suttie, N., . . . de Freitas, S. (2013). The development approach of a pedagogically-driven serious game to support Relationship and Sex Education (RSE) within a classroom setting. *Computers & Education*, 69, 15-30. DOI: 10.1016/j.compedu.2013.06.013

Keywords: serious games; game development; relationships and sex education; sexual coercion; intervention mapping

Didactic approaches to Relationships and Sex Education (RSE) have been shown to yield limited outcomes when compared to approaches that stimulate peer discussion and debate. Creating effective interventions, which stimulate peer involvement, remains a demanding task and finding a solution that is not only engaging but also pedagogically sound is vital. A case thus exists for exploring how game technology might facilitate more feasible solutions. This paper presents the development approach of a digital game: PR:EPARe (Positive Relationships: Eliminating Coercion and Pressure in Adolescent Relationships), designed by a cross-disciplinary team of UK researchers from Coventry University's Studies in Adolescent Sexual Health (SASH) research group and the Serious Games Institute (SGI). Psychological targets for game content were identified through Intervention Mapping (IM) and the game design process was based on the Four-Dimensional Framework of Learning (4DF) emphasizing the context of deployment, learner profiling and the pedagogical perspective that influence the mode of representation of the learning content. Early efficacy testing of the game solution was validated through a cluster-randomized controlled trial in local schools (n = 505) indicated some positive outcomes in favour of the game-based approach, based on self-reported measures of psycho-social preparedness for avoiding coercion ($F [3, 501] = 15.306$, $p < .001$, View the MathML source = 0.084). Analysis of observation data suggests that blending this interactive game-based approach with traditional classroom delivery encouraged the teachers and students to engage in communal discussions and debriefing during and after game play. Together, the results demonstrated real benefits for pedagogy-driven game-based approaches to support the delivery of RSE within a classroom setting. (Abstract)

Arnab, S., Lim, T., Carvalho, M., Bellotti, F., de Freitas, S., Suttie, N., . . . De Gloria, A. (2015). Mapping learning and game mechanics for serious games analysis. *British Journal of Educational Technology*, 46(2), 391-411. DOI: 10.1111/bjet.12113

Keywords: teaching methods; educational games; design; models; case studies; evaluation methods; educational objectives; maps

Although there is a consensus on the instructional potential of Serious Games (SGs), there is still a lack of methodologies and tools not only for design but also to support analysis and assessment. Filling this gap is one of the main aims of the Games and Learning Alliance (http://www.galanoe.eu) European Network of Excellence on Serious Games, which has a focus upon *pedagogy-driven SGs*.

This paper relies on the assumption that the fundamental aspect of SG design consists in the translation of learning goals/practices into mechanical element of gameplay, serving to an instructional purpose beside that of play and fun. This paper proposes the Learning Mechanics–Game Mechanics (LM-GM) model, which supports SG analysis and design by allowing reflection on the various pedagogical and game elements in an SG. The LM-GM model includes a set of pre-defined game mechanics and pedagogical elements that we have abstracted from literature on game studies and learning theories. Designers and analysts can exploit these mechanics to draw the LM-GM map for a game, so as to identify and highlight its main pedagogical and entertainment features, and their interrelations. The tool may also be useful for teachers to evaluate the effectiveness of a given game and better understand how to implement it in educational settings. A case study is reported to illustrate the framework's support in determining how gameplay and pedagogy intertwine in an SG. Finally, the paper presents the results of two comparative user tests demonstrating the advantages of the proposed model with respect to a similar state-of-the-art framework. (Abstract)

Attali, Y., & Arieli-Attali, M. (2015). Gamification in assessment: Do points affect test performance? *Computers & Education, 83*, 57-63. DOI: 10.1016/j.compedu.2014.12.012

Keywords: gamification; assessment; performance; engagement

Gamification, applying game mechanics to nongame contexts, has recently become a hot topic across a wide range of industries, and has been presented as a potential disruptive force in education. It is based on the premise that it can promote motivation and engagement and thus contribute to the learning process. However, research examining this assumption is scarce. In a set of studies we examined the effects of points, a basic element of gamification, on performance in a computerized assessment of mastery and fluency of basic mathematics concepts. The first study, with adult participants, found no effect of the point manipulation on accuracy of responses, although the speed of responses increased. In a second study, with 6–8 grade middle school participants, we found the same results for the two aspects of performance. In addition, middle school participants' reactions to the test revealed higher likeability ratings for the test under the points condition, but only in the first of the two sessions, and perceived effort during the test was higher in the points condition, but only for eighth grade students. (Abstract)

Augustin, T., Hockemeyer, C., Kickmeier-Rust, M., Podbregar, P., Suck, R., & Albert, D. (2013). The simplified updating rule in the formalization of digital educational games. *Journal of Computational Science, 4*(4), 293-303. DOI: 10.1016/j.jocs.2012.08.020

Keywords: knowledge space theory; competence assessment; personalized game-based learning; adaptive storytelling

Competence-based Knowledge Space Theory (CbKST) has been proven to be a very well-fitting basis for realizing personalization in technology-enhanced learning. Especially in the area of game-based learning, however, some extensions and improvements are needed. Personalization in a serious game cannot be regarded simply as the selection of game assets according to the individual learner's current competences but it must also pay heed to the up-keeping of a storyline, it must be ensured

that no part of the story is omitted that may be necessary to understand a later part. Therefore, a CbKST-compatible Markovian model for storytelling is proposed. A second issue is the ongoing, non-invasive assessment of the learner's current competences during the game. Every action of the learner within the game should be taken into account for the competence assessment, and the assessment must be done in real-time, i.e. there must not be any delay caused by the assessment which would interrupt the flow of the game. A simplified update procedure for competence assessment within CbKST is suggested which can solve this issue, and simulation results are presented comparing the new procedure with the classical one. (Abstract)

Bachvarova, Y., Bocconi, S., van der Pols, B., Popescu, M., & Roceanu, I. (2012). Measuring the effectiveness of learning with serious games in corporate training. *Procedia Computer Science, 15*, 221-232. DOI: 10.1016/j.procs.2012.10.074

Keywords: serious games; evaluation; metrics; corporate training; knowledge management; game features

This paper discusses metrics for the effectiveness of learning of serious games in corporate training. Existing evaluation models are examined in order to verify their applicability to modern organizations in the knowledge economy. Designing metrics for learning requires taking into account different stakeholders, such as the employees, the employers and the management for the financial side. Game builders can also benefit from metrics that relate known game features, such as immersion, to learning effectiveness. Such metrics would allow an early assessment of the suitability of a game for training, thereby reducing the consequences of a wrong design and the development costs. (Abstract)

Baid, H., & Lambert, N. (2010). Enjoyable learning: The role of humour, games, and fun activities in nursing and midwifery education. *Nurse Education Today, 30*(6), 548-552. DOI: 10.1016/j.nedt.2009.11.007

Keywords: humour; games; teaching methods

Education that captures the attention of students is an essential aspect of promoting meaningful, active learning. Rather than standing at the front of a group of learners simply speaking about a topic, teachers have the opportunity of livening up their teaching with humour, games, and other fun activities. This article critically evaluates the benefits and limitations of humour within nursing education as well as the use of games and fun activities as teaching strategies. Examples of various games and interactive activities are also provided. (Abstract)

Banos, M. R., Cebolla, A., Oliver, E., Alcaniz, M., & Botella, C. (2013). Efficacy and acceptability of an internet platform to improve learning of nutritional knowledge in children: The ETIOBE. *Health Education Research, 28*(2), 234-248. DOI: 10.1093/her/cys044

Keywords: computer games; video games; obesity; nutrition; eating habits; misconceptions; knowledge level; comparative analysis; prevention; health promotion

Possessing sufficient nutritional knowledge is a necessary component in the prevention and treatment of obesity. A solid understanding of nutrition can help people make appropriate food selections and can also help correct irrational ideas or myths people may believe about food. It is a

challenge to provide this information to children in ways that are exciting. Thus, we propose an online video game platform to deliver the information. The objective of this study was to study the efficacy and acceptability of an online game called "ETIOBE Mates" that was designed to improve children's nutritional knowledge; furthermore, we compare it with the traditional paper-pencil mode of information delivery. A sample of 228 children participated in the study. Participants were divided into two groups: an experimental group (who used ETIOBE Mates) and a control group (who were given a pamphlet). Both groups increased their scores for nutritional knowledge. The interaction between group x time was also statistically significant; it indicated that acquisition of nutritional knowledge was superior in the experimental group. The children considered the serious games platform to be a useful medium for improving their nutritional knowledge. Online games can be an effective method of delivery for preventive and treatment tasks that are otherwise tedious for children. (Abstract)

Barab, S. A., Gresalfi, M., & Ingram-Goble, A. A. (2010). Transformational play: Using games to position person, content and context. *Educational Researcher, 39*(7), 525-536. DOI: 10.3102/0013189X10386593

Keywords: computers and learning; instructional design/development; instructional technologies

Videogames are a powerful medium that curriculum designers can use to create narratively rich worlds for achieving educational goals. In these worlds, youth can become scientists, doctors, writers, and mathematicians who critically engage complex disciplinary content to transform a virtual world. Toward illuminating this potential, the authors advance the theory of transformational play. Such play involves taking on the role of a protagonist who must employ conceptual understandings to transform a problem-based fictional context and transform the player as well. The authors first survey the theory and then ground their discussion in two units that, as part of their design-based research methodology, have simultaneously given rise to and been informed by their theory of transformational play. They close with a discussion of research and design challenges. (Abstract)

Barajas-Saavedra, A., Álvarez-Rodriguez, F., Mendoz-González, R., & Oviedo-De-Luna, A. (2015). Short serious games creation under the paradigm of software process and competencies as software requirements. Case study: Elementary math competencies. *Turkish Online Journal of Educational Technology, 14*(2), 155-166. URL: http://www.tojet.net/articles/v14i2/14219.pdf

Keywords: computer software; case studies; educational games; mathematics instruction; video games; grade 6; elementary school students; learning processes; foreign countries; identification; educational quality; mathematics skills; teaching methods

Although there is a consensus on the instructional potential of Serious Games (SGs), there is still a lack of methodologies and tools not only for design but also to support analysis and assessment. Filling this gap is one of the main aims of the Games and Learning Alliance (http://www.galanoe.eu) European Network of Excellence on Serious Games, which has a focus upon "pedagogy-driven SGs". This paper relies on the assumption that the fundamental aspect of SG design consists in the translation of learning goals/practices into mechanical element of gameplay, serving to an

instructional purpose beside that of play and fun. This paper proposes the Learning Mechanics-Game Mechanics (LM-GM) model, which supports SG analysis and design by allowing reflection on the various pedagogical and game elements in an SG. The LM-GM model includes a set of pre-defined game mechanics and pedagogical elements that we have abstracted from literature on game studies and learning theories. Designers and analysts can exploit these mechanics to draw the LM-GM map for a game, so as to identify and highlight its main pedagogical and entertainment features, and their interrelations. The tool may also be useful for teachers to evaluate the effectiveness of a given game and better understand how to implement it in educational settings. A case study is reported to illustrate the framework's support in determining how gameplay and pedagogy intertwine in an SG. Finally, the paper presents the results of two comparative user tests demonstrating the advantages of the proposed model with respect to a similar state-of-the-art framework. (Abstract)

Baratè, A., Bergomi, M. G., & Ludovico, L. A. (2013). Development of serious games for music education. *Journal of E-Learning and Knowledge Society, 9*(2), 89-104. ISSN: 1826-6223

Keywords: serious games development; music education; educational tool; international standard; XML multilayer format; multilayer learning object; music contents; IEEE 1599 standard; heterogeneous; multimedia contents

Serious games have proved to be an effective educational tool in many fields. The first goal of this paper is to illustrate some possible applications to music and their advantages. Moreover, music can be characterized by heterogeneous multimedia contents. Among the different facets music information is made of it is worth citing music symbols, their graphical representations as scores, their audio renderings as tracks, etc. The international standard known as IEEE 1599 is an XML multilayer format for heterogeneous music contents, and describes such different aspects in an integrated and synchronized context. Making relationships among music contents explicit provides a potentially rich educational environment. Consequently, this paper discusses the concept of multilayer learning object, introduces the IEEE 1599 standard, and finally shows some applications and case studies. (Abstract)

Baskin, C. (2007). Reciprocal disconnectedness: Computer games, schooling and boys at risk. *E-Learning, 4*(2), 150-160. DOI: 10.2304/elea.2007.4.2.150

Keywords: classroom communication; computer assisted instruction; males; middle schools; computers; games; teacher student relationship; student participation; technology uses in education; at risk students

Ethnomethodology is the analytical frame used here to recover embedded cultural discursive phenomena in the language of "at risk" middle-school boys as they talk about "computer games" and "schooling". What emerges is a rich picture of myths and heroes, identities of participation where member values and a discernible moral order are part of the "gaming" culture. A second picture emerges of "boys in school". Here "sleepers, avoiders and disconnected teachers" are disclosed through conversational structures as identities of non-participation in the classroom. Through

student talk we learn that identities of non-participation are a reciprocal phenomena, wherein these students and their teachers co-construct a reciprocal disconnectedness, each to the other. To the individual learner, the computer game is "serious fun"; to the classroom it is a "peripheral distraction"; to the school community it is a marker for identifying boys "at risk" of disengaging. Each of these individual accounts stands only as a "partial" explanation of the role of computer games in schooling. The article argues that our ability to nourish learners' inner capacities is not dependent on the level or nature of technology, but on the creative learning applications it invokes. (Abstract)

Barendregt, W., & Bekker, T. M. (2011). The influence of the level of free-choice learning activities on the use of an educational computer game. *Computers & Education, 56*(1), 80-90. DOI: 10.1016/j.compedu.2010.08.018

Keywords: elementary education; motivation; interactive learning environments; teaching/learning strategies

Employing a mixed-method explorative approach, this study examined the in situ use of and opinions about an educational computer game for learning English introduced in three schools offering different levels of freedom to choose school activities. The results indicated that the general behaviour of the children with the game was very different for each of the schools while there were no significant differences in subjective opinions or previous computer game experience as measured with a questionnaire. The gaming records and interviews informed that children do enjoy playing the game in comparison with other formal learning activities, but appreciate it less as a leisure-time activity. Furthermore it appears that children used to teacher-initiated activities tend to depend on their teacher's directions for how and when to play. The study highlights the level of choice as one of the important aspects to consider when introducing a game in the classroom. The study also points out some suggestions for the design of educational games, such as providing communication possibilities between players and integrating fast-paced motor-skill based games with learning content in a meaningful way. (Abstract)

Bedwell, W. L., Pavlas, D., Heyne, K., Lazzara, E. H., & Salas, E. (2012). Towards a taxonomy of linking game attributes to learning: An empirical study. *Simulation & Gaming, 43*(6), 729-760. DOI: 10.1177/1046878112439444

Keywords: card sort; computer-based training; game attribute; game attribute taxonomy; learning; learning outcomes; mental model; serious games; simulation/gaming; subject matter experts; taxonomy

The serious games community is moving toward research focusing on direct comparisons between learning outcomes of serious games and those of more traditional training methods. Such comparisons are difficult, however, due to the lack of a consistent taxonomy of game attributes for serious games. Without a clear understanding of what truly constitutes a game, scientific inquiry will continue to reveal inconsistent findings, making it hard to provide practitioners with guidance as to the most important attribute(s) for desired training outcomes. This article presents a game attribute taxonomy derived from a comprehensive literature review and subsequent card sorts performed by subject matter experts (SMEs). The categories of serious game attributes that emerged represent the shared mental models of game SMEs and serve to provide a comprehensive collection of game

attributes. In order to guide future serious games research, the existing literature base is organized around the framework of this taxonomy. (Abstract)

Beier, M. E., Miller, L. M., & Wang, S. (2012). Science games and the development of scientific possible selves. *Cultural Studies of Science Education, 7*(4), 963-978. DOI: 10.1007/s11422-012-9408-0

Keywords: scientific possible selves; self-concept; science games; career development; science identity; transformative identity

Serious scientific games, especially those that include a virtual apprenticeship component, provide players with realistic experiences in science. This article discusses how science games can influence learning about science and the development of science-oriented possible selves through repeated practice in professional play and through social influences (e.g., peer groups). We first review the theory of possible selves (Markus and Nurius 1986) and discuss the potential of serious scientific games for influencing the development of scientific possible selves. As part of our review, we present a forensic game that inspired our work. Next we present a measure of scientific possible selves and assess its reliability and validity with a sample of middle-school students (N = 374). We conclude by discussing the promise of science games and the development of scientific possible selves on both the individual and group levels as a means of inspiring STEM careers among adolescents. (Abstract)

Bellotti, F., Berta, R., De Gloria, A., Lavagnino, E., Antonaci, A., Dagnino, F., . . . Mayer, I. S. (2014). Serious games and the development of an entrepreneurial mindset in higher education engineering students. *Entertainment Computing, 5*(4), 357-366. DOI: 10.1016/j.entcom.2014.07.003

Keywords: technology enhanced learning; serious games; entrepreneurship education; business games & simulations; real-time strategy games; higher education

The paper discusses adoption of Serious Games (SGs) for supporting development of an entrepreneurial mindset in university students of technical and scientific universities. The paper relies on the authors experience in the eSG project, which aims at introducing students, mainly through practice, to basic concepts of entrepreneurship and company management. In the framework of the project, courses have been designed and carried out in three different countries: Italy, Spain and the Netherlands. The paper discusses the main requirements for the courses and presents a table template, based on state of the art models for entrepreneurship education, that we have used for the scouting of the most suited SGs and defining the most appropriate mix for their use in the courses, keeping into account targeted competences and skills, usability and pedagogical effectiveness. Using the template, the paper draws a comprehensive overview of relevant SGs available on the market and identifies, through an expert analysis, key benefits and issues concerning their adoption in teaching entrepreneurship for the target students. Finally, the paper critically analyzes the state of the art, indicating directions for future research that should lead to development of more effective SGs for entrepreneurship education. (Abstract)

Bellotti, F., Berta, R., De Gloria, A., Lavagnino, E., Dagnino, F., Ott, M., . . . Mayer, I. S. (2012). Designing a course for stimulating entrepreneurship in higher education through serious games. *Procedia Computer Science, 15*, 174-186. DOI: 10.1016/j.procs.2012.10.069

Keywords: serious games; entrepreneurship; business games simulations; higher education; collection of requirements

Enhancing the offer for entrepreneurship education is an important challenge for the nowadays knowledge societies. The eSG project is addressing this issue by analysing the added value that could be contributed by employing serious games (SGs) as a tool for allowing students – in particular technology students - to become familiar, mainly through practice, with basic concepts of entrepreneurship and company management. This paper presents the main requirements for the course and SGs obtained by surveying literature, entrepreneurs, students and teachers. We represented the requirements in a table template keeping into account usability, pedagogy, the entrepreneurship skills expressed by state of the art models and three major axes for entrepreneurship education at universities. These table descriptors were then used to assess validity of SGs and choose an appropriate mix for the courses. We have also defined a set of metrics to evaluate the advancement of students during the course. Based on these tools and knowledge, the next steps of the project will involve extensive user testing in the actual courses that are being performed in Genoa, Delft and Barcelona. (Abstract)

Bellotti, F., Berta, R., De Gloria, A., & Ozolina, A. (2011). Investigating the added value of interactivity and serious games for educational TV. *Computers & Education, 57*(1), 1137-1148. DOI: 10.1016/j.compedu.2010.11.013

Keywords: interactive TV; serious games; TV-based learning; t-learning; user tests; user centered design; television; digital TV

TV is a medium with high penetration rates and has been suited to deliver informal education in several aspects since years. Thus, interactive TV may play a significant role in the current Life-Long Learning challenges, provided that meaningful applications are implemented. In this research work, we have explored the added value of interactivity in digital TV, with a particular focus on Serious Games (SGs), given their growing relevance in technology-enhanced learning. We have followed an evolutionary rather than revolutionary approach, in particular given the still traditional use of TV by a large audience. The approach preserves a media-driven strategy and the role of the author/director in proposing contents (storytelling), as in the TV tradition. We argue that interactive SGs may help the viewer to better contextualize/understand the video stream and go more in depth about the touched items at the end of the stream. This also enables new iTV applications, in particular to support weaker users (i.e. users that could not view the video without a help). This paper presents the results from user tests based on an interactive enhancement of a clip from the Disney's Snow White movie, that challenged the authors in addressing a dynamic, high-value document. Qualitative and quantitative results show the potential of the system for informal education. The tests also stress the importance of good solutions (e.g., development languages, display modalities, metaphors) for synchronizing video and overlaid interactive elements. To the best of our knowledge, this research work is the first one discussing user test results about the usefulness of a class of iTV SG applications that can be instantiated serially in several different contexts. (Abstract)

Bellotti, F., Berta, R., De Gloria, A., & Primavera, L. (2010). Supporting authors in the development of task-based learning in serious virtual worlds. *British Journal of Educational Technology, 41*(1), 86-107. DOI: 10.1111/j.1467-8535.2009.01039.x

Keywords: foreign countries; educational games; learning theories; models; urban areas; educational technology; computer assisted instruction; electronic learning; instructional design; virtual classrooms; computer software; programming; computer system design; simulated environments; travel; instructional development

Serious virtual worlds (SVWs) represent a great opportunity for learning and should embed a lot of high-quality contextualised information so that the player can take the most from his or her exploration of the environment. This requires defining new methodologies and tools for effective production. We have investigated this issue in implementing a couple of SVWs and abstracted a conceptual framework relying on the task-based learning pedagogical theory. The model defines games set in realistic SVWs enriched with embedded educational tasks. Tasks are simple trial activities that embody units of knowledge. The player can discover them in his or her SVW exploration and interact with them in order to construct meaning, build lasting memories and deepen understanding of the featured item(s). The model involves pedagogical task annotation--which allows decoupling the tasks, which can be reused in different VWs from the definition of their delivery strategy in the context of a specific VW, which is specified by the VW designer and automatically managed by the run-time engine. This approach simplifies the authoring work. The visual Creative Toolkit (CT) we have developed is being used for producing contents for the 15 reconstructed cultural cities that will be featured in the first version of the Travel in Europe VW. The paper described the overall framework and the details of the CT. It also presented an implemented example, briefly discussing the methodology we have followed for developing cultural heritage content. (Abstract)

Bernardini, S., Porayska-Pomsta, K., & Smith, T. J. (2014). ECHOES: An intelligent serious game for fostering social communication in children with autism. *Information Sciences, 264*, 41-60. DOI: 10.1016/j.ins.2013.10.027

Keywords: virtual social partner; pedagogical agent; autonomous intelligent agent; artificial intelligence planning; Autism; social communication

This paper presents ECHOES, a serious game built to help young children with autism spectrum conditions practice social communication skills. We focus on the design and implementation of the interactive learning activities, which take place in a two-dimensional sensory garden, and the autonomous virtual agent, which acts as a credible social partner to children with autism. Both the activities and the agent are based on principles of best autism practice and input from users. Specification guidelines are given for building an autonomous socially competent agent that supports learning in this context. We present experimental results pertaining to the effectiveness of the agent based on an extensive evaluation of the ECHOES platform, which show encouraging tendencies for a number of children. (Abstract)

Binsubaih, A., Maddock, S., & Romano, D. (2006). A serious game for traffic accident investigators. *Interactive Technology and Smart Education, 3*(4), 329-346. DOI: 10.1108/17415650680000071

Keywords: game-based learning; traffic investigation; comparative study; performance; virtual environments

In Dubai, traffic accidents kill one person every 37 hours and injure one person every 3 hours. Novice traffic accident investigators in the Dubai police force are expected to "learn by doing" in this intense environment. Currently, they use no alternative to the real world in order to practice. This paper argues for the use of an alternative learning environment, where the novice investigator can feel safe in exploring different investigative routes without fear for the consequences. The paper describes a game-based learning environment that has been built using a game engine. The effectiveness of this environment in improving the performance of traffic accident investigators is also presented. Fifty-six policemen took part in an experiment involving a virtual traffic accident scenario. They were divided into two groups: novices (0 to 2 years experience) and experienced personnel (with more than 2 years experience). The experiment revealed significant performance improvements in both groups, with the improvement reported in novices significantly higher than the one reported in experienced personnel. Both groups showed significant differences in navigational patterns (e.g. distances travelled and time utilization) between the two training sessions. (Abstract)

Blackman, S. (2005). Serious games... and less! *ACM SIGGRAPH Computer Graphics, 39*(1), 12-16. DOI: 10.1145/1057792.1057802

Keywords: serious games

Many of us first heard the term "serious games" a couple of years ago at GDC (Game Developers Conference), the premier gathering place for game developers, publishers and industry hopefuls. As it happened, a colleague of mine thought he would take a peek into the room where a talk entitled "Serious Games" was being held. Expecting to see only a few people attending, he was amazed to find that it was standing room only! The use of game engines for non-game related applications had generated an inordinate amount of interest among a group of people normally known more for destroying grotesque aliens with absurdly proportioned weapons than reproducing mundane or real-life tasks in 3D. (Abstract)

Boada, I., Rodriguez-Benitez, A., Garcia-Gonzalex, J. M., Olivet, J., Carreras, V., & Sbert, M. (2015). Using a serious game to complement CPR instruction in a nurse facility. *Computer Methods and Programs in Biomedicine, 122*(2), 282-291. DOI: 10.1016/j.cmpb.2015.08.006

Keywords: serious games; cardiopulmonary resuscitation; e-learning; nursing informatics

Cardiopulmonary resuscitation (CPR) is a first aid key survival technique used to stimulate breathing and keep blood flowing to the heart. Its effective administration can significantly increase the chances of survival for victims of cardiac arrest. LISSA is a serious game designed to complement CPR teaching and also to refresh CPR skills in an enjoyable way. The game presents an emergency situation in a 3D virtual environment and the player has to save the victim applying the CPR actions.

In this paper, we describe LISSA and its evaluation in a population composed of 109 nursing undergraduate students enrolled in the Nursing degree of our university. To evaluate LISSA we performed a randomized controlled trial that compares the classical teaching methodology, composed of self-directed learning for theory plus laboratory sessions with a mannequin for practice, with the one that uses LISSA after self-directed learning for theory and before laboratory sessions with a mannequin. From our evaluation we observed that students using LISSA (Group 2 and 3) gave significantly better learning acquisition scores than those following traditional classes (Group 1). To evaluate the differences between students of these groups we performed a paired samples t-test between Group 1 and 2 ($\mu1 = 35, 67, \mu2 = 47, 50$ and $p < 0.05$) and between students of Group 1 and 3 ($\mu1 = 35, 67, \mu3 = 50, 58$ and $p < 0.05$). From these tests we observed that there are significant differences in both cases. We also evaluated student performance of main steps of CPR protocol. Students that use LISSA performed better than the ones that did not use it. (Abstract)

Bottino, R. M., Ferlino, L., Ott, M., & Tavella, M. (2007). Developing strategic and reasoning abilities with computer games at primary school level. *Computers & Education, 49*(4), 1272-1286. DOI: 10.1016/j.compedu.2006.02.003

Keywords: elementary education; pedagogical issues; interactive learning environments

The paper reports a small-scale, long-term pilot project designed to foster strategic and reasoning abilities in young primary school pupils by engaging them in a number of computer games, mainly those usually called mind games (brainteasers, puzzlers, etc.). In this paper, the objectives, work methodology, experimental setting, and tools used in the project are outlined, together with an analysis of some findings. In particular, we perform a brief analysis of some of the cognitive processes involved in playing with the computer games considered; we then discuss software features that, in our experience, help children tackle different cognitive tasks. The quantitative data collected during the pilot allow us, also, to take account of children's performance according to a number of different parameters, such as their level of achievement, the game's degree of difficulty and the type of data handled. Moreover, we reflect on the general impact of the project on children's reasoning abilities. The extent and duration of the study mean that, whilst the findings are not generalizable, they do offer insights into mechanisms underpinning basic strategic and reasoning skills as well as the educational potentialities offered by some of the existing computer games; they also point to some areas for further research. (Abstract)

Bourgonjon, J., De Grove, F., De Smet, C., Van Looy, J., Soetaert, R., & Valcke, M. (2013). Acceptance of game-based learning by secondary school teachers. *Computers & Education, 67*, 21-35. DOI: 10.1016/j.compedu.2013.02.010

Keywords: game-based learning; video games; secondary school teachers; educational beliefs

The adoption and the effectiveness of game-based learning depend largely on the acceptance by classroom teachers, as they can be considered the true change agents of the schools. Therefore, we need to understand teachers' perceptions and beliefs that underlie their decision-making processes. The present study focuses on the factors that influence the acceptance of commercial video games as learning tools in the classroom. A model for describing the acceptance and predicting the uptake of commercial games by secondary school teachers is suggested. Based on data gathered from 505

teachers, the model is tested and evaluated. The results are then linked to previous research in the domains of technology acceptance and game-based learning. (Abstract)

Bourgonjon, J., Valcke, M., Soetaert, R., & Schellens, T. (2010). Students' perceptions about the use of video games in the classroom. *Computers & Education, 54*(4), 1145-1156. DOI: 10.1016/j.compedu.2009.10.022

Keywords: multimedia/hypermedia systems; interactive learning environments; media in education; pedagogical issues; secondary education

Video games are often regarded as promising teaching and learning tools for the 21st century. One of the main arguments is that video games are appealing to contemporary students. However, there are indications that video game acceptance cannot be taken for granted. In this study, a path model to examine and predict student acceptance of video games is proposed, and empirically tested by involving 858 secondary school students. The results show that students' preference for using video games in the classroom is affected directly by a number of factors: the perceptions of students regarding the usefulness, ease of use, learning opportunities, and personal experience with video games in general. Gender effects are found as well, but appear to be mediated by experience and ease of use. (Abstract)

Boyle, E. A., Connolly, T., & Hainey, T. (2011). The role of psychology in understanding the impact of computer games. *Entertainment Computing, 2*(2), 69-74. DOI: 10.1016/j.entcom.2010.12.002

Keywords: computer games; psychology; engagement; serious games; learning

Over the last 40 years, computer games have become an extremely popular leisure activity and more recently there has also been interest in the potential of serious games to help in learning, skill acquisition and attitude and behaviour change. Initially public interest in computer games focused on concerns about their violent and gender stereotyped content and their potentially addictive properties, but more recently the benefits of games have also been recognised. Psychology is at the interface between science, cognitive science and social science and in this paper we examine the role that theories and research in psychology have played in understanding the impacts of playing games, the appeal of games and the potential of games in supporting learning and behaviour change. (Abstract)

Boyle, E. A., Hainey, T., Connolly, T. M., Gray, G., Earp, J., Ott, M., Lim, T., Ninaus, Ribeiro, C., & Pereira, J. (2016). An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games. *Computers & Education*, *94*, 178-192.

Keywords: computer games; serious games; entertainment; engagement; learning; systematic literature review

Continuing interest in digital games indicated that it would be useful to update Connolly et al.'s (2012) systematic literature review of empirical evidence about the positive impacts and outcomes of games. Since a large number of papers were identified in the period from 2009 to 2014, the current review focused on 143 papers that provided higher quality evidence about the positive

outcomes of games. Connolly et al.'s multidimensional analysis of games and their outcomes provided a useful framework for organising the varied research in this area. The most frequently occurring outcome reported for games for learning was knowledge acquisition, while entertainment games addressed a broader range of affective, behaviour change, perceptual and cognitive and physiological outcomes. Games for learning were found across varied topics with STEM subjects and health the most popular. Future research on digital games would benefit from a systematic programme of experimental work, examining in detail which game features are most effective in promoting engagement and supporting learning.

Boyle, E. A., Connolly, T., Hainey, T., & Boyle, J. M. (2012). Engagement in digital entertainment games: A systematic review. *Computers in Human Behavior, 28*(3), 771-780. DOI: 10.1016/j.chb.2011.11.020

Keywords: engagement; enjoyment; entertainment; computer games; flow; motives

Since their introduction over 40 years ago, digital entertainment games have become one of the most popular leisure activities globally. While digital games clearly provide highly engaging activities, the nature of this engagement is not well understood. The current study aims to advance our understanding by reporting a systematic review of recent literature addressing engagement in computer games. The papers in the review comprise a sub-sample of papers relating to engagement in digital games that was selected from a broader literature search carried out on the outcomes and impacts of playing computer games. A diverse range of studies was identified that examined varied aspects of engagement in games including subjective experiences while playing games, the physiological concomitants of these experiences, motives for playing games, game usage and time spent playing games and the impact of playing on life satisfaction. A narrative review was carried out to capture these diverse aspects of engagement and to develop a more coherent understanding of engagement in computer games. (Abstract)

Boyle, E. A., Hainey, T., Connolly, T., Gray, G., Earp, J., Ott, M., . . . Riberio, C. (2016). An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games. *Computers & Education*. DOI: 10.1016/j.compedu.2015.11.003

Keywords: serious games; entertainment; engagement; learning; systematic literature review

Continuing interest in digital games indicated that it would be useful to update [Authors', 2012] systematic literature review of empirical evidence about the positive impacts and outcomes of games. Since a large number of papers was identified in the period from 2009 to 2014, the current review focused on 143 papers that provided higher quality evidence about the positive outcomes of games. [Authors'] multidimensional analysis of games and their outcomes provided a useful framework for organising the varied research in this area. The most frequently occurring outcome reported for games for learning was knowledge acquisition, while entertainment games addressed a broader range of affective, behaviour change, perceptual and cognitive and physiological outcomes. Games for learning were found across varied topics with STEM subjects and health the most popular. Future research on digital games would benefit from a systematic programme of experimental work, examining in detail which game features are most effective in promoting engagement and supporting learning. (Abstract)

Boyle, E. A., MacArthur, E., Connolly, T., Hainey, T., Manea, M., Kärki, A., & van Rosmalen, P. (2014). A narrative literature review of games, animations and simulations to teach research methods and statistics. *Computers & Education, 74*, 1-14. DOI: 10.1016/j.compedu.2014.01.004

Keywords: games; simulations; animations; research methods; statistics

Basic competence in research methods and statistics is core for many undergraduates but many students experience difficulties in acquiring knowledge and skills in this area. Interest has recently turned to serious games as providing engaging ways of learning. The CHERMUG project was developed against this background to develop games to support students in learning about research methods and statistics. As a first step in designing the CHERMUG games a narrative literature review was carried out to establish whether similar games, animations and simulations already existed. Search terms used in the literature review included varied terms for digital games, simulations and animations, terms relevant to the twin goals of learning and engagement in games and terms for research methods and statistics. Application of the inclusion criteria led to 26 papers which were considered relevant. Synthesis of the papers suggested that there is reason to be optimistic that a game-based approach might be effective in learning in this area. (Abstract)

Breuer, J., & Bente, G. (2010). Why so serious? On the relation of serious games and learning. *Journal for Computer Game Culture, 4*(1), 7-24. ISSN: 1886-6124

Keywords: serious games; digital games; definitions; typologies; future development

Serious games have become a key segment in the games market as well as in academic research. Although the number of games that identify themselves as belonging to this category as well as the research done on their effects has been rapidly growing, there has thus far been no attempt to define all of the various opportunities that digital games provide for learning. To address this issue we look at existing definitions of serious games and their potential for learning. We identify the shortcomings of existing definitions and typologies. We discuss opportunities for an educational use of serious games which have been marginalized so far and develop a more flexible classification system for serious games in order to include commercial-off-the-shelf (COTS) games for learning purposes and description options for future developments of gaming technology. This classification system for digital and serious games uses labels and tags as a preferable solution instead of fixed genre categories. The aim of this paper is to move the focus from what serious games and their uses for learning currently are to what they can be. (Abstract)

Brom, C., Bromova, E., Děchetěrenko, F., Buchtová, M., & Pergel, M. (2014). Personalized messages in a brewery educational simulation: Is the personalization principle less robust than previously thought? *Computers & Education, 72*, 339-366. DOI: 10.1016/j.compedu.2013.11.013

Keywords: simulations; serious games; personalization principle; beer brewing; mental models; flow

The personalization principle, one of the design principles of multimedia learning, states that people learn better from multimedia presentations when instructions are in a conversational style rather than a formal style, possibly due to learners' increased interest. This principle was shown to be

robust in short interventions that could be completed within minutes or a few dozen minutes; however, complex digital simulations and games that support the acquisition of complex mental models usually take longer to complete. In this study, we investigate the personalization principle in a new context: in an interactive simulation on the topic of beer brewing, which lasts 2–3 h. Instructions were presented in the Czech language, either in a personalized style, where learners were addressed conversationally by "their grandpa, an owner of the family brewery," or in a non-personalized, more formal style without the grandpa. In Experiment 1, 26 college students, who interacted with both simulation versions, expressed on average a preference for the personalized version of the simulation. However, some of them worried that personalization could distract them. In Experiment 2 with a between-subject design, the knowledge of 75 predominantly college students was tested by means of retention and transfer tests immediately after completing the simulation and also a month later. Contrary to most previous works, our results showed no difference between the personalized and non-personalized groups in learning achievement, despite the fact that learners who received the personalized treatment voluntarily spent about 20% more time on the simulation. We also applied various measures of the learner's affective state, including Flow Short Scale and PANAS, but – again – no between-group differences were observed. These results indicate that personalization is not always beneficial to learning, which raises important questions for future research. Additional findings suggest that the simulation, no matter the treatment type, was most beneficial to learners with high mathematical abilities and who play computer games frequently, and also to those who liked the simulation more. (Abstract)

Brom, C., Levčik, D., Buchtová, M., & Klement, D. (2015). Playing educational micro-games at high schools: Individually or collectively? *Computers in Human Behavior, 48*, 682-694. DOI: 10.1016/j.chb.2015.02.025

Keywords: educational games; collective play; learning effects; secondary education; classrooms

The effectivity of learning by playing serious games is increasingly subject to research, but information about how these games should actually be used in classes is limited. In this explorative study with between-subject design (N = 166; high school students), we investigated the effectivity of playing two different micro-games in two different ways. After an expository lecture, either students played a game individually at computers ("individual play"), or the teacher played it, while showing it to the class on a projector and prompting the students on how to proceed with the game ("collective play"). Results indicated that the two modes of play were nearly comparable as concerns immediate and one month delayed learning gains, as well as subjective evaluation of educational experience. There were only two notable differences. First, immediate test scores for factual questions, but not transfer questions, for one of the games were higher for the individual play (medium effect size). Second, this difference was accompanied by a higher enjoyment in the better performing group (small to medium effect size). The results support the idea that collective play, which is easier to implement in schools, is a method that should be considered in educational design and future research. (Abstract)

Brom, C., Preuss, M., & Klement, D. (2011). Are educational computer micro-games engaging and effective for knowledge acquisition at high-schools? A quasi-experimental study. *Computers & Education, 57*(3), 1971-1988. DOI: 10.1016/j.compedu.2011.04.007

Keywords: interactive learning environments; multi-media/hypermedia systems; simulations; secondary education; applications in subject areas

Curricular schooling can benefit from the usage of educational computer games, but it is difficult to integrate them in the formal schooling system. Here, we investigate one possible approach to this integration, which capitalizes on using a micro-game that can be played with a teacher's guidance as a supplement after a traditional expository lecture followed by a debriefing. The game's purpose is to reinforce and integrate part of the knowledge learnt during the lecture. We investigated feasibility of this approach in a quasi-experimental study in 70 min long seminars on the topic of animal learning at 5 classes at 4 different high-schools in the Czech Republic. Each class was divided to two groups randomly. After an expository lecture, the game group played a game called Orbis Pictus Bestialis while the control group received an extra lecture that used media-rich materials. The time allotment was the same in both groups. We investigated the immediate and one month delayed effects of the game on students' knowledge reinforced and integrated by the game as well as on knowledge learnt during the expository lecture but not strengthened by the game. We also investigated students' overall appeal towards the seminar and its perceived educational value. Data from 100 students were analysed. The results showed that a) the game-playing is comparable to the traditional form of teaching concerning immediate knowledge gains and has a significant medium positive effect size regarding retention, b) the game-playing is not detrimental to information transmitted in the expository lecture but not strengthened by the game, c) perceived educational value and the overall appeal were high in the game group, nevertheless the perceived educational value was slightly lower in the game group comparing to the traditional group. Our results suggest that the proposed approach of harnessing educational computer games at high-schools is promising. (Abstract)

Bronack, S. C. (2011). The role of immersive media in online education. *Journal of Continuing Higher Education, 59*(2), 113-117. DOI: 10.1080/07377363.2011.583186

Keywords: immersive media; online learning; games; simulations; virtual worlds; augmented reality; adult learning

An increasing number of educators are integrating immersive media into core course offerings. Virtual worlds, serious games, simulations, and augmented reality are enabling students and instructors to connect with content and with one another in novel ways. As a result, many are investigating the new affordances these media provide and the impact each is having on important pedagogical constructs such as presence, immediacy, and immersion. New models for designing, delivering, and facilitating instruction are emerging, many with a particular eye toward supporting adult and continuing learners in the 21st century. (Abstract)

Broussard, M. J. S. (2014). Using games to make formative assessment fun in the academic library. *The Journal of Academic Librarianship, 40*(1), 35-42. DOI: 10.1016/j.acalib.2012.12.001

Keywords: formative assessment; games; library instruction

Assessment is everywhere in higher education. It is no longer acceptable to assume students are learning what is taught in the classroom or the library; administrations and accrediting bodies want

to see evidence of learning. In libraries, this often happens in the form of major evaluation projects such as LibQual+®, or locally-created equivalents. More specifically for library instruction, there are standardized assessments such as Project Sails, iSkills, and ILT. These all have an important role to play in assessing student satisfaction and learning, but they are all summative macro-assessments and quite intimidating to librarians and students alike. They often require significant resources in the form of time and money and do not allow for immediate improvements of student learning. More mini-assessments are needed in the library classroom while there is still time to improve instruction. For assistance in this endeavor, librarians can learn from the literature on formative assessment and game-based learning. This article makes two arguments. The first is for increased awareness of formative assessment among instruction librarians. The second is that educational games have the potential to make good environments for formative assessment. There are solid bodies of literature available on each subject, though little on formative assessment in the library literature. In analyzing the literature on the pedagogical qualities of each, remarkable similarities emerged. This article analyzes these similarities in detail and uses two information literacy games to demonstrate how formative assessment can be embedded in educational library games. (Abstract)

Brown, D. J., McHugh, D., Standen, P., Evett, L., Shopland, N., & Battersby, S. (2011). Designing location-based learning experiences for people with intellectual disabilities and additional sensory impairments. *Computers & Education, 56*(1), 11-20. DOI: 10.1016/j.compedu.2010.04.014

Keywords: cooperative/collaborative learning; cross-cultural projects; human-computer interface; navigation; public spaces and computing

The research reported here is part of a larger project which seeks to combine serious games (or games-based learning) with location-based services to help people with intellectual disabilities and additional sensory impairments to develop work based skills. Specifically this paper reports on where these approaches are combined to scaffold the learning of new routes and ultimately independent travel to new work and educational opportunities. A phased development methodology is applied in a user sensitive manner, to ensure that user feedback drives the ongoing development process. Methods to structure this include group feedback on conceptual storyboards, expert review of prototypes using usability heuristics relating to the main system goals, and finally co-discovery methods with student pairs exploring all three modes of the system in real world contexts. Aspects of developmental and cognitive psychological theories are also reviewed and it is suggested that combining games-based learning approaches with location-based services is an appropriate combination of technologies for an application specifically designed to scaffold route learning for this target audience. (Abstract)

Browne, K., Anand, C., & Gosse, E. (2014). Gamification and serious game approaches for adult literacy tablet software. *Entertainment Computing, 5*(3), 135-146. DOI: 10.1016/j.entcom.2014.04.003

Keywords : gamification; serious game; tablet user experience; user experience; literacy; adult literacy

In this paper, we overview the design of tablet apps we designed and built to teach literacy to adults, and present the results and conclusions derived from experiments performed with target users. Low

adult literacy is a significant problem with a high economic cost both for the individuals and for society. Programs created to address low adult literacy face access and engagement barriers that tablet software may be able to help overcome. We designed three tablet apps, using two contrasting approaches of incorporating game-design elements to engage the users. We tested the apps with participants from the Brant Skills Centre, a non-profit organization that offers adult literacy programs in Brantford, Ontario. Though participants were divided on whether they preferred the apps to more traditional instruction, most participants preferred using the apps in addition to more traditional instruction. Based on this we conclude that gamification and serious game design approaches were effective at increasing learner engagement, and we propose a direction for future research. (Abstract)

Butler, Y. G. (2015). The use of computer games as foreign language learning tasks for digital natives. *System, 54*, 91-102. DOI: 10.1016/j.system.2014.10.010

Keywords : young learners; computer games; tasks; primary schools; researching with children; vocabulary learning; English as a foreign language

Although children's use of computer games as tools for learning foreign languages (FL) is on the rise, we know little about which game elements aid in the FL-learning process. Adhering to Pinter's (2014) call for conducting research with children as opposed to research on children, this study asked children working in groups to design computer games to help them learn FL vocabulary. Our aim was to better understand the elements and structures that, from children's points of view, are both attractive and effective for FL learning. The participants were 82 sixth-grade students (11–12 year olds) enrolled in a public primary school in Japan. The children first discussed and identified game elements and vocabulary learning elements while examining existing games. Next, they worked in groups to design computer games based on the elements they identified, presented the game designs in class using storyboards, and evaluated their own game designs and those of their peers. The children identified 16 game elements and 8 learning elements. Among the learning elements the children identified were repeating/reviewing, using multiple modalities and means, and having control over their own learning. Game elements valued by the children included challenging, fantasies, self-control, instant feedback, and applause. (Abstract)

Buttussi, F., Pellis, T., Cabas Vidani, A., Pausler, D., Carchietti, E., & Chittaro, L. (2013). Evaluation of a 3D serious game for advanced life support retraining. *International Journal of Medical Informatics, 82*(9), 798-809. DOI: 10.1016/j.ijmedinf.2013.05.007

Keywords : education; retraining; advanced cardiac life support; computer simulation; serious gaming; evaluation studies

Advanced life support (ALS) knowledge and skills decrease in as little as three months, but only a few ALS providers actually attend retraining courses. We assess the effectiveness of a 3D serious game as a new tool for frequent ALS retraining. We developed a 3D serious game for scenario-based ALS retraining. The serious game, called EMSAVE, was designed to promote self-correction while playing. We organized a retraining course in which 40 ALS providers played two cardiac arrest scenarios with EMSAVE and took a test with 38 multiple-choice questions before and after playing. We administered the same test again 3 months later to evaluate retention. Participants also rated

EMSAVE and the overall retraining experience. After using EMSAVE, the number of correct answers per participant increased by 4.8 (95%CI +3.4, +6.2, $p < 0.001$) and all but one participant improved. After 3 months, despite an expected decrease in ALS knowledge and skills (−1.9 correct answers, 95%CI −0.6, −3.3, $p < 0.01$), there was a significant retention benefit (+2.9 correct answers per participant, 95%CI +1.5, +4.2, $p < 0.001$). Moreover, all but one participant regarded EMSAVE as a valuable tool to refresh ALS knowledge and skills, and 85% of participants were also willing to devote 1 h/month to retrain with the serious game. A 3D serious game for scenario-based retraining proved effective to retrain in ALS and supported retention of acquired knowledge and skills at 3 months. EMSAVE also positively engaged and motivated participants. (Abstract)

Cagiltay, N. E., Ozcelik, E., & Ozcelik, N. S. (2015). The effect of competition on learning in games. *Computers & Education, 87*, 35-41. DOI: 10.1016/j.compedu.2015.04.001

Keywords : interactive learning environments; post-secondary education

Today serious games are having an important impact on areas other than entertainment. Studies show that serious games have a potential of creating learning environments to better reach the educational and training goals. The game design characteristics and game elements are need to be explored in detail for increasing the expected benefits of the gaming environments. In this study, the effect of competition, one of the design elements of game environments, on learning is analyzed experimentally. The study is conducted with 142 students. The results of this study show that when a competition environment is created in a serious game, motivation and post-test scores of learners improve significantly. The results of this study are expected to guide the serious game designers for improving the potential benefits of serious games. (Abstract)

Calderón, A., & Ruiz, M. (2015). A systematic literature review on serious games evaluation: An application to software project management. *Computers & Education, 87*, 396-422. DOI: 10.1016/j.compedu.2015.07.011

Keywords : serious game; evaluation; systematic literature review; software project management

Training that future practitioners receive in software project management is a topic of great importance. The objective of this systematic literature review is to summarize the current state of the art of the different methods and procedures used to assess serious games. The review follows a predefined procedure that involves automatically searching well-known digital databases. 1199 papers were found by the automatic searches in the digital databases and 102 papers were selected as primary studies. The process was complemented with manual searches using author and backward snowballing techniques. Our systematic literature review identified the main methods followed to assess serious games, the application domains in which the assessments took place, the categories of serious games assessed, the main features considered to assess the educational effectiveness of serious games, the procedures followed for the assessments and the size of the population that participated in the assessments. The results are useful to researchers and practitioners willing to assess serious games in different fields, but specially to those interested in assessing serious games in the area of software project management. (Abstract)

Carvalho, M., Bellotti, F., Berta, R., De Gloria, A., Gazzarata, G., Hu, J., & Kickmeier-Rust, M. (2015). A case study on service-oriented architecture for serious games. *Entertainment Computing, 6*, 1-10. DOI: 10.1016/j.entcom.2014.11.001

Keywords: adaptive serious games; games for learning; serious games; serious games development; service orientated architecture; architecture tradeoff analysis method

Service-Oriented Architecture (SOA) is a set of practices for architectural design of software that exploits services as loosely coupled components orchestrated to deliver various functionalities. The SOA paradigm is not well established in the Serious Games (SG) domain, but it is expected to provide benefits, particularly in reducing the conceptual and technological complexity of the development. In this paper, we propose and study the application of a SOA approach to SG development. We have used the SOA approach to develop an adaptive Serious Game for teaching basic elements of probability to high school and entry-level university students, called The Journey. Details of the architecture implementation are offered, as well as the results of an evaluation of the system using the Architecture Tradeoff Analysis Method (ATAM). Based on our experience, we argue that the SOA approach can make SG development shorter, more flexible and more focused. (Abstract)

Carvalho, M., Bellotti, F., Berta, R., De Gloria, A., Sedano, C. I., Hauge, J. B., . . . Rauterberg, M. (2015). An activity theory-based model for serious games analysis and conceptual design. *Computers & Education, 87*, 166-181. DOI: 10.1016/j.compedu.2015.03.023

Keywords: serious games; educational serious games; serious games analysis; serious games design; activity theory

There are currently a number of models, frameworks and methodologies for serious games analysis and design that provide useful interpretations of the possibilities and limitations offered by serious games. However, these tools focus mostly on high-level aspects and requirements and do not help understand how such high-level requirements can be concretely satisfied. In this paper, we present a conceptual model, called Activity Theory-based Model of Serious Games (ATMSG), that aims to fill this gap. ATMSG supports a systematic and detailed representation of educational serious games, depicting the ways that game elements are connected to each other throughout the game, and how these elements contribute to the achievement of the desired pedagogical goals. Three evaluation studies indicate that ATMSG helped participants, particularly those with gaming experience, identify and understand the roles of each component in the game and recognize the game's educational objectives. (Abstract)

Cela-Ranilla, J. M., Esteve-Mon, F. M., Esteve-González, V., & Gisbert-Cervera, M. (2014). Developing self-management and teamwork using digital games in 3D simulations. *Australasian Journal of Educational Technology, 30*(6), 634-651. ISSN: E1449-5554

Keywords: educational environment; self management; teamwork; marketing; educational games; simulated environments; computer simulation; scoring rubrics; teaching methods; student attitudes; gender differences; foreign countries; college students

Emerging technologies are providing opportunities for designing new learning environments, especially environments in which students can learn by putting their skills into practice. Knowledge

about the development of these experiences needs to be accumulated and processed so that they can be integrated effectively into training programmes. In this study we describe how transferable skills such as self-management and teamwork have been developed by 70 Spanish students of Education and Marketing. The learning experience comprised a serious game designed in a 3D simulation environment. For the analysis, two analytical rubrics were taken as references. Descriptive statistics and non-parametric tests such as Mann-Whitney "U" and Spearman "rho" were conducted for comparison and correlation analysis. Our results showed that the students performed well and had a positive perception of the suitability of using the simulation environment for the development of transferable skills. We also found that women performed better than men in activities involving teamwork, especially communication tasks. (Abstract)

Charksy, D. (2010). From edutainment to serious games: A change in the use of game characteristics. *Games and Culture, 5*(2), 177-198. DOI: 10.1177/1555412009354727

Keywords: games; edutainment; serious games; game characteristics; simulations

Serious games use instructional and video game elements for non-entertainment purposes. Serious games attempt to create instructionally sound and relevant learning experiences for a wide variety of audiences and industries. The author contends that for serious games to be effective, instructional designers and video game designers need to understand how the game characteristics, competition and goals, rules, challenges, choices, and fantasy, used in both edutainment and serious games, can influence motivation and facilitate learning. (Abstract)

Cheng, M.-T., & Annetta, L. A. (2012). Students' learning outcomes and learning experiences through playing a serious educational game. *Journal of Biological Education, 46*(4), 203-213. DOI: 10.1080/00219266.2012.688848

Keywords: serious educational games; interactive learning environment; neuroscience education; drug-use education

This study attempted to examine students' learning outcomes and their learning experiences through playing a Serious Educational Game. A mixed-method research design was employed collecting both quantitative and qualitative data. A total of 98 middle-school students ranging from sixth to eighth grades participated through paper-and-pencil instruments, interviews and video recordings as data sources. A series of paired t-tests was used to analyse whether there were differences in learning outcomes and attitude changes toward methamphetamine use. The results showed that students learned more neuroscience content after exposure to the game (p less than 0.01) and their attitude toward methamphetamine use became more negative (p less than 0.01). Moreover, they actively performed several cognitive and metacognitive strategies to help the learning activity to best fit individual learning styles and to make the cognitive processes more efficient while interacting with the Serious Educational Game. (Abstract)

Cheng, M.-T., Annetta, L., Folta, E., & Holmes, S.Y. (2011). Drugs and the brain: Learning the impact of Methamphetamine abuse on the brain through a virtual exhibit in the museum. *International Journal of Science Education, 33*(2), 299-319.DOI: 10.1080/09500693.2010.482571

Keywords: informal education; museum; public; science education; evaluation; serious game; drug use education

"Drugs and the Brain: A Serious Game," a prototype museum exhibit, was designed to employ virtual models of the brain into a video game format. It was done to create a fun and engaging way of conveying knowledge and concepts about neuroscience, as well as the impact of methamphetamine abuse on the brain. The purpose of this study is to evaluate this prototype exhibit that promises to educate participants from various age, ethnicity, and gender backgrounds, and to establish a stronger concept of drug abuse prevention among children. A quantitative methodology using the pre- and post-experimental designs was conducted on 175 museum visitors. A series of two-sample paired "t"-tests and subsequent ANOVAs were performed to examine the difference between pre- and post-tests and to determine if there was a difference in the results in age, gender, ethnicity, and race. Results showed that both the understanding and attitudes of the participants toward the impact of methamphetamine abuse on the brain improved significantly (p less than 0.01). (Abstract)

Cheng, M.-T., Lin, Y.-W., & She, H.-C. (2015). Learning through playing Virtual Age: Exploring the interactions among student concept learning, gaming performance, in-game behaviors, and the use of in-game characters. *Computers & Education, 86*, 18-29. DOI: 10.1016/j.compedu.2015.03.007

Keywords: secondary education; applications in subject areas; interactive learning environments; teaching/learning strategies; virtual reality

Video games possess many unique features that facilitate learning. Meanwhile, teaching about evolution is never an easy task due to the existence of some barriers to its learning. Virtual Age, therefore, has been developed in an attempt to harness the power of gaming to increase student understanding of biological evolution. The aim of this study was to examine whether Virtual Age is effective for learning about evolution and to further explore the interplay of student concept learning, gaming performance, and in-game behaviors. A total of 62 7th graders took part in the study, and significant findings were revealed. The students did learn by playing Virtual Age, and their long-term knowledge retention was promising. The in-game behaviors, such as times and duration of viewing the relevant information embedded in Virtual Age, were significantly related to gaming performance (game score), which subsequently influenced learning outcomes. Moreover, the results of cluster analysis indicated that three clusters of low learning outcomes/low gaming performance, high learning outcomes, and high gaming performance emerged. Overall, Virtual Age is an effective game for learning about evolution based on its sound and sophisticated design. Implications derived from the study and suggestions for future work are proposed. (Abstract)

Cheng, M.-T., She, H.-C., & Annetta, L. A. (2015). Game immersion experience: Its hierarchical structure and impact on game-based science learning. *Journal of Computer Assisted Learning, 31*(3), 232-253. DOI: 10.1111/jcal.12066

Keywords: immersion; science learning; serious educational games

Many studies have shown the positive impact of serious educational games (SEGs) on learning outcomes. However, there still exists insufficient research that delves into the impact of immersive experience in the process of gaming on SEG-based science learning. The dual purpose of this study was to further explore this impact. One purpose was to develop and validate an innovative measurement, the Game Immersion Questionnaire (GIQ), and to further verify the hierarchical structure of game immersion by construct validity approaches, including exploratory factor analysis (EFA) (n?=?257) and confirmatory factor analysis (CFA) (n?=?1044). The second purpose was to investigate the impact of game immersion on science learning through SEG play (n?=?260). Overall, the results supported the internal structure of the GIQ with good reliability and validity, and the inter factor bivariate correlations for each construct indicated a high internal consistency. Players did learn from playing an SEG, and game immersion experience did lead to higher gaming performance. Moreover, players' gaming performance plays a role in mediating the effect of immersion on science learning outcomes through SEG play. However, as players became more emotionally and subjectively attached to the game, the science learning outcomes were not definitively reliable. (Abstract)

Cheon, J., Chung, S., Song, J., & Kim, Y. (2015). An investigation of the effects of a graphic organiser in an serious game on learning outcomes and attitudinal perceptions. *Interactive Learning Environments, 23*(4), 437-452. DOI: 10.1080/10494820.2013.788030

Keywords: serious game; digital game-based learning; post organizer; advance organizer

A serious game, which is designed for learning purposes rather than recreational purposes, has been applied for digital game-based Learning. This study investigated the effects of graphic organizers in a serious game, "The Transistor", on learning outcomes and attitudinal perceptions. A total of 99 participants were randomly assigned to three groups: non-organizer group, advance organizer group, and post organizer group. The results revealed that participants using a post organizer, which was presented after the game for review, outperformed those using a non-organizer and an advance organizer on both learning outcomes (recall test scores and recycling intention) and attitudinal perceptions (perceived enjoyment, perceived usefulness, and satisfaction). These findings implied that a post-graphic organizer could enhance the instructional value of a serious game. More detailed implications, limitations, and suggestions for future research are discussed. (Abstract)

Cheong, C., Filippou, J., & Cheong, F. (2014). Towards the gamification of learning: Investigating student perceptions of game elements. *Journal of Information Systems Education, 25*(3), 233-244.ISSN: 10553096

Keywords: student perceptions; computer assisted education; student expectations; pedagogy

Games offer people engaging and motivating experiences. The process of recreating this type of experience in systems that are not typically considered games is called "gamification." Improving engagement and motivation in a learning environment is desired by many educators as traditional

approaches do not seem to be as engaging as they once were with students. Hence, gamification may be a useful tool to improve the learning environment. As a precursor to the development of a game-like learning system, we survey 51 undergraduate IT students to obtain their perceptions on game elements, which are the building blocks of what makes a game identifiable as such. All game elements that were presented to tire respondents were highly rated. It was found that undergraduate students have a positive perception of systems that use game elements and are interested in its use for learning. Overall, students favored social interaction, engagement, feedback, and increased learning, which suggests that gamification is particularly suited to learning approaches such as social constructivism. We suggest that future work should include the development of a prototype for a game-like educational system that helps to provide useful feedback for students about their learning progress. (Abstract)

Chittaro, L., & Sioni, R. (2015). Serious games for emergency preparedness: Evaluation of an interactive vs. a non-interactive simulation of a terror attack. *Computers in Human Behavior, 50*, 508-519. DOI: 10.1016/j.chb.2015.03.074

Keywords: behavioral sciences; digital simulation; emergency management; serious games (computing); serious games; emergency preparedness; user population; video games; terror attack; threat appraisal; emotional response

Emergency preparedness is a relevant emerging application of serious games. A general issue in exploiting such approach concerns the breadth of the population that can be reached by serious games. Indeed, serious games need to be actively played and this can restrict their user population, because there are people who have no experience with video games or do not like them or do not have the proper hardware to play them. Moreover, there are organizational contexts in which a non-interactive presentation is preferred because it can be given in a more convenient and less costly way with simple traditional media, i.e., printed materials, slides or videos. This paper deals with the possibility of generating and using a non-interactive version of the experience provided by serious games. First, we propose a serious game that simulates a mass emergency caused by a terror attack in a train station. To obtain design guidance, we explore psychological models that explain how people are motivated to protect themselves from danger. Then, we generate the non-interactive version of the terror attack simulation and we contrast it with the interactive version. Results of our study show that both versions of the simulation can provide positive outcomes in learning, risk severity perception and self-efficacy, but they differ in how much they affect user's threat appraisal and emotional response. (Abstract)

Clark, D. B., Nelson, B. C., Chang, H.-Y., Martinez-Garza, M., Slack, K., & D'Angelo, C. M. (2011). Exploring Newtonian mechanics in a conceptually-integrated digital game: Comparison of learning and affective outcomes for students in Taiwan and the United States. *Computers & Education, 57*(3), 2178-2195. DOI: 10.1016/j.compedu.2011.05.007

Keywords: games; applications in subject areas; cross-cultural projects; interactive learning environments; pedagogical issues; secondary education

This study investigates the potential of a digital game that overlays popular game-play mechanics with formal physics representations and terminology to support explicit learning and exploration of

Newtonian mechanics. The analysis compares test data, survey data, and observational data collected during implementations in Taiwan and the United States with students in grades 7–9. Results demonstrate learning on some core disciplinary measures and high levels of learner engagement, indicating the potential benefits of this genre of conceptually-integrated games, but also suggesting that further research and development will be needed to more fully harness this potential. Encouragingly, striking similarities were observed across the two countries in terms of learning and engagement, suggesting that this genre of learning games may prove suitable for engaging students in active exploration of core science concepts across multiple countries. (Abstract)

Codish, D., & Ravid, G. (2014). Academic course gamification: The art of perceived playfulness. *Interdisciplinary Journal of E-Learning and Learning Objects*, 10, 131-151.ISSN: 2375-2033

Keywords: gamification; personality; extraversion; introversion; game mechanics; perceived playfulness

Gamification in education is being used as a way to increase student engagement and learning. While carrying a big promise, little is known about how students with different personalities, specifically extraverts and introverts, are influenced by game elements and mechanics: knowledge that is essential to ensure that implementing gamification will not disengage some students. In two quasi-experiments performed in an academic course, students (n = 102; n = 58) were faced with the immediate feedback game mechanics such as points, rewards, and badges, and comparative feedback mechanics such as leaderboards and progress bars. The perceived playfulness from the implementation was measured and a Partial Least Squares (PLS) analysis was performed measuring the relations between these elements and the way they increase the perceived playfulness throughout the semester. A moderation analysis was performed examining how extraverts and introverts perceive each implementation. Our results show that in both cases there were significant moderating effects between game mechanics and perceived playfulness. More specifically, the effect of leaderboards on perceived playfulness was higher for introverts and was negative for extraverts, meaning that implementing leaderboards may disengage extraverts. These results are important for gamification researchers who are looking at how different personalities derive perceived playfulness, based on different game mechanics and to educators who plan to include game elements in their courses. (Abstract)

Cohen, E. L. (2014). What makes good games go viral? The role of technology use, efficacy, emotion and enjoyment in players' decision to share a prosocial digital game. *Computers in Human Behavior, 33*, 321-329. DOI: 10.1016/j.chb.2013.07.013

Keywords: serious games; content sharing; viral marketing; enjoyment; emotion; campaigns

Serious digital games may be an effective tool for prosocial message dissemination because they offer technology and experiences that encourage players to share them with others, and spread virally. But little is known about the factors that predict players' willingness to share games with others in their social network. This panel study explores how several factors, including sharing technology use, emotional responses, and game enjoyment, contribute to players' decision to share the game Darfur is Dying, with others. College students played the game and completed

questionnaires that assessed whether they had shared the games at two different time points: during game play and after game play. Positive emotions predicted sharing while students played the game, but negative emotions predicted whether the game was shared after initial game play. Game enjoyment predicted players' intentions to share the game, but it did not predict actual sharing behavior. Neither players' general use of sharing technologies nor their satisfaction related to sharing digital content predicted sharing intentions or behavior. These findings have implications for the study of viral social marketing campaigns, and serious game design and theory. (Abstract)

Cojocariu, V.-M., & Boghian, I. (2014). Teaching the relevance of game-based learning to Preschool and Primary teachers. *Procedia - Social and Behavioural Sciences, 142*, 640-646. DOI: 10.1016/j.sbspro.2014.07.679

Keywords: educational games; teaching method; game-based learning; digital game-based learning

Nowadays there is an increasing need for teachers to help learners engage with learning and keep them motivated, as well as a need to familiarize teachers – adults who have not been familiar with computers and hence regard their use in education with a greater or smaller degree of anxiety – with the use of the new technologies in education. We believe that helping teachers, adults, understand the importance of games in learning, as well as how to use game-based teaching and learning, will meet both of the needs mentioned above. Game-based learning has been found to promote a positive attitude towards learning and develop memory skills, along with its potential to connect learners and help them build self-constructed learning. Our paper attempts to distinguish between traditional and digital game-based learning, highlight the advantages and disadvantages of this type of educational approach and propose ways in which preschool and primary school teachers/adults may be taught the relevance of game-based learning, as well as methods to apply game-based teaching-learning techniques in class. (Abstract)

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education, 59*(2), 661-686. DOI: 10.1016/jcompedu.2012.03.004

Keywords: computer games; serious games; learning; skill enhancement; engagement

This paper examines the literature on computer games and serious games in regard to the potential positive impacts of gaming on users aged 14 years or above, especially with respect to learning, skill enhancement and engagement. Search terms identified 129 papers reporting empirical evidence about the impacts and outcomes of computer games and serious games with respect to learning and engagement and a multidimensional approach to categorizing games was developed. The findings revealed that playing computer games is linked to a range of perceptual, cognitive, behavioural, affective and motivational impacts and outcomes. The most frequently occurring outcomes and impacts were knowledge acquisition/content understanding and affective and motivational outcomes. The range of indicators and measures used in the included papers are discussed, together with methodological limitations and recommendations for further work in this area. (Abstract)

Connolly, T., Stansfield, M., & Hainey, T. (2011). An alternate reality game for language learning: ARGuing for multilingual motivation. *Computers & Education, 57*(1), 1389-1415. DOI: 10.1016/j.compedu.2011.01.009

Keywords: alternate reality game; motivation; Web2.0; Moodle; language education; quests; puppetmaster

Over the last decade, Alternate Reality Games (ARGs), a form of narrative often involving multiple media and gaming elements to tell a story that might be affected by participants' actions, have been used in the marketing and promotion of a number of entertainment related products such as films, computer games and music. This paper discusses the design, development and evaluation of an ARG aimed at increasing the motivations of secondary school level students across Europe in the learning of modern foreign languages. The ARG was developed and implemented as part of a European Commission Comenius project and involved 6 project partners, 328 secondary school students and 95 language teachers from 17 European countries. The collaborative nature of ARGs provides a potentially useful vehicle for developing collaborative activities within an educational context. This paper describes the educational value of ARGs, in particular the ARG for supporting the teaching of modern European languages and the specific activities that were developed around Web 2.0 and gaming that underpinned the ARG and helped promote cooperation and learning within an educational environment. An evaluation of the ARG was conducted using an experimental design of pre-test → ARG intervention → post-test. 105 students completed the pre-test, 92 students completed the post-test and 45 students completed both the pre-test and post-test questionnaires. In general, student attitudes towards the ARG were very positive with evidence suggesting that the ARG managed to deliver the motivational experience expected by the students. The majority of students who completed the post-test either agreed or strongly agreed that they would be willing to play the game over a prolonged period of time as part of a foreign language course. In addition, through using the ARG, students believed that they obtained skills relating to cooperation, collaboration and teamwork. (Abstract)

Cook, N. F., McAloon, T., O'Neill, P., & Beggs, R. (2012). Impact of a web based interactive simulation game (PULSE) on nursing students' experience and performance in life support training — A pilot study. *Nurse Education Today, 32*(6), 714-720. DOI: 10.1016/j.nedt.2011.09.013

Keywords: simulation; life support training; nursing students; serious games; educational multimedia

The delivery of effective life support measures is highly associated with the quality, design and implementation of the education that underpins it. Effectively responding to a critical event is a requirement for all nurses illustrating the need for effective educational approaches from pre-registration training through to enhancing and maintaining life support skills after qualification. This paper reports the findings of utilising a web-based multimedia simulation game PULSE (Platform for Undergraduate Life Support Education). The platform was developed to enhance the student experience of life support education, to motivate on-going learning and engagement and to improve psychomotor skills associated with the provision of Intermediate Life Support (ILS) training. Pre training participants played PULSE and during life support training data was collected from an intervention and a control group of final year undergraduate nursing students (N = 34). Quantitative

analysis of performance took place and qualitative data was generated from a questionnaire assessing the learning experience. A statistically significant difference was found between the competence the groups displayed in the three skills sets of checking equipment, airway assessment and the safe/effective use of defibrillator at ILS level, and PULSE was positively evaluated as an educational tool when used alongside traditional life support training. (Abstract)

Cowley, B., Fantato, M., Jennett, C., Ruskov, M., & Ravaja, N. (2014). Learning when serious: Psychophysiological evaluation of a technology-enhanced learning game. *Journal of Educational Technology & Society, 17*(1), 3-16. URL: http://www.ifets.info/journals/17_1/2.pdf

Keywords: technology; enhanced learning; serious games; heart rate variability; mental workload; psychophysiology; evaluation; competence development

We report an evaluation study for a novel learning platform, motivated by the growing need for methods to do assessment of serious game efficacy. The study was a laboratory experiment combining evaluation methods from the fields of learning assessment and psychophysiology. 15 participants used the TARGET game platform for 25 minutes, while the bio-signals electrocardiography, electrodermal activity and facial electromyography were recorded. Learning was scored using pre- and post-test question-based assessments Repeated-measures analysis with Generalised Estimating Equations was used to predict scores by tonic psychophysiological data. Results indicate some learning effect, plus a relationship between mental workload (indexed by electrocardiography) and learning. Notably, the game format itself influences the nature of this relationship. We conclude that a high quality of insight is afforded by the combination of subjective self-report and objective psychophysiology, satisfying two of three observable domains. (Abstract)

Cowley, B., Heikura, T., & Ravaja, N. (2013). Learning loops -- Interactions between guided reflection and experience-based learning in serious game activity. *Journal of Computer Assisted Learning, 29*(4), 348-370. DOI: 10.1111/jcal.12013

Keywords: assessment; experience-based learning; reflection; serious game; technology; enhanced learning

In a study on experience-based learning in serious games, 45 players were tested for topic comprehension by a questionnaire administered before and after playing the single-player serious game Peacemaker (Impact Games 2007). Players were divided into two activity conditions: 20 played a 1-h game with a 3-min half-time break to complete an affect self-report form while 25 also participated in a 20-min reflective group discussion during their half-time break. During the discussion, they were asked by an experimenter to reflect on a set of topics related to the game. We present the analysis of the questionnaires, which illustrates that contrary to our expectations the reflection period had a negative effect on the learning of the players as judged by their performance on closed-form questions at levels 1-5 (out of 6) on the Bloom taxonomy of learning outcomes. The questionnaire also included a few open questions which gave the players a possibility to display deep (level 6) learning. The players did not differ significantly between conditions regarding the questions measuring deep learning. (Abstract)

Cowley, B., Moutinho, J. L., Bateman, C., & Oliveira, A. (2011). Learning principles and interaction design for 'Green My Place': A massively multiplayer serious game. *Entertainment Computing, 2*(2), 103-113. DOI: 10.1016/j.entcom.2011.01.001

Keywords: serious games; game design; pedagogical principles; energy efficiency; behavlet

The usual approach to serious game design is to construct a single game intended to address the specific domain problem being addressed. This paper describes a novel alternative approach, focussed on embedding smaller game elements into a comprehensive framework, which provides stronger motive for play and thus greater chance of effect. This serious game design methodology was developed for an EU project to teach energy efficient knowledge and behaviour to users of public buildings around Europe. The successful implementation of this game is also described. The cutting-edge educational principles that formed the basis for the design are drawn from recent research in serious games and energy efficiency, and include the Behavlet, a novel behaviour-transformation concept developed by the authors. The game design framework presented illustrates a clear approach for serious games dealing with topics applicable at societal scales. (Abstract)

Cowley, B., Ravaja, N., & Heikura, T. (2013). Cardiovascular physiology predicts learning effects in a serious game activity. *Computers & Education, 60*(1), 299-309. DOI: 10.1016/j.compedu.2012.07.014

Keywords: serious game; peacemaker; learning; assessment; heart rate variability; facial electromyography; bloom taxonomy

In a study on learning in serious games, 45 players were tested for topic-comprehension by a questionnaire administered before and after solo-playing of the serious game Peacemaker (Impact Games 2007), during which their psychophysiological signals were measured. Play lasted for 1 h, with a break at half time. The questionnaire was divided into two parts, with fixed and open questions respectively. We use the Bloom taxonomy to distinguish levels of difficulty in demonstrated learning – with the first five levels assigned to fixed questions – and gain scores to measure actual value of demonstrated learning. We present the analysis of the psychophysiology recorded during game play and its relationship to learning scores. The Heart Rate Variability (HRV) (an indicator of mental workload) and interaction between HRV and electromyography of Orbicularis Oculi (an indicator of positive affect) significantly predicted the learning results at certain levels of difficulty. Results indicate that increased working-memory related mental workload in support of on-task attention aids learning at these levels. (Abstract)

Crookall, D. (2010). Serious games, debriefing, and simulation/gaming as a discipline. *Simulation Gaming, 41*(6), 898-920. DOI: 10.1177/1046878110390784

Keywords: computers; debriefing; design; discipline; experiential learning; feedback; games; interdisciplinarity; learning; practice; publication; research; simulation; gaming; theory; training

At the close of the 40th Anniversary Symposium of S&G, this editorial offers some thoughts on a few important themes related to simulation/gaming. These are development of the field, the notion of serious games, the importance of debriefing, the need for research, and the emergence of a discipline. I suggest that the serious gaming community has much to offer the discipline of

simulation/gaming and that debriefing is vital both for learning and for establishing simulation/gaming as a discipline. (Abstract)

Crovato, S., Pinto, A., Giardullo, P., Macarello, G., Neresini, F., & Ravarotto, L. (2016). Food safety and young consumers: Testing a serious game as a risk communication tool. *Food Control, 62*, 134-141. DOI: 10.1016/j.foodcont.2015.10.009

Keywords: food safety; serious game; young consumers; risk communication tool

Raising consumers' awareness about food safety issues is one of the primary objectives of Italian public health organizations. New dynamic and interactive tools, based on web applications, are already playing a leading role in health promotion campaigns targeted at adolescents. Among the web-based tools specifically designed for young people, educational videogames have proved especially effective in furthering learning and disseminating information, as they arouse adolescents' interest and curiosity. When a number of cases of Haemolytic-uraemic syndrome (HUS) were reported in 2010, particularly among children, the Italian Ministry of Health stressed the need to implement communication initiatives aimed at raising consumers' awareness of the potential risks associated with raw milk consumption at home. The pilot study described in the article is a relevant example of educational projects implemented in Italy, oriented to transmit knowledge about food risks to young consumers (aged 16–18). To provide correct information on safe milk handling practices and to reduce health issues, including serious ones, the videogame "A mysterious poisoning" was developed. This tool was administered online to 359 upper secondary school students from four different provinces in Italy. The videogame covered all stages of the milk supply chain, from stable to table, and enabled players to identify the crucial moments when milk can be contaminated and to discover safe milk handling practices. By completing a series of tasks, students helped a detective discover the cause of a food poisoning outbreak. This videogame provided an opportunity for students to test their knowledge of the product and to receive more detailed and accurate information. Data collected through two structured questionnaires that were administered before and after the controlled use of the videogame showed that this serious game was capable of changing players' perception of risk exposure and their cognitive associations, particularly increasing their levels of knowledge about the risks associated with raw milk consumption. (Abstract)

Cuccurullo, S., Francese, R., Passero, I., & Tortora, G. (2013). A 3D serious city building game on waste disposal. *International Journal of Distance Education Technologies, 11*(4), 112-135. DOI: 10.4018/ijdet.2013100108

Keywords: computer simulation; simulated environments; educational technology; educational games; foreign countries; environmental education; instructional effectiveness; student attitudes; teacher attitudes; teaching methods; knowledge level

The environmental priority requires structural interventions that will be effective in the long period only if they are accompanied by modifications of behaviors, orientations and beliefs, specially investing in the new generations. This paper presents a 3D Virtual World serious game named Pappi World, designed according to pedagogical theories and to the Italian Environmental Ministry guidelines. This game aims at helping children to learn how to dispose waste and to understand that waste can become a relevant resource when correctly managed. The game proposes individual and

collaborative activities and exploits the city evolution mechanism proper of city-building games to involve the students. Pappi World is also evaluated 1) considering the learning efficacy and the student perceptions and 2) collecting the teachers opinions related to the game usability, fun, engagement, mechanism and metaphor adequateness as well as expected learning outcomes. Also the student perceptions on the game were collected. With regards to learning effectiveness, the empirical evaluation revealed a significant difference between pre-game and post-game knowledge. Students reported they were engaged and had fun playing Pappi World. Teachers expressed a positive opinion on the game adoption and its effectiveness, also providing useful suggestions to improve it. (Abstract)

D'Apice, C., Grieco, C., Piscopo, R., & Liscio, L. (2015). DMS2015short-2: Advanced learning technologies for eLearning in the enterprise: Design of an educational adventure game to teach computer security. *Journal of Visual Languages & Computing, 31*(Part B), 260-266. DOI: 10.1016/j.jvlc.2015.10.004

Keywords: educational adventure game; game design; assessment

Emerging requirements for learning in the enterprise are developing critical reasoning and keeping the learner engaged. Advanced didactical material that exploits gameful design should increase engagement by creating a product that has the spirit, and not just the mechanics, of a good game. This article presents game design guidelines for the development of an Educational Adventure Game and how they have been applied during the development of SIRET Security Game, a game that teaches workers the importance of following computer security policies. (Abstract)

Dawood, N., Miller, G., Patacas, J., & Kassem, M. (2014). Construction health and safety training: the utilisation of 4D enabled serious games. *Electronic Journal of Information Technology in Construction, 19*, 326-335. ISSN: 1400-6529

Keywords: construction health and safety training; 4D enabled serious games; H&S risk reduction; construction industry; scenario-led training; discrete game sections; sandbox style serious game; safety hazards

Health and safety (H&S) is a major concern in the construction industry. Recent and historical data from the construction industry worldwide demonstrate that the human, social, and economic burden, inflicted as a result of H&S-related fatalities, is still significant. Training is a key strategy to reduce H&S risks. The investigation of serious games for H&S training in construction as complementary to traditional training methods has attracted significant interest in recent years. Current studies in this area have mainly focussed on scenario-led training where trainees interact with the same environment through pre-defined options in discrete game sections. This approach has limitations in terms of variety and amount of skills that trainees can learn. In this paper, the proposed approach is to enable a sandbox style serious game through the encapsulation of 4D (3D + time) concept in the game design with the hypothesis that this approach would influence the capability of trainee to spot safety hazards and the way they interact with the game. Such a serious game was developed for a real-world project which was modelled at three different as a replica of the planned schedule. The testing of the environment with 12 students demonstrated that combining serious games and 4D approaches can improve users' engagement and affect their abilities to spot H&S hazards. (Abstract)

Deater-Deckard, K., El Mallah, S., Chang, M., Evans, M. A., & Norton, A. (2014). Student behavioral engagement during mathematics educational video game instruction with 11–14 year olds. *International Journal of Child-Computer Interaction, 2*(3), 101-108. DOI: 10.1016/j.ijcci.2014.08.001

Keywords: education; computer assisted education; adolescents; tablet computers; field studies

"Serious digital games" for education are presumed to be engaging, but little is known about whether engagement is ubiquitous, whether it persists over time, whether it is found for all students across the full range of prior gaming experience, and whether it is actually associated with game-based learning outcomes. To address these gaps, student behavioral engagement (i.e., sustained attention, persistence was examined during mathematics instruction using a mathematics serious digital game for the iPad®, in a study of 97 11–14 year olds (i.e., 6–8th grade students in the United States system). Consistent with the study hypotheses, observations revealed that most students were highly engaged, but engagement was lower for students who were observed later in the semester and who had the most prior gaming experience. In addition, observed engagement was associated with better performance on an assessment of the skills being taught in the game. In contrast, none of these effects was evident for self-reported student engagement. Time course, prior gaming experience, and method of assessing engagement are important modulators of student differential response to game-based instruction and should be considered when evaluating the influence of serious digital games on learning outcomes. (Abstract)

de Freitas, S., & Neumann, T. (2009). The use of 'exploratory learning' for supporting immersive learning in virtual environments. *Computers & Education, 52*(2), 343-352. DOI: 10.1016/j.compedu.2008.09.010

Keywords: simulations; pedagogic issues; teaching/learning strategies; interactive learning environments; authoring tools and methods

User interfaces are becoming more intuitive following the requirements of the individual learner and reinforcing the drive towards more personalised learning and greater learner autonomy. There are clearly a new set of challenges emerging for teaching practitioners that will have implications upon not just what is learned but importantly upon lesson planning. This paper explores these changes to teaching through a consideration of an exploratory learning model which allows practitioners to rethink how they teach in 3D and immersive spaces where learning sequences and experiences are choreographed to support peer interactions and exchanges. The ELM extends from Kolb's experiential learning model to adapt the use of 3D applications, and provides examples from research and development projects to exemplify how the model works in practice. Teaching in these contexts provides less emphasis upon curriculum and more emphasis upon sequencing learning experiences, meta-reflection, peer assessment and group work. (Abstract)

de Freitas, S., & Oliver, M. (2006). How can exploratory learning with games and simulations within the curriculum be most effectively evaluated? *Computers & Education, 46*(3), 249-264. DOI: 10.1016/j.compedu.2005.11.007

Keywords: authoring tools and methods; elementary education; evaluation of CAL systems; interactive learning environments; pedagogical issues; simulations

There have been few attempts to introduce frameworks that can help support tutors evaluate educational games and simulations that can be most effective in their particular learning context and subject area. The lack of a dedicated framework has produced a significant impediment for the uptake of games and simulations particularly in formal learning contexts. This paper addresses this shortcoming by introducing a four-dimensional framework for helping tutors to evaluate the potential of using games- and simulation-based learning in their practice, and to support more critical approaches to this form of games and simulations. The four-dimensional framework is applied to two examples from practice to test its efficacy and structure critical reflection upon practice. (Abstract)

de Freitas, S., Rebodello-Mendez, G., Liarokapis, F., Magoulas, G., & Poulovassilis, A. (2010). Learning as immersive experiences: Using the four-dimensional framework for designing and evaluating immersive learning experiences in a virtual world. *British Journal of Educational Technology, 41*(1), 69-85. DOI: 10.1111/j.1467-8535.2009.01024.x

Keywords: concentrated study; shared virtual environments; virtual reality in education; knowledge transfer; educational technology; learning theories in action

Traditional approaches to learning have often focused upon knowledge transfer strategies that have centred on textually-based engagements with learners, and dialogic methods of interaction with tutors. The use of virtual worlds, with text-based, voice-based and a feeling of 'presence' naturally is allowing for more complex social interactions and designed learning experiences and role plays, as well as encouraging learner empowerment through increased interactivity. To unpick these complex social interactions and more interactive designed experiences, this paper considers the use of virtual worlds in relation to structured learning activities for college and lifelong learners. This consideration necessarily has implications upon learning theories adopted and practices taken up, with real implications for tutors and learners alike. Alongside this is the notion of learning as an ongoing set of processes mediated via social interactions and experiential learning circumstances within designed virtual and hybrid spaces. This implies the need for new methodologies for evaluating the efficacy, benefits and challenges of learning in these new ways. Towards this aim, this paper proposes an evaluation methodology for supporting the development of specified learning activities in virtual worlds, based upon inductive methods and augmented by the four-dimensional framework reported in a previous study. The study undertaken aimed to test the efficacy of the proposed evaluation methodology and framework, and to evaluate the broader uses of a virtual world for supporting lifelong learners specifically in their educational choices and career decisions. The paper presents the findings of the study and considers that virtual worlds are reorganising significantly how we relate to the design and delivery of learning. This is opening up a transition in learning predicated upon the notion of learning design through the lens of 'immersive learning experiences' rather than sets of knowledge to be transferred between tutor and learner. The challenges that remain for tutors rest with the design and delivery of these activities and experiences. The approach advocated here builds upon an incremental testing and evaluation of virtual world learning experiences. (Abstract)

de Freitas, S., & Veletsianos, G. (2010). Editorial: Crossing boundaries: Learning and teaching in virtual worlds. *British Journal of Educational Technology, 41*(1), 3-9. DOI: 10.1111/j.1467-8535.2009.01045.x

Keywords: virtual reality in education; educational technology

The article presents an editorial introduction to the issue, highlighting its central focus on the use of virtual worlds in education and contextualizing featured contributions by Barney Dalgarno, Francesco Bellotti, and George Veletsianos. (Abstract)

Del Blanco, A., Marchiori, E. J., Torrente, J., Martínez-Ortiz, I., & Fernández-Manjón, B. (2013). Using e-learning standards in educational video games. *Computer Standards & Interfaces, 36*(1), 178-187. DOI: 10.1016/j.csi.2013.06.002

Keywords: educational standards; game based learning; virtual learning environments; authoring tool; eAdventure

The integration of educational video games in Virtual Learning Environments (VLEs) is a challenging task in need of standardization to improve interoperability and to safeguard investment. The generalized use of VLEs has fostered the emergence of rich contents, and different standards exist to improve their interoperability and reusability. This work describes a proposal of how existing e-learning standards can be used to improve the integration of educational games in VLEs, while introducing a set of models that take into account the features of the selected standards. A specific implementation of this approach in the eAdventure game platform is also presented. (Abstract)

DeLuuw, K. E., & Mayer, R. E. (2011). Cognitive consequences of making computer-based learning activities more game-like. *Computers in Human Behavior, 27*(5), 2011-2016. DOI: 10.1016/j.chb.2011.05.008

Keywords: computer game; serious game; educational game; competition; sex differences

Some students (base group) played the Circuit Game, a 10-level computer-based learning activity intended to help students learn how electrical circuits work. Other students (competition group) played the same game but with competition features added – including a score bar showing performance on each level, the opportunity to earn one ticket per level if a performance criterion is met, and the opportunity to win a prize based on the number of tickets earned. On a retention test given after the game, the competition group remembered significantly more than the base group (d = 0.47). On an embedded transfer test constituting the final level of the game, the groups did not differ significantly. However, on the transfer test there was a significant gender by group interaction in which men performed worse in the competition group than the base group (d = −0.54) and women performed better in the competition group than the base group (d = 0.24). Overall, adding game-like features to a computer-based learning activity caused students to pay attention to game details but did not motivate students – particularly men – to learn more deeply. (Abstract)

de-Marcos, L., Domínguez, A., Saenz-de-Navarrete, J., & Pagés, C. (2015). An empirical study comparing gamification and social networking on e-learning. *Computers & Education, 75*, 82-91. DOI: 10.1016/j.compedu.2014.01.012

Keywords: gamification; playful design; social network; e-learning; participation; motivation

While social networking has already demonstrated its efficiency in e-learning, gamification, which is the use of game-thinking and playful design in non-game contexts, has only shown its potential as a motivational tool. This paper presents the results of testing both social networking and gamification in an undergraduate course, comparing them in terms their effect on students' academic achievement, participation and attitude. The effects of a gamification plugin deployed in a learning management system were compared to those of a social networking site in the same educational setting. We found that both approaches presented better performance than a traditional e-learning approach in terms of academic achievement for practical assignments, but that, when it came to assessing knowledge, the traditional e-learning approach was better. Also challenging current assumptions, participation rates and scores remained low with the new tools, although students' attitudes were positive. (Abstract)

Dennis, A. R., Bhagwatwar, A., & Minas, R. K. (2013). Play for performance: Using computer games to improve motivation and test-taking performance. *Journal of Information Systems Education, 24*(3), 223-231. DOI: 10.1109/hicss.2012.474

Keywords: proficiency testing

The importance of testing, especially certification and high-stakes testing, has increased substantially over the past decade. Building on the "serious gaming" literature and the psychology "priming" literature, we developed a computer game designed to improve test-taking performance using psychological priming. The game primed the concept of achievement to increase an individual's expectation of success and motivation. Our results show that individuals who took a test immediately after playing the game significantly outperformed those who played a placebo computer game designed to have no effect. The effect size was medium (0.63). We believe that these results have important implications for information system education, including improving individual test-taking performance, identifying ways to develop information systems topic-specific games, and the need for more research to better understand how and why such games influence performance. (Abstract)

Derbali, L., & Frasson, C. (2012). Assessment of learners' motivation during interactions with serious games: A study of some motivational strategies in Food-Force. *Advances in Human-Computer Interaction*, 1-15. DOI: 10.1155/2012/624538

Keywords: motivational strategies; food-force; serious gameplay; physiological sensors; heart rate; skin conductance; electroencephalogram; logistic repressions; nonparametric tests; ARCS model; confidence categories; attention categories; educational computer-based systems; learner motivation; serious games

This study investigated motivational strategies and the assessment of learners' motivation during serious gameplay. Identifying and intelligently assessing the effects that these strategies may have

on learners are particularly relevant for educational computer-based systems. We proposed, therefore, the use of physiological sensors, namely, heart rate, skin conductance, and electroencephalogram (EEG), as well as a theoretical model of motivation (Keller's ARCS model) to evaluate six motivational strategies selected from a serious game called Food-Force. Results from nonparametric tests and logistic regressions supported the hypothesis that physiological patterns and their evolution are suitable tools to directly and reliably assess the effects of selected strategies on learners' motivation. They showed that specific EEG "attention ratio" was a significant predictor of learners' motivation and could relevantly evaluate motivational strategies, especially those associated with the Attention and Confidence categories of the ARCS model of motivation. Serious games and intelligent systems can greatly benefit from using these results to enhance and adapt their interventions. (Abstract)

DeSmet, A., Van Ryckeghem, D., Compermolle, S., Baranowski, T., Thompson, D., Crombez, G., . . . De Bourdeaudhuij, I. (2014). A meta-analysis of serious digital games for healthy lifestyle promotion. *Preventive Medicine, 69*, 95-107. DOI: 10.1016/j.ypmed.2014.08.026

Keywords: serious games; digital games; systematic review; meta-analysis; tailoring; multicomponent; health promotion

Several systematic reviews have described health-promoting effects of serious games but so far no meta-analysis has been reported. This paper presents a meta-analysis of 54 serious digital game studies for healthy lifestyle promotion, in which we investigated the overall effectiveness of serious digital games on healthy lifestyle promotion outcomes and the role of theoretically and clinically important moderators. Findings showed that serious games have small positive effects on healthy lifestyles (g = 0.260, 95% CI 0.148; 0.373) and their determinants (g = 0.334, 95% CI 0.260; 0.407), especially for knowledge. Effects on clinical outcomes were significant, but much smaller (g = 0.079, 95% CI 0.038; 0.120). Long-term effects were maintained for all outcomes except for behavior. Serious games are best individually tailored to both socio-demographic and change need information, and benefit from a strong focus on game theories or a dual theoretical foundation in both behavioral prediction and game theories. They can be effective either as a stand-alone or multi-component programs, and appeal to populations regardless of age and gender. Given that effects of games remain heterogeneous, further explorations of which game features create larger effects are needed. (Abstract)

Di Blas, N., & Paolini, P. (2014). Multi-user virtual environments fostering collaboration in formal education. *Educational Technology & Society, 17*(1), 54-69.ISSN: 1436-4522

Keywords: MUVEs; 3D virtual environments; computer-supported collaborative learning; educational benefits

This paper is about how serious games based on MUVEs in formal education can foster collaboration. More specifically, it is about a large case-study with four different programs which took place from 2002 to 2009 and involved more than 9,000 students, aged between 12 and 18, from various nations (18 European countries, Israel and the USA). These programs proved highly effective into fostering a number of transversal skills, among which collaboration (both remote and in presence), stood out as

prominent. The paper will introduce the four programs, the way they were designed to foster collaboration and the data on their impact. (Abstract)

Dieleman, H., & Husingh, D. (2006). Games by which to learn and teach about sustainable development: exploring the relevance of games and experiential learning for sustainability. *Journal of Cleaner Production, 14*(9-11), 837-847. DOI: 10.1016/j.jclepro.2005.11.031

Keywords: games and simulations in education; learning through simulations; simulations for teaching sustainability

This paper discusses the roles of games in experiential learning for sustainability. It includes applied emphases upon four topics: (1) The challenges of sustainable development education with the need for interdisciplinarity, knowledge, skills and attitudinal training and with a special focus upon the urgent needs for paradigm, context and practice changes to help ensure that we make progress toward sustainable societies. We emphasize that these characteristics challenge existing teaching and educational philosophies and methods. (2) The theory of experiential learning, as developed by David Kolb in the nineteen eighties. We underscore that experiential learning is a good model for education for sustainability. (3) The usefulness of games as tools in learning processes. Various aspects of games are discussed such as the 'functions of games' and 'the different categories of games,' and 'the role of games in learning and particular in experiential learning.' These three aspects form the theoretical part of the paper. (4) Brief reviews of some illustrative games. The authors provide practical advice on how to play games in the context of learning for SD. They underscore facets such as the contextualization of games, technical aspects of playing games and the debriefing after the games have been played. The authors conclude the paper with conclusions that games are potentially relevant in all of the four learning phases of experiential learning. Games are especially relevant in phase four. In this phase games can contribute to helping learners to effect shifts in their personal paradigms, context and practice that are needed for sustainable development. The final conclusion is that many games exist and have been proven to be helpful. Educators are invited to change their curricula to facilitate usage of games as integral components of their educational philosophy tools and practice. (Abstract)

Dobrescu, L., Greiner, B., & Motta, A. (2015). Learning economics concepts through game-play: An experiment. *International Journal of Educational Research, 69*, 23-37. DOI: 10.1016/j.ijer.2014.08.005

Keywords: economics education; new teaching methods; video-game; experiment

This paper introduces a video-game designed to support teaching introductory economics at undergraduate level. In order to test its effectiveness compared to traditional textbook learning we designed a laboratory experiment. Results show no evidence that playing the video-game leads to lower exam performance than reading a textbook, neither for multiple-choice nor for essay questions. We also find no gender bias and no effect of announcing the test prior to the learning task or thereafter. However, game behavior appears to be related to test performance, and differently so for different types of learning. Students perceive the two learning tools similarly in terms of understanding requirements or usefulness, but enjoyed the video-game considerably more.

Interestingly, although women enjoyed the game less than men, they do not differ in their test performance. (Abstract)

Dominguez, A., Saenz-de-Navarrete, J., de-Marcos, L., Fernandez-Sanz, L., Pages, C., & Martinez-Herraiz, J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education, 63*, 380-392.DOI: 10.1016/j.compedu.2012.12.020

Keywords: gamification; games-based learning; computer game; game mechanic; motivation; engagement; e-learning

Gamification is the use of game design elements and game mechanics in non-game contexts. This idea has been used successfully in many web based businesses to increase user engagement. Some researchers suggest that it could also be used in web based education as a tool to increase student motivation and engagement. In an attempt to verify those theories, we have designed and built a gamification plugin for a well-known e-learning platform. We have made an experiment using this plugin in a university course, collecting quantitative and qualitative data in the process. Our findings suggest that some common beliefs about the benefits obtained when using games in education can be challenged. Students who completed the gamified experience got better scores in practical assignments and in overall score, but our findings also suggest that these students performed poorly on written assignments and participated less on class activities, although their initial motivation was higher. (Abstract)

Dormann, C., & Biddle, R. (2009). A review of humor for computer games: Play, laugh and more. *Simulation & Gaming, 40*(6), 802-824. DOI: 10.1177/1046878109341390

Keywords: affective learning; fun; communication; computer games; game design; game mechanics; game-play; humor; incongruity; laughter; learning; player experience; relief; serious games; social presence; superiority

Computer games are now becoming ways to communicate, teach, and influence attitudes and behavior. In this article, we address the role of humor in computer games, especially in support of serious purposes. We begin with a review of the main theories of humor, including superiority, incongruity, and relief. These theories and their interrelationships do well in helping us understand the humor process, but they have been developed in the context of traditional human activity. To explore how they relate to computer games, we present the findings of a qualitative study of player experience of humor and show how it relates to the theoretical perspectives. We then review the main functions of humor, especially its effects on social, emotional, and cognitive behavior. We show how each of these functions can be used in game design to support the specific experiences and outcomes of game-play. Finally, we address the issue of serious games and make suggestions on how humor can inform and support the design of those games. We suggest that humor can support design by smoothing and sustaining the game mechanics. Moreover, games can draw on the functions of humor in the real world for enhancing communication, learning, and social presence. Using humor makes games richer and more powerful, as well as fun. (Abstract)

Dubbels, B. (2013). Gamification, serious games, ludic simulation and other contentious categories. *International Journal of Gaming and Computer-Mediated Simulations, 5*(2), 1-19. DOI: 10.4018/jgcms.2013040101

Keywords: gamification; serious games; ludic simulation; contentious categories; productivity software; entertainment; cognitive feature analysis; game play structure; game abandonment

This paper provides a conceptual framework for gamification, ludic simulations, and serious games. Central to this framework is the spectrum of design that differentiates work and play. Work and play help define software in purpose as games, productivity software, and entertainment. These categories are informed through cognitive feature analysis of narrative and game play structure. Both can be analyzed to determine the degree of work or play in an activity, as well as issues that influence sustained engagement, which is essential for avoiding game abandonment. To demonstrate the framework for the design and analysis of gamification, ludic simulations, and serious games, several case studies are presented with feature analysis to substantiate the categories. (Abstract)

Duin, H., & Thoben, K.-D. (2014). *The construction of serious games supporting creativity in student labs*. Paper presented at the 5th International Conference, Serious Games Development and Applications, Berlin, Germany. DOI: 10/1007/978-3-319-11623-5_17

Keywords: computer aided instruction; educational institutions; laboratories; management education; serious games (computing); serious games; student labs; student creativity; industrial engineering and management; creativity supporting techniques; creativity inspiring element extraction; online multiplayer engine

Solving challenges and complexities of today's businesses, organizational members need to come up with creative solutions that arise from joint ideation which harnesses the combined knowledge and abilities of people with different perspectives. Integrated to the creativity process is the act of play. Playing is considered as a powerful mechanism to support creativity, encourage exploration, inspire thinking out of the box and support cooperation and collaboration. Creativity is also the cornerstone of innovation and new product development generating a flow of new ideas ensuring not to stay behind of competitors in today's economic world characterized by high volatility and increasingly complex, fast-paced change.In a lecture given at the University of Bremen master degree students of industrial engineering and management were introduced to diverse creativity supporting techniques with the goal to extract creativity inspiring elements of the various techniques to be used in Serious Games constructed by those students using a given online multiplayer engine. This paper reports on the outcomes and discusses approach and results. (Abstract)

Ebner, M., & Holzinger, A. (2007). Successful implementation of user-centered game based learning in higher education: An example from civil engineering. *Computers & Education*, 49(3), 873-890. DOI: 10.1016/j.compedu.2005.11.026

Keywords: game-based learning; e-Learning; human-computer interaction; usability; civil engineering; structural concrete; theory of structures

The use of an online game for learning in higher education aims to make complex theoretical knowledge more approachable. Permanent repetition will lead to a more in-depth learning. The objective of this research was to gain insight into whether and to what extent, online games have the potential to contribute to student learning in higher education. The online game was used for the first time during a lecture on Structural Concrete at Master's level, involving 121 seventh semester students. A Pre-test/post-test experimental control group design with questionnaires and an independent online evaluation was used. The minimum learning result of playing the game was equal to that achieved with traditional methods. A factor called "joy" was introduced, according to [Nielsen, J. (2002): User empowerment and the fun factor. In Jakob Nielsen's Alertbox, July 7, 2002. Available from http://www.useit.com/alertbox/20020707.html.], which was amazingly high. The experimental findings support the efficacy of game playing. Students enjoyed this kind of e-learning.

Echeverría, A., Barrios, E., Nussbaum, M., Améstica, M., & Leclerc, S. (2012). The atomic intrinsic integration approach: A structured methodology for the design of games for the conceptual understanding of physics. *Computers & Education, 59*(2), 806-816. DOI: 10.1016/j.compedu.2012.03.025

Keywords: simulations; improving classroom teaching; interactive learning environments

Computer simulations combined with games have been successfully used to teach conceptual physics. However, there is no clear methodology for guiding the design of these types of games. To remedy this, we propose a structured methodology for the design of conceptual physics games that explicitly integrates the principles of the intrinsic integration approach for designing instructional games (Habgood & Ainsworth, 2011) with an atomic analysis of the structure of games (Cook, 2007; Cousins, 2005; Koster, 2005). To test this approach, we redesigned an existing game to teach electrostatics and compared the educational effectiveness of the original and redesigned versions. Our studies also compared an endogenous fantasy version of the game with a non-fantasy version. Our results showed that students who played the game which had been redesigned using the Atomic Intrinsic Integration Approach achieved a statistically significant improvement in results and showed fewer conceptual problems than the students who played the original version. The fantasy and non-fantasy versions, however, did not display any significant differences in outcomes. Based on the analysis and redesign of the game, we defined one possible methodology to assist in the design of games for the conceptual understanding of physics. (Abstract)

Eearp, J., Ott, M., Romero, M., & Usart, M. (2014). Supporting human capital development with serious games: An analysis of three experiences. *Computers in Human Behavior, 30*, 715-720. DOI: 10.1016/j.cnb.2013.09.004

Keywords: human capital development; serious games; formal educational settings; formal learning context; SG-based educational experiences; European countries; Italy; Spain; Romania; cognitive standpoint; affective-behavioural standpoint

Serious Games (SGs) are increasingly being used in formal educational settings and it is almost universally acknowledged that they have strong potential for bringing innovation to education and for enhancing learning, this way also contributing to the development of Human Capital. This paper proposes some reflections on the usefulness and effectiveness of SGs when used in formal learning contexts. The considerations are derived from a set of SG-based educational experiences carried out

in three European countries: Italy, Spain and Romania. The paper briefly summarizes the key aspects of the three research experiences and, by referring to the main lessons learnt, it also draws some general conclusions as to the potential of SGs to support the development of Human Capital both from the cognitive and from the affective/behavioural standpoint. (Abstract)

Eichenbaum, A., Bavlier, D., & Green, S. (2014). Video games: Play that can do serious good. *American Journal of Play, 7*(1), 50-72.

Keywords: skills; cognitive ability; teaching; behavior; studies; animal cognition; design; dopamine; brain research; play; computer & video games; electronic games; psychologists

The authors review recent research that reveals how today's video games instantiate naturally and effectively many principles psychologists, neuroscientists, and educators believe critical for learning. A large body of research exists showing that the effects of these games are much broader. In fact, some types of commercial games have been proven to enhance basic perceptual and cognitive skills. These effects are significant enough that educators use these games for such practical, real-world purposes as training surgeons and rehabilitating individuals with perceptual or cognitive deficits. Although many individuals may still consider video games nothing more than mindless fun, the authors argue that games serve also as serious tools for good. (Abstract)

Enah, C., Piper, K., & Moneyham, L. (2015). Qualitative evaluation of the relevance and acceptability of a web-based HIV prevention game for rural adolescents. *Journal of Pediatric Nursing, 30*(2), 321-328. DOI: 10.1016/j.pedn.2014.09.004

Keywords: adolescent health; gaming interventions; sexual health; HIV prevention; rural health; qualitative research; serious games; minority health; health disparities

African Americans in the rural Southern United States continue to experience disproportionate increases in new HIV/AIDS infections. Electronic gaming interventions hold promise but the use of HIV prevention games is limited. The purpose of this study was to assess the acceptability and relevance of a web-based HIV prevention game for African American rural adolescents. Findings from focus groups conducted with 42 participants suggested that the game was educational and somewhat entertaining but lacking in real-life scenarios and player-control. Findings are congruent with self-efficacy literature and constructivist approaches to learning. Findings have implications for gaming intervention development and further research. (Abstract)

Falloon, G. (2013). Young students using iPads: App design and content influences on their learning pathways. *Computers & Education, 68*, 505-521. DOI: 10.1016/j.compedu.2013.06.006

Keywords: iPads; apps; design; tablet; learning

The past few years have seen an array of new technological gadgets arrive on the education scene, perhaps the best known of these being Apple's i-Device range, particularly the iPad. Such devices have been described by some as ‘game changers’, and promoted as a key component to stimulating much-needed educational reform. However, history suggests the hype and rhetoric surrounding these technological innovations has failed to match the reality of their performance, in action. Some have attributed this failure to a lack of alignment by teachers of pedagogical models with the

potential of technologies, while others argue that claims made are simply unrealistic sales hype. Regardless, schools continue to be seduced by these new technologies, purchasing ever increasing amounts based on the alleged learning promises they offer their students. This study presents an innovative approach to exploring student interaction with iPad apps, and is an attempt to begin to unpack factors that affect their learning pathways, in an effort to improve the educational potential of these popular devices. It focuses specifically on design and content features of apps selected by an experienced teacher to enhance literacy, numeracy and problem-solving capabilities of her 5 year old students. Findings reveal a complex matrix of influencing factors. These include the effect of embedded pedagogical scaffolds (eg., modelling, reflection time), corrective and formative feedback, text-to-speech functionality, imposed interaction parameters, impediments (eg., web links, advertisements, buying content) and the entertainment/education balance. Arguments are made for researchers, teachers and developers to work together and adopt methodologies such as that introduced in this article, to gather data to radically improve the design of apps used by young students for learning. (Abstract)

Figueroa Flores, J. F. (2015). Using gamification to enhance second language learning. *Digital Education Review,* (27), 32-54. ISSN: E2013-9144

Keywords: gamification; second language learning; motivational theory; student engagement

One major competence for learners in the 21st century is acquiring a second language (L2). Based on this, L2 instruction has integrated new concepts to motivate learners in their pursue of achieving fluency. A concept that is adaptable to digital natives and digital immigrants that are learning a L2 is Gamification. As a pedagogical strategy, Gamification is basically new, but it has been used successfully in the business world. Gamification not only uses game elements and game design techniques in non-game contexts (Werbach & Hunter, 2012), but also empowers and engages the learner with motivational skills towards a learning approach and sustaining a relax atmosphere. This personality factor as Brown (1994) addresses is fundamental in the teaching and learning of L2. This article covers aspects regarding language, second language learning methodology and approaches, an overview of the integration of technology towards L2 instruction, Gamification as a concept, motivational theory, educational implications for integrating the strategy effectively, and current applications used. It also calls for a necessity of empirical evidence and research in regards to the strategy. (Abstract)

Filsecker, M., & Hickey, D. T. (2014). A multilevel analysis of the effects of external rewards on elementary students' motivation, engagement and learning in an educational game. *Computers & Education, 75*, 136-148. DOI: 10.1016/j.compedu.2014.02.008

Keywords: educational games; external rewards; digital badges; gamification; motivation; engagement

This study investigated the effects of external rewards on fifth graders' motivation, engagement and learning while playing an educational game. We were interested in exploring whether the feedback-rich environment of the game could mitigate the predicted negative effects of external rewards. Data of students' engagement and learning were collected and analyzed at multiple levels. A quasi-experimental design was used to examine the effect of external rewards in one group (n = 50)

compared to a control group without such rewards (n = 56). According to the results, the external rewards did not undermine students' motivation (e.g., at proximal and distal levels), however they did not foster disciplinary engagement. On the other hand, students in the reward condition showed significantly larger gains in conceptual understanding (proximal) and non-significantly larger gains in achievement (distal). These results suggest that the predicted negative consequences of external rewards may be addressed in this new generation of learning environments. Future research and contributions of the study are provided. (Abstract)

Foster, A. (2008). Games and motivation to learn science: personal identity, applicability, relevance and meaningfulness. *Journal of Interactive Learning Research, 19*(4), 597-614. URL: http://www.editlib.org/p/24259/

Keywords: 21st century; cognition; educational technology; game-based; games; gaming; science education; sciences; teaching methods; virtual environments

Game-based learning and designing has become a hot topic in educational technology. It is believed that video gaming is one way to get students engaged in learning complex and ill-structured material, holistic learning, and preparing learners for 21st century jobs. However, beyond engagement, games may also be used for learning and developing personal interest in science by utilizing the affordances for personal identity, applicability beyond the school setting and for a personal agenda, and relevance and meaningfulness of scientific practices and ideas. This article, based on the synthesis of information from the games, science education, and motivational research literatures present a focused view on how games for learning (serious games) can be designed and used for learning and developing an interest in science. The article also points in the direction of much needed research to assess the claims about games for learning. (Abstract)

Gameiro, J., Cardoso, T., & Rybarczyk. (2014). Kinect-Sign, teaching sign language to 'listeners' through a game. *Procedia Technology, 17*, 384-491. DOI: 10.1016/j.protcy.2014.10.199

Keywords: Kinect sensor; sign language; serious game; gesture recognition

The sign language is widely used by deaf people around the globe. As the spoken languages, several sign languages do exist. The way sign language is learned by deaf people may have some details to be improved, but one can state that the existing learning mechanisms are effective when we talk about a deaf child, for example. The problem arises for the non-deaf persons that communicate with the deaf persons – the so-called listeners. If, for example, one couple has a new child that turns to be deaf, these two persons find a challenge to learn the sign language. In one hand, they cannot stop their working life, especially because of this sad news turns to be more costly, on the other hand, the existing mechanisms target the deaf-persons and are not prepared for the listeners. This paper proposes a new playful approach to help these listeners to learn the sign language. The proposal is a serious game composed of two modes: School-mode and Competition-mode. The first provides a school-like environment where the user learns the letter-signs and the second provides the user an environment used towards testing the learned skills. Behind the scenes, the proposal is based on two phases: 1 – the creation of a gestures library, relying on the Kinect depth camera; and 2 – the real-time recognition of gestures, by comparing what the depth camera information to the existing gestures previously stored in the library. A prototype system, supporting only the Portuguese sign

language alphabet, was developed – the Kinect-Sign – and tested in a Portuguese Sign-Language school resulting in a joyful acceptance of the approach. (Abstract)

Garcia, L., Nussbaum, M., & Preiss, D. (2011). Is the use of information and communication technology related to performance in working memory tasks? Evidence from seventh-grade students. *Computers & Education, 57*(3), 2068-2076. DOI: 10.1016/j.compedu.2011.05.009

Keywords: working memory; visuo-spatial skills; computer use; video games; digital divide; Chile

The main purpose of this study was to assess whether seventh-grade students use of information and communication technology (ICT) was related to performance on working memory tasks. In addition, the study tested whether the relationship between ICT use and performance on working memory tasks interacted with seventh-grade students' socioeconomic level and gender. 275 students recruited from 30 Chilean schools were grouped according to their self-reported use of PC, the Internet, Chat and Video games. To assess students' working memory performance, they were tested with a digit span test and a visuo-spatial measure. Only one of our two dependent variables reflected a relationship between specific profiles of ICT use and working memory. Higher scores on the digits span test were related to those user profiles combining PC use and video game play, that is, those identified as Full users and as PC and Console Gamers. We did not find an interaction effect of gender and ICT use or an interaction effect of socioeconomic level and ICT use. There are three possible explanations for these results: first, a proclivity of students with higher working memory capacity to engage in technology use; second, an impact on working memory of potential differences in multitasking; and, third, an impact on working memory of video game play. However, these results must be interpreted cautiously since scores on the GEFT, our visuo-spatial working memory measure, were not related to any profile of technology use. As serious educational games become more regularly used at school, previous differences in video game experience become growingly important. Future research must study whether the intended benefits of serious educational games are being mediated by individual differences in previous exposure to video games and other information and computer technologies, with independence of the directionality of the relationship between video game play and working memory. (Abstract)

Gauthier, A., Corrin, M., & Jenkinson, J. (2015). Exploring the influence of game design on learning and voluntary use in an online vascular anatomy study aid. *Computers & Education, 87*, 24-34. DOI: 10.1016/j.compedu.2015.03.017

Keywords: serious games; interactive learning environments; media in education; teaching/learning strategies; computer-mediated communication

This research explores the educational impact of an online study aid-game for studying human vascular anatomy (n = 24) versus a similar non-game study aid (n = 22) and how it relates to medical students' demographic traits and voluntary use over a 35-day period. Hierarchical linear regression models revealed that study aid success rate (a metric for assessing performance through the study aids) was a significant predictor of anatomy test improvement with the game (β = 0.41, p = 0.05), but not for the non-game (β = 0.14, p = 0.56). Our analyses suggest that game mechanics encouraged more specific problem-solving strategies than did the control study aid, leading to greater predictability of learning outcomes. There was a non-significant trend among game treatment

participants, who were more likely to complete study tasks than those assigned to the control treatment (p = 0.11). It would appear that students' studying habits had the greatest influence (though opposite in both tools) on level of engagement in study aid use. However, contrary to expectations, self-reported gaming habits did not impact participation. Overall, these findings support the integration of game design into undergraduate study aids as a means of increasing use of supplementary educational tools and assessing knowledge. (Abstract)

Giannakos, M. N. (2013). Enjoy and learn with educational games: Examining factors affecting learning performance. *Computers & Education, 68*, 429-439. DOI: 10.1016/j.compedu.2013.06.005

Keywords: media in education; secondary education; learning communities; evaluation of CAL systems

Educational games have enhanced the value of instruction procedures in institutions and business organizations. Factors that increase students' adoption of learning games have been widely studied in past; however, the effect of these factors on learners' performance is yet to be explored. In this study, factors of Enjoyment, Happiness, and Intention to Use were chosen as important attitudes in learning educational games and increasing learning performance. A two-step between group experiment was conducted: the first study compared game-based learning and traditional instruction in order to verify the value of the game. 41 Gymnasium (middle school) students were involved, and the control and experimental groups were formed based on a pretest method. The second study, involving 46 Gymnasium students, empirically evaluates whether and how certain attitudinal factors affect learners' performance. The results of the two-part experiment showed that a) the game demonstrated good performance (as compared to traditional instruction) concerning the gain of knowledge, b) learners' enjoyment of the game has a significant relation with their performance, and c) learners' intention to use and happiness with the game do not have any relation with their performance. Our results suggest that there are attitudinal factors affecting knowledge acquisition gained by a game. (Abstract)

Giessen, H. W. (2015). Serious games effects: An overview. *Procedia - Social and Behavioural Sciences, 174*, 2240-2244. DOI: 10.1016/j.sbspro.2015.01.881

Keywords: serious games; e-learning; media effects; language learning

“Games und Gamification” were declared by the “New Media Consortium” as one of the important trends in E-Leanring for the near future. If the NMC's assumptions are correct, we need a discussion on whether Games, especially so-called “Serious Games” indeed help in learning. The paper wants to give an overview on the state-of-the-art of what can be expected by Serious Games, according to the research already done. (Abstract)

Girard, C., Ecalle, J., & Magnan, A. (2013). Serious games as new educational tools: how effective are they? A meta-analysis of recent studies. *Journal of Computer Assisted Learning, 29*, 207-219. DOI: 10.1111/j.1365-2729.2012.00489x

Keywords: engagement; learning effect; serious game; video games

Computer-assisted learning is known to be an effective tool for improving learning in both adults and children. Recent years have seen the emergence of the so-called 'serious games (SGs)' that are flooding the educational games market. In this paper, the term 'serious games' is used to refer to video games (VGs) intended to serve a useful purpose. The objective was to review the results of experimental studies designed to examine the effectiveness of VGs and SGs on players' learning and engagement. After pointing out the varied nature of the obtained results and the impossibility of reaching any reliable conclusion concerning the effectiveness of VGs and SGs in learning, we stress the limitations of the existing literature and make a number of suggestions for future studies. (Abstract)

Goldberg, B., & Cannon-Bowers, J. (2015). Feedback source modality effects on training outcomes in a serious game: Pedagogical agents make a difference. *Computers in Human Behavior, 52*, 1-11.DOI: 10.1016/j.chb.2015.05.008

Keywords: intelligent tutoring systems; explicit feedback; pedagogical agents; generalized intelligent framework for tutoring; game-based training; cognitive load

The aim of this research is to enhance game-based training applications to support educational events in the absence of live instruction. The overarching purpose of the presented study was to explore available tools for integrating intelligent tutoring communications in game-based learning platforms and to examine theory-based techniques for delivering explicit feedback in such environments. The primary tool influencing the design of this research was the open-source Generalized Intelligent Framework for Tutoring (GIFT), a modular domain-independent architecture that provides the tools and methods to author, deliver, and evaluate intelligent tutoring technologies within any instructional domain. Influenced by research surrounding social cognitive theory and cognitive load theory, the resulting experiment tested varying approaches for utilizing an Embodied Pedagogical Agent (EPA) to function as a tutor during interaction in a game-based training environment. Conditions were authored to assess the tradeoffs between embedding an EPA directly in a game, embedding an EPA in GIFT's browser-based Tutor–User Interface (TUI), or using audio prompts alone with no social grounding. The resulting data supported the application of using an EPA embedded in GIFT's TUI to provide explicit feedback during a game-based learning event. Analyses revealed conditions with an EPA situated in the TUI to be as effective as embedding the agent directly in the game environment. (Abstract)

González, C. S., Gómez, N., Navarro, V., Cairós, M., Quirce, C., Toledo, P., & Marrero-Gordillo, N. (2016). Learning healthy lifestyles through active videogames, motor games and the gamification of educational activities. *Computers in Human Behavior, 55*, 529-551. DOI: 10.1016/j.chb.2015.08.052

Keywords: informal learning; healthy lifestyles; active video games; motor play; gamification in education; obesity and overweight

The World Health Organization (WHO) has declared obesity as a 21st-century epidemic after reaching global proportions. In Spain, this disease is suffered by 62% of the population, leading to the emergence of new health problems. Increasing childhood obesity in the world is a direct result of changes in the lifestyles of the population. Therefore, in this paper we present a gamification training program to prevent childhood obesity based on motor games, and active videogames

developed for overweight children ages 8–12. The design of the program consisted of: group sessions in a school setting, individual sessions at home for the children, and developing healthy habits to help families. The motivation and the effectiveness of the gamification training program were studied. The results involving biometric variables, learning healthy habits and experience in the intervention were highly satisfactory. (Abstract)

Gotterbarn, D. (2013). Serious games: Learning why professionalism matters can be fun. *ACM Inroads, 4*(2). DOI: 10.1145/2465085.2465091

Keywords: computer aided instruction; computer science education; professional aspects; serious games (computing); software engineering; software management; serious games ; learning; computer science; serious sustainability games; software system design; software system development; software system management; professional responsibility; computer games

Many students are first attracted to computer science by gaming. At a recent sustainability conference, a student poster on "Serious Sustainability Games" caught my attention. The author think we can make use of "serious games" to help students understand responsible design, development and management of software systems. In this column, however, the author have something positive to say about computer games. The author think we can use "serious games" to help dissuade students of a cavalier dichotomy used to justify unprofessional and irresponsible approaches to software. At the same time, we can add some fun to learning about professional responsibility. There is a special class of games - "serious games" - for which such a cavalier attitude is obviously mistaken, for such a cavalier approach is clearly dangerous in serious games. (Abstract)

Greitzer, F. L., Kuchar, O. A., & Huston, K. (2007). Cognitive science implications for enhancing training effectiveness in a serious gaming context. *Journal on Educational Resources in Computing, 7*(3). DOI: 10.1145/1281320.1281322

Keywords: serious gaming; cognitive principles; computer-based training; cyber security education; training effectiveness

Serious games use entertainment principles, creativity, and technology to meet government or corporate training objectives, but these principles alone will not guarantee that the intended learning will occur. To be effective, serious games must incorporate sound cognitive, learning, and pedagogical principles into their design and structure. In this paper, we review cognitive principles that can be applied to improve the training effectiveness in serious games and we describe a process we used to design improvements for an existing game-based training application in the domain of cyber security education. (Abstract)

Guillén-Nieto, V., & Aleson-Carbonell, M. (2012). Serious games and learning effectiveness: The case of 'It's a Deal!'. *Computers & Education, 58*(1), 435-448. DOI: 10.1016/j.compedu.2011.07.015

Keywords: adult learning; cross-cultural projects; interactive learning environments; interdisciplinary projects; simulations

Although the value of serious games in education is undeniable and the potential benefits of using video games as ideal companions to classroom instruction is unquestionable, there is still little consensus on the game features supporting learning effectiveness, the process by which games engage learners, and the types of learning outcomes that can be achieved through game play. Our aim in this discussion is precisely to advance in this direction by providing evidence of some of the factors influencing the learning effectiveness of a serious game called *It's a Deal!* This serious game was created for the purpose of teaching intercultural business communication between Spaniards and Britons in business settings in which English is used as the *lingua franca*. This paper hypothesizes that the immersive, all-embracing and interactive learning environment provided by the video game to its users may contribute to develop and enhance their intercultural communicative competence. The study attempts to answer three main research questions: (a) after playing *It's a Deal!*, did the students sampled improve their intercultural awareness, intercultural knowledge and intercultural communicative competence in business English? (b) If they improved their intercultural learning, what are the factors influencing such improvement? And (c) if they did not improve their intercultural learning, what are the factors influencing such failure? The game participants who volunteered to take part in the study were all students of English Studies at the University of Alicante in the academic year 2010–2011. One hundred and six students completed both the pre-test and the post-test questionnaires, and played *It's a Deal!* A sample of fifty students was selected randomly for the empirical study. The results obtained in the tests performed were compared and contrasted intra-group, both qualitatively and quantitatively, for the purpose of finding any statistically significant difference that may confirm whether or not there was an improvement in the students' intercultural communicative competence in business English as a result of the implementation of the *It's a Deal!* serious game. Findings of this study demonstrate that the video game is an effective learning tool for the teaching of intercultural communication between Spaniards and Britons in business settings in which English is used as the *lingua franca*. In particular, whereas the game had a small learning effect on intercultural awareness and a medium learning effect on intercultural knowledge, it had a large learning effect on intercultural communicative competence. The study also documents correlating factors that make serious games effective, since it shows that the learning effectiveness of *It's a Deal!* stems from the correct balance of the different dimensions involved in the creation of serious games, specifically instructional content, game dimensions, game cycle, debriefing, perceived educational value, transfer of learnt skills and intrinsic motivation. (Abstract)

Gunter, G., Kenny, R. F., & Vick, E. H. (2006). A case for a formal design paradigm for serious games. *The Journal of the International Digital Media and Arts Association, 3*(1), 93-105. URL: http://idmaa.org/?journalarticle=v3n1-a-case-for-a-formal-design-paradigm-for-serious-games

Keywords: serious games; serious game design; game design; instructional strategies; instructional design; design formalism; educational rubric

We are witnessing a mad rush to pour educational content into games in an ad hoc manner in hopes that players are motivated to learn simply because the content is housed inside a game. A failure to base serious game design on well-established learning theories as proposed by well respected educators like Robert Gagne and James Keller, increases the risk of the game failing to meet its intended educational goals, yielding a player base who is entertained but who have not acquired

new skills or knowledge. Well-developed video games certainly engage players, but games designated as educational are not always based on sound educational principles and theories, thereby potentially losing power as an educational tool. We contend that if content learning is to take place as a result of playing serious games, a new design paradigm design must be developed. We also contend that educational effectiveness needs to be integrated as a goal from the start of the design process and that sound educational practices need to be formally incorporated into all serious games. (Abstract)

Hall, L., Jones, S. J., Aylett, R., Hall, M., Tazzyman, S., Paiva, A., & Humphries, L. (2013). Serious game evaluation as a meta-game. *Interactive Technology and Smart Education, 10*(2), 130-146. DOI: 10.1108/ITSE-02-2013-0003

Keywords: computer software; learning methods; serious games; evaluation methods

This paper aims to briefly outline the seamless evaluation approach and its application during an evaluation of ORIENT, a serious game aimed at young adults. Design/methodology/approach - In this paper, the authors detail a unobtrusive, embedded evaluation approach that occurs within the game context, adding value and entertainment to the player experience whilst accumulating useful data for the development team. Findings - The key result from this study was that during the "seamless evaluation" approach, users were unaware that they had been participating in an evaluation, with instruments enhancing rather than detracting from the in-role game experience. Practical implications - This approach, seamless evaluation, was devised in response to player expectations, perspectives and requirements, recognising that in the evaluation of games the whole process of interaction including its evaluation must be enjoyable and fun for the user. Originality/value - Through using seamless evaluation, the authors created an evaluation completely embedded within the "magic circle" of an in-game experience that added value to the user experience whilst also yielding relevant results for the development team. (Abstract)

Hainey, T., Connolly, T., Stansfield, M., & Boyle, E. A. (2011). Evaluation of a game to teach requirements collection and analysis in software engineering at tertiary education level. *Computers & Education*, 56(1), 21-35. DOI: 10.1016/j.compedu.2010.09.008

Keywords: games-based learning; software engineering; requirements collection and analysis; evaluation; pedagogy

A highly important part of software engineering education is requirements collection and analysis which is one of the initial stages of the Database Application Lifecycle and arguably the most important stage of the Software Development Lifecycle. No other conceptual work is as difficult to rectify at a later stage or as damaging to the overall system if performed incorrectly. As software engineering is a field with a reputation for producing graduates who are inappropriately prepared for applying their skills in real life software engineering scenarios, it suggests that traditional educational techniques such as role-play, live-through case studies and paper-based case studies are insufficient preparation and that other approaches are required. To attempt to combat this problem we have developed a games-based learning application to teach requirements collection and analysis at tertiary education level as games-based learning is seen as a highly motivating, engaging form of media and is a rapidly expanding field. This paper will describe the evaluation of the requirements

collection and analysis game particularly from a pedagogical perspective. The game will be compared to traditional methods of software engineering education using a pre-test/post-test, control group/experimental group design to assess if the game can act as a suitable supplement to traditional techniques and assess if it can potentially overcome shortcomings. The game will be evaluated in five separate experiments at tertiary education level. (Abstract)

Hainey, T., Westera, W., Connolly, T., Boyle, E. A., Baxter, G., Beeby, R. B., & Soflano, M. (2013). Students' attitudes toward playing games and using games in education: Comparing Scotland and the Netherlands. *Computers & Education*, 69, 474-484. DOI: 10.1016/j.compedu.2013.07.023

Keywords: computer games; empirical evidence; motivations; comparative study; education

Games-based learning has captured the interest of educationalists and industrialists who seek to exploit the characteristics of computer games as they are perceived by some to be a potentially effective approach for teaching and learning. Despite this interest in using games-based learning there is a dearth of empirical evidence supporting the validity of the approach covering the wider context of gaming and education. This study presents a large scale gaming survey, involving 887 students from 13 different Higher Education (HE) institutes in Scotland and the Netherlands, which examines students' characteristics related to their gaming preferences, game playing habits, and their perceptions and thoughts on the use of games in education. It presents a comparison of three separate groups of students: a group in regular education in a Scottish university, a group in regular education in universities in the Netherlands and a distance learning group from a university in the Netherlands. This study addresses an overall research question of: Can computer games be used for educational purposes at HE level in regular and distance education in different countries? The study then addresses four sub-research questions related to the overall research question:

What are the different game playing habits of the three groups?

What are the different motivations for playing games across the three groups?

What are the different reasons for using games in HE across the three groups?

What are the different attitudes towards games across the three groups?

To our knowledge this is the first in-depth cross-national survey on gaming and education. We found that a large number of participants believed that computer games could be used at HE level for educational purposes and that further research in the area of game playing habits, motivations for playing computer games and motivations for playing computer games in education are worthy of extensive further investigation. We also found a clear distinction between the views of students in regular education and those in distance education. Regular education students in both countries rated all motivations for playing computer games as significantly more important than distance education students. Also the results suggest that Scottish students aim to enhance their social experience with regards to competition and cooperation, while Dutch students aim to enhance their leisurely experience with regards to leisure, feeling good, preventing boredom and excitement. (Abstract)

Halpern, D. F., Millis, K., Graesser, A., Butler, H., Forsyth, C., & Cai, Z. (2012). Operation ARA: A computerised learning game that teaches critical thinking and scientific reasoning. *Thinking Skills and Creativity, 7*(2), 93-100. DOI: 10.1016/j.tsc.2012.03.006

Keywords: computerized learning; critical thinking; scientific reasoning; science of learning; learning games; serious games

Operation ARA (Acquiring Research Acumen) is a computerized learning game that teaches critical thinking and scientific reasoning. It is a valuable learning tool that utilizes principles from the science of learning and serious computer games. Students learn the skills of scientific reasoning by engaging in interactive dialogs with avatars. They are tutored by avatars with tutoring sessions that vary depending on how well students have responded to questions about the material they are learning. Students also play a jeopardy-like game against a feisty avatar to identify flaws in research and then generate their own questions to determine the quality of different types of research. The research examples are taken from psychology, biology, and chemistry to help students transfer the thinking skills across domains of knowledge. Early results show encouraging learning gains. (Abstract)

Hämäläinen, R., Oksanen, K., & Häkkinen, P. (2008). Designing and analyzing collaboration in a scripted game for vocational education. *Computers in Human Behavior, 24*(6), 2496-2506. DOI: 10.1016/j.chb.2008.03.010

Keywords: learning games; collaborative learning

This study attempts to combine the technological possibilities of 3D-game environments and collaborative learning scripts. The study is a design experiment (N = 64) with multiple data collection and analysis (quantitative and qualitative) methods. The aims were twofold: The aim was to develop a game environment to simulate issues of work safety in a vocational context and to answer the following questions on the basis of an empirical study: (1) What kind of activities did the scripted game environment generate among the players? (2) How did the least and the most successful groups differ in this respect despite the same scripted game environment? Findings indicated that scripted game environment enriched the learning activities by enabling aspects that would not have been possible in traditional classroom settings. The scripted game environment also helped the players proceed in the different phases. However, the groups differed in terms of results in the test, collaboration processes, and the type and quantity of discussion. Especially discussion differed between the groups with highest and lowest test scores. (Abstract)

Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Asbell-Clarke, J., & Edwards, T. (2016). Challenging games help students learn: An empirical study on engagement, flow and immersion in game based learning. *Computers in Human Behavior, 54*, 170-179. DOI: 10.1016/j.chb.2015.07.045

Keywords: game-based learning; gamification; serious games; flow experience; engagement; immersion

In this paper, we investigate the impact of flow (operationalized as heightened challenge and skill), engagement, and immersion on learning in game-based learning environments. The data was gathered through a survey from players (N = 173) of two learning games (Quantum Spectre: N = 134 and Spumone: N = 40). The results show that engagement in the game has a clear positive effect on

learning, however, we did not find a significant effect between immersion in the game and learning. Challenge of the game had a positive effect on learning both directly and via the increased engagement. Being skilled in the game did not affect learning directly but by increasing engagement in the game. Both the challenge of the game and being skilled in the game had a positive effect on both being engaged and immersed in the game. The challenge in the game was an especially strong predictor of learning outcomes. For the design of educational games, the results suggest that the challenge of the game should be able to keep up with the learners growing abilities and learning in order to endorse continued learning in game-based learning environments. (Abstract)

Hansbol, M., & Meyer, B. (2011). Shifting ontologies of a serious game and its relationship with English education for beginners. *E-learning and Digital Media, 8*(3), 228-246. DOI: 10.2304/elea.2011.8.3.228

Keywords: English (second language); second language instruction; simulated environment; role; world views; educational technology; teaching methods; educational philosophy; learning activities; foreign countries; learner engagement; access to computers

This article takes as its point of departure a language project which is a subproject under the larger ongoing (2007-2011) research project Serious Games on a Global Market Place. The language project follows how the virtual universe known as Mingoville (http://www.mingoville.com) becomes an actor in English education for beginners. The virtual universe provides an online environment for students beginning to learn English in schools and at home. This article will focus on the shifting ontologies of Mingoville and teaching and learning situations in beginners' English. It takes as its point of departure neither Mingoville as part of the media ecologies of the classroom, nor the epistemological ramifications of Mingoville. Instead, it suggests that opening up the shifting ontologies of Mingoville (i.e. what mediates Mingoville and its relationships with doing beginners' English) may offer a different and useful approach to understanding how Mingoville becomes a multiple actor. It reveals that such an actor both influences and is influenced by manifold constitutive entanglements involved in organizing English teaching and learning activities for beginners. Theoretically and methodologically, the article and the empirical gatherings and analysis are inspired by science and technology studies (STS) and Actor Network Theory (ANT). The arguments and descriptions provided throughout the article will focus on the shifting ontologies of Mingoville as it moves into, and out of, different teaching and learning situations of English for beginners. (Abstract)

Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education, 80*, 152-161. DOI: 10.1016/j.compedu.2014.08.019

Keywords: virtual reality; improving classroom teaching; human-computer interface; interactive learning environments; teaching strategies

Gamification, the application of game elements to non-game settings, continues to grow in popularity as a method to increase student engagement in the classroom. We tested students across two courses, measuring their motivation, social comparison, effort, satisfaction, learner empowerment, and academic performance at four points during a 16-week semester. One course

received a gamified curriculum, featuring a leaderboard and badges, whereas the other course received the same curriculum without the gamified elements. Our results found that students in the gamified course showed less motivation, satisfaction, and empowerment over time than those in the non-gamified class. The effect of course type on students' final exam scores was mediated by students' levels of intrinsic motivation, with students in the gamified course showing less motivation and lower final exam scores than the non-gamified class. This suggests that some care should be taken when applying certain gamification mechanics to educational settings. (Abstract)

Harteveld, C., Guimaraes, R., Mayer, I., & Bidarra, R. (2010). Balancing play, meaning and reality: The design philosophy of LEVEE PATROLLER. *Simulation & Gaming, 41*(3), 316-340. DOI: 10.1177/1046878108331237

Keywords: computer-based simulation; design philosophy; digital games; serious games; flood risk management; game design; levee inspection

Most serious games have been developed without a proper and comprehensive design theory. To contribute to the development of such a theory, this article presents the underlying design philosophy of LEVEE PATROLLER, a game to train levee patrollers in the Netherlands. This philosophy stipulates that the design of a digital serious game is a multiobjective problem in which trade-offs need to be made. Making these trade-offs takes place in a design space defined by three equally important components: (a) Play, (b) Meaning, and (c) Reality. The various tensions between these three components result in design dilemmas and trilemmas that make it difficult to balance a serious game. Each type of tension is illustrated with one or more examples from the design of LEVEE PATROLLER. (Abstract)

Hauge, J. B., & Riedel, J. C. K. H. (2012). Evaluation of Simulation Games for Teaching Engineering and Manufacturing. *Procedia Computer Science*, 15, 210-220. DOI: 10.1016/j.procs.2012.10.073

Keywords: serious games; evaluation; evaluation methods; engineering; manufacturing

This paper reports on the evaluation methods and findings from serious games for teaching engineering and manufacturing. Two serious games are considered: Cosiga, a new product development simulation game and Beware, a risk management simulation game. These two games cover the front and middle parts of the engineering process – from design to manufacture to sale. For the Cosiga simulation evaluations of the communication and cognitive change were performed. For the Beware game evaluation of communication, risk awareness and improvement of risk management skills were performed The findings from the evaluations showed that serious games deliver learning outcomes. However, there are drawbacks to their use that need to be taken into account. Principally the high cost of development and the need for expert facilitators for running game sessions. (Abstract)

Hauser, F., Leich, A., & Schiffer, K. (2013). Facing the challenge: Evaluation of serious games. *Journal for Interactive and Cooperative Media, 12*(2), 32-38. DOI: 10.1515/icom.2013.0014

Keywords: serious games (computing); serious games evaluation; education application; serious games design; serious games assessment; health application

This paper gives an overview about the current academic research state of the art in the field of serious games. We illustrate issues concerning the concept of serious games which are games that claim to be more than just entertainment and pursue the serious aim to transfer knowledge in a playful way. We present application areas such as military, health or education and identify new trends within the field. An overview of the positive impacts on the players' development by playing such games is given as well. As there is still not enough empirical evidence on the effectiveness of serious games we present some promising approaches for the design and assessment of serious games. We conclude that more experimental studies have to be conducted which already have to be considered at the very beginning of the design process. (Abstract)

Hendrix, M., Backlund, P., & Vampula, B. (2014). A rating tool for sharing experiences with serious games. *International Journal of Game-Based Learning, 4*(4), 1-18. DOI: 10.4018/jgbl.2014100101

Keywords: rating tool; serious games; computer games; educational market; educational games; EduGameLab project; European school; metadata schema

The potential of Computer Games for non-entertainment purposes, such as education, is well established. A wide variety of games have been developed for the educational market, covering subjects such as mathematics and languages. However, while a growing industry developing educational games exist, the practical uptake in schools is not as high as one would expect, based on current evidence of their effectiveness. The EduGameLab project investigates causes and solutions to the relatively low level of uptake in European schools. This paper describes a rating tool for sharing experiences about educational games among educators and parents, developed in the EduGameLab project. The ambition is that sharing knowledge about how games can be used in practice will stimulate practical use and acceptance. The development of this tool is based on a metadata schema for formally describing serious games and experiences with these games. (Abstract)

Hess, T., & Gunter, G. (2013). Serious game-based and nongame-based online courses: Experiences and outcomes. *British Journal of Educational Technology, 44*(3), 372-385. DOI: 10.1111/bjet.12024

Keywords: online courses; video games; mixed methods research; student motivation; academic achievement; history instruction; learning experience; outcomes of education; time on task; self determination; high school students; secondary school teachers; interviews; educational games; student attitudes; teacher attitudes

When combining the increasing use of online educational environments, the push to use serious video games and the lack of research on the effectiveness of online learning environments and video games, there is a clear need for further investigation into the use of serious video games in an online format. A mix methods model was used to triangulate statistical and qualitative findings on student performance, completion time, student intrinsic motivation, as well as desirable, undesirable, helpful and hindering aspects of serious game-based and nongame-based courses. Students in the game-based course were found to have performed significantly better and to have taken significantly longer. Students and teachers in the game-based course provided more reasons for student motivation along with more desirable, more helpful and less hindering aspects compared to students

and teachers in the non-game-based course. In addition, students and teachers in both courses provided an equal number of undesirable aspects. The results from this study inform instructional designers, teachers, education stakeholders and educational game designers by providing research-based evidence related to the learning experiences and outcomes of the serious game-based online course. (Abstract)

Hew, K. F., Huang, B., Chu, K. W. S., & Chiu, D. K. W. (2016). Engaging Asian students through game mechanics: Findings from two experiment studies. *Computers & Education, 92-93*, 221-236. DOI: 10.1016/j.compedu.2015.10.010

Keywords: gamification; behavioral engagement; cognitive engagement; blended learning

There is an increasing interest in using game mechanics to foster user engagement in many real-world contexts. Many previous studies, however, focused on investigating user perceptions, while some experiment studies lacked control groups. Additionally, many studies in the higher education context focused on the discipline of Computer Science and Information Technology, and involved participants mainly in Europe or North America. In this paper, we report the effects of game mechanics on student cognitive and behavioral engagements through two experiment studies conducted in an Asian university. In Study 1, we employed a randomized experiment-control group design. The experiment group (n = 11) attended an education-related course on Designing Questionnaire that incorporated the use of game mechanics (points, badges, and leader board), as well as course activities informed by the Self-Determination theory of motivation. The control group (n = 11) attended the same course and activities taught by the same instructor but without the game mechanics. In a subsequent semester, we repeated the research with a larger cohort of students (Study 2) through a quasi-experiment design (n = 20 experiment, and n = 22 control group). The deployment of game mechanics produced greater student contribution in the discussion forums, but no significant difference on students' recall of factual knowledge. However, we found that the use of game mechanics had a positive effect on motivating students to engage with more difficult tasks, and that the quality of artifacts produced by participants in the experimental groups were higher than those in the control groups. (Abstract)

Hickey, D. T., Ingram-Goble, A. A., & Jameson, E. M. (2009). Designing assessments and assessing designs in virtual educational environments. *Journal of Science Education and Technology, 18*(2), 187-208. DOI: 10/1007/s10956-008-9143-1

Keywords: educational videogaming; virtual environments; formative assessment; design-based research; formative feedback

This study used innovative assessment practices to obtain and document broad learning outcomes for a 15-hour game-based curriculum in Quest Atlantis, a multi-user virtual environment that supports school-based participation in socio scientific inquiry in ecological sciences. Design-based methods were used to refine and align the enactment of virtual narrative and scientific investigations to a challenging problem solving assessment and indirectly to achievement test items that were independent of the curriculum. In study one, one-sixth grade teacher used the curriculum in two of his classes and obtained larger gains in understanding and achievement than his two other classes, which used an expository text to learn the same concepts and skills. Further treatment

refinements were carried out, and two forms of virtual formative feedback were introduced. In study two, the same teacher used the curriculum in all four of his classes; the revised curriculum resulted in even larger gains in understanding and achievement. Gains averaged 1.1 SD and 0.4 SD, respectively, with greater gains shown for students who engaged more with formative feedback. Principles for assessing designs and designing assessments in virtual environments are presented. (Abstract)

Hummel, H. G., van Houcke, J., Nadolski, R. J., van der Hiele, T., Kurvers, H. J., & Löhr, A. (2011). Scripted collaboration in serious gaming for complex learning: Effects of multiple perspectives when acquiring water management skills. *British Journal of Educational Technology, 42*(6), 1029-1041. DOI: 10.1111/j.1467-8535.2010.01122.x

Keywords: student attitudes; educational games; case method (teaching technique); vignettes; workplace learning; pilot projects; cooperative learning; skill development; computer assisted instruction; electronic learning; educational; technology; water quality; environmental education

This paper examines how learning outcomes from playing serious games can be enhanced by including scripted collaboration in the game play. We compared the quality of advisory reports that students in the domain of water management had to draw up for an authentic case problem, both before and after collaborating on the problem with (virtual) peer students. Peers studied the case from either an ecological or governance perspective, and during collaboration both perspectives had to be confronted and reflected upon. This paper argues why such type of workplace-based learning scenarios are important for professional development, describes how serious gaming scenarios can be designed to support such complex learning, and reports data on student satisfaction and learning effects of including scripted collaboration. Preliminary results from a pilot study with 12 students show that including scripted collaboration significantly enhances the quality of learning outcomes. (Abstract)

Ismailović, D., Köhler, B., Haladjian, J., Pagano, D., & Brügge, B. (2012). *Towards a conceptual model for adaptivity in serious games*. Paper presented at the IADIS International Conferences on Interfaces and Human Computer Interaction 2012 and Game Entertainment Technologies 2012, Lisbon, Portugal. URL: http://www.iadisportal.org/ihci-2012-proceedings

Keywords: intelligent tutoring systems; serious games (computing); conceptual model; serious games; virtual environments; e-learning; adaptivity approach; game elements

In serious games, learning happens intrinsically while playing and the learning process is based on exploration and experience. Serious games are based on goals, rules, challenge, and interaction with a game world based on a virtual environment. A major goal in modern serious games is to provide adaptivity to the learner. This paper presents a review of literature about adaptivity approaches in both e-Learning and serious games. We argue that the problem in adaptivity approaches for serious games is that they are based on e-learning approaches, where the adaptivity for the game environment is not related to learning content. We conclude that in adaptivity of serious games there is no approach that adapts the game environment based on learning content and that there is no connection between both. We provide a conceptual model that extends e-learning approaches with the concept of the game environment and additionally connects the game environment and game elements with learning content. (Abstract)

Jenson, J. (2007). Shifting design values: A playful approach to serious content. *E-Learning, 4*(4), 497-507. DOI: 10.2304/elea.2007.4.4.497

Keywords: intelligent tutoring systems; student teachers; teaching (occupation); ethics; legal responsibility; educational malpractice; school law; instructional design; electronic learning; content analysis; learner engagement; self-evaluation ; video games; video technology; tests; instructional effectiveness

This article documents the design and development of an online tutorial for student and practising teachers at York University, Canada, that familiarizes them with the ethical and legal aspects of teaching. In particular, it focuses on the key design decisions that were made, emphasizing how these were also deeply "pedagogical" considerations, including: (1) a modular menu and content structure which, in combination with a user-enabled progress tracking system, allows for non-linear, entirely student-directed progress through the site; (2) accessible and engaging, rather than dense and jargonistic content, redesigned around the spatial economy of the site; and (3) a series of animated legal case stories that moves content delivery from a narrowly propositional mode to one driven by narrative and play. The article concludes with a discussion of how these attempts at enacting "pedagogic interactivity"--a unity of pedagogy and design--were undermined by the introduction of an evaluative component requiring students to achieve and submit a score. The "ELSE" (Ethics and Legal Studies in Education) tutorial site illustrates what types of innovations in instructional design in what has been broadly termed "e-learning" are made possible by subverting the conventional dichotomy between content and delivery. (Abstract)

Johnson, L. W. (2010). Serious use of a serious game for language learning. *International Journal of Artificial Intelligence in Education, 20*(2), 175-195. DOI: 10.3233/JAI-2010-0006.

Keywords: game-based learning; computer-aided language learning; technology transition

The Tactical Language and Culture Training System (TLCTS) helps learners acquire basic communicative skills in foreign languages and cultures. Learners acquire communication skills through a combination of interactive lessons and serious games. Artificial intelligence plays multiple roles in this learning environment: to process the learner's speech, to interpret and evaluate learner actions, to control the response of non-player characters, to generate hints, and to assess the trainee's mastery of the skills. AI is also used in the authoring process to assist in the generation and validation of lesson content. This article gives an overview of the system, and describes the experience to date in transitioning the system from research prototype into a training system that is in regular use by tens of thousands of users in the United States and elsewhere. Experimental results from field studies are presented, relating learning outcomes, motivational effects, and the role of game-based learning and intelligent tutoring in achieving the learning outcomes. (Abstract)

Jones, C. (2007). Enterprise education: The frustration of a pure contest. *Education & Training, 49*(8), 596-604. DOI: 10.1108/00400910710834030

Keywords: education; management activities; management games; teaching aids; Australia

This paper seeks to discuss the development of a strategy game for enterprise education. It is argued that requiring students to initially struggle with the game's rules and strategies results in a

worthwhile test of their persistence and ability to manage ambiguity. Further, that in the absence of uncertainty, students will not benefit from the game's potential contribution to their overall learning. Design/methodology/approach - The paper is constructed around the infusion of student narratives and the author's self-reflective thoughts. The papers explores the process of developing a game that: provides the students with access to an enterprise reality; strengthens their engagement with the theoretical foundations of their studies; and provides a process for serious self-reflection. Findings - Despite the mixed views presented in this paper, the game's development thus far has been very successful. Students do enjoy and benefit from enduring the frustration of a pure contest. Having to work through uncertainty is a good practice for students in higher education, especially those engaged in enterprise education. Practical implications - Whilst the use of games in experiential education is not uncommon, consideration of how and why they are developed is not always well understood. This paper suggests that enterprise educators have significant opportunities to develop games that genuinely provide student access to the entrepreneur's way of life. Originality/value - This paper provides evidence of how a game can be constructed to add significant value to an existing curriculum. It also provides evidence of the inner thoughts of students frustrated by a challenge on which they refuse to give up. As such, it provides a valuable window through which to contemplate the minds of tomorrow's nascent entrepreneurs. (Abstract)

Juzeleniene, S., Mikelioniene, J., Escudeiro, P., & Vaz de Carvalho, C. (2014). GABALL Project: Serious games based language learning. *Procedia - Social and Behavioural Sciences, 136*, 350-354. DOI: 10.1016/j.sbspro.2014.05.340

Keywords: serious games; language learning; game-based learning

The European Community introduces a variance of views and approaches for common problems and issues - however it is also a barrier for companies trying to internationalize or establish joint ventures in the European market or outside of it. The use of an intermediary language, like English or German is an incomplete solution as good commercial relations always depend on full understanding and confidence between the parts. In particular, this can be a problem for Micro Enterprises (start-ups) and SMEs that do not have dedicated staff for this purpose. As a consequence, these companies still depend largely on their domestic markets despite the opportunities made available by the enlarged single market and by globalization at large. Business to Business (B to B) e-commerce and e-marketing possibilities are not being effectively exploited by these companies. This article presents an approach that seeks to address the reinforcement of Micro and SME's managers' skills in the process of internationalization to internal and external markets through electronic business platforms. Therefore, the project aims for the improvement of languages and culture skills relative to the use of e-marketing and e-commerce tools, the establishment of relations through electronically supported social platforms and the encouragement of entrepreneurship. The project methodology is based on a Serious Game approach that provide rule-based, professional, real-life situations and contexts of interaction where the player tries to achieve learning objectives and improve personal skills and social competencies. (Abstract)

Kampf, R., & Cuhadar, E. (2015). Do computer games enhance learning about conflicts? A cross-national inquiry into proximate and distant scenarios in Global Conflicts. *Computers in Human Behavior, 52*, 541-549. DOI: 10.1016/j.chb.2014.08.008

Keywords: global conflicts; Israeli-Palestinian conflict; Guatemalan civil war; active learning; knowledge acquisition from games; attitude change

Interactive conflict resolution and peace education have developed as two major lines of practice to tackle intractable inter-group conflicts. Recently, new media technologies such as social media, computer games, and online dialogue are added to the existing set of tools used for peace education. However, a debate is emerging as to how effective they are in motivating learning and teaching skills required for peace building. We take issue with this question and have conducted a study investigating the effect of different conflict contexts on student learning. We have designed a cross-national experimental study with Israeli-Jewish, Palestinian, and Guatemalan undergraduate students using the Israeli–Palestinian and Guatemalan scenarios in the computer game called "Global Conflicts." The learning effects of these scenarios were systematically analyzed using pre- and post-test questionnaires. The study indicated that Israeli-Jews and Palestinians acquired more knowledge from the Guatemalan game than Guatemalans acquired from the Israeli–Palestinian game. All participants acquired knowledge about proximate conflicts after playing games about these scenarios, and there were insignificant differences between the three national groups. Israeli-Jews and Palestinians playing the Israeli–Palestinian game changed their attitudes about this conflict, while Guatemalans playing the Guatemalan game did not change their attitudes about this case. All participants changed their attitudes about distant conflicts after playing games about these scenarios. (Abstract)

Kapralos, B., Fisher, S., Clarkson, J., & van Oostveen, R. (2015). A course on serious game design and development using an online problem-based learning approach. *Interactive Technology and Smart Education, 12*(2), 116-136. DOI: 10.1108/ITSE-10-2014-0033

Keywords: instructional design; undergraduates; problem-based learning; simulation; online; teaching methods; distance learning; video games; serious games; game design

The purpose of this paper is to describe a novel undergraduate course on serious game design and development that integrates both game and instructional design, thus providing an effective approach to teaching serious game design and development. Very little effort has been dedicated to the teaching of proper serious game design and development leading to many examples of serious games that provide little, if any, educational value. Design/Methodology/Approach: Organized around a collection of video clips (that provided a brief contextualized overview of the topic and questions for further exploration), readings, interdisciplinary research projects and games, the course introduced the principles of game and instructional design, educational theories used to support game-based learning and methods for evaluating serious games. Discussions and activities supported the problems that students worked on throughout the course to develop a critical stance and approach toward implementing game-based learning. Students designed serious games and examined potential issues and complexities involved in developing serious games and incorporating them within a teaching curriculum. Findings: Results of student course evaluations reveal that the course was fun and engaging. Students found the course fun and engaging, and through the

successful completion of the final course project, all students met all of the course objectives. A discussion regarding the techniques and approaches used in the course that were successful (or unsuccessful) is provided. Research Limitations/Implications: It should be noted that a more detailed analysis has not been presented to fully demonstrate the effectiveness of the course. A more detailed analysis may have included a comparison with, for example, past versions of the course that was not based on an online problem-based learning (PBL) approach, to better quantify the effectiveness of the course. However, such a comparison could not be carried out here, given there was no measure of prior knowledge of students taken before they took course (e.g. no "pre-test data"). Originality/Value: Unlike the few existing courses dedicated to serious game design, the course was designed specifically to facilitate a fully online PBL approach and provided students the opportunity to take control of their own learning through active research, exploration and problem-solving alone, in groups and through facilitated class discussions. (Abstract)

Kapralos, B., Hogan, M., APribetic, A. I., & Dubrowski, A. (2011). Virtual simulations and serious games in a laptop-based university: gauging faculty and student perceptions. *Interactive Technology and Smart Education, 8*(2), 106-119. DOI: 10.1108/17415651111141821

Keywords: experiential learning; laptop computers; educational technology; instructional design; college instruction; instructional effectiveness; student surveys; computer simulation; educational games; simulated environments; teacher attitudes; college faculty; college students

Gaming and interactive virtual simulation environments support a learner-centered educational model allowing learners to work through problems acquiring knowledge through an active, experiential learning approach. To develop effective virtual simulations and serious games, the views and perceptions of learners and educators must be assessed and taken into account, regarding their use in the classroom. This paper aims to present the results of two surveys conducted to assess faculty and student perceptions. Design/methodology/approach - Both surveys were conducted at University of Ontario Institute of Technology. The surveys were made available to students and faculty members via a link on an institute-wide internal course management system. Findings - Results indicate that students and educators appreciate the use of virtual simulations and serious games, but care must be taken to ensure that they are relevant to the course material and that educators are familiar with their use to assist students, should problems arise. Originality/value - This is the first study of its kind conducted at a laptop-based university and the results are important when considering the development of virtual simulations and serious games for teaching and learning. (Abstract)

Kazimoglu, C., Kiernan, M., Bacon, L., & MacKinnon, L. (2012). Learning programming at the computational thinking level via digital game-play. *Procedia Computer Science, 9*, 522-531. DOI: 10.1016/j.procs.2012.04.056

Keywords: computational thinking; game based learning; serious games; introductory programming; games and learning

This paper outlines an innovative game model for learning computational thinking (CT) skills through digital game-play. We have designed a game framework where students can practice and develop their skills in CT with little or no programming knowledge. We analyze how this game supports

various CT concepts and how these concepts can be mapped to programming constructs to facilitate learning introductory computer programming. Moreover, we discuss the potential benefits of our approach as a support tool to foster student motivation and abilities in problem solving. As initial evaluation, we provide some analysis of feedback from a survey response group of 25 students who have played our game as a voluntary exercise. Structured empirical evaluation will follow, and the plan for that is briefly described. (Abstract)

Ke, F. (2008). A case study of computer gaming for math: Engaged learning from gameplay? *Computers & Education, 51*(4), 1609-1620. DOI: 10.1016/j.compedu.2008.03.003

Keywords: applications in subject areas; elementary education; media in education; multimedia/hypermedia systems; teaching/learning strategies

Employing mixed-method approach, this case study examined the in situ use of educational computer games in a summer math program to facilitate 4th and 5th graders' cognitive math achievement, metacognitive awareness, and positive attitudes toward math learning. The results indicated that students developed more positive attitudes toward math learning through five-week computer math gaming, but there was no significant effect of computer gaming on students' cognitive test performance or metacognitive awareness development. The in-field observation and students' think-aloud protocol informed that not every computer math drill game would engage children in committed learning. The study findings have highlighted the value of situating learning activities within the game story, making games pleasantly challenging, scaffolding reflections, and designing suitable off-computer activities. (Abstract)

Ke, F. (2013). Computer-game-based tutoring of mathematics. *Computers & Education, 60*(1), 448-457. DOI: 10.1016/j.compedu.2012.08.012

Keywords: game-based learning; media in education

This in-situ, descriptive case study examined the potential of implementing computer mathematics games as an anchor for tutoring of mathematics. Data were collected from middle school students at a rural pueblo school and an urban Hispanic-serving school, through in-field observation, content analysis of game-based tutoring–learning interactions, and achievement test. Findings suggested that game-based tutoring is dynamic in terms of its timing, initiation, content, style, and tutee reaction created. There was an improvement in students' state test performance at the pueblo school after the game-based tutoring program, but the improvement was not statistically significant at the urban school. The study can serve as a catalyst for insight and further research of using educational gaming as an instructional artifact to augment other instructional approaches. (Abstract)

Kebritchi, M., & Hirumi, A. (2008). Examining the pedagogical foundations of modern educational computer games. *Computers & Education, 51*(4), 1729-1743. DOI: 10.1016/j.compedu.2008.05.004

Keywords: educational computer games; simulations; interactive learning environments; pedagogical issues; teaching/learning strategies

This study examines the pedagogical foundations of modern educational (computer video) games. Specifically, Cooper's [Cooper, H. (1985, Mar 31–April 4). A taxonomy of literature reviews. In Paper presented at the American Educational Research Association, Chicago, IL] literature review framework was used to locate and examine relevant literature and games (published between the years 2000 and 2007) and to organize and report findings. A total of 50 articles and 55 educational games met specified selection criteria. The pedagogical foundations of the games were further investigated by contacting the authors of the games. Twenty-two games were based on established learning theories or instructional strategies and two games included basic instructional events that were not associated with any particular theory or strategy. No information regarding the pedagogical foundations of the 31 games was found or received. Analysis of the games and supporting literature revealed several patterns of practice that may be used to guide future research and development of educational games. (Abstract)

Kebritchi, M., Hirumi, A., & Bai, H. (2010). The effects of modern mathematics computer games on mathematics achievement and class motivation. *Computers & Education, 55*(2), 427-443. DOI: 10.1016/j.compedu.2010.02.007

Keywords: human-computer interface; improving classroom teaching; interactive learning environments; simulations; teaching/learning strategies

This study examined the effects of a computer game on students' mathematics achievement and motivation, and the role of prior mathematics knowledge, computer skill, and English language skill on their achievement and motivation as they played the game. A total of 193 students and 10 teachers participated in this study. The teachers were randomly assigned to experimental and control groups. A mixed method of quantitative and interviews were used with Multivariate Analysis of Co-Variance to analyze the data. The results indicated significant improvement of the achievement of the experimental versus control group. No significant improvement was found in the motivation of the groups. Students who played the games in their classrooms and school labs reported greater motivation compared to the ones who played the games only in the school labs. Prior knowledge, computer and English language skill did not play significant roles in achievement and motivation of the experimental group. (Abstract)

Kennedy-Clark. (2011). Pre-service teachers' perspectives on using scenario-based virtual worlds in science education. *Computers & Education, 57*(4), 2224-2235. DOI: 10.1016/j.compedu.2011.05.015

Keywords: virtual worlds; serious games; science education; pre-service teachers; ICT

This paper presents the findings of a study on the current knowledge and attitudes of pre-service teachers on the use of scenario-based multi-user virtual environments in science education. The 28 participants involved in the study were introduced to Virtual Singapura, a multi-user virtual environment, and completed an open-ended questionnaire. Data from the questionnaire indicated that gender and current computer game use were likely to affect the perceived benefits of using virtual worlds in a classroom setting. Behavior management was seen as being a constraining factor on a pre-service teacher's willingness to use a virtual world in the future. Overall, the results of the study indicate that pre-service teachers as a result of their use of Virtual Singapura are both aware of

virtual worlds and have a reasonable understanding of both their potential advantages and disadvantages within a classroom setting. (Abstract)

Khaled, R., & Vasalou, A. (2014). Bridging serious games and participatory design. *International Journal of Child-Computer Interaction, 2*(2), 93-100. DOI: 10.1016/j.ijcci.2014.03.001

Keywords: participatory design; serious games; children; procedural literacy; conflict resolution education

Participatory design (PD) has become widely popular within the interaction design community, but to date has had little influence within serious game design processes. We argue that serious game design complicates the notion of involving users as co-designers, as serious game designers must be fluent with both domain content and game design. In this paper, we share our experiences of using PD during the design process of a serious game. We present observations stemming from attempts to apply the existing PD methods of brainstorming and storyboarding. Reflecting on the shortcomings of these methods, we go on to propose a novel PD method that leverages two fundamental qualities of serious games–domain expertise and procedurality–to scaffold players' existing knowledge and make co-design of serious games an attainable goal. (Abstract)

Khan, M. S. (2012). Serious science games, social selves and complex nature of 'possible selves'. *Cultural Studies of Science Education, 7*(4), 993-1000. DOI: 10.1007/s11422-012-9467-2

Keywords: narrative; possible selves; self-concept mapping; serious science games

Margaret Beier, Leslie Miller, and Shu Wang's paper, "Science games and the development of possible selves" examines the effects of game-playing in a serious scientific game on science possible selves identity creation, utilizing a possible selves identification instrument they created. This paper continues the discussion that Beier and colleagues start in the paper by calling into question both the idea that a predictive model of science career choice can be attained by serious science game-playing and the nature of the instrument created and used by Beier and her colleagues to identify participants' creation of science possible selves. Recommendations include incorporating the idea of possible selves as being complex, dynamic and intertwined with self-concept in interpreting their findings and casting a wider net to capture the phenomena of their participants' identities and experiences by potentially making use of possible selves identification methodologies from the career training arena. (Abstract)

Khanal, P., Vankipuram, A., Ashby, A., Vankipuram, M., Gupta, A., Drumm-Gumme, D., . . . Smith, M. (2014). Collaborative virtual reality based advanced cardiac life support training simulator using virtual reality principles. *Journal of Biomedicals Informatics, 51*, 49-59. DOI: 10.1016/j.jbi.2014.04.005

Keywords: computer uses in education; collaborative thinking; multimedia information systems; virtual reality; serious games; computer applications in medicine; advanced cardiac life support; medical team training

Advanced Cardiac Life Support (ACLS) is a series of team-based, sequential and time constrained interventions, requiring effective communication and coordination of activities that are performed

by the care provider team on a patient undergoing cardiac arrest or respiratory failure. The state-of-the-art ACLS training is conducted in a face-to-face environment under expert supervision and suffers from several drawbacks including conflicting care provider schedules and high cost of training equipment. The major objective of the study is to describe, including the design, implementation, and evaluation of a novel approach of delivering ACLS training to care providers using the proposed virtual reality simulator that can overcome the challenges and drawbacks imposed by the traditional face-to-face training method. We compare the efficacy and performance outcomes associated with traditional ACLS training with the proposed novel approach of using a virtual reality (VR) based ACLS training simulator. One hundred and forty-eight (148) ACLS certified clinicians, translating into 26 care provider teams, were enrolled for this study. Each team was randomly assigned to one of the three treatment groups: control (traditional ACLS training), persuasive (VR ACLS training with comprehensive feedback components), or minimally persuasive (VR ACLS training with limited feedback components). The teams were tested across two different ACLS procedures that vary in the degree of task complexity: ventricular fibrillation or tachycardia (VFib/VTach) and pulseless electric activity (PEA). The difference in performance between control and persuasive groups was not statistically significant (P = .37 for PEA and P = .1 for VFib/VTach). However, the difference in performance between control and minimally persuasive groups was significant (P = .05 for PEA and P = .02 for VFib/VTach). The pre-post comparison of performances of the groups showed that control (P = .017 for PEA, P = .01 for VFib/VTach) and persuasive (P = .02 for PEA, P = .048 for VFib/VTach) groups improved their performances significantly, whereas minimally persuasive group did not (P = .45 for PEA, P = .46 for VFib/VTach). Results also suggest that the benefit of persuasiveness is constrained by the potentially interruptive nature of these features. Our results indicate that the VR-based ACLS training with proper feedback components can provide a learning experience similar to face-to-face training, and therefore could serve as a more easily accessed supplementary training tool to the traditional ACLS training. Our findings also suggest that the degree of persuasive features in VR environments have to be designed considering the interruptive nature of the feedback elements. (Abstract)

Khenissi, M. A., Essalmi, F., & Jemi, M. (2015). Comparison between serious games and learning version of existing games. *Procedia - Social and Behavioural Sciences, 191*, 487-494.DOI: 10.1016/j.sbspro.2015.04.380

Keywords: serious games; learning version of existing games; level of knowledge; TAM

In recent years, there has been a growing interest in computer games that support learning and teaching. In particular, Serious Games and learning version of existing games were pointed out in many works that they succeeded in improving student motivation, increase students' desire to learn and make learning more enjoyable. However, a little of works have examined the impact of these types of learning games on students' level of knowledge and students' satisfaction. Thereafter, this work study the impact of Serious Games and learning version of existing computer games on the level of knowledge and satisfaction of students. Furthermore, this work conducts a comparative effectiveness studies between these two types of learning games. The comparison reveals the effectiveness of serious games in improving students' level of knowledge and the convergence of the two types of learning games in terms of students' satisfactions. (Abstract)

Kiili, K. (2005). Content creation challenges and flow experience in educational games: The IT-Emperor case. *The Internet and Higher Education, 8*(3), 183-198.DOI: 10.1016/j.iheduc.2005.06.001

Keywords: educational games; flow experience; web-based education; learning; higher education

Students increasingly demand more constructive online courses that not only provide information but also facilitate studying experiences. Educational games offer a viable strategy to this end. In this paper, the experiences of university students (n = 18) playing an educational game, IT-Emperor, which was designed to facilitate flow experience, are studied through questionnaires and interviews. The main purpose of this paper is to study the usefulness of content creation challenges included in IT-Emperor and factors that have an influence on flow experience. Results indicate that half of the participants experienced flow while playing IT-Emperor. This finding is significant because flow tends to have a positive impact on learning. Content creation was reported as the main activity causing flow; bad usability and low gamefulness were cited as obstacles of flow experience. However, because of the small sample size of this study, more research on the topic is recommended. (Abstract)

Kiili, K., Lainema, T., de Freitas, S., & Arnab, S. (2014). Flow framework for analyzing the quality of educational games. *Entertainment Computing, 5*(4), 367-377. DOI: 10.1016/j.entcom.2014.08.002

Keywords: game-based learning; game analysis; serious games; technology-enhanced learning; flow experience; user experience

The challenge of educational game design is to develop solutions that appeal to as many players as possible, but are still educationally effective. One foundation for analyzing and designing educational engagement is the flow theory. This article presents a flow framework that describes the dimensions of flow experience that can be used to analyze the quality of educational games. The framework also provides design-support for producing good educational games, because it can be used to reveal ways to optimize learning effects and user experience. However, the framework only works as a link between educational theory and game design, which is useful for game analysis but does not provide the means for a complete game design. To evaluate the elements included in the proposed framework, we analyzed university student's experiences in participating in a business simulation game. We found that the students' flow experience in the game was high and the findings indicated that sense of control, clear goals and challenge-skill dimensions of flow scored the highest. Overall, the results indicate that the flow framework is a useful tool to aid the analysis of game-based learning experiences. (Abstract)

Kim, B., Park, H., & Baek, Y. (2009). Not just fun, but serious strategies: Using meta-cognitive strategies in game-based learning. *Computers & Education, 52*(4), 800-810. DOI: 10.1016/j.compedu.2008.12.004

Keywords: media in education; interactive learning environments; teaching/learning strategies; virtual reality

The purpose of this study is to explore the effects of the meta-cognitive strategies on the academic and gaming achievements. Exploring the effects of those achievements on the social problem solving of students is also of interest. For this purpose, the MMORPG [Massively Multiple Online Role Playing Game] "Gersang" was used. The participants, consisting of ninth graders, played the game until they all reached the third level to ensure that they have the same gaming ability prior to gaming for the study. Three meta-cognitive strategies were developed: self-recording, modeling and thinking aloud. Those strategies are specially related to gaming activities and applied in pre-gaming activities, gaming activities, and post-gaming activities. Three meta-cognitive strategies were set as independent variables. The social problem solving ability was set as a mediating variable, and academic achievement and scores in the game were chosen as dependent variables. The path between meta-cognitive strategies and both academic achievement and game performance by mediating social problem solving abilities were discovered. The social problem solving ability, which is the mediating variable, affects the academic achievement and the game performance very strongly. These results imply that a commercial game playing in conjunction with meta-cognitive strategies can be an effective way to increase students' performance both in learning and gaming by keeping them involved. Talking and observation activities such as thinking aloud and modeling are more effective than writing activities in enhancing the students' achievements both in learning and gaming. (Abstract)

Kingsley, T. L., & Grabner-Hagen, M. (2015). Gamification: Questing to integrate content knowledge, literacy, and 21st-century learning. *Journal of Adolescent & Adult Literacy, 59*(1), 51-61.DOI: 10.1002/jaal.426

Keywords: content literacy; digital/media literacies; strategies, methods and materials; early adolescence; adolescence

This article showcases the use of gamification as a means to turn an existing curriculum into a game-based learning environment. The purpose of this article is to examine how gamification, coupled with effective pedagogy, can support the acquisition of 21st-century skills. Gamifying content allows students to earn experience points, badges, and awards to "level up" through the curriculum by completing quests. We discuss the theoretical framework, New Literacies theory, which has informed our case study of one teacher's journey using gamification. We align our case study within two educational reforms and initiatives: the Common Core State Standards and Partnership for 21st Century Skills. Survey results and teacher interview data are provided. (Abstract)

Kitchen, G. B., & Humphreys, J. (2014). Serious games in medical education. Do they have a role in anaesthetic training? *Trends in Anaesthesia and Critical Care, 4*(2-3), 63-66. DOI: 10.1016/j.tacc.2014.03.001

Keywords: medical education; serious games

As a medical professional we have committed ourselves to a career of lifelong learning, and although one can never underestimate the importance of experience, there are some situations that may happen less than once in an anaesthetists career, such as the management of malignant hyperthermia or anaphylaxis. Nonetheless as doctors in anaesthesia we need to be adequately prepared to deal with these scenarios if and when they arrive. To do this successfully the medical

profession has developed algorithms for various critical incidents. These algorithms are tested in postgraduate exams and after that for many it is up to the individual to keep abreast with the latest changes and remain current in their knowledge. Simulation is one way these scenarios can be covered with many schools of anaesthesia including critical incident training for their trainees and some hospitals providing simulation updates for their consultant body. We explore a growing alternative medium for continued professional development, the serious game. (Abstract)

Knight, J. F., Carley, S., Tregunna, B., Jarvic, S., Smithies, R., de Freitas, S., . . . Mackway-Jones, K. (2010). Serious gaming technology in major incident triage training: A pragmatic controlled trial. *Resuscitation, 81*(9), 1175-1179. DOI: 10.1016/j.resuscitation.2010.03.042

Keywords: triage; major incident; education; serious games

By exploiting video games technology, serious games strive to deliver affordable, accessible and usable interactive virtual worlds, supporting applications in training, education, marketing and design. The aim of the present study was to evaluate the effectiveness of such a serious game in the teaching of major incident triage by comparing it with traditional training methods. During Major Incident Medical Management and Support Courses, 91 learners were randomly distributed into one of two training groups: 44 participants practiced triage sieve protocol using a card-sort exercise, whilst the remaining 47 participants used a serious game. Following the training sessions, each participant undertook an evaluation exercise, whereby they were required to triage eight casualties in a simulated live exercise. Performance was assessed in terms of tagging accuracy (assigning the correct triage tag to the casualty), step accuracy (following correct procedure) and time taken to triage all casualties. Additionally, the usability of both the card-sort exercise and video game were measured using a questionnaire. Tagging accuracy by participants who underwent the serious game training was significantly higher than those who undertook the card-sort exercise [Chi2 = 13.126, p = 0.02]. Step accuracy was also higher in the serious game group but only for the numbers of participants that followed correct procedure when triaging all eight casualties [Chi2 = 5.45, p = 0.0196]. There was no significant difference in time to triage all casualties (card-sort = 435 ± 74 s vs video game = 456 ± 62 s, p = 0.155). Serious game technologies offer the potential to enhance learning and improve subsequent performance when compared to traditional educational methods. (Abstract)

Kopp, W., & Hanson, M. A. (2012). High-fidelity and gaming simulations enhance nursing education in end-of-life care. *Clinical Simulation in Nursing, 8*(3), 97-102. DOI: 10.1016/j.ecns.2010.07.005

Keywords: critical thinking skills; end-of-life care; end-of-life scenarios; experiential learning; gaming; nursing education; simulation

Existing research suggests that nursing education has not adequately prepared nurses to provide quality end-of-life care. As the population in the United States ages and chronic diseases increase, the number of dying patients will also increase. It is now more important than ever that nurses provide high-quality end-of-life care to those patients dying in hospitals or other inpatient facilities. Opportunities to care for dying patients are often unavailable to students in traditional clinical settings. This article describes the use of simulation as an innovative teaching strategy to prepare

students in providing end-of-life care. The authors describe how an end-of-life scenario using high-fidelity simulation and an experiential gaming simulation, Seasons of Loss©, were used to enhance the curriculum on end-of-life care presented to nursing students. (Abstract)

Kosmadoudi, Z., Lim, T., Ritchie, J., Louchart, S., Liu, Y., & Sung, R. (2013). Engineering design using game-enhanced CAD: The potential to augment the user experience with game elements. *Computer-Aided Design, 45*(3), 777-795. DOI: 10.1016/j.cad.2012.08.001

Keywords: CAD; engineering design; games; user experience; engagement

Since the coining of the term 'serious games' by Clark Abt, practitioners in fields such as education, the military, and medical science, as well as researchers from other disciplines, have investigated with interest game mechanics and the dynamics of games in non-gaming applications. Gaming has extended beyond what was initially its natural boundary of entertainment and is now associated with the process of problem solving while providing analytical questioning of scientific viewpoints through active gameplay. The rules of game interaction or game mechanics include the concepts of usability and playability which are focused in a less complex environment which provides a more intuitive user experience (UX). In the process of CAD development and applications the effective use and support of the user's perception and their UX have been compromised by the engineering design system's functionality and step-by-step evolution. This article reviews gaming techniques and mechanisms that may potentially be beneficial to the future development of CAD systems in engineering, in particular to maintain cognitive engagement. In light of this, the article focuses on the fundamental activity of engineering using CAD systems with particular attention on CAD graphical user interfaces (GUIs) and how they can be potentially enhanced using game mechanics to provide more engaging and intuitive environments. (Abstract)

Kuo, M.-S., & Chuang, T.-Y. (2016). How gamification motivates visits and engagement for online academic dissemination – An empirical study. *Computers in Human Behavior, 55*, 16-27.DOI: 10.1016/j.chb.2015.08.025

Keywords: gamification; academic dissemination; game elements; game mechanisms; web analytics

Gamification, an emerging trend of using game mechanisms or elements in non-game contexts for commercial or educational purposes, has been applied in advertisements, competitions and rewards for many years. Although gamification could easily be applied to various daily activities, challenges arise when digitizing it for use online with educational applications. The purpose of this study is thus to apply gamification to an online context for academic promotion and dissemination. An online platform was designed to involve faculty members, students, and visitors from industry and the general public to form groups for the mutual dissemination of academic knowledge, products and activities. Both quantitative and qualitative data were collected and analyzed. The findings with regard to the most significant game design elements are discussed, along with the statistical results related to the engagement behaviors demonstrated by the participants. The quantitative data provided by the online analytical tools to examine user behaviors reveals that gamification has the potential to attract, motivate, engage and retain users. The system implementation used in this work is described, and provides empirical examples of how gamification impacts user behaviors in this

context. This study also demonstrates how the theory and practice of online gamification for use in academia can be connected. (Abstract)

Laamarti, F., Eid, M., & El Saddik, A. (2014). An overview of serious games. *International Journal of Computer Games Technology*. DOI: 10.1155/2014/358152

Keywords: serious games (computing); health care; interpersonal communication; cultural heritage; advertisement; well-being; education; digital serious games; academic research; gaming industry

Serious games are growing rapidly as a gaming industry as well as a field of academic research. There are many surveys in the field of digital serious games; however, most surveys are specific to a particular area such as education or health. So far, there has been little work done to survey digital serious games in general, which is the main goal of this paper. Hence, we discuss relevant work on serious games in different application areas including education, well-being, advertisement, cultural heritage, interpersonal communication, and health care. We also propose a taxonomy for digital serious games, and we suggest a classification of reviewed serious games applications from the literature against the defined taxonomy. Finally, the paper provides guidelines, drawn from the literature, for the design and development of successful serious games, as well as discussing research perspectives in this domain. (Abstract)

Lacasa, P., Méndez, L., & Martínez, R. (2008). Bringing commercial games into the classroom. *Computers and Composition, 25*(3), 341-358. DOI: 10.1016/j.compcom.2008.04.009

Keywords: commercial video games; new literacies; educational contexts; Bakhtin; formal and informal learning

One of the challenges facing us when we try to bring commercial materials such as video games into the classroom to be used as educational tools is to identify appropriate strategies of collaboration with teachers, families, and even industries. This paper explores how multimedia contexts can be created in which children become active participants in a digital universe where multiple technologies are present (so that video games are just one of several digital tools). We present several examples derived from specific projects carried out in formal and informal educational contexts, in action research and from ethnographical perspectives. As participant observers in and outside the classroom, we designed workshops as innovative educational contexts; all the sessions were video and audio recorded. Our analysis adopted a socio-cultural perspective. Several preliminary results clearly appeared: (a) Children playing commercial games inside and outside classrooms produce different writing texts depending of the context in which they are generated; (b) using video games combined with other digital technologies seems to be an effective way of introducing children to the content and structure of games considered as dynamic systems; (c) using and reflecting on video games in and outside the school, via discussions in digital media such as blogs or pictures, can contribute to the development of digital literacies as a way of using multimodal discourses. Our main goal at this moment is to design digital materials capable of supporting teachers' and families' use of games and in particular, to reveal the rules that organize their structure, codes and symbolic universe. (Abstract)

Lancaster, R. J. (2014). Serious game simulation as a teaching strategy in pharmacology. *Clinical Simulation in Nursing, 10*(3), 129-137.DOI: 10.1016/j.ecns.2013.10.005

Keywords: nursing education; games; serious games; simulation; teaching strategies; research

The purpose of this pilot study was to explore student learning through the use of a serious game (SG) simulation. A pre-test/post-test design was used to measure knowledge. Importance of the SG simulation design and satisfaction and self-confidence were also measured. Seventy-nine (n = 79) students participated in this SG simulation. There was a significant increase in scores between pre- and post-tests ($p < .01$). Students evaluated the importance of design elements and were satisfied and confident engaging in this activity. SG simulation may be an effective teaching strategy and has promise as an emerging pedagogical approach. (Abstract)

Larsen, L. J. (2012). A new design approach to game-based learning. *Journal of Interactive Learning Research, 23*(4), 313-323. ISSN: 1093-023X

Keywords: educational environment; teaching methods; reflection; learning theories; computer games; communities of practice; learning processes; educational games; instructional effectiveness; visual aids; rewards; learning motivation

This paper puts forward a new design perspective for game-based learning. The general idea is to abandon the long sought-after dream of designing a closed learning system, where students in both primary and secondary school could learn--without the interference of teachers--whatever subject they wanted while sitting in front of a computer. This describes a caricature, I know, but it still lurks in the background whenever we speak of, read or write about learning with computer games. The entire field of learning with games is called "serious games", since they find themselves on a direct collision course with off-the-shelf, commercial entertainment games. This paper promotes two different yet interconnected ideas. The first aims to describe a new design perspective for game-based learning, which in many ways not only will provoke the abovementioned latent dream of a closed game-based learning system, but will also confront aspects of modern learning theory, especially the notion of reference between the content of an assignment and the reality with which it should or could be connected (situated learning). The second idea promotes a way of tackling the common experience of the average learner from primary to secondary school. He or she is often unable to fully grasp, understand or comprehend the learning process in which he or she is embedded. Portfolios, and especially e-portfolios, can be used to encourage reflection on both the learner's development and the learning process in order to ground the student's reason to learn. This paper proposes a different approach: using visualisation in immersive 3D worlds as both documentation of learning progress and as a reward system which motivates further learning. The overall design idea is to build a game-based learning system from three or more different, yet interconnected, elements; namely a teacher, a web-based platform and an immersive game or play world. (Abstract)

Law, E. L.-C., & Sun, X. (2012). Evaluating user experience of adaptive digital educational games with Activity Theory. *International Journal of Human-Computer Studies, 70*(7), 478-497. DOI: 10.1016/j.ijhcs.2012.01.007

Keywords: user experience; digital educational game; adaptivity; usability; activity theory; contradictions; breakdowns; downstream utility

Adaptive digital educational games (DEGs) providing players with relevant interventions can enhance gameplay experience. This advance in game design, however, renders the user experience (UX) evaluation of DEGs even more challenging. To tackle this challenge, we developed a four-dimension evaluation framework (i.e., gaming experience, learning experience, adaptivity, and usability) and applied it to an empirical study with a DEG on teaching geography. Mixed-method approaches were adopted to collect data with 16 boys aged 10–11. Specifically, a so-called Dyadic User Experience Tests (DUxT) was employed; participants were paired up to assume different roles during gameplay. Learning efficacy was evaluated with a pre-post intervention measurement using a domain-specific questionnaire. Learning experience, gaming experiences and usability were evaluated with intensive in situ observations and interviews guided by a multidimensional scheme; content analysis of these transcribed audio data was supplemented by video analysis. Effectiveness of adaptivity algorithms was planned to be evaluated with automatic logfiles, which, unfortunately, could not be realised due to some technical problem. Nonetheless, the user-based data could offer some insights into this issue. Furthermore, we attempted to bridge the existing gap in UX research – the lack of theoretical frameworks in understanding user experience – by adopting Engeström's (1987) extended framework of Activity Theory (AT) that provides contextual information essential for understanding contradictions and breakdowns observed in the interactions between the game players. The dyadic gameplay setting allows us to explore the issue of group UX. Implications for further applications of the AT framework in the UX research, especially the interplay between evaluation and redesign (i.e., downstream utility of UX evaluation methods), are discussed. (Abstract)

Lawson, C. L., & Lawson, L. L. (2010). Adventures in learning: Creating role playing video games to teach and learn economics. *International Review of Economics Education, 9*(1), 93-110. DOI: 10.1016/S1477-3880(15)30058-X

This article examines pedagogical lessons derived from the learning theory embodied in commercially successfully video games and their link to reported increases in ‘fluid intelligence’ of student populations. The scholarly literature in this area is reviewed in order to elicit practical principles by which to guide the development of instructional video game modules for the teaching of economics. The authors’ experiences in developing and pilot testing such a module, and in subsequently guiding student research efforts to develop an additional module, are then reviewed.The paper concludes that harnessing the benefits of video game technologies in the service of teaching and learning economics is both pedagogically sound and feasible for individual instructors. (Abstract)

Leach, G. J., & Sugarman, T. S. (2005). Play to win! Using games in library instruction to enhance student learning. *Research Strategies, 20*(3), 191-203. DOI: 10.1016/j.resstr.2006.05.002

Keywords: educational games; library instruction; academic libraries; student learning; Jeopardy!; instructional materials

Research has shown that educational games can have positive impacts on student learning and motivation. The success of a game played in a library instruction class depends on the type of game selected, the development of learning outcomes, and the flexibility of the librarian during class. This article explains the benefits to students and librarians of using games, discusses the development and use of a Jeopardy-style game, and provides practical tips for librarians interested in developing and incorporating games into one-time library instruction sessions. (Abstract)

Lester, J. C., Spires, H. A., Nietfeld, J. L., Mott, B. W., & Lobene, E. V. (2014). Designing game-based learning environments for elementary science education: A narrative-centered learning perspective. *Information Sciences, 264*, 4-18. DOI: 10.1016/j.ins.2013.09.005

Keywords: serious games; game-based learning; narrative-centered learning; science education

Game-based learning environments hold significant promise for STEM education, yet they are enormously complex. Crystal Island: Uncharted Discovery, is a game-based learning environment designed for upper elementary science education that has been under development in our laboratory for the past four years. This article discusses curricular and narrative interaction design requirements, presents the design of the Crystal Island learning environment, and describes its evolution through a series of pilots and field tests. Additionally, a classroom integration study was conducted to initiate a shift towards ecological validity. Results indicated that Crystal Island produced significant learning gains on both science content and problem-solving measures. Importantly, gains were consistent for gender across studies. This finding is key in light of past studies that revealed disproportionate participation by boys within game-based learning environments. (Abstract)

Lewis, M. A., & Maylor, H. R. (2007). Game playing and operations management education. *International Journal of Production Economics, 105*(1), 134-149. DOI: 10.1016/j.ijpe.2006.02.009

Keywords: games; playing; teaching; competition; experimentation

There is a well established tradition of teaching operations management (OM) via various kinds of production game: real players making real decisions in a practical, albeit simulated, situation. Surprisingly, there has been much less conceptual reflection on the process and content of this approach to OM education, something this paper aims to begin to rectify. The first section clarifies terminology and defines the game concept in terms of a transformation process. The second section reviews the extant population of teaching games and deploys the conceptual model to generate a number of specific observations that underpin a discussion about the content and process of OM-related game playing. In the conclusions, particular attention is drawn to (1) the predominant content of OM-related games has not developed with the same emphasis as the taught subject with manufacturing planning and control still dominating (2) the tendency to produce complex OM games

requiring IT support, and (3) the removal of competition in gaming in favour of facilitating experimentation by players. The paper finishes with a discussion of potential further work. (Abstract)

Lim, C. P. (2008). Global citizenship education, school curriculum and games: Learning Mathematics, English and Science as a global citizen. *Computers & Education, 51*(3), 1073-1093. DOI: 10.1016/j.compedu.2007.10.005

Keywords: multi-user virtual environment; game-like elements; global citizenship; curriculum; engagement; social commitment

Based on an account of how two classes of primary five students in Singapore engage in the learning of English, Mathematics and Science by playing the role of global citizens, the paper suggests an alternative but realistic approach to teaching global citizenship education. Set against the back story of Atlantis facing ecological, social and cultural decay due to the blind pursuit of prosperity and modernisation by its rulers, each student became a quester called on to save Atlantis. Throughout the mission they were presented with different problems in Atlantis (similar to existing global issues) and were expected to research and suggest solutions to the problems by alone or with fellow questers. These problems were tied to the primary five English, Mathematics and Science curriculum. Through documenting and making sense of these activities via observations, interviews and pre-post questionnaire surveys, the paper shows how the new approach may enhance the learning engagement, academic motivation and social commitments among the students. We also explore the sustainability and scalability of such an approach in the school system and highlight constraints. The paper then draws implications for global citizenship education in schools that include designing a meaningful context for engaged learning in schools with components of global citizenship, developing a research culture in schools as a stepping stone for global citizenship education and building capacity of teachers and school leaders in global citizenship. (Abstract)

Lin, D. T., Park, J., Liebert, C. A., & Lau, J. N. (2015). Validity evidence for surgical improvement of clinical knowledge ops: A novel gaming platform to assess surgical decision making. *The American Journal of Surgery, 209*(1), 79-85. DOI: 10.1016/j.amjsurg.2014.08.033

Keywords: surgical evidence; surgical decision making; gamification; assessments

Current surgical education curricula focus mainly on the acquisition of technical skill rather than clinical and operative judgment. SICKO (Surgical Improvement of Clinical Knowledge Ops) is a novel gaming platform developed to address this critical need. A pilot study was performed to collect validity evidence for SICKO as an assessment for surgical decision making. Forty-nine subjects stratified into 4 levels of expertise were recruited to play SICKO. Later, players were surveyed regarding the realism of the gaming platform as well as the clinical competencies required of them while playing SICKO. Each group of increasing expertise outperformed the less experienced groups. Mean total game scores for the novice, junior resident, senior resident, and expert groups were 5,461, 8,519, 11,404, and 13,913, respectively (P = .001). Survey results revealed high scores for realism and content. SICKO holds the potential to be not only an engaging and immersive educational tool, but also a valid assessment in the armamentarium of surgical educators. (Abstract)

Ling, Y., & Pranantha, D. (2013). HTML5 serious games platform for education. *IEEE Technology and Engineering Education, 8*(2), 15-17. ISSN: 1558-7908

Keywords: HTML5 serious games platform; game based learning; technological development; HTML5 serious games development; web technologies; social networks; open platform; web-based serious game platform; game technology; sensor system; gesture information; natural interaction; web-based game platform; 3D virtual navigation game platform; geographical education; direct interaction; cognition load; GAT; UPPL; game control

Considering game-based learning advantage and technological development, we designed and constructed one platform which is still work in progress, to facilitate HTML5 serious games development through the utilization of current web technologies and social networks which support open platform and ease propagation. Our designed web-based serious game platform integrates puzzle game technology because of its general development enhancement on logic, memory, and problem solving, etc. Additionally, we developed sensor system to capture gesture information to apply natural interaction to web-based game platform with the purpose of education. Our realized 3D virtual navigation game platform with embodied conversation for geographical education induces more direct and natural interaction with fewer cognition loads. In the end, the further work of this research in the future, such as realization of GAT, UPPL, and the integration with the sensors for game control are suggested. (Abstract)

Lombardi, I. (2012). Not-so-Serious games for language learning. Now with 99.9% more humor on top. *Procedia Computer Science, 15*, 148-158. DOI: 10.1016/j.procs.2012.10.066

Keywords: serious games; language learning; fun; culture

Verbal and figurative humour characterise some of the most memorable commercial video games. Humour, in general, is also a precious strategy to enhance language learning. What happens if we embed humour in serious games for language learning? This paper will briefly cover: a) the origin of fun; b) the essence of humour; c) both the cultural dependence and the universality of humour; c) its meaningfulness to language learning. In the end, a proposal for integrating humou r in serious games is formulated, along with several examples of ‘teaching humour’ extrapolated from a successful commercial video game (Day of the Tentacle). (Abstract)

Lucke, U., & Rensing, C. (2014). A survey on pervasive education. *Pervasive and Mobile Computing, 14*, 3-16. DOI: 10.1016/j.pmcj.2013.12.001

Keywords: pervasive learning; ubiquitous learning; mobile learning; contextualized learning; seamless learning; e-learning; e-teaching; context awareness; adaptivity; personalization; augmentation

Researchers and developers worldwide have put their efforts into the design, development and use of information and communication technology to support teaching and learning. This research is driven by pedagogical as well as technological disciplines. The most challenging ideas are currently found in the application of mobile, ubiquitous, pervasive, contextualized and seamless technologies for education, which we shall refer to as pervasive education. This article provides a comprehensive overview of the existing work in this field and categorizes it with respect to educational settings.

Using this approach, best practice solutions for certain educational settings and open questions for pervasive education are highlighted in order to inspire interested developers and educators. The work is assigned to different fields, identified by the main pervasive technologies used and the educational settings. Based on these assignments we identify areas within pervasive education that are currently disregarded or deemed challenging so that further research and development in these fields are stimulated in a trans-disciplinary approach. (Abstract)

Mallan, K., Foth, M., Greenaway, R., & Young, G. T. (2010). Serious playground: Using 'second life' to engage high school students in urban planning. *Learning, Media and Technology, 35*(2), 203-225. DOI: 10.1080/17439884.2010.494432

Keywords: Second Life; virtual world; constructivist learning; text as game; play; urban informatics; neogeography

Virtual world platforms such as "Second Life" have been successfully used in educational contexts to motivate and engage learners. This article reports on an exploratory workshop involving a group of high school students using "Second Life" for an urban planning project. Young people are traditionally an under-represented demographic when it comes to participating in urban planning and decision-making processes. The research team developed activities that combined technology with a constructivist approach to learning. Real-world experiences and purposes ensured that the workshop enabled students to see the relevance of their learning. Our design also ensured that play remained an important part of the learning. By conceiving of the workshop as a "serious playground", we investigated the ludic potential of learning in a virtual world. (Abstract)

Manero, B., Torrente, J., Serrano, Á., Martínez-Ortiz, I., & Fernández-Manjón, B. (2015). Can educational video games increase high school students' interest in theatre? *Computers & Education, 87*, 182-191. DOI: 10.1016/j.compedu.2015.06.006

Keywords: serious games; theatre learning; media in education; educational games; digital humanities

The value of educational video games in education is undeniable and the benefits of using video games in classroom instruction have been proved by many researchers. Nevertheless, these benefits have not been proved sufficiently for some domains, such as artistic disciplines. In this paper we explore the effects of an educational video game on high school students' interest towards classical theatre. The game covers the story of “The Foolish Lady” (La Dama Boba) based on the homonymous classic theatre play by Spanish playwright Lope de Vega. A mixed experimental design was followed, whereby researchers conducted pre-tests and post-tests to estimate the effect of playing the video game on student interest (within-subjects factor) towards theatre. We also measured changes in linguistic knowledge and knowledge about the play. The experiment was carried out with 754 students from 8 different schools in the Madrid region in Spain, divided into experimental group and two control groups. With the objective of improving the comparative power of the study, two control groups were used: (1) traditional teaching with the usual teacher and, (2) as the best educative case we could implement, teaching with a professional actor who had played the male protagonist of the theatre play. The experimental group played the video game. Results show that the video game was more effective in incrementing students' interest in theatre than the traditional

class, but slightly less effective than the class with the actor. On the other hand, game and teacher approaches obtained similar results in the improvement of students' knowledge about the play's plot and some linguistic concepts. These results open up a new horizon in using video games as motivators in different artistic domains. (Abstract)

Marchiori, E. J., Del Blanco, A., Torrente, J., Martinez-Ortiz, I., & Fernández-Manjón, B. (2011). A visual language for the creation of narrative educational games. *Journal of Visual Languages & Computing, 22*(6), 443-452. DOI: 10.1016/j.jvlc.2011.09.001

Keywords: domain-specific visual language; educational video games; serious games; educators; story-flow; game authoring

This paper presents a DSVL that simplifies educational video game development for educators, who do not have programming backgrounds. Other solutions that reduce the cost and complexity of educational video game development have been proposed, but simple to use approaches tailored to the specific needs of educators are still needed. We use a multidisciplinary approach based on visual language and narrative theory concepts to create an easy to understand and maintain description of games. This language specifically targets games of the adventure point-and-click genre. The resulting DVSL uses an explicit flow representation to help educational game authors (i.e. educators) to design the story-flow of adventure games, while providing specific features for the integration of educational characteristics (e.g. student assessment and content adaptation). These highly visual descriptions can then be automatically transformed into playable educational video games. (Abstract)

Marchiori, E. J., Torrente, J., Del Blanco, A., Moreno Ger, P., Sancho, P., & Fernández-Manjón, B. (2012). A narrative metaphor to facilitate educational game authoring. *Computers & Education, 58*(1), 590-599. DOI: 10.1016/j.compedu.2011.09.017

Keywords: authoring tools and methods; serious games; improving classroom teaching

In this paper we present WEEV (Writing Environment for Educational Video games), a methodology for educational point-and-click adventure game authoring. Our approach aims to allow educators to actively collaborate in the educational game development process, using a narrative-based representation. WEEV is based on a pragmatic reinterpretation of previous works on narrativity and video games, enhanced by the use of a novel visual language to represent the flow of the story or narrative. The WEEV methodology has been implemented into an actual tool based on the already established <e-Adventure> platform for educational games. This tool was improved with feedback gathered from formative evaluation, end-users testing (i.e. educators), and actual use in the development of an educational game. The system, still under development, presents some user-interaction problems along with a need for the educational effectiveness of the resulting games to be further analyzed. However, this paper highlights that, according to the qualitative results of evaluations, WEEV can indeed be successfully applied to simplify the game creation process and that by using representations of games that educators can understand, WEEV can help provide educational value to games. (Abstract)

Marín, V., López, M., & Maldonado, G. (2015). Can gamification be introduced within primary classes? *Digital Education Review,* (27), 55-68. ISSN: E2013-9144

Keywords: ITC; video games; training; pupils; curriculum; primary education

Training through gamification is everyday a more evident reality in Primary Education classes. The teachers' view about this has been modified as it is shown in the study published by aDeSe in 2012. However, does it really have place in the students' curricular development in the primary education stage? For the sake of responding to this question, we have carried out a descriptive study about the opinion that the future teachers from primary education have got about this "new" form of implementing the curricular contents. The sample, conformed by 244 students of second course of Media Literacy and Didactic Application of ICT, answered a questionnaire consisting of 23 questions, of which 14 are devoted to determine the attitude that future teachers have facing videogames and the remaining 9 indicate the educative dimension that they give to it within the primary class. The most significant initial result we find is that while they consider having a proactive view as users of this, women are less active within this tool, although the female teachers conclude, however, that it could be an attractive resource for the learning of the youngest students. (Abstract)

Marlow, S. L., Salas, E., Landon, L. B., & Presnell, B. (2016). Eliciting teamwork with game attributes: A systematic review and research agenda. *Computers in Human Behavior, 55*, 413-423. DOI: 10.1016/j.chb.2015.09.028

Keywords: simulation/gaming; game-based training; teamwork; game attribute; review

The modern workplace has become increasingly complex as a function of numerous factors, including technological and economic growth. Teams are more frequently implemented within organizations to facilitate high performance within these complex, dynamic conditions. Game-based training has become a common method of delivering training to teams, paralleling the recent trend towards gamification, which refers to integrating games into traditionally non-game based settings. However, the extant literature remains nascent as there is a dearth of theory relating independent game attributes to teamwork behaviors. Specifically, it is unknown why or how game-based training may foster desired competencies within teams. To address this gap, the present article conducts a systematic review to identify opportunities for research and potential relationships between game attributes and teamwork behaviors. These proposed relationships are ultimately intended to uncover the manner in which game-based training can be leveraged to facilitate effective teamwork. (Abstract)

Marne, B., & Labat, J.-M. (2014). Model and authoring tool to help teachers adapt serious games to their educational contexts. *International Journal of Learning Technology, 9*(2), 161-180. DOI: 10.1504/IJLT.2014.064491

Keywords: authoring tool; serious games; educational scenarios

After a study, we established that one of the obstacles of the adoption of serious games (SGs) by teachers was that they cannot shape their educational scenarios to their specific teaching context. The work we present in this paper tackles the general problem of designing tools to help them customise the educational scenarios of SGs. Our approach is to provide a model suited to describe

SGs that are composed of several stages, and to provide its implementation in an authoring tool in order to help the teachers to visualise, modify and check the consistency of the scenarios. The evaluation of our model shows that it is capable of describing most of the SGs we targeted, and the first user tests of our authoring tool prototype are also promising. (Abstract)

Marsh, T. (2015). Slow serious games, interactions and play: Designing for positive and serious experience and reflection. *Entertainment Computing*. DOI: 10.1016/j.entcom.2015.10.001

Keywords: serious games; design; experience

Proposed herein are slow interactions and gameplay with serious games, referred to as slow serious games. These are slow movements intended to focus attention/concentration, and provide openings and opportunities for reflection, contemplation, and learning. Like devices used in film and theatre, this forms part of an emerging design repertoire of strategies and devices to articulate and manipulate time and space and narrative in interactions and games for the shaping of experience. To illustrate the idea of slow serious interactions and gameplay, the related interaction design, interactive art and game literature is reviewed. Next, devices and strategies for the design and development of slow serious interactions are proposed. Through example, we describe the development of a game to raise awareness of issues and threats affecting ecosystems in Australia's Great Barrier Reef. This includes novel design strategies to engage the player in interaction/play with these issues and threats, and to blend slow and fast interaction and gameplay to stimulate thought and shape experience between positive and serious experience. The design strategies outlined herein can be used to inform design and development of other interactions, games and slow serious games and art games. (Abstract)

Martin, M.W. (2014). The effects of game design on learning outcomes. *Computers in the Schools: Interdisciplinary Journal of Practice, Theory, and Applied Research, 31*(1), 23-42.DOI: 10.1080/0730569.2014.879684

Keywords: serious games; design principles; learning outcomes; learning

This article details the administration and results of an experiment conducted to assess the impact of three videogame design concepts upon learning outcomes. The principles tested include game aesthetics, player choice, and player competition. The experiment participants were asked to play a serious game over the course of a week, and the learning outcomes were measured by comparing their pretest and posttest scores. The results of a one-tailed t test indicated, with a p value of 0.043, that there was a statistically significant effect of the aesthetic presentation of the game upon the learning outcome. There was no indication of a significant effect by the player choice or player competition conditions, but the results from these experiment groups point to some potentially interesting interactions between the conditions and learning, as well as possible future lines of experimental inquiry. (Abstract)

Masek, M., Murcia, K., & Morrison, J. (2013). Getting serious with iPads: The intersection of game design and teaching principals. *Australian Educational Computing, 27*(2), 34-38. URL:http://acce.edu.au/sites/acce.edu.au/files/pj/journal/27_2Getting_Serious_With_iPads_p34.pdf

Keywords: foreign countries; science curriculum; handheld devices; material development; instructional materials; instructional design; national curriculum; educational games; computer games; educational technology; computer assisted instruction; multimedia materials; computer software; science instruction; early science; early childhood education

Mobile devices, such as tablets and smart phones, are increasingly being utilised as tools for education, with tablets such as the Apple iPad being introduced into many classrooms. These devices are seen as enablers of learning through a fun, interactive interface; however the process of producing a pedagogically valid, yet entertaining application is often poorly understood. This problem motivated the authors to work collaboratively on the design and development of an iPad game targeted at foundation level classrooms and linked to the Australian science curriculum. In this paper we review the tools and processes that are available for the production of educational games. We begin by reviewing the technology and development paths available for targeting a variety of mobile platforms. Following this, we examine theories of game design as applied to educational settings. This review frames our discussion of the design features of the iPad game "Aussie Explorers" produced as an outcome of the project. (Abstract)

Mathers, N., Goktogen, A., Rankin, J., & Anderson, M. (2012). Robotic Mission to Mars: Hands-on, minds-on, web-based learning. *Acta Astronautica, 80*, 124-131. DOI: 10.1016/j.actaastro.2012.06.003

Keywords: education; engagement; scenario-based learning; problem-based learning; hands-on learning; games technology; serious gaming; space mission simulation; 21st century learning; on-line learning; STEM

Problem-based learning has been demonstrated as an effective methodology for developing analytical skills and critical thinking. The use of scenario-based learning incorporates problem-based learning whilst encouraging students to collaborate with their colleagues and dynamically adapt to their environment. This increased interaction stimulates a deeper understanding and the generation of new knowledge. The Victorian Space Science Education Centre (VSSEC) uses scenario-based learning in its Mission to Mars, Mission to the Orbiting Space Laboratory and Primary Expedition to the M.A.R.S. Base programs. These programs utilize methodologies such as hands-on applications, immersive-learning, integrated technologies, critical thinking and mentoring to engage students in Science, Technology, Engineering and Mathematics (STEM) and highlight potential career paths in science and engineering. The immersive nature of the programs demands specialist environments such as a simulated Mars environment, Mission Control and Space Laboratory, thus restricting these programs to a physical location and limiting student access to the programs. To move beyond these limitations, VSSEC worked with its university partners to develop a web-based mission that delivered the benefits of scenario-based learning within a school environment. The Robotic Mission to Mars allows students to remotely control a real rover, developed by the Australian Centre for Field Robotics (ACFR), on the VSSEC Mars surface. After completing a pre-mission training program and

site selection activity, students take on the roles of scientists and engineers in Mission Control to complete a mission and collect data for further analysis. Mission Control is established using software developed by the ACRI Games Technology Lab at La Trobe University using the principles of serious gaming. The software allows students to control the rover, monitor its systems and collect scientific data for analysis. This program encourages students to work scientifically and explores the interaction between scientists and engineers. This paper presents the development of the program, including the involvement of university students in the development of the rover, the software, and the collation of the scientific data. It also presents the results of the trial phase of this program including the impact on student engagement and learning outcomes. (Abstract)

Mayer, I. (2012). Towards a comprehensive methodology for the research and evaluation of serious games. *Procedia Computer Science, 15*, 233-247. DOI: 10.1016/j.procs.2012.10.075

Keywords: evaluation; game-based learning; serious gaming; simulation gaming

The author presents the methodological backgrounds and underlying research design of an on-going scientific research project concerned with the scientific evaluation of serious games and/or computer-based simulation-games (SG) for advanced learning. The main questions of this research project are: 1. what are the requirements and design principles for a comprehensive social-scientific methodology for the evaluation of SG? 2. To what extend does SG contribute to advanced learning? 3. What factors contribute to, or determine this learning? 4. To what extend and under what conditions can SG- based learning be transferred to the real world (RW)? Between 2004 and 2012, several hundreds of SG-sessions in the Netherlands with twelve different SG were evaluated systematically, uniformly and quantitatively to give a data-set of 2100 respondents in higher education and in work-organizations. The author presents the research model, the quasi-experimental design and evaluation instruments. This focus in this article is on methodology and data-set to establish a proper foundation for forthcoming publications on empirical results. (Abstract)

Mayer, I., Bekebrede, G., Harteveld, C., Warmelink, H., Zhou, Q., van Rujiven, T., . . . Wenzler, I. (2014). The research and evaluation of serious games: Toward a comprehensive methodology. *British Journal of Educational Technology, 45*(3), 502-527. DOI: 10.1111/bjet.12067

Keywords: identification; self-concept; career choice; career development; evaluation problems; test construction; science instruction; educational technology; educational games; self-concept measures; psychometrics

The authors present the methodological background to and underlying research design of an ongoing research project on the scientific evaluation of serious games and/or computer-based simulation games (SGs) for advanced learning. The main research questions are: (1) what are the requirements and design principles for a comprehensive social scientific methodology for the evaluation of SGs?; (2) to what extent do SGs contribute to advanced learning?; (3) what factors contribute to or determine this learning?; and (4) to what extent and under what conditions can SG-based learning be transferred to the real world? In the Netherlands between 2005 and 2012, several hundred SG sessions with 12 SGs were evaluated systematically, uniformly and quantitatively to

create a dataset, which comprises data on 2488 respondents in higher education or work organizations. The authors present the research model, the quasi-experimental design and the evaluation instruments. This focus in this paper is on the methodology and dataset, which form a sound foundation for forthcoming publications on the empirical results. (Abstract)

Mayer, I., Warmelink, H., & Bekebrede, G. (2013). Learning in a game-based virtual environment: A comparative evaluation in Higher Education. *European Journal of Engineering Education, 38*(1), 85-106. DOI: 10.1080/03043797.2012.742872

Keywords: interactive learning environment; simulations; authoring tools and methods; cooperative/collaborative learning; interdisciplinary projects

The authors define the requirements and a conceptual model for comparative evaluation research of simulation games and serious games (SGs) in a learning context. A first operationalisation of the model was used to comparatively evaluate a suite of 14 SGs on varying topics played between 2004 and 2009 in 13 institutes of higher education in the Netherlands. The questions in this research were: what is the perceived learning effectiveness of the games and what factors explain it? How can we comparatively evaluate games for learning? Data were gathered through pre- and post-game questionnaires among 1000 students, leading to 500 useful datasets and 230 complete datasets for analysis (factor analysis, scaling, "t"-test and correlation analysis) to give an explorative, structural model. The findings are discussed and a number of propositions for further research are formulated. The conclusion of the analysis is that the students' motivation and attitudes towards game-based learning before the game, their actual enjoyment, their efforts during the game and the quality of the facilitator/teacher are most strongly correlated with their learning satisfaction. The degree to which the experiences during the game were translated back into the underlying theories significantly determines the students' learning satisfaction. The quality of the virtual game environment did not matter so much. The authors reflect upon the general methodology used and offer suggestions for further research and development. (Abstract)

Meluso, A., Zheng, M., Spires, H. A., & Lester, J. (2012). Enhancing 5th graders' science content knowledge and self-efficacy through game-based learning. *Computers & Education, 59*(2), 497-504. DOI: 10.1016/j.compedu.2011.12.019

Keywords: Collaborative learning; Interactive learning environments; Media and education; Simulation; Pedagogical issues

Many argue that games can positively impact learning by providing an intrinsically motivating and engaging learning environment for students in ways that traditional school cannot. Recent research demonstrates that games have the potential to impact student learning in STEM content areas and that collaborative gameplay may be of particular importance for learning gains. This study investigated the effects of collaborative and single game player conditions on science content learning and science self-efficacy. Results indicated that there were no differences between the two playing conditions; however, when conditions were collapsed, science content learning and self-efficacy significantly increased. Future research should focus on the composition of collaboration interaction among game players to assess what types of collaborative tasks may yield positive learning gains. (Abstract)

Mettler, T., & Pinto, R. (2015). Serious games as a means for scientific knowledge transfer - a case from engineering management education. *IEEE Transactions on Engineering Management, 62*(2), 256-265.DOI: 10.1109/TEM.2015.2413494

Keywords: computer aided instruction; continuing professional development; engineering education; information dissemination; knowledge management; management education; serious games (computing); scientific knowledge transfer; engineering management education; knowledge society; lifelong learning needs; serious games; management-related research findings; management-related research finding dissemination; engineering-related research finding dissemination

Disseminating scientific findings through journal publications is the very nature of every academic discipline. However, with the emergence of knowledge society and lifelong learning needs, there is a growing demand for alternative ways to enhance the dissemination of research findings to a broader audience than academics and young students. In this paper, we first introduce the concept of serious games as a well-acknowledged alternative method to discourse and delivering current engineering or management-related research findings to society. Then, considering the lack of a unified serious game design framework and the gaps in the extant literature, we illustrate our design rationale for the development and evaluation of serious games. The proposed framework contributes the following advancements to the body of extant literature and practices. It is strongly centered on a well-known knowledge transfer framework, and it is strongly based on a participatory design approach deliberately involving iterative and frequent testing and fine-tuning sessions that overcome the inherent limitations of traditional stage-gate or waterfall development models. We conclude by providing some insights gained during the development of the game and the framework, as well as by discussing the challenges associated with the design and use of serious games as an alternative genre for disseminating engineering- and management-related research findings. (Abstract)

Meyer, B. (2013). Game-based language learning for pre-school children: A design perspective. *Electronic Journal of e-Learning, 11*(1), 39-48.ISSN: 1479-4403

Keywords: language learning; game-based learning; design for preschool learning

During the last decade there has been a growing focus on preschool learning within education, especially with regard to the learning of basic literacies such as reading and writing. In addition to this many nation states increasingly focus on the basic literacy competences of the information society, ICT and English. This has, as suggested by for instance Scanlon and Buckingham (2007) boosted opportunities for the sale of educational material and hardware to children for home learning, but also for learning material that links content directly to the curriculum, to school work and to assessment. This paper will focus on the design of learning material for pre-school teaching and learning through the example of a game-based platform for learning English called Mingoville.com. Mingoville has been studied in connection with the project Serious Games on a Global Market Place (2007-11), where a number of games were followed into classroom environments across nations. Currently, the developers of Mingoville are working on a platform version that targets preschool learners and works on tablets as well as pcs and smartboards. The paper will discuss the implications of redesigning the platform for pre-school teaching and learning and how this affects game-based language teaching and learning with Mingoville. (Abstract)

Miguel, J., Caballé, S., Xhafa, F., Prieto, J., & Barolli, L. (2016). A methodological approach for trustworthiness assessment and prediction in mobile online collaborative learning. *Computers Standards & Interfaces, 44*, 122-136. DOI: 10.1016/j.csi.2015.04.008

Keywords: information security; trustworthiness; e-assessment; online collaborative learning; mobile learning

Trustworthiness and technological security solutions are closely related to online collaborative learning and they can be combined with the aim of reaching information security requirements for e-Learning participants and designers. Moreover, mobile collaborative learning is an emerging educational model devoted to providing the learner with the ability to assimilate learning any time and anywhere. In this paper, we justify the need of trustworthiness models as a functional requirement devoted to improving information security. To this end, we propose a methodological approach to modelling trustworthiness in online collaborative learning. Our proposal sets out to build a theoretical approach with the aim to provide e-Learning designers and managers with guidelines for incorporating security into mobile online collaborative activities through trustworthiness assessment and prediction. (Abstract)

Minović, M., Milovanović, M., Šošević, U., & Conde González, M. Á. (2015). Visualisation of student learning model in serious games. *Computers in Human Behavior, 47*, 98-107. DOI: 10.1016/j.cnb.2014.09.005

Keywords: student learning model; serious games; distance learning; student satisfaction; dynamic game environment; real-time tracking; visulisation approach; learning analytics method

Application of serious games in distance learning can raise quality of education and student satisfaction on a higher level. However, when student learns through game, his focus is moved from learning domain to different context of the game. This actually enables to achieve fun and learn at the same time. But this approach also makes harder for educators to track and analyse students learning progress during game session, which is crucial in order to provide immediate feedback and to help students reach established learning goals. Such a specific learning environment requires concrete real-time analytical tool that will adequately match the dynamic game environment. This paper proposes a new tool for visualisation of student learning model during gameplay session. Tool can be used by educators and by students to track the game progress. Using this tool educators are provided with real-time tracking of students learning and it enables them to react and influence the overall learning process. Evaluation of the proposed approach was done through an empirical study, conducted on educators group monitoring an educational game session, using the combination of traditional analytic tool and the newly proposed visualisation approach. Initial quantitative results and recorded opinions of the participants speak in favour of the proposed approach and justify further investment in development of this specific learning analytics method. (Abstract)

Monteiro, B. D. S., Gomes, A. S., & Mendes Neto, F. M. (2016). Youubi: Open software for ubiquitous learning. *Computers in Human Behavior*, 55, 1145-1164. DOI: 10.1016/j.chb.2014.09.064

Keywords: ubiquitous learning; ubiquitous computing; software engineering; design interactive; gamification

Popularization of mobile and personalized services motivates the adoption of learning strategies supported by the principles of ubiquitous computing. However, because it is a new field, there is a perceived lack of ubiquitous learning environments, based on reference architectures, and open source software. Against this backdrop, this article aims to present the Youubi; one u-learning environment that was developed as a component-oriented reference architecture, applied to the context of formal and informal learning. For validation, the Youubi was used and installed by undergraduate's students and teachers in their smartphones. The method applied in this research includes design process and quantitative and qualitative analysis techniques, with the goal of identifying scenarios of ubiquitous learning and realize the impressions of students and teachers about the playful and motivational aspects, and its contribution to learning. (Abstract)

Mortara, M., Catalano, C. E., Bellotti, F., Fiucci, G., Houry-Panchetti, M., & Petridis, P. (2014). Learning cultural heritage by serious games. *Journal of Cultural Heritage, 15*(3), 318-325. DOI: 10.1016/j.culher.2013.04.004

Keywords: serious games; digital humanities and heritage; game-based learning

Immersive technologies such as virtual environments and augmented reality have a clear potential to support the experiencing of cultural heritage by the large public, complementing the current tools and practices based on tangible goods such as museums, exhibitions, books and visual content. Serious games – videogames designed for educational objectives – appear as a new tool to learn cultural content in an engaging way. In this paper, we will provide an extensive portrait of the current proposition of serious games in the cultural sector, highlighting the educational objectives of games in this domain and analysing the complex relations between genre, context of use, technological solutions and learning effectiveness. We finally identify and discuss the most significant challenges in the design and adoption of educational games in cultural heritage. (Abstract)

Mouaheb, H., Fahli, A., Moussetad, M., & Elijamili, S. (2012). The serious game: What educational benefits. *Procedia - Social and Behavioural Sciences, 46*, 5502-5508. DOI: 10.1016/j.sbspro.2012.06.465

Keywords: serious game; constructivist psychocognitive theories; intrinsic motivation; socio-cognitive conflicts; situated learning

This work lies in the educational opportunities of a learning tool: the serious game. The serious game was investigated using an American example: Virtual University.We first highlight the main features of this media, namely that it can be used as: a teaching tool, a means of entertainment, and as a technology of information and communication. It aims for multiple learning objectives, it finds application in many areas and it targets all age groups. Then, we show that learning through the serious game has educational values that are based on learning concepts advocated by constructivist psycho-cognitive theories; it guarantees intrinsic motivation, generates cognitive conflicts and provides situated learning. (Abstract)

Moylan, G., Burgess, A. W., Figley, C., & Michael, B. (2015). Motivating game-based learning efforts in Higher Education. *International Journal of Distance Education Technologies, 13*(2), 54-72. DOI: 10.4018/ijdet.2015040104

Keywords: teaching methods; higher education; educational games; online courses; educational technology; distance education; technology uses in education; thinking skills; critical thinking; computer simulation; computer software; course content; program development

Though there is considerable research to support using Game-Based Learning (GBL) in higher education, its implementation is lagging behind K-12 education by an order of magnitude. By considering the current state of GBL from leadership, primary consumer, academic and technical perspectives, the authors frame the main issues involved with successfully implementing these efforts. These issues involve obtaining the resources required to make mature serious games that are similar in presentation, functionality and effectiveness to the commercial-based products so widely used today, while ensuring that they are imbued with academic content worthy of college curricula. After motivating a compelling case for GBL, despite a number of constraints and difficulties, the authors present two higher education efforts that are designed to augment the core curriculum for undergraduate and graduate level courses associated with the field of Trauma--a field enhanced by virtual efforts due to its challenging subject matter. (Abstract)

Muñoz, K., McKevitt, P., Lunney, T., Noguez, J., & Neri, L. (2011). An emotional student model for game-play adaptation. *Entertainment Computing, 2*(2), 133-141. DOI: 10.1016/j.entcom.2010.12.006

Keywords: affective student modeling; Dynamic Bayesian Network (DBN); game-based learning environment; Intelligent Tutoring System (ITS); PlayPhysics; Probabilistic Relational Model (PRM)

Game-based learning offers key advantages for learning through experience in conjunction with offering multi-sensorial and engaging communication. However, ensuring that learning has taken place is the ultimate challenge. Intelligent Tutoring Systems (ITSs) have been incorporated into game-based learning environments to guide learners' exploration. Emotions have proven to be deeply intertwined with cognitive and motivational factors. ITSs attempt to recognise and convey emotion in order to enhance students' learning and engagement. The ITS student model is responsible for attainment of adaptability and understanding of learners' needs. It is not clear which emotions are relevant to the teaching-learning experience, or what antecedents and interpersonal differences are involved in determining an emotion. Therefore, student modelling involves uncertainty. Creating an emotional student model that can reason about students' observable behaviour during online game-play is the main goal of our research. The analysis, design and implementation for this model are our central focus here. The model uses as a basis the Control-Value theory of achievement emotions and employs motivational and cognitive variables to determine an emotion. A Probabilistic Relational Model (PRM) approach was applied to facilitate the derivation of three Dynamic Bayesian Networks (DBNs) corresponding to three types of achievement emotions. Results from a prototyping exercise conducted along with the outcome-prospective emotions DBN are presented and discussed. In future work a larger population of students will be employed to develop an accurate DBN model to incorporate into PlayPhysics, an emotional game-based learning environment for teaching Physics. (Abstract)

Nadolski, R. J., Hummel, H. G., van den Brink, H. J., Hoefakker, R. E., Slootmaker, A., Kurbers, H. J., & Storm, J. (2008). EMERGO: A methodology and toolkit for developing serious games in higher education. *Simulation Gaming, 39*(3), 338-352. DOI: 10.1177/1046878108319278

Keywords: EMERGO; higher education; methodology; multimedia practicals; scenarios; serious games; toolkit

Societal changes demand educators to apply new pedagogical approaches. Many educational stakeholders feel that serious games could play a key role in fulfilling this demand, and they lick their chops when looking at the booming industry of leisure games. However, current toolkits for developing leisure games show severe shortcomings when applied to serious games. Developing effective serious games in an efficient way requires a specific approach and tool set. This article describes the EMERGO methodology and generic toolkit for developing and delivering scenario-based serious games that are aimed at the acquisition of complex cognitive skills in higher education. Preliminary evaluation results with case developers using the EMERGO methodology and toolkit and with learners using EMERGO cases are presented. (Abstract)

Noemí, P.-M., & Máximo, S. H. (2014). Educational games for learning. *Universal Journal of Educational Research, 2*(3), 230-238. DOI: 10.13189/ujer.2014.020305

Keywords: serious games; tutoring; game-based learning

The introduction of new technologies in society has created a need for interactive contents that can make the most of the potential that technological advances offer. Serious games as educational games are such content: they can be defined as video games or interactive applications whose main purpose is to provide not only entertainment but also training in areas such as health, marketing, education, etc. This paper reviews various cases of successful serious games and their influence on the learning process, looks at tutoring as the key to guiding the learning process throughout serious games and considers what kind of abilities and skills can be achieved via such games. At this time of financial, economic and social crisis citizens must be prepared to confront the challenges of the future, and the individual values of each citizen must be joined to those of society as a whole. Serious games are the perfect tool for achieving these aims, and for transmitting contents and values attractively and efficiently. (Abstract)

Núñez Castellar, E., All, A., de Marez, L., & Van Looy, J. (2015). Cognitive abilities, digital games and arithmetic performance enhancement: A study comparing the effects of a math game and paper exercises. *Computers & Education, 85*, 123-133. DOI: 10.1016/j.compedu.2014.12.021

Keywords: educational game; arithmetic training; working memory; visuo-motor skills; enjoyment

Besides entertainment, games have shown to have the potential to impact a broader variety of cognitive abilities. Research has consistently shown that several aspects in cognition such as visual short-memory, multitasking and spatial skills can be enhanced by game play. In a previous study, it was found that playing Monkey Tales, a game aimed at training arithmetic skills, helped second grade pupils to increase their accuracy in mental calculation as compared to paper exercises. In this follow up study we explore whether traditional methods and game training differ in terms of the cognitive processes that both are able to impact. We incorporated standardized measures of

working memory and visuo-motor skills. Additionally, the mathematics game was modified and its contents extracted to allow precise comparison between the gaming and paper exercises condition. Thus each single math exercise, type of question (e.g., multiple choice), quantity and order was perfectly matched in the game training and the traditional training conditions. Gains in arithmetical performance, and self-reported measures of enjoyment were also investigated. We found some evidence suggesting that arithmetic performance enhancement induced by game play and paper exercises differ not only in terms of enjoyment but also of working memory capacity improvements. (Abstract)

Núñez Castellar, E., Van Looy, J., Szmalec, A., & de Marez, L. (2014). Improving arithmetic skills through gameplay: Assessment of the effectiveness of an educational game in terms of cognitive and affective learning outcomes. *Information Sciences, 264*, 19-31. DOI: 10.1016/j.ins.2013.09.030

Keywords: arithmetic training; mental calculation; educational game; effectiveness; cognitive learning outcome; affective learning outcome

The present study assesses the effectiveness of a commercial educational math game for improving the arithmetic skills of children. Eighty-eight second graders were randomly assigned to one of three groups: a 'gaming group' which was instructed to play through the entire commercial game 'Monkey Tales', a group which was instructed to complete math exercises on paper and a control group that that did not receive any arithmetic exercises. We used a multidimensional approach to estimate the impact of game playing on objective measures of arithmetic performance such as speed and accuracy on a math test, as well as subjective measures such as math anxiety, enjoyment and perceived competence. Overall, the present study shows that the use of games for arithmetic can be beneficial both in terms of affective and cognitive learning outcomes. (Abstract)

Obikwelu, C., Read, J., & Sim, G. (2013). Children's problem-solving in serious games: The "Fine-Tuning System (FTS)" elaborated. *Electronic Journal of e-Learning, 11*(1), 49-60.

Keywords: expertise-reversal effect; fading; fine-tuning system; peer-tutoring; problem-based learning; redundancy effect; scaffolding; serious game; ZPD

For a child to learn through Problem-Solving in Serious games, the game scaffolding mechanism has to be effective. Scaffolding is based on the Vygotzkian Zone of Proximal Development (ZPD) concept which refers to the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers. Scaffolds in serious games are learning stimulators. The effectiveness of these learning stimulators lies in the way they are managed or regulated. Scaffolds that are not regulated could lead to expertise-reversal effect or redundancy effect which inhibits learning. In the current classroom application of serious games, the game-based learning stimulators remain the same for everyone ("blanket scaffolding")--the learning stimulators are not managed or regulated. In order to make scaffolding in serious games more effective for classroom use, the calibration of the game's learning stimulators has to be enabled--this would help in meeting the changing needs of the learners. The concept of fading which is critical to scaffolding is introduced to serious games, to facilitate the fine-tuning of the learning

stimulators to the changing needs of the learners. This paper seeks to address the issues in the design and implementation of a Fine-Tuning System for serious games based on the fading concept. Also discussed in this paper are the factors to be considered in the implementation of the Fine-Tuning System in serious games. These include fading decisions; fading and learning rates; optimal scaffolding distance; classroom culture and collaborative learning. The adverse effects of neglecting fading such as expertise-reversal effect and redundancy effect are also discussed. (Abstract)

Oliveira, V., Coelho, A., Guimarães, R., & Rebelo, C. (2012). Serioous game in security: A solution for security trainees. *Procedia Computer Science, 15*, 274-282. DOI: 10.1016/j.procs.2012.10.079

Keywords: serious game; security; safety; multiplayer; cooperation

Serious games have been used with success for training field operatives in tasks where there is a danger of injury or life threatening situations. This paper presents the development of a serious game aimed at the areas of security and safety, supporting the training of specialists through supervised situational scenarios. The training plans involve security against third parties, focusing on social level security at a corporate level, and also safety actions on events such as floods and fires in buildings/facilities. The game provides a 3D virtual environment of the real location/facility to be secured and a multiplayer platform to allow collaborative training and supervising. (Abstract)

O'Neil, H. F., Chung, G. K. W. K., Kerr, D., Vendinski, T. P., Buschang, R. E., & Mayer, R. E. (2014). Adding self-explanation prompts to an educational computer game. *Computers in Human Behavior, 30*, 23-28. DOI: 10.1016/j.chb.2013.07.025

Keywords: educational games; computer games; self-explanation; fractions

Proponents envision a role for computer games in improving student learning of academic material, including mathematics and science. Asking learners to engage in self-explanations during learning has been found to be an effective instructional method. In the present experiment, we examined the effects of adding a self-explanation prompt—asking players to answer one of three questions after completing each level of the game—within a children's math game on addition of fractions. Middle-school participants played either a base version of the game (n = 57) or the base version with a self-explanation instructional feature (n = 57). Participants' learning was measured by a fractions posttest and their learning processes measured via in-game measures of game progress and errors. When we separated the self-explanation condition into participants who used a focused self-explanation strategy versus those who did not, the focused participants had significantly fewer game level deaths, game level resets, and progressed significantly farther in the game, compared to the control group, than participants not using a focused self-explanation strategy. The major new contribution of this study is that self-explanation can help the process of playing educational games in some situations and hurt in others. In particular, the most effective self-explanation prompts were aimed at helping learners make connections between game terminology and mathematics terminology, whereas the least effective self-explanation prompts asked very simple or very abstract questions. (Abstract)

Ozcelik, E., Cagiltay, N. E., & Ozcelik, N. S. (2013). The effect of uncertainty on learning in game-like environments. *Computers & Education, 67*, 12-20. DOI: 10.1016/j.compedu.2013.02.009

Keywords: interactive learning environments; post-secondary education

Considering the role of games for educational purposes, there has an increase in interest among educators in applying strategies used in popular games to create more engaging learning environments. Learning is more fun and appealing in digital educational games and, as a result, it may become more effective. However, few research studies have been conducted to establish principles based on empirical research for designing engaging and entertaining games so as to improve learning. One of the essential characteristics of games that has been unexplored in the literature is the concept of uncertainty. This study examines the effect of uncertainty on learning outcomes. In order to better understand this effect on learning, a game-like learning tool was developed to teach a database concept in higher education programs of software engineering. The tool is designed in two versions: one including uncertainty and the other including no uncertainty. The experimental results of this study reveal that uncertainty enhances learning. Uncertainty is found to be positively associated with motivation. As motivation increases, participants tend to spend more time on answering the questions and to have higher accuracy in these questions. (Abstract)

Padilla-Zea, N., Gutiérrez, F., López-Arcos, J. R., Abad-Arranz, a., & Paderewski, P. (2014). Modeling storytelling to be used in educational video games. *Computers in Human Behavior, 31*, 461-474. DOI: 10.1016/j.chb.2013.04.020

Keywords: digital storytelling; educational videogames; game-based learning

Including storytelling in educational video games is currently a highly studied field as it is one element with which to maintain students' motivation. From previous studies, we have confirmed that including changes in the story changes the way in which students perceive the video game. In this paper, we present an extension of our previously defined VGSCL (a reference model for educational game development incorporating collaborative activities), in which balanced ludic and educative contents were designed. With this extension we focus on the storytelling itself, highlighting elements included in the story composition, attributes to be defined and relationships to be specified in order to integrate this proposal in the existing model. In addition, due to our target group being aged from 3 to 7, we have introduced some considerations to adapt the general rules to these children. Finally, we present the process followed to incorporate digital storytelling in the educational videogame "Ato's Adventure", the educational goal of which is to train grapho-motor skills. (Abstract)

Pannese, L., & Carlesi, M. (2007). Games and learning come together to maximise effectiveness: The challenge of bridging the gap. *British Journal of Educational Technology, 38*(3), 438-454. DOI: 10.1111/j.1467-8535.2007.00708.x

Keywords: foreign countries; training objectives; training; case studies; surveys; college students; computers; games; student attitudes; business; comparative analysis

The authors are designing and carrying out some training sessions based on serious games with customers from different business environments and with some university student groups, both in northern Italy. Some business case studies are described in this article specifying the context, the training goal, the adopted training solution and the main characteristics of the designed game. Some screenshots are also shown. Furthermore, the authors are carrying out a survey both in the business and the university environment to analyse how the learners perceive these kinds of games in terms of effectiveness, engagement, pleasure, usability and freedom of behaviour while playing. Some results are reported in this paper, and the comparison between students' and employees' perception is shown. The questionnaire used can be found in the Appendix. (Abstract)

Papastergiou, M. (2009). Digital Game-Based Learning in high school Computer Science education: Impact on educational effectiveness and student motivation. *Computers & Education, 52*(1), 1-12. DOI: 10.1016/j.compedu.2008.06.004

Keywords: interactive learning environments; multi-media/hypermedia systems; applications in subject areas; secondary education; gender studies

The aim of this study was to assess the learning effectiveness and motivational appeal of a computer game for learning computer memory concepts, which was designed according to the curricular objectives and the subject matter of the Greek high school Computer Science (CS) curriculum, as compared to a similar application, encompassing identical learning objectives and content but lacking the gaming aspect. The study also investigated potential gender differences in the game's learning effectiveness and motivational appeal. The sample was 88 students, who were randomly assigned to two groups, one of which used the gaming application (Group A, N = 47) and the other one the non-gaming one (Group B, N = 41). A Computer Memory Knowledge Test (CMKT) was used as the pretest and posttest. Students were also observed during the interventions. Furthermore, after the interventions, students' views on the application they had used were elicited through a feedback questionnaire. Data analyses showed that the gaming approach was both more effective in promoting students' knowledge of computer memory concepts and more motivational than the non-gaming approach. Despite boys' greater involvement with, liking of and experience in computer gaming, and their greater initial computer memory knowledge, the learning gains that boys and girls achieved through the use of the game did not differ significantly, and the game was found to be equally motivational for boys and girls. The results suggest that within high school CS, educational computer games can be exploited as effective and motivational learning environments, regardless of students' gender. (Abstract)

Parodi, E., Bedek, M. A., Seitlinger, P., Vannucci, M., Jennett, C., Ruskov, M., & Celdran, J. M. (2014). Analysing players' performance in serious games. *International Journal of Technology Enhanced Learning, 6*(3), 237-248. DOI: 10.1504/IJTEL.2014.068363

Keywords: player performance analysis; serious games; learning technologies; short-medium term; learner performance measurement; learner performance tracing; game sessions; competence performance analyser tool; CPA tool; player activity

Serious games are recognised as one of the most promising innovative learning technologies in the short-medium term. Even if the empowerment of learning they provide is widely recognised, there

are few means to trace and measure learners' performance during game sessions. This paper describes a Competence Performance Analyser (CPA) tool that keeps trace of the players' activity in the shape of events in the game and, based on these activities, assesses related performance with respect to a predefined set of competences. (Abstract)

Paraskeva, F., Mysitlaki, S., & Papagianni, A. (2010). Multiplayer online games as educational tools: Facing new challenges in learning. *Computers & Education, 54*(2), 298-505. DOI: 10.1016/j.compedu.2009.09.001

Keywords: digital games; education; activity theory; collaborative learning

This paper outlines a proposal for the development of educational multiplayer online games based on the activity theory, as an alternative to the current trend in multiplayer gaming and a means of promoting collaboration among students. In order to examine whether online games are engaging for learners, we consider multiple factors regarding game play – such as frequency of game use, gender differences, identification with the characters, and game preferences – as well as some psychosocial factors that may influence learning – such as academic performance, self-esteem, and computer self-efficacy. This paper suggests that online multiplayer educational games should be approached as a complex learning system, based on the principles of activity theory, where the Subjects would interact with other Subjects, Objects and Tools of the game, under specified Rules and create Communities through division of labor, leading to the expected learning outcome. Thus, we suggest taking into account some important issues concerning the Subjects that the activity theory refers to, such as gender differences in playing games, academic performance, self-esteem and computer self-efficacy. (Abstract)

Pedreira, O., García, F., Brisaboa, N., & Piattini, M. (2015). Gamification in software engineering – A systematic mapping. *Information and Software Technology, 57*, 157-168. DOI: 10.1016/j.infsof.2014.08.007

Keywords: gamification; software engineering; systematic mapping

Gamification seeks for improvement of the user's engagement, motivation, and performance when carrying out a certain task, by means of incorporating game mechanics and elements, thus making that task more attractive. Much research work has studied the application of gamification in software engineering for increasing the engagement and results of developers. The objective of this paper is to carry out a systematic mapping of the field of gamification in software engineering in an attempt to characterize the state of the art of this field identifying gaps and opportunities for further research. We carried out a systematic mapping with a view to finding the primary studies in the existing literature, which were later classified and analyzed according to four criteria: the software process area addressed, the gamification elements used, the type of research method followed, and the type of forum in which they were published. A subjective evaluation of the studies was also carried out to evaluate them in terms of methodology, empirical evidence, integration with the organization, and replicability. As a result of the systematic mapping we found 29 primary studies, published between January 2011 and June 2014. Most of them focus on software development, and to a lesser extent, requirements, project management, and other support areas. In the main, they consider very simple gamification mechanics such as points and badges, and few provide empirical

evidence of the impact of gamification. Existing research in the field is quite preliminary, and more research effort analyzing the impact of gamification in SE would be needed. Future research work should look at other game mechanics in addition to the basic ones and should tackle software process areas that have not been fully studied, such as requirements, project management, maintenance, or testing. Most studies share a lack of methodological support that would make their proposals replicable in other settings. The integration of gamification with an organization's existing tools is also an important challenge that needs to be taken up in this field. (Abstract)

Pereira, G., Brisson, A., Prada, R., Paiva, A., Bellotti, F., Kravcik, M., & Klamma, R. (2012). Serious games for personal and social learning & ethics: Status and trends. *Procedia Computer Science, 15*, 53-65. DOI: 10.1016/j.procs.2012.10.058

Keywords: serious games; personal learning; social learning; ethics; survey

The blooming growth of interest in Serious Games (SG) over the last decade spread its applicational areas into an extremely wide and fragmented domain. As a consequence, it is extremely difficult to create a complete panorama snapshot regarding the application of SGs. With this work we contribute to the de-fragmentation of the domain Personal and Social Learning & Ethics(PSLE). We established a shared vocabulary with the creation of a detailed taxonomy based on which we carried out two surveys to analyze 1) the current status, trends and gaps and 2) the barriers and facilitators of SG adoption in PSLE. (Abstract)

Petit dit Dariel, O. J., Raby, T., Ravaut, F., & Rothan-Tondeur, M. (2013). Developing the serious games potential in nursing education. *Nurse Education Today, 33*(12), 1569-1575. DOI: 10.1016/j.nedt.2012.12.014

Keywords: nurse education; serious games; video games; community care; clinical reasoning

Shortened hospital stays, high patient acuity and technological advances demand that nurses increasingly make decisions under conditions of uncertainty and risk (Ebright et al., 2003). With rising trends towards out-patient care, nurses will need to perform complex problem-solving within a dynamic and changing environment for which there is not one clear solution (Schofield et al., 2010 and Wolff et al., 2009). The development of sharp clinical reasoning skills, as well as skills in detection, monitoring, investigation and evaluation are therefore essential (Aitken et al., 2002). Yet few nursing students have long-term exposure to home-care and community situations. This is primarily due to scarce human resources and the time-consuming requirements of student supervision (Duque et al., 2008). When students are given the opportunity to experience home-care or community visits these tend to be unstructured leading to wide variations in their competencies. New pedagogical tools are needed to adequately and consistently prepare nurses for the skills they will need to care for patients outside acute care settings. Advances in Information and Communications Technologies (ICT) offer an opportunity to explore innovative pedagogical solutions that could help students develop these skills in a safe environment. A three-phased project is underway that aims to create and test a Serious Game to improve nurses' clinical reasoning and detection skills in home-care and community settings. The first phase of this project involves the development of a scenario, the game engine and the graphic design and will be the focus of this

paper. The second and third phases will test the Serious Game as an educational intervention and will be reported in subsequent papers. (Abstract)

Pourabdollahian, B., Taisch, M., & Kerga, E. (2012). Serious games in manufacturing education: Evaluation of learners' engagement. *Procedia Computer Science, 15*, 256-265. DOI: 10.1016/j.procs.2012.10.077

Keywords: manufacturing education; serious game evaluation; engagement

Presently industries need new generation of knowledge workers who are adept with the dynamics of manufacturing systems. Consequently, application of serious games as a promising learning method has emerged in manufacturing education. Serious game is aimed at learning rather than pure entertainment. Thus, evaluating the effectiveness of a serious game in improving the learning outcome is a paramount issue. In this paper, after reviewing efforts which have been made in serious games' evaluation, the level of learners' engagement that played the Set Based Concurrent Engineering (SBCE) game is examined. The game is designed at Politecnico di Milano, Italy to bring a hand-on experience on lean product development for practitioners and academia. The study is based on one company case in Italy. The results show that a high level of engagement among learners is exhibited based on the evaluation framework adopted. (Abstract)

Prestopnik, N. R., & Tang, J. (2015). Points, stories, worlds, and diegesis: Comparing player experiences in two citizen science games. *Computers in Human Behavior, 52*, 492-506. DOI: 10.1016/j.chb.2015.05.051

Keywords: gamification; crowdsourcing; citizen science; diegesis; stories; narrative

We conducted an experiment to examine how people perceive differences between points-based and story-based gamification approaches. We were interested in how these differences impact peoples' play experiences and perceptions of working on a citizen science task. Our findings show that the story-based game, Forgotten Island, was strongly preferred over the points-based game, Happy Match. Participants indicated that this was because of "diegesis" in Forgotten Island – in other words, a focus on story-motivated activities and rewards made the citizen science task more enjoyable and gave participants various reasons to continue play. This study suggests that story-based games can be a powerful tool for attracting participants to citizen science tasks. In particular, compared to point-based games, story-based games may be more useful for attracting and engaging participants who are ambivalent about scientific inquiry. This paper also discusses some of the challenges and possibilities for both points-based and story-based gamification. (Abstract)

Proaps, A. B., & Bliss, J. P. (2014). The effects of text presentation format on reading comprehension and video game performance. *Computers in Human Behavior, 36*, 41-47.DOI: 10.1016/j.chb.2014.03.039

Keywords: video game-based training; military; mobile devices; reading comprehension; rapid serial visual presentation

The military has used video games to help geographically distributed military teams develop specific skills in a safe, controlled environment. Military trainers have also used hand-held devices and rapid serial visual presentation (RSVP) of text and graphics for training and mission planning. This research

continued previous work investigating the influence of RSVP of intelligence reports on task performance, reading comprehension, and affect. Seventy-eight participants moved through a video game to find a target avatar as quickly as possible based on intelligence reports. There were two presentation styles (RSVP or traditional) and two intelligence formats (content-relevant words or full sentences). Differences in task performance, reading comprehension, and affect occurred as a function of text presentation. Participants in the RSVP group found the medic more quickly when reading full sentences than when reading only content words. Individuals reading traditional text of content words scored higher on comprehension tests than when reading either RSVP format. Participants also found RSVP tasks to be more challenging and more engaging than traditional text formats. These results suggest researchers and trainers should continue to investigate RSVP to determine its applicability for training other skills. (Abstract)

Proctor, M. D., & Marks, Y. (2013). A survey of exemplar teachers' perceptions, use, and access of computer-based games and technology for classroom instruction. *Computers & Education, 62*, 171-180. DOI: 10.1016/j.compedu.2012.10.022

Keywords: educational computer games; improving classroom teaching; interactive learning environments; pedagogical issues; simulations; human-computer interface

This research reports and analyzes for archival purposes surveyed perceptions, use, and access by 259 United States based exemplar Primary and Secondary educators of computer-based games and technology for classroom instruction. Participating respondents were considered exemplary as they each won the Milken Educator Award during the 1996–2009 computer era. Overall perceptions are reported along with trend, differences in perceptions by subject area taught, and differences in perception by Primary and Secondary teacher population categories. Overall game usage is reported along with association of perceptions with game usage as well as usage differences due to grade category. Among other findings, adoption of computer-based games for educational use in the classroom by exemplar Primary teacher populations appeared to be in the Late Majority stage of the Rogers Technology Adoption Curve while adoption in the classroom by exemplar Secondary teacher populations appeared to be in the beginning of the Early Majority stage. (Abstract)

Radianti, J., Lazreg, M. B., & Grandmo, O.-C. (2015). Fire simulation-based adaptation of SmartRescue App for serious game: Design, setup and user experience. *Engineering Applications of Artificial Intelligence, 46*, 312-325. DOI: 10.1016/j.engappai.2015.06.012

Keywords: fire simulations; sensors; game app; serious game; disaster management; bayesian network

Managing the crisis by embracing game and simulation elements and human participation into an interactive system is a mean to learn about responding to unexpected events. This so-called serious game approach is adopted in a summer school for crisis management attended by doctoral students and practitioners, as a part of its learning curriculum. The participants took part in the Disaster in my Backyard serious game, designed as a realistic crisis environment. A smartphone app encompassing fire simulations of a five-story apartment, showing how the flame, smoke and temperature of the fire developed over time from floor to floor, was tested in this serious game scenario. The color-coding of smoke and temperature information indicating the danger levels was used as a guide and

decision support for the rescue team to evacuate victims out of the burning apartment. In this paper, we elaborate the underlying technology, design, and setup of the app. Finally, we discuss the evaluation of the user experience, and the merits and shortcomings of the app for search and rescue activity in a serious game fire situation. (Abstract)

Rancchod, A., Gurău, C., Loukis, E., & Trivedi, R. (2014). Evaluating the educational effectiveness of simulation games: A value generation model. *Information Sciences, 264*, 75-90. DOI: 10.1016/j.ins.2013.09.008

Keywords: simulation games; markstrat; marketing management education; value generation; model development and validation

This article investigates the relationships between various types of educational value generated by the Markstrat simulation game. Considering several theoretical models of experiential learning and the research framework proposed by previous studies, an educational value generation model is developed and validated, using primary data collected from 305 UK-based students. Four types of educational value are identified: experience generation, conceptual understanding, skills development, and affective evaluation. The application of structural equation modelling indicates several significant relationships: experience generation has a strong impact on conceptual understanding, and both of them have medium to high direct impacts on skills development. On the other hand, the participants' perception regarding the professional skills developed during the simulation game determines their affective evaluation of the Markstrat exercise. The model presented in this study is generalizable to other simulation games, and to other academic disciplines that implement the same experiential learning approach. (Abstract)

Raybourn, E. M. (2014). A new paradigm for serious games: Transmedia learning for more effective training and education. *Journal of Computational Science, 5*(3), 471-481.DOI: 10.1016/j.jocs.2013.08.005

Keywords: transmedia learning; serious games; transmedia campaigns; storytelling; social media; data mining; xAPI; MOOC

Serious games present a relatively new approach to training and education for international organizations such as NATO (North Atlantic Treaty Organization), non-governmental organizations (NGOs), the U.S. Department of Defense (DoD) and the U.S. Department of Homeland Security (DHS). Although serious games are often deployed as stand-alone solutions, they can also serve as entry points into a comprehensive training pipeline in which content is delivered via different media to rapidly scale immersive training and education for mass audiences. The present paper introduces a new paradigm for more effective and scalable training and education called transmedia learning. Transmedia learning leverages several new media trends including the peer communications of social media, the scalability of massively openonline course (MOOCs), and the design of transmedia storytelling used by entertainment, advertising, and commercial game industries to sustain audience engagement. Transmedia learning is defined as the scalable system of messages representing a narrative or core experience that unfolds from the use of multiple media, emotionally engaging learners by involving them personally in the story. In the present paper, we introduce the transmedia learning paradigm as offering more effective use of serious games for training and education. This

approach is consistent with the goals of international organizations implementing approaches similar to those described by the Army Learning Model (ALM) to deliver training and education to Soldiers across multiple media. We discuss why the human brain is wired for transmedia learning and demonstrate how the Simulation Experience Design Method can be used to create transmedia learning story worlds for serious games. We describe how social media interactions and MOOCs may be used in transmedia learning, and how data mining social media and experience tracking can inform the development of computational learner models for transmedia learning campaigns. Examples of how the U.S. Army has utilized transmedia campaigns for strategic communication and game-based training are provided. Finally, we provide strategies the reader can use today to incorporate transmedia storytelling elements such as Internet, serious games, video, social media, graphic novels, machinima, blogs, and alternate reality gaming into a new paradigm for training and education: transmedia learning. (Abstract)

Reese, D. D. (2007). First steps and beyond: Serious games as preparation for future learning. *Journal of Educational Multimedia and Hypermedia, 16*(3), 283-300.

Keywords: learning; instructional systems design; cognitive science; game theory; direct instruction; electronic games

Electronic game technologies can prepare novice learners for future learning of complex concepts. This article describes the underlying instructional design, learning science, cognitive science, and game theory. A structural, or syntactic mapping (structure mapping), approach to game design can produce a game world relationally isomorphic to a targeted complex concept. Such a game world should provide experiential and reflective gameplay to help learners form a preconceptual mental model of the targeted concept. A preparation for future learning (PFL) approach would follow gameplay with direct instruction. (Abstract)

Riemer, V., & Schrader, C. (2015). Learning with quizzes, simulations, and adventures: Students' attitudes, perceptions and intentions to learn with different types of serious games. *Computers & Education, 88*, 160-168. DOI: 10.1016/j.compedu.2015.05.003

Keywords: serious games; attitudes toward media; interactive learning environments; scale development; media in education

Students' attitudes, their perceptions of cognitive and affective quality as predictors of attitudes, and the resulting intention toward learning with serious games remains ambiguous, largely due to the use of imprecise measures. The presented studies have aimed to develop and test a measurement of students' attitudes, perceptions, and intentions to learn with serious games in general, and to use the instrument to examine differences for the most common types of serious games, that is quiz, simulation, and adventure. To this end, a pretest (n = 301) and two main studies (Study 1: n = 135, Study 2: n = 375) were conducted. The developed instrument shows high reliability and convergent validity. Results demonstrate positive attitudes, positive cognitive perceptions, and high positive and low negative affective perceptions of students toward learning with serious games in general, as well as with different game types. Findings from a multivariate analysis of variance (MANOVA), however, indicate differences between the three game types that could be related to the perceptions of cognitive and affective quality. Predominately, compared to quizzes and adventures, simulations

were perceived as more supportive for the comprehension and application of knowledge while promoting a less positive affect. Additionally, there was a significant difference due to gender. Whereas females reported higher perceptions of negative affective quality compared to males when serious games were addressed in general, answers to questions about the specific game types revealed a more detailed picture. In contrast to previous findings in existing literature, female students reported a more positive attitude, as well as higher perceptions of positive affective quality, than males for all three game types. These results stress the importance of examining the types of serious games separately and considering gender when evaluating students' attitudes and perceptions when learning with serious games. (Abstract)

Robinson, A. J. (2008). The design is the game: Writing games, teaching writing. *Computers and Composition, 25*(3), 359-370. DOI: 10.1016/j.compcom.2008.04.006

Keywords: writing; composition; rhetoric; curriculum; design; development; video games; games; video; pedagogy; literacy

This article makes both conceptual and empirical arguments for why composition scholars and teachers ought to take notice of how video games are designed and developed in such a way as to make them so compelling. Thinking about games' design principles as an analogy for composition curricula, I argue that video game designers and developers discuss and approach their design processes in many of the same ways writing teachers do. Data presented are taken from several years' worth of ethnographic interviews, observations, and artifact analyses from within the game design and development community. This paper demonstrates how one of the designers from this ongoing study builds on his knowledge of games as distinctly interactive meaning-making spaces, noting that this approach to game design fits well with a re-thinking of the task of designing writing and learning spaces. (Abstract)

Ronimus, M., Kujala, J., Tolvanen, A., & Lyytinen, H. (2014). Children's engagement during digital game-based learning of reading: The effects of time, rewards, and challenge. *Computers & Education, 71*, 237-246. DOI: 10.1016/j.compedu.2013.10.008

Keywords: elementary education; evaluation methodologies; evaluation of CAL systems; interactive learning environments

This study investigated the effects of two game features (the level of challenge and the reward system) on first and second graders' engagement during digital game-based learning of reading. We were particularly interested in determining how well these features managed to maintain children's engagement over the 8-week training period. The children (N = 138) used GraphoGame, a web-based game training letter–sound connections, at home under the supervision of parents. Data regarding the children's gaming and engagement were stored on the GraphoGame online server. A 2 × 2 factorial design was used to investigate the effects of the level of challenge (high challenge vs. high success) and the presence of the reward system (present vs. absent). Children's engagement was measured by session frequency and duration and through an in-game self-report survey that was presented at the end of the each session. According to the results, the children enjoyed GraphoGame but used it less frequently than expected. The reward system seemed to encourage the children to play longer sessions at the beginning of the training period, but this effect vanished after

a few sessions. The level of challenge had no significant effect on children's engagement. The results suggest a need to investigate further the effectiveness of various game features in maintaining learner's engagement until the goals set for learning are achieved. (Abstract)

Ruphina, A., Wei Ting, J., & Li, Y. (2012). Serious game motivation in an EFL classroom in Chinese primary school. *Turkish Online Journal of Educational Technology, 11*(1). URL: http://www.tojet.net/articles/v11i1/11114.pdf

Keywords: motivation; Mingoville; serious games; Chinese students; primary schools; ESL

This paper is a report on the findings of a qualitative PhD pilot research study on the integration of Serious Games specifically Mingoville to motivate the Chinese primary students in an EFL classrooms. It was carried out in two primary schools: the students are both from low and high income families respectively in Jiangsu Province, PR, China. Content analyses techniques were used to analyze the transcript of which the researcher systematically works through each transcript assigning codes using numbers to specific characteristics within the text, the categories emerged from data by reading through each transcript as well as from literature reviews. The findings identified the differences on how Mingoville motivated the students in the two schools. It revealed some mitigating factors that affected the student's full motivation when Mingoville was integrated in their English learning classroom. The findings indicate that teachers and parent's attitude are key factors to consider for a successful game based learning. Lastly, this paper explores the question, how can Serious Games be integrated successfully in ESL classrooms in order to motivate the Chinese primary school students? (Abstract)

Rüppel, U., & Schatz, K. (2011). Designing a BIM-based serious game for fire safety evacuation simulations. *Advanced Engineering Informatics, 25*(4), 600-611. DOI: 10.1016/j.aei.2011.08.001

Keywords: serious gaming; game design; Building Information Modeling (BIM); fire safety engineering; evacuation simulation

This paper presents results of the first phase of the research project “Serious Human Rescue Game” at Technische Universität Darmstadt. It presents a new serious gaming approach based on Building Information Modeling (BIM) for the exploration of the effect of building condition on human behavior during the evacuation process. In reality it is impossible to conduct rescue tests in burning buildings to study the human behavior. Therefore, the current methods of data-collecting for existing evacuation simulation models have limitations regarding the individual human factors. To overcome these limitations the research hypothesis is that the human behavior can be explored with a serious computer game: The decisions of a person during the game should be comparable to decisions during an extreme situation in the real world. To verify this hypothesis, this paper introduces a serious gaming approach for analyzing the human behavior in extreme situations. To implement a serious game, developers generally make use of 3D-modeling software to generate the game content. After this, the game logic needs to be added to the content with special software development kits for computer games. Every new game scenario has to be built manually from scratch. This is time-consuming and a great share of modeling work needs to be executed twice (e.g., 3D-modeling), at first by the architect for the parametric building model and the second time by the

game designer for the 3D-game content. The key idea of the presented approach is to use the capabilities of BIM together with engineering simulations (fire, smoke) to build realistic serious game scenarios in a new and efficient way. This paper presents the first phase results of the research project mainly focusing on the conceptual design of the serious game prototype. The validation concept is also presented. The inter-operability between building information modeling applications and serious gaming platforms should allow different stakeholders to simulate building-related scenarios in a new, interactive and efficient way. (Abstract)

Sabri, H., Cowan, B., Kapralos, B., Porte, M., Backstein, D., & Dubrowskie, A. (2010). Serious games for knee replacement surgery procedure education and training. *Procedia - Social and Behavioural Sciences, 2*(2), 3483-3488. DOI: 10.1016/j.sbspro.2010.03.539

Keywords: knee replacement; virtual simulations; learner-centered teaching; serious games; interactive learning

Total knee arthroplasty (TKA) is a commonly performed surgical procedure whereby knee joint surfaces are replaced with metal and polyethelene components that serve to function in the way that bone and cartilage previously had. Here we describe a multi-player, serious game that was designed to train orthopedic surgical procedures to orthopedic surgical residents, and to gauge whether learning in an online serious gaming environment will enhance complex surgical skill acquisition. The serious game allows residents to focus on and develop an understanding of the procedure itself (the ordering of each of the steps in the procedure, and the various tools used). By clearly understanding the steps of a procedure and the underpinning surgical decision making processes, when placed in real operative environment, trainees will be able to focus on the technical aspect of the procedure. (Abstract)

Sanchez, J., & Olivares, R. (2011). Problem solving and collaboration using mobile serious games. *Computers & Education, 57*(3), 1943-1952.DOI: 10.1016/j.compedu.2011.04.012

Keywords: mobility; serious games; problem solving; collaboration; science learning

This paper presents the results obtained with the implementation of a series of learning activities based on Mobile Serious Games (MSGs) for the development of problem solving and collaborative skills in Chilean 8th grade students. Three MSGs were developed and played by teams of four students in order to solve problems collaboratively. A quasi-experimental design was used. The data shows that the experimental group achieved a higher perception of their own collaboration skills and a higher score in the plan execution dimension of the problem solving cycle than did the non-equivalent control group, revealing that MSG-based learning activities may contribute to such learning improvements. This challenges future research to identify under which conditions learning activities based on mobile serious games can promote the development of higher order skills. (Abstract)

Sandberg, J., Maris, M., & Hoogendoorn, P. (2014). The added value of a gaming context and intelligent adaptation for a mobile learning application for vocabulary learning. *Computers & Education*, 76, 119-130. DOI: 10.1016/j.compedu.2014.03.006

Keywords: mobile learning; serious gaming; language learning; multimedia

Two groups participated in a study on the added value of a gaming context and intelligent adaptation for a mobile learning application. The control group worked at home for a fortnight with the original Mobile English Learning application (MEL-original) developed in a previous project. The experimental group worked at home for a fortnight with MEL-enhanced, the original application embedded in an adventure game and augmented with intelligent adaptation. Two learning themes were used: Zoo animals and Neighbourhood. Both groups attended lessons at school on Zoo Animals and Neighbourhood during the same periods they were allowed to work with the application at home. A pre- and post-test were conducted to establish the initial vocabulary knowledge and the knowledge acquired during the learning phase. The main results indicated that the students in the experimental condition (MEL-enhanced) outperformed the children from the control group (MEL-original), although the former group did not spend more time with the learning material than the latter, and that the students in the experimental group valued MEL-enhanced more than the children from the control group valued MEL-original. (Abstract)

Sanford, K., Starr, L. J., Merkel, L., & Kurki, S. B. (2015). Serious games: video games for good? *E-learning and Digital Media, 12*, 90-106. DOI: 10.1177/2042753014558380

Keywords: video games; serious games; adolescents; educational games; entertainment–education

As video games become a ubiquitous part of today's culture internationally, as educators and parents we need to turn our attention to how video games are being understood and used in informal and formal settings. Serious games have developed as a genre of video games marketed for educating youth about a range of world issues. At face value this seems a worthwhile enterprise; however, how is this genre viewed by youth who are immersed in video game culture? This paper explores what can be learned by inviting a group of youth to play and analyze current “serious” games. Key findings include adolescents’ comments on how serious games compare to mainstream entertainment-based games and how world issues are represented in games. Implications from this research suggest that serious game designers need to pay attention to the perceptions and experiences of gamers if video games are going to be developed as instructional tools for youth and children. (Abstract)

Savoie, M. J., & Hubbard, E. (2012). Serious games for instant media (IM) generation girls. *International Journal of Business Excellence, 5*(6), 706-719. DOI: 10.1504/IBJEX.2012.049542

Keywords: serious games; instant media generation girls; IM generation girls; facilitate learning; game developers; game opinions; 3D virtual worlds; 2D virtual worlds; personal touches; humour senses; consumer products; market penetration

In order to facilitate learning with games for instant media (1M) generation girls, games developers and producers must accept the fact that girls not only play games differently than boys, but their opinions of games and their access to games are heavily influenced by their mothers. Girls want 2D+ or 3D virtual worlds that reflect reality yet allow for adding their own personal touches, preferences, and senses of humour. From a business perspective, IM generation girls represent the most highly sought after market segment due to their significant spending power and interest in shopping. Serious games for 1M generation girls must be developed and produced following the same

strategies of consumer products in order to generate the market penetration and revenues that are possible. (Abstract)

Scholes, L., Jones, C., Stieler-Hunt, C., & Rolfe, B. (2014). Serious games for learning: Games-based child sexual abuse prevention in schools. *International Journal of Inclusive Education, 18*(9), 934-956. DOI: 10.1080/13603116.2013.860195

Keywords: games-based learning; contemporary pedagogy; child protection; school programmes; child abuse prevention

In spite of research demonstrating conceptual weakness in many child sexual abuse (CSA) prevention programmes and outdated modes of delivery, students continue to participate in a diversity of initiatives. Referring to the development of a games-based approach to CSA prevention in Australia, this paper examines empirically based attributes of effective CSA prevention programmes for schools including contemporary pedagogies for learning. The paper draws on findings to inform the conceptual development phase of Orbit, an online, free and equal-access, games-based educational approach to CSA prevention for children aged 8-10 years. First, the paper provides a review of CSA prevention in schools and games-based approaches to key learnings in prevention. Second, an overview of Orbit (the Feeling Safe sexual abuse prevention project) is provided. Finally, implications for the development of games-based prevention programmes are offered and an argument is made for the advancement of games-based prevention resources. (Abstract)

Schmitz, B., Klemke, R., Walhout, J., & Specht, M. (2015). Attuning a mobile simulation game for school children using a design-based research approach. *Computers & Education, 81*, 35-48. DOI: 10.1016/j.compedu.2014.09.001

Keywords: mobile learning; serious games; health education; design-based research (DBR)

We report on a design-based research study that was conducted over nine months. It chronicles the development and implementation of HeartRun, a cardiopulmonary resuscitation (CPR) training approach for school children. Comparable to an unexpected emergency, HeartRun consists of authentic activities involving different roles, game tasks, locations and physical objects to support process-oriented learning for first responders. It aims to enhance the psychological preparedness of the rescuer and thus promotes a more prompt and appropriate response. In this paper, we describe a cycle of three design-based research (DBR) studies in which HeartRun was explored with school children. In order to better understand how to design mobile game environments that support dimensions of seamless learning, we analysed children and their knowledge-building practices while learning with HeartRun. The mobile game has evolved significantly from its initial conception through an iterative process of (re) designing and testing the synchronization between physical and digital worlds, learner collaboration and ubiquitous knowledge access, i.e. dimensions of mobile seamless learning activities. Based on our experiences, we conclude by discussing challenges and shortcomings of mobile game–based learning environments. (Abstract)

Schmitz, B., Schuffelen, P., Kreijns, K., Klemke, R., & Specht, M. (2015). Putting yourself in someone else's shoes: The impact of a location-based, collaborative role-playing game on behaviour. *Computers & Education, 85*, 160-169. DOI: 10.1016/j.compedu.2015.02.012

Keywords: mobile games; mobile learning; serious games for health; health behavior change

The goal of this study was to probe the effectiveness of a mobile game-based learning approach in modifying behavioural outcomes and competence. The experiment was set against the background of low rates of laymen providing CPR during sudden cardiac arrests. A post-test control group design was used to contrast and evaluate the effects of the two different types of learning. Two hundred two students were randomly assigned to two conditions, a game-based variant simulating an emergency situation (experimental group), and an instruction-based approach (control group). After the intervention participants completed a questionnaire assessing self-prediction, self-efficacy, attitude, subjective norm, empathy and competence. The largest arguably significant difference between the two groups showed in self-prediction and capacity beliefs. Results further revealed a positive relationship between self-prediction and the variables attitude and self-efficacy. The type of scenario did not translate into the other concepts we assessed, though, and results were inconclusive regarding the effectiveness of the type of learning scenario and CPR knowledge. We explain the small effect size partly by the experimental procedure and the design of the game intervention, which is discussed in the course of this article. (Abstract)

Schultz Colby, R., & Colby, R. (2008). A pedagogy of play: Integrating computer games into the writing classroom. *Computers and Composition, 25*(3), 300-312. DOI: 10.1016/j.compcom.2008.04.005

Keywords: game; game theory; writing pedagogy; World of Warcraft; MMORPG

Traditional distinctions between work/play and classroom/gamespace create barriers to computer games' integration into academic settings and the writing classroom in particular. For a writing class, the work/play distinction often relegates games to an object of analysis in which students critique the games but have little invested in the gameplay itself. After examining briefly how historical changes in education created these distinctions, we offer an alternative position that places play and gamespace within the realm of the classroom. In so doing, we open up a gap for computer game theory to inform the pedagogy that can be practiced in a writing classroom. We show one such example of game theory informing writing pedagogy—the theory of emergent gaming. We then offer an example of an enacted emergent pedagogy in which students play the massively multiplayer online role-playing game World of Warcraft throughout the term, composing self-determined, rhetorically focused writing projects informed by play and written for other game players. (Abstract)

Schulze, J., Martin, R., Finger, A., Henzen, C., Lindner, M., Pietzach, K., . . . Seppelt, R. (2015). Design, implementation and test of a serious online game for exploring complex relationships of sustainable land management and human well-being. *Environmental Modelling & Software, 65*, 58-66. DOI: 10.1016/j.envsoft.2014.11.029

Keywords: serious game; game-based learning; environmental education; sustainability; dynamic model; spatial explicit model; system dynamics; systems thinking; SLM

Land is a limited resource providing various services. Decisions on land use shape the distribution of these life support functions and thus require understanding of complex feedbacks between decisions on land use and human resource appropriation. Due to multiple nonlinear feedbacks between management, productivity, environmental quality, and human well-being, complexity is an inherent property of land systems. We present an educational game, which aims at illustrating options of sustainable land management to the interested public, students and stakeholders. The game provides the opportunity to govern a country by exploring how contrasting dimensions of sustainability (economy, environment and social conditions), can be harmonized regionally, while continuously being threatened by global trade fluctuations. The game was tested by several groups of students from high schools and universities. The feedback shows that the game is a valuable tool in environmental education initiating learning the complexity of feedbacks in land use and resources appropriation. (Abstract)

Seaborn, K., & Fels, D. I. (2015). Gamification in theory and action: A survey. *International Journal of Human-Computer Studies, 74*, 14-31. DOI: 10.1016/j.ijhcs.2014.09.006

Keywords: gamification; gameful design; motivation; user experience

Gamification has drawn the attention of academics, practitioners and business professionals in domains as diverse as education, information studies, human–computer interaction, and health. As yet, the term remains mired in diverse meanings and contradictory uses, while the concept faces division on its academic worth, underdeveloped theoretical foundations, and a dearth of standardized guidelines for application. Despite widespread commentary on its merits and shortcomings, little empirical work has sought to validate gamification as a meaningful concept and provide evidence of its effectiveness as a tool for motivating and engaging users in non-entertainment contexts. Moreover, no work to date has surveyed gamification as a field of study from a human–computer studies perspective. In this paper, we present a systematic survey on the use of gamification in published theoretical reviews and research papers involving interactive systems and human participants. We outline current theoretical understandings of gamification and draw comparisons to related approaches, including alternate reality games (ARGs), games with a purpose (GWAPs), and gameful design. We present a multidisciplinary review of gamification in action, focusing on empirical findings related to purpose and context, design of systems, approaches and techniques, and user impact. Findings from the survey show that a standard conceptualization of gamification is emerging against a growing backdrop of empirical participants-based research. However, definitional subjectivity, diverse or unstated theoretical foundations, incongruities among empirical findings, and inadequate experimental design remain matters of concern. We discuss how gamification may to be more usefully presented as a subset of a larger effort to improve the user experience of interactive systems through gameful design. We end by suggesting points of departure for continued empirical investigations of gamified practice and its effects. (Abstract)

Seager, W., Ruskov, M., Sasse, A. M., & Oliveira, M. (2011). Eliciting and modelling expertise for serious games in project management. *Entertainment Computing, 2*(2), 75-80. DOI: 10.1016/j.entcom.2011.01.002

Keywords: serious games; knowledge elicitation; game design

Without achieving a clear understanding of the learning domain, it is difficult to develop a successful serious game that enables users to achieve the desired learning outcomes. Thus, the first step in serious game design is to establish an understanding of the particular learning domain, usually through consultation with domain experts. Whilst game design is inherently a creative process, we believe the capturing of the knowledge domain can be systematised and we present a structured approach to knowledge elicitation and representation as a basis for serious game design. We have adapted and extended the applied cognitive task analysis (ACTA) method and have combined it with additional knowledge representation frameworks. We explain how the outputs of this approach can inform the game mechanic and the development of non-player characters, and apply it to the design of a serious game aimed at reducing time-to-competence in soft project management skills for professionals working in corporate environments. A total of 26 domain experts from five different countries were involved in a two-stage interview process. The interviews yielded more than 300 task elements, and information about the cognition underlying the more challenging tasks. This data was incorporated into several representation frameworks and used to indicate features to be implemented in the game and the game mechanics of the supported features. (Abstract)

Serrano-Laguna, Á., Torrente, J., Moreno Ger, P., & Fernández-Manjón, B. (2014). Application of Learning Analytics in educational video games. *Entertainment Computing, 5*(4), 313-322. DOI: 10.1016/j.entcom.2014.02.003

Keywords: learning analytics; educational games; educational data mining; assessment; reporting

Assessment of learning contents, learning progress and learning gain is essential in all learning experiences. New technologies promote the use of new types of contents like educational videogames. They are highly interactive compared to more traditional activities and they can be a powerful source of data for all forms of assessment. In this paper, we discuss how to apply Learning Analytics (LA) with assessment purposes, studying how students interact with games. One of the biggest barriers for this approach is the variety of videogames, with many genres and types. This makes it difficult to create a comprehensive LA model for educational games that can be generally applied. In order to maintain manageable costs, we propose a two-step approach to apply LA: we first identify simple generic traces and reports that could be applied to any kind of game, and then build game-specific assessment rules based on combinations of these generic traces. This process aims to achieve a balance between the complexity and reusability of the approach, resulting in more scalable LA models for game-based learning. We also test this approach in two preliminary case studies where we explore the use of these techniques to cover different forms of assessment. (Abstract)

Sierra, W., & Stedman, K. D. (2012). Ode to sparklepony: Gamification in action. *Kairos: A Journal of Rhetoric, Technology, and Pedagogy, 16*(2), 0. ISSN: 1521-2300

Keywords: educational games; writing instruction; college instruction; teacher orientation; college faculty; rhetoric

Games are becoming increasingly prevalent in education, both in traditional school settings and beyond. In this Disputatio webtext, we look specifically at one application of games for pedagogical use: gamification. Rather than introducing a pre-existing game into the learning spaces, gamification

adds elements of games into educational (or other) spaces. After a brief exploration of the debates surrounding the term, we present two successful uses of gamification. The first, C's the Day, is a game run as part of the Conference on College Composition and Communication. We discuss C's the Day from the perspective of a creator (Wendi) and winner (Kyle), roles that are present in any game but which also complicate issues of agency and community in the particular rhetorical situations of gameplay. Our second example, FYC's the Day, is based on the original C's the Day game and was part of the instructor orientation at the University of South Florida. (Abstract)

Simões, J., Redondo, R. D., & Vilas, A. F. (2013). A social gamification framework for a K-6 learning platform. *Computers in Human Behavior*, 29(2), 345-353. DOI: 10.1016/j.chb.2012.06.007

Keywords: game-based learning; gamification; e-learning; social networks; social games

As video games, particularly, social games are growing in popularity and number of users, there has been an increasing interest in its potential as innovative teaching tools. Gamification is a new concept intending to use elements from video games in non-game applications. Education is an area with high potential for application of this concept since it seeks to promote people's motivation and engagement. The research in progress will try to find how to apply social gamification in education, testing and validating the results of that application. To fulfil these objectives, this paper presents the guidelines and main features of a social gamification framework to be applied in an existent K-6 social learning environment. (Abstract)

Squire, K. D. (2013). Video game-based learning: An emerging paradigm for instruction. *Performance Improvement Quarterly, 26*(1), 101-130. DOI: 10.1002/piq.21139

Keywords: educational technology; models; video games; problem solving; electronic learning; educational games; case studies; interviews; computer games

Interactive digital media, or video games, are a powerful new medium. They offer immersive experiences in which players solve problems. Players learn more than just facts--ways of seeing and understanding problems so that they "become" different kinds of people. "Serious games" coming from business strategy, advergaming, and entertainment gaming embody these features and point to a future paradigm for eLearning. Building on interviews with leading designers of serious games, this article presents case studies of three organizations building serious games, coming from different perspectives but arriving at similar conclusions. This article argues that such games challenge us to rethink the role of information, tools, and aesthetics in a digital age. (Abstract)

Soflano, M., Connolly, T., & Hainey, T. (2015). An application of adaptive games-based learning based on learning style to teach SQL. *Computers & Education, 86*, 192-211. DOI: 10.1016/j.compedu.2015.03.015

Keywords: games-based learning; adaptivity; learning style; SQL; role-playing games

The fact that each student has a different way of learning and processing information has long been recognised by educationalists. In the classroom, the benefits derived from delivering learning content in ways that match the student's learning style have also been identified. As new modes of delivery of learning content such as computer-assisted learning systems (e.g. eLearning) have

become increasingly popular, research into these has also identified the benefits of tailoring learning content to learning styles. However, in games-based learning (GBL), the adaptation based on learning style to enhance the educational experience has not been well researched. For the purpose of this research, a game with three game modes has been developed: 1) non-adaptivity mode; 2) a mode that customises the game according to the student's learning style identified by using a learning style questionnaire; and 3) a mode that has an in-game adaptive system that dynamically and continuously adapts its content according to the student's interactions in the game. This paper discusses the term adaptivity in a GBL context and presents the results of an experimental study investigating the differences in learning effectiveness of the different game modes compared to a paper-based learning. The study was performed with 120 Higher Education students learning the database language SQL (Structured Query Language). The results show that the game developed, regardless of mode, produced better learning outcomes than those who learned from a textbook while adaptive GBL was better in terms of allowing learners to complete the tasks faster than the other two game versions. (Abstract)

Song, H., Kim, J., Kwon, R. J., & Jung, Y. (2013). Anti-smoking educational game using avatars as visualized possible selves. *Computers in Human Behavior, 29*(5), 2029-2036. DOI: 10.1016/j.chb.2013.04.008

Keywords: educational game; serious game; smoking; possible selves; susceptibility

Few social smokers envision themselves being affected by the negative consequences of smoking despite well-known facts that smoking causes serious illnesses and death. However, as smoking habits quickly develop, social smokers cannot be free from the negative consequences of smoking. In this study, we pose the following question: “Would showing social smokers’ possible future as a consequence of smoking help them alter their current smoking behaviors?” Thus, using the theoretical concept of possible selves, an anti-smoking educational game was created in which players could see changes to the appearance of their future selves as a consequence of smoking. We used a 2 (Future face: Showing vs. Not showing) × 2 (Self avatar: Self-avatar vs. Other-avatar) between-subjects design for the experiment. Results indicated that participants who viewed the future face, compared to who did not, reported more negative attitudes toward social smoking and greater intention to quit smoking. The main effect of the self avatar was insignificant; however, seeing the future face in the self-avatar condition led to an increase in perceived risks compared to other-avatar condition. The implications of using avatars as visualized possible selves in health promotion are discussed. (Abstract)

Stanley, D., & Latimer, K. (2011). ‘The Ward’: A simulation game for nursing students. *Nurse Education in Practice, 11*(1), 20-25. DOI: 10.1016/j.nepr.2010.05.010

Keywords: games; simulated learning; critical thinking; teamwork

To evaluate the effectiveness and suitability of ‘The Ward’ as a simulation game to promote and support students’ understanding of decision making, critical thinking and team work in clinical practice situations. Students commonly indicate that there is a ‘gap’ between the theory and practice aspects of their nursing education. Nursing is also a team-based profession requiring collaboration and cooperation that is rarely seem in educational programs. Attempts to address

these issues resulted in the development and trial of the simulation game 'The Ward'. A qualitative study using a questionnaire (n = 76) and four focus groups. 'The Ward' proved to be well received as a learning tool and was enjoyable and effective in addressing learning issues related to clinical skill practice, ward management, nursing practice knowledge, critical thinking, medication knowledge and leadership. It also offered valuable learning in the areas of team work and decision making. 'The Ward' was shown to be a very useful simulation exercise that has evaluated well and helped promote the pivotal role of team work for student nurses and bridge the gap between theory and clinical practice in a safe, non-threatening way. (Abstract)

Su, C., & Cheng, C. (2015). A mobile gamification learning system for improving the learning motivation and achievements. *Journal of Computer Assisted Learning, 31*(3), 268-286.DOI: 10.1111/jcal.12088

Keywords: elementary education; gamification; mobile learning; teaching strategies

This paper aims to investigate how a gamified learning approach influences science learning, achievement and motivation, through a context-aware mobile learning environment, and explains the effects on motivation and student learning. A series of gamified learning activities, based on MGLS (Mobile Gamification Learning System), was developed and implemented in an elementary school science curriculum to improve student motivation and to help students engage more actively in their learning activities. The responses to our questionnaire indicate that students valued the outdoor learning activities made possible by the use of a smartphone and its functions. Pre- and post-test results demonstrated that incorporating mobile and gamification technologies into a botanical learning process could achieve a better learning performance and a higher degree of motivation than either non-gamified mobile learning or traditional instruction. Further, they revealed a positive relationship between learning achievement and motivation. The correlation coefficient for ARCS dimensions and post-test shows that the ARCS-A (attention) is greater than ARCS-R, ARCS-C and ARCS-S. This means that the attention (ARCS-A) of this system is an important dimension in this research. The results could provide parents, teachers and educational organizations with the necessary data to make more relevant educational decision. (Abstract)

Susi, T., Johannesson, M. & Backlund, P. (2007). Serious games – An overview. Sweden: University of Skode. Technical Report HS-IKI-TR-07-001. URL: http://www.diva-portal.org/smash/get/diva2:2416/FULLTEXT01.pdf

This report discusses some issues concerning serious games, that is, (digital) games used for purposes other than mere entertainment. The starting point is the serious games concept itself, and what the actually means. Further, serious games allow learners to experience situations that are impossible in the real world for reasons of safety, cost, time, etc., but they are also claimed to have positive impacts on the players' development of a number of different skills. Subsequently, some possible positive (and negative) impacts of serious games are discussed. Further, some of the markets such games are used in are considered here, including, military games, government games, educational games, corporate games, and healthcare games. This report also identifies some (mainly academic) actors in the North American and the European serious games market. This report is part of the DISTRICT (Developing Industrial Strategies Through Innovative Cluster and Technologies)

project: Serious Games Cluster and Business Network (SER3VG), which is part of the Interreg IIIC Programme. (Abstract).

Suttie, N., Louchart, S., Lim, T., Macvean, A., Westera, W., Brown, D., & Djaouti, D. (2012). Introducing the 'Serious game mechanics' a theoretical framework to analyse relationships between 'game' and 'pedagogical aspects' of serious games. *Procedia Computer Science, 15*, 314-315. DOI: 10.1016/j.procs.2012.10.091

Keywords: serious games; game mechanics; pedagogy; design framework; mapping

The careful balance of education and play is essential for the development of effective Serious Games. It is necessary to develop a clear understanding of game mechanics (i.e. the tools of game-play) and how these relate to relevant educational strategies. In this paper, we raise conceptual questions regarding the nature of Serious Games and the relationship between game mechanics, pedagogy and the conceptual level at which they connect. In developing theoretical framework linking game mechanics and learning, we aim to ease the work of the Serious Game designers attempting to produce both fun and pedagogically effective Serious Games. (Abstract)

Tang, S., Hanneghan, M., & Carter, C. (2013). A platform independent game technology model for model driven serious games development. *Electronic Journal of e-Learning, 11*(1), 61-79.

Keywords: models; instructional design; computer games; information technology; computer software; computer interfaces; educational games; educational Technology; engineering technology

Game-based learning (GBL) combines pedagogy and interactive entertainment to create a virtual learning environment in an effort to motivate and regain the interest of a new generation of 'digital native' learners. However, this approach is impeded by the limited availability of suitable 'serious' games and high -level design tools to enable domain experts to develop or customise serious games. Model Driven Engineering (MDE) goes some way to provide the techniques required to generate a wide variety of interoperable serious games software solutions whilst encapsulating and shielding the technicality of the full software development process. In this paper, we present our Game Technology Model (GTM) which models serious game software in a manner independent of any hardware or operating platform specifications for use in our Model Driven Serious Game Development Framework. (Abstract)

ter Vrugte, J., de Jong, T., Vandercruysse, S., Wouters, P., van Oostendorp, H., & Elen, J. (2015). How competition and heterogeneous collaboration interact in prevocational game-based mathematics education. *Computers & Education, 89*, 42-52. DOI: 10.1016/j.compedu.2015.08.010

Keywords: cooperative/collaborative learning; interactive learning environments; game-based learning; secondary education

The present study addresses the effectiveness of an educational mathematics game for improving proportional reasoning in students from prevocational education. Though in theory game-based learning is promising, research shows that results are ambiguous and that we should look into ways to support game-based learning. The current study explored two factors (i.e., collaboration and competition) that have been associated with motivational and cognitive effects, and have potential

to optimize game-based learning. In a fully crossed design, four conditions were examined: collaboration and competition, collaboration control, competition control, and control. It was found that, over all, gameplay did improve students' proportional reasoning skills but that learning effects did not differ between conditions. However, when students' ability levels were taken into account, an interaction between collaboration and competition was found. For below-average students, the effect of collaboration was modified by competition, showing a negative effect of competition on domain knowledge gains in a collaborative learning situation. In contrast, for above-average students, the data demonstrated a trend that suggests a positive effect of competition on domain knowledge gain in a collaborative learning situation. (Abstract)

Terzidou, T., & Tsiatsos, T. (2014, 3-5 April 2014). *The impact of pedagogical agents in 3D collaborative serious games.* Paper presented at the 2014 IEEE Global Engineering Education Conference (EDUCON), Istanbul, Turkey. DOI: 10.1109/EDUCON.2014.7096838

Keywords: pedagogical agents; 3D collaborative serious games; PA; 3D collaborative educational game; virtual environment; OpenSim platform; 3D collaborative game based learning; team level; personal level; 3D game functions; game learning process; pedagogical agent assistance

This paper examines the impact of an pedagogical agent (PA), in a 3D collaborative educational game in the virtual environment of OpenSim platform. The main goal of this paper is to evaluate the impact of a pedagogical agent to 3D collaborative game based learning by developing an agent that interacts with the students both at team and personal level. In order to enhance the already implemented 3D game functions, a pedagogical agent that supports students during the game learning process was implemented. The evaluation approach attempts to investigate the impact of PAs in 3D collaborative educational games focusing on two dimensions: a) on PAs usefulness in collaborative 3D games and b) on students' teams performance in the game learning process. This research concludes that the intervention of pedagogical agent's assistance in the game has a strong positive impact on teams performance and can be considered as useful in collaborative serious games. (Abstract)

Thompson, D., Baranowski, T., Buday, R., Baranowski, J., Thompson, V., Jago, R., & Griffith, M. J. (2010). Serious video games for health: How behavioral science guided the development of a serious video game. *Simulation Gaming, 41*(4), 587-606. DOI: 10.1177/1046878108328087

Keywords: action-adventure; adolescents; behavioral change; behavioral science; edutainment; ESCAPE FROM DIAB; game design; health behavior; obesity; theory; Type 2 diabetes; video game

Serious video games for health are designed to entertain players while attempting to modify some aspect of their health behavior. Behavior is a complex process influenced by multiple factors, often making it difficult to change. Behavioral science provides insight into factors that influence specific actions that can be used to guide key game design decisions. This article reports how behavioral science guided the design of a serious video game to prevent Type 2 diabetes and obesity among youth, two health problems increasing in prevalence. It demonstrates how video game designers and behavioral scientists can combine their unique talents to create a highly focused serious video game that entertains while promoting behavior change. (Abstract)

Tobias, S., & Fletcher, D. J. (2012). Reflections on 'A Review of Trends in Serious Gaming'. *Review of Educational Research, 82*(2), 233-237. DOI: 10.3102/0034654312450190

Keywords: computer games and instruction; video games and instruction; games and instruction

This article briefly summarizes findings from a review of 95 empirical studies of games used in instruction. The article suggests that such efforts are best assessed as transfer from game play to performance on external tasks that are targeted by the instruction. Review findings suggest that such transfer may be expected only if the cognitive processes engaged by games and external tasks overlap. Integrating games into a course of study is likely to facilitate such transfer. Research on improvement in cognitive processes as a result of playing “first-person shooter” games is briefly overviewed, and suggestions for similar research not using aggressive content are made. Minimal overlap between this and another research review of the effects of games used in instruction is discussed, and the need for generally accepted definitions and a taxonomy of games is noted. (Abstract)

Triantafyllakos, G., Palaigeorgiou, G., & I.A, T. (2011). Designing educational software with students through collaborative design games: The We!Design&Play framework. *Computers & Education, 56*(1), 227-242. DOI: 10.1016/j.compedu.2010.08.002

Keywords: participatory design; design games; idea generation; student-centred design; collaborative educational software design

In this paper, we present a framework for the development of collaborative design games that can be employed in participatory design sessions with students for the design of educational applications. The framework is inspired by idea generation theory and the design games literature, and guides the development of board games which, through the use of adequate stimuli, rules and props, facilitate students in extracting and expressing their needs, desires and prospects regarding future educational software. To evaluate the proposed framework three studies were conducted. The first study aimed at the design of a web learning platform with the participation of 62 undergraduate higher education students in 13 design sessions; in the second study, a structured design approach was employed (12 sessions, 54 students) with the same design objective for comparison reasons; in the third study, the framework was deployed for the design of an electronic assessment application so as to examine its applicability in different learning domains (8 design sessions, 28 students). Students were very positive regarding both their participation and experience with the design games, and the needs elicited. The games favored a quick, broad exploration of the design space and facilitated the elicitation of numerous diverse needs and ideas, almost twice as many as produced by the structured approach. They also facilitated the creation of an informal atmosphere and limited the effects of common social influences on idea generation, such as social loafing, evaluation apprehension and production blocking. The three studies indicated that the proposed framework may simplify the development and employment of effective and efficient participatory design sessions in educational settings. (Abstract)

Tsai, F.-H., Tsai, C.-C., & Lin, K.-Y. (2015). The evaluation of different gaming modes and feedback types on game-based formative assessment in an online learning environment. *Computers & Education, 81*, 259-269. DOI: 10.1016/j.compedu.2014.10.013

Keywords: game-based learning; game-based assessment; online learning; formative assessment

This study proposed an online learning system for energy education, modifying the typical rules of tic-tac-toe and incorporating multiple choice tests into the game in order to develop a game-based formative assessment tool for an online learning course. In order to explore how different gaming modes and feedback types in this game-based formative assessment affect knowledge acquisition effectiveness and participation perceptions, a tic-tac-toe quiz game (TRIS-Q) with two gaming modes: single-player online game (SOG) and multi-player online game (MOG), and two feedback types: immediate elaborated feedback (IEF) and no immediate elaborated feedback (no IEF), were developed. A 2(SOG vs. MOG) × 2(IEF vs. no IEF) between-subject experiment was also conducted to investigate the effects on 109 ninth-grade students from four junior high school classes. The research findings indicated that different gaming modes of TRIS-Q did not affect the effectiveness of knowledge acquisition; providing IEF for each question answered in the game facilitated the enhancement of both energy knowledge acquisition and student tic-tac-toe ability when comparing it with the no IEF type. Additionally, the different gaming modes and feedback types did not affect participation perceptions. (Abstract)

Truong, H. M. (2016). Integrating learning styles and adaptive e-learning system: Current developments, problems and opportunities. *Computers in Human Behavior, 55*, 1185-1193. DOI: 10.1016/j.chb.2015.02.014

Keywords: learning styles; adaptive learning system; literature review; e-learning; IT in education

Learning styles which refer to students' preferred ways to learn can play an important role in adaptive e-learning systems. With the knowledge of different styles, the system can offer valuable advice and instructions to students and teachers to optimise students' learning process. Moreover, e-leaning system which allows computerised and statistical algorithms opens the opportunity to overcome drawbacks of the traditional detection method that uses mainly questionnaire. These appealing reasons have led to a growing number of researches looking into the integration of learning styles and adaptive learning system. This paper, by reviewing 51 studies, delves deeply into different parts of the integration process. It captures a variety of aspects from learning styles theories selection in e-learning environment, online learning styles predictors, automatic learning styles classification to numerous learning styles applications. The results offer insights into different developments, achievements and open problems in the field. Based on these findings, the paper also provides discussion, recommendations and guidelines for future researches. (Abstract)

Tubelo, R. A., Branco, V. L. C., Dahmer, A., Maria, S., Samuel, W., & Collares, F. M. (2016). The influence of a learning object with virtual simulation for dentistry: A randomized controlled trial. *International Journal of Medical Informatics, 85*(1), 68-75. DOI: 10.1016/j.ijmedinf.2015.11.005

Keywords: virtual reality; zinc phosphate; dental materials; e-learning; virtual learning object

The study aimed to evaluate the influence of virtual learning object (VLO) in the theoretical knowledge and skill practice of undergraduate dentistry students as it relates to zinc phosphate cement (ZPC). Only students enrolled in the dentistry course the course were included in the trial. Forty-six students received a live class regarding ZPC and were randomized by electronic sorting into the following 4 groups: VLO Immediate (GIVLOn = 9), VLO longitudinal (GLVLOn = 15) and two control groups without VLO (GICn = 9 and GLCn = 13). The immediate groups had access to VLO or a book for 20 min before the ability assessment, whereas the longitudinal groups had access to VLO or a book for 15 days. A pre- and posttest on theoretical knowledge and two laboratory skill tests, evaluated by blinded examiners, were performed regarding zinc phosphate cement manipulation in all groups. The students who used the VLO obtained better results in all the tests performed than the control students. The theoretical posttest showed a significant difference between the longitudinal groups, GLC (6.0 ± 1.15) and GLVLO (7.33 ± 1.43). The lower film thickness presented with a significant difference in the VLO groups: (GIC 25 ± 9.3) and GIVLO (16.24 ± 5.17); GLC (50 ± 27.08) and GLVLO (22.5 ± 9.65). The higher setting time occurred in the VLO groups, and the immediate group showed a significant difference (GIC 896 ± 218.90) and GIVLO (1138.5 ± 177.95). The ZPC manipulated by the students who used the VLO had better mechanical properties in the laboratory tests. Therefore, the groups that used the VLO had clinical handling skills superior to its controls and greater retention of knowledge after 15 days. (Abstract)

Tüzün, H., Yilmaz-Soylu, M., Karakuş, T., İnal, Y., & Kızılkaya, G. (2009). The effects of computer games on primary school students' achievement and motivation in geography learning. *Computers & Education, 52*(1), 68-77. DOI: 10.1016/j.compedu.2008.06.008

Keywords: interactive learning environments; computer games; virtual reality; elementary education; applications in subject areas

The implementation of a computer game for learning about geography by primary school students is the focus of this article. Researchers designed and developed a three-dimensional educational computer game. Twenty four students in fourth and fifth grades in a private school in Ankara, Turkey learnt about world continents and countries through this game for three weeks. The effects of the game environment on students' achievement and motivation and related implementation issues were examined through both quantitative and qualitative methods. An analysis of pre and post achievement tests showed that students made significant learning gains by participating in the game-based learning environment. When comparing their motivations while learning in the game-based learning environment and in their traditional school environment, it was found that students demonstrated statistically significant higher intrinsic motivations and statistically significant lower extrinsic motivations learning in the game-based environment. In addition, they had decreased focus on getting grades and they were more independent while participating in the game-based activities. These positive effects on learning and motivation, and the positive attitudes of students and teachers suggest that computer games can be used as an ICT tool in formal learning environments to support students in effective geography learning. (Abstract)

Vallett, D., Annetta, L. A., Lamb, R., & Bowling, B. (2014). Diffusing innovations: Adoption of serious educational games by K-12 science teachers. *Contemporary Issues in Technology and Teacher Education, 14*(3). URL: http://www.citejournal.org/vol14/iss3/science/article1.cfm

Keywords: educational games; elementary school teachers; secondary school teachers; innovation; mixed methods research; faculty development; technology integration; technology uses in education; use studies; teacher attitudes; teacher placement; teacher workshops; likert scales; pedagogical content knowledge; educational practices; technology education; teaching methods; science teachers

Innovation is a term that has become widely used in education; especially as it pertains to technology infusion. Applying the corporate theory of diffusing innovation to educational practice is an innovation in itself. This mixed-methods study examined 38 teachers in a science educational gaming professional development program that provided baseline characteristics about personal technology use and post professional development workshop experiences to ascertain characteristics that align with diffusion of innovation theory and educational game development as a new innovation in current pedagogical practices. The posttest-only design tested correlation (ANOVA) between factors, following scale conversion employing Rasch modeling, using the established Ocean Explorers workshop survey to collect data. Results suggested that while none of the demographic factors were significantly correlated with participant perceptions of the workshop, participants' perceptions of the presentation of the material were strongly correlated to their perceptions of the opportunities afforded by the workshop and the level of technological pedagogical content knowledge learning that took place. Frequencies of response ranges from the survey, for each scale, were paired with qualitative data to propose a fit to Rogers' innovation adoption curve and provide a richer description of participant perceptions. Additionally, the findings from this study serve as a framework for professional development of innovative educational technologies for subsequent studies. (Abstract)

van der Meij, H., Albers, E., & Leemkuil, H. (2011). Learning from games: Does collaboration help? *British Journal of Educational Technology, 42*(4), 655-664. DOI: 10.1111/j.1467-8535.2010.01067.x

Keywords: feedback; play; educational games; interaction; cooperation; learning processes; teamwork; participation; knowledge level; interpersonal communication

This paper examines whether people benefit more from playing a commercial off-the-shelf game in pairs rather than in solitary mode. The basic idea behind this didactic method is that there is a serious risk that solitary game play yields insufficient articulation and explanation for learning to take place. Participants in the experimental condition played a strategy game in collaborative mode (pairs). Solitary play formed the control condition. During game play data were gathered about engagement (ie, flow). Also, the dialogues of the pairs were recorded. After game completion participants individually completed a knowledge test. For solitary players this ended the session. Collaborating pairs could discuss test answers (without receiving experimenter feedback) and give a final group answer. Collaboration was found not to affect game engagement and also did not affect individual knowledge test scores. The collaboration presumably did not advance the players' individual knowledge because the game dialogues mainly dealt with superficial game features such

as move proposals. The collaborating players benefitted significantly from the opportunity to discuss test scores. The discussion revolves around game selection and game didactics (including scripted collaboration and debriefing) as routes for future studies to follow in ways of improving game utilisation in school. (Abstract)

van Rosmalen, P., & Westera, W. (2014). Introducing serious games with Wikis: empowering the teacher with simple technologies. *Interactive Learning Environments, 22*(5), 564-577. DOI: 10/1080/10494820.2012.707128

Keywords: serious games, teacher training, gamification, Wiki-games, Wiki

Despite the continuous and abundant growth of the game market the uptake of games in education has been hampered by the general impression that games require complex technologies and that games are difficult to organise and to embed in education curriculums. This article explores to what extent a simple serious game scenario that can be easily adopted and adapted by individual teachers and that only uses a common, relatively simple technology can leverage the adoption of serious games. It discusses the design of such a game, Argument, based on a Wiki and its use in a six weeks trial by students of a Master of Learning Sciences Programme. The results indicate that, even though a Wiki has clear limitations, it is a useful instrument to build game alike educational activities, to gain experience with and as a first step to use (more) complex serious games. (Abstract)

van de Sandre, E., Segers, E., & Verhoeven, L. (2015). The role of executive control in young children's serious gaming behavior. *Computers & Education, 82*, 432-441. DOI: 10.1016/j.compedu.2014.12.004

Keywords: action control; attentional control; behavior; children; serious games

The present study examined (1) how executive control contributed to in-game behaviors in young children while playing a serious game, (2) whether the levels of control changed when the game was played repeatedly, and (3) how the first experience with the game mediated the role of executive control to in-game behaviors when the game was repeated. Attentional and action control were directly assessed in 106 kindergartners, who played a single-leveled serious game twice. During their gameplay, the following behaviors were registered: time, number of scaffolds needed, mistakes, verbal expressions, questions, irrelevant game activities (drawings), and off-task behavior. The results for the first game round showed that time, expressions, and the need for scaffolds were predicted by attentional control. In the second round, a strong role for action control was found to overcome off-task behavior and irrelevant drawings. Verbal expressiveness was again influenced by attentional control. Moreover, mediation effects of attentional control to efficient in-game behaviors in the second gameplay were evidenced via scaffolding and expressiveness in the first gameplay. It is concluded that in new games children's attentional control contributes to formulating strategies and problem-solving, while their action control underlies sustained and goal-directed learning over time. (Abstract)

van der Spek, E. D., van Oostendorp, H., & Ch Meyer, J.-J. (2013). Introducing surprising events can stimulate deep learning in a serious game. *British Journal of Educational Technology, 44*(1), 156-169. DOI: 10.1111/j.1467-8535.2011.01282.x

Serious games show great potential, but many fail to live up to that potential. One way to improve serious game design could be to introduce surprising events linked to the instructional material. We modified our serious game for triage training, called Code Red Triage, to include three surprising events pertaining to decision-making moments in the triage procedure. Forty-one participants were divided into two groups: one group played a version of the game with the surprising events, and the other group played a control version of the game. A pre-posttest design showed no significant difference in engagement and surface learning, but did show the participants in the surprising events condition obtained significantly superior knowledge structures, indicating that surprising events in a serious game foster deeper learning. What is already known about this topic What this paper adds times A thorough, single-blind, controlled empirical experiment on the effects of serious game design on different factors of learning and engagement. times Surprising events should be introduced in a serious game to improve learning. (Abstract)

van der Spek, E. D., Wouters, P., & van Oostendorp, H. (2011). Code red: Triage or cognition-based design rules enhancing decisionmaking training in a game environment. *British Journal of Educational Technology, 42*(3), 441-455. DOI: 10.1111/j.1467-8535.2009.01021.x

Keywords: design requirements; instructional design; crisis management; educational games; training methods; decision making; cognitive structures; educational technology; computer software; computer assisted instruction; computer software evaluation; instructional development

Serious games have a great potential for training and educating people in novel and engaging ways. However, little empirical research has been done on the effectiveness of serious games, and although early findings do point to a moderately positive direction, even less is known about why some games succeed in effectively educating while others do not. We therefore propose a serious game, COgnition-based DEsign Rules Enhancing Decisionmaking TRaining In A Game Environment (Code Red: Triage), which is designed to empirically test a number of cognition-based design guidelines in the context of crisis management training that ameliorate mental model construction. Our purpose is to come to a set of design guidelines through empirical experiments that enhance the instructional design of serious games and can be used in the development of future games. Furthermore a method is discussed to extract the mental structure players have built during gameplay. (Abstract)

van der Zee, D.-J., Holkenborg, B., & Robinson, S. (2012). Conceptual modeling for simulation-based serious gaming. *Decision Support Systems, 54*(1), 33-45. DOI: 10.1016/j.dss.2012.03.006

Keywords: serious gaming; discrete event simulation; conceptual modeling; operations management; education; training

In recent years many simulation-based serious games have been developed for supporting (future) managers in operations management decision making. They illustrate the high potential of using discrete event simulation for pedagogical purposes. Unfortunately, this potential does not seem to

go together with the availability of guidance for the game designer on the use of simulation. In response, we propose a conceptual modeling framework for simulation-based serious gaming. It structures the conceptual modeling process by identifying five key modeling activities in defining a conceptual model, i.e., a blue print for model coding. Activities aim to explore the learning environment, and capture modeling objectives, and model inputs, outputs and contents. Each activity is further detailed in terms of steps to undertake, good practices, and supportive methods. Use of the framework is illustrated by a case example concerning education of retail managers on inventory control. (Abstract)

Vangsnes, V., Økland, N. T. G., & Krumsvik, R. (2012). Computer games in pre-school settings: Didactical challenges when commercial educational computer games are implemented in kindergartens. *Computers & Education, 58*(4), 1138-1148. DOI: 10.1016/j.compedu.2011.12.018

Keywords: educational computer games; kindergarten; dramaturgy; didactical dissonance; pre-school teacher

This article focuses on the didactical implications when commercial educational computer games are used in Norwegian kindergartens by analysing the dramaturgy and the didactics of one particular game and the game in use in a pedagogical context. Our justification for analysing the game by using dramaturgic theory is that we consider the game to be a multimodal performance utilising text, graphics, pictures, sound and animation. Similarly we analyse the didactic situation by using dramaturgic theories and concepts because we consider the didactic meeting between the medium (the game), children (the player(s), and teacher to be a dramaturgic situation comprising different roles, actions in progress, time and space. Our data material shows that the pre-school teacher is more or less absent during the children's playing with the computer games, but when the pre-school teacher involves him/herself, she finds it difficult to realise her ideal socio-cultural didactical project in which dialogue is a central medium for exploration and learning. Through our analysis of the data material we find that there are two different dramaturgies at stake; the built-in interactive dramaturgy of the game materialised in the gaming situation and the dialogical dramaturgy that the pre-school teacher tries to create in the didactical situation. This implies that there is a didactical dissonance between the learning space which the game and the learning space the pre-school teacher wants to construct and orchestrate. (Abstract)

Venpoorten, D., Castaigne, J.-L., Westera, W., & Specht, M. (2014). A quest for meta-learning gains in a physics serious game. *Education and Information Technologies, 19*(2), 361-374. DOI: 10.1007/s10639-012-92129-7

Keywords: serious games; meta-cognition; confidence degrees; secondary school pupils; reflection

This paper describes how a short, repeated and structured opportunity to reflect was integrated in the storyline of a serious game in order to stimulate the development of a meta-cognitive skill: the ability to self-assess the degree of confidence in own answers. An empirical validation of the approach, conducted with 28 secondary school pupils, delivers an uncommon pattern: while the cognitive benefits--the acquisition of academic knowledge in optics--are negligible and mixed up, the meta-cognitive gains present a raising tendency. The experiment also demonstrates that reflection

does not necessarily hamper the game flow, if certain conditions, discussed in the paper, are met. (Abstract)

VerBruggen, R. (2012). Games people play. *Academic Questions, 25*(4), 552-560. DOI: 10.1007/s12129-012-9324-5

Keywords: video games; creative ability; macro processors; technological innovations; Super Mario Bros. (game)

Today's video games aren't even a little bit like the ones that came out a few decades ago. Not only has the underlying technology dramatically improved, but the medium has matured remarkably in the years since "Pong" and "Space Invaders." ruled the arcades. The artistic promise of video games has yet to be fulfilled. The current state of the medium is impressive in many ways, and the possibilities--for education as well as art--are boundless. Video games do a far better job of connecting with young men than colleges do. So, should colleges consider using games in their instruction to deepen historical knowledge and attract more men? Certainly, there are risks with this approach. Because of their simple beginnings and predominantly young and male audience, video games have a reputation for being unserious. Many games are, indeed, unserious. But at long last, there is emerging a subset of games that demand to be considered alongside movies, books, and other forms of art. Serious cultural critics ignore video games at their peril. (Abstract)

Vos, N., van der Meijden, H., & Denessen, E. (2011). Effects of constructing versus playing an educational game on student motivation and deep learning strategy use. *Computers & Education, 56*(1), 127-137. DOI: 10.1016/j.compedu.2010.08.013

Keywords: games; elementary education; interactive learning environments; learning strategies; media in education

In this study the effects of two different interactive learning tasks, in which simple games were included were described with respect to student motivation and deep strategy use. The research involved 235 students from four elementary schools in The Netherlands. One group of students (N = 128) constructed their own memory ‘drag and drop’ game, whereas the other group (N = 107) played an existing ‘drag and drop’ memory game. Analyses of covariance demonstrated a significant difference between the two conditions both on intrinsic motivation and deep strategy use. The large effect sizes for both motivation and deep strategy use were in favour of the construction condition. The results suggest that constructing a game might be a better way to enhance student motivation and deep learning than playing an existing game. Despite the promising results, the low level of complexity of the games used is a study limitation. (Abstract)

Vrasidas, C., & Solomou, M. (2013). Using educational design research methods to examine the affordances of online games for teacher learning. *Educational Media International, 50*(3), 192-205. DOI: 10.1080/09523987.2013.839151

Keywords: computer games; inservice teacher education; computer uses in education; student attitudes; graduate students; educational opportunities; barriers; learner engagement; educational research

The purpose of this research was to examine the affordances and opportunities from using online games in teacher professional development. Following an educational design research approach, we developed an environment to provide opportunities for in-service teachers to engage in-game-based activities. Our work presented in this manuscript was of exploratory nature. The basic questions that guided our inquiry were as follows: (1) What affordances do online game environments provide for teacher professional development? (2) What opportunities and challenges arise from the implementation of games for teacher learning? Data were collected from online design sessions, semi-structured interviews with all participants, online and face-to-face observations, focus group discussions, and artifact review. Findings showed that online games provide great opportunities for learner engagement and teacher preparation. However, the challenges such as the lack of infrastructure, skills, time, and the structure of curricula and assessment are serious barriers that hinder wider adoption of games for learning and teacher preparation. (Abstract)

Waddington, D. I. (2015). Dewey and video games: From education through occupations to education through simulations. *Educational Theory, 65*(1). DOI: 10.1111/edth.12092

Keywords: video games; simulation; educational games; educational technology; educational philosophy; educational principles; teaching methods; computer simulation; educational objectives; classroom techniques; barriers; technology uses in education

Critics like Leonard Waks argue that video games are, at best, a dubious substitute for the rich classroom experiences that John Dewey wished to create and that, at worst, they are profoundly miseducative. Using the example of "Fate of the World," a climate change simulation game, David Waddington addresses these concerns through a careful demonstration of how video games can recapture some of the lost potential of Dewey's original program of education through occupations. Not only do simulation games realize most of the original goals of education through occupations, but they also solve some of the serious practical problems that Dewey's curriculum generated. Waddington concludes the essay with an analysis of Waks's critiques and some cautionary notes about why it is important to be temperate in our endorsement of educational video gaming. (Abstract)

Walton, M. (2007). Cheating literacy: The limitations of simulated classroom discourse in educational software for children. *Language and Education, 21*(3), 197-215. ISSN: 0950 0782

Keywords: drill-and-practice; literacy software; local; global; multimodal analysis

This paper presents a multimodal discourse analysis of children using "drill-and-practice" literacy software at a primary school in the Western Cape, South Africa. The children's interactions with the software are analysed. The software has serious limitations which arise from the global political economy of the educational software industry. The package was structured around the UK National Curriculum's standardised literacy testing, and then adapted or "localised" for use in South Africa. In the localisation process, details of content and language are customised, but the coded structure of the package (together with its educational assumptions) remains essentially unchanged. The children's interactions with the localised program are analysed as a simulation of classroom discourse. Despite the obvious limitations of the software, the study shows the children constructing their own contextual meanings from the rules of the package, and learning to interact with them as a

rule-governed text. Their troubleshooting and cheating exploits are a source of pleasure to them, as they focus on the software's game-like economy of scores and marks. (Abstract)

Wang, A. I. (2015). The wear out effect of a game-based student response system. *Computers & Education*, 82, 217-227. DOI: 10.1016/j.compedu.2014.11.004

Keywords: game-based learning; interactive learning environments; student-response systems; evaluation

The Bring Your Own Device (BYOD) wave and advancement in technical infrastructures and in learning technology opens for new ways of teaching in the classroom. The teachers' laptops connected to a video projector, access to wireless network and the students smartphones, tablets or laptops can be utilized to enhance the interaction between the teacher and students, as well as boost the students motivation, engagement and learning. The introduction of new learning technology in the classroom normally results in immediate enthusiasm and excitement both from the teacher and the students. However, the immediate positive effects might fade when the new learning technology has become familiar to the teacher and the students. This paper shows the results from investigating the wear off effect of using the game-based student response system Kahoot! in classroom teaching. More specifically, it compares the results from students using Kahoot! for the first time in a single motivational lecture vs. using Kahoot! in every lecture in a class for five months. The quasi-experiment focused on how the students' perception changed in relation to user-friendliness, engagement, motivation, classroom dynamics, concentration, and perceived learning. The results show a slight reduction in the students motivation and engagement, but the only statistically significant wear out effect found was related to classroom dynamics. At large, the game-based student response system managed to boost students engagement, motivation and learning after using it repeatedly for five months. The core factor to keep the students attention after heavy repeated usage was found to be the competitive nature of Kahoot!. (Abstract)

Wendel, V., Gutjahr, M., Göbel, S., & Steinmetz, R. (2013). Designing collaborative multiplayer serious games: Escape from Wilson Island - a multiplayer 3D serious game for collaborative learning in teams. *Education and Information Technologies, 18*(2), 287-308. DOI: 10.1007/s10639-012-9244-6

Keywords: computer aided instruction; serious games (computing); collaborative multiplayer serious games; computer supported collaborative learning; Wilson island; multiplayer 3D serious game; video games; game-based learning concepts; single player game design concepts; collaborative behavior; game-based CSCL approach

The idea of Computer Supported Collaborative Learning (CSCL) is being investigated for more than twenty years. Since a few years, game-based approaches like video games for learning (Serious Games) offer new fields of application. The combination of game-based learning concepts and collaborative learning may enable new, game-based application areas of CSCL, like collaborative multiplayer Serious Games. Designing such games, however, is very challenging as it requires to take into account traditional single player game design concepts, concepts for multiplayer game design, and concepts for Serious Game design simultaneously. Only very few examples of such games exist today. In this paper we describe an approach for the design of game-based collaborative learning

scenarios using multiplayer Serious Games. Our approach aims at combining design concepts from the fields of collaborative learning and (multiplayer) game design. Our approach takes into account the requirements of traditional single player games (fun, narration, immersion, graphics, sound), challenges of multiplayer games (concurrent gaming, interaction) and Serious Game design (seamless inclusion of learning content, adaptation and personalization). Furthermore, requirements of collaborative learning are considered, like group goals, positive interdependence, and individual accountability. Our design concept was used to create a collaborative 3D multiplayer game fostering collaborative behavior as a foundation for game-based collaborative learning in small teams. We performed a user study with eight gaming sessions and a total of 23 participants. Results showed that the game enables a collaborative game play and fosters collaborative behavior. This may allow us to use a game-based CSCL approach to combine the advantages of game-based learning with those of collaborative learning in future. (Abstract)

Westera, W. (2015). On the cybernetic arrangement of feedback in serious games: a systems-theoretical perspective. *Education and Information Technologies, 20*(1), 57-73. DOI: 10.1007/s10639-013-9267-7

Keywords: cybernetic arrangement; serious games; cybernetic regulation; complex human learning; machine-generated learner feedback; cybernetic principles; feedback control theory; optimal control; complex systems; online learning technologies; self-regulating feedback loops; learning activities; learning performances; feedback decision procedure

This paper explores the cybernetic regulation of complex human learning and teaching. It provides a theoretical description of the arrangement of adaptive, machine-generated learner feedback which relies on cybernetic principles. Cybernetics-today often referred to as control theory, or feedback control theory-involves the incorporation of self-establishing feedback mechanisms for optimal control in complex systems. Although feedback is considered a key element of any learning process, the arrangement of feedback by teachers and educators is under pressure because of the ever-growing complexity of learning environments which is being reinforced by open, online learning technologies and topical models of learning (competence learning, experiential learning, situated cognition, serious gaming). This paper explores how cybernetic principles could be implemented in complex learning environments, e.g. serious games, for the arrangement of self-regulating feedback loops for learners. The approach is based on a quantitative description of learning activities and learning performances. For the presentation of the feedback, a feedback decision procedure is suggested which is to be linked with pedagogical theories and assessment models. The proposed cybernetic approach is elucidated with a theoretical example. The paper provides a proof of principle and gives suggestions for further development. (Abstract)

Westera, W., Nadolski, R. J., Hummel, H. G., & Wopereis, I. G. J. H. (2008). Serious games for higher education: a framework for reducing design complexity. *Journal of Computer Assisted Learning, 24*(5), 420-432. DOI: 10/1111/j.1365-2729.2008.00279.x

Keywords: serious games

Serious games open up many new opportunities for complex skills learning in higher education. The inherent complexity of such games, though, requires large efforts for their development. This paper

presents a framework for serious game design, which aims to reduce the design complexity at conceptual, technical and practical levels. The approach focuses on a relevant subset of serious games labelled as scenario-based games. At the conceptual level, it identifies the basic elements that make up the static game configuration; it also describes the game dynamics, i.e. the state changes of the various game components in the course of time. At the technical level, it presents a basic system architecture, which comprises various building tools. Various building tools will be explained and illustrated with technical implementations that are part of the Emergo toolkit for scenario-based game development. At the practical level, a set of design principles are presented for controlling and reducing game design complexity. The principles cover the topics of game structure, feedback and game representation, respectively. Practical application of the framework and the associated toolkit is briefly reported and evaluated. (Abstract)

Williams-Bell, F. M., Kapralos, B., Hogue, A., Murphy, B. M., & Weckman, E. J. (2015). Using serious games and virtual simulation for training in the Fire Service: A review. *Fire Technology, 51*(3), 553-584. DOI: 10.1008/s10694-014-0398-1

Fire fighting is an extremely physiologically and psychologically demanding occupation, requiring tremendous resources for training personnel as well as incurring significant workplace safety and insurance board (WSIB) costs. Approximately 33% of fire fighter injuries result from exposure to fire leading to the possibility of reducing these injuries through training fire fighters to make better decisions, particularly when under stress. Simulation (and virtual simulation in particular) offers a safe and cost-effective alternative to practice with real fire, offering entry level training to aid fire fighters to reach a specific competency level. With the ubiquity of video game play and advent of new consumer-level physical interfaces for video games (e.g., the Nintendo Wii Fit balance-board and the Microsoft Kinect), serious games (games whose primary purpose is education and training), are able to provide users with innovative interactive techniques that are highly engaging and immersive. This paper reviews the development of serious games and virtual simulation applications that may be utilized for training in the fire service. Current technology allows for the simulation of fire spread and smoke movement along with training certain fire fighting skills and incident command co-ordination. To date, gaming technology is not capable of providing a real world scenario that is completely and faithfully accurate in a dynamic virtual environment. Future work could utilize serious games to also recreate the decision making processes and the physical requirements that fire fighters encounter in an emergency situation. These could be incorporated into a simulation environment where the physical and psychological stresses are analogous to live fire fighting situations. (Abstract)

Witte, A. E. (2014). Serious games: A seminar map for international business schools. *Business and Professional Communication Quarterly, 77*(1), 31-49. DOI: 10.1177/2329490613516487

Keywords: international business education; finance education; business games; intercultural communication; experiential learning

One business school addressed the "zeitgeist" of the financial crisis by introducing in its inaugural seminar the cultural and ethical values too often absent from the types of transactions students are trained to manage. Drawing from cross-cultural and communication studies, the author tested "serious games"--cultural situations and personal development exercises aimed at rewarding rule-

based cooperation, interpersonal communication, and cultural empathy. Observations made during the games fostered curriculum reform by integrating humanistic concerns considered vital for international finance careers. Linking such training to business learning objectives enhances accountability, rule-based action, and cultural awareness reform. (Abstract)

Wouters, P., van der Spek, E. D., & van Oostendorp, H. (2011). Measuring learning in serious games: A case study with structural assessment. *Educational Technology Research and Development, 59*(6), 741-763. DOI: 10/1007/s11423-010-9183-0

Keywords: complex skills; knowledge structures; serious games; structural assessment; verbal assessment

The effectiveness of serious games is often measured with verbal assessment. As an alternative we propose Pathfinder structural assessment (defined as measuring the learners' knowledge organization and compare this with a referent structure) which comprises three steps: knowledge elicitation, knowledge representation and knowledge evaluation. We discuss practical and theoretical considerations for the use of structural assessment and showcase its application with the game Code Red: Triage. Results suggest that structural assessment measures an individual's understanding of a domain at least differently from verbal assessment. While verbal assessment may provide a more nuanced picture regarding declarative and procedural knowledge, structural assessment may add an in-depth understanding of the concepts that are regarded important in a domain. In the Discussion we propose four guidelines to effectively use structural assessment in serious games: (1) Determine the appropriateness of the domain for structural assessment, (2) select an appropriate referent for the target group(s), (3) select the number of concepts needed for structural assessment, and (4) consider the analysis of the graphical knowledge representations to obtain in-depth information about the quality of the knowledge structures. (Abstract)

Wouters, P., van Nimwegen, C., van Oostendorp, H., & van der Spek, E. D. (2013). A meta-analysis of the cognitive and motivational effects of serious games. *Journal of Educational Psychology, 105*(2), 249-265. DOI: 10.1037/a0031311

Keywords: serious games; game-based learning; cognition; motivation; meta-analysis

It is assumed that serious games influences learning in 2 ways, by changing cognitive processes and by affecting motivation. However, until now research has shown little evidence for these assumptions. We used meta-analytic techniques to investigate whether serious games are more effective in terms of learning and more motivating than conventional instruction methods (learning: $k = 77$, $N = 5{,}547$; motivation: $k = 31$,$N = 2{,}216$). Consistent with our hypotheses, serious games were found to be more effective in terms of learning ($d = 0.29$, $p < .01$) and retention ($d = 0.36$, $p < .01$), but they were not more motivating ($d = 0.26$, $p > .05$) than conventional instruction methods. Additional moderator analyses on the learning effects revealed that learners in serious games learned more, relative to those taught with conventional instruction methods, when the game was supplemented with other instruction methods, when multiple training sessions were involved, and when players worked in groups. (Abstract)

Wouters, P., & van Oostendorp, H. (2013). A meta-analytic review of the role of instructional support in game-based learning. *Computers & Education, 60*(1), 412-425. DOI: 10.1016/j.compedu.2012.07.018

Keywords : computer games; serious games; game-based learning; cognition; meta-analysis; instructional support

Computer games can be considered complex learning environments in which players require instructional support to engage in cognitive processes such as selecting and actively organizing/integrating new information. We used meta-analytical techniques to test if instructional support enhances learning in game-based learning (k = 107, Nadj = 3675). We found that instructional support in game-based learning environments improved learning (d = .34, p < .001). Additional moderator analyses revealed that the learning effect was largest when learning of skills was involved (d = .62, p < .001) and when the instructional support aimed at the selection of relevant new information (d = .46, p < .001). Furthermore, we found some evidence for a publication bias since the effect sizes for studies in peer-reviewed journals was significantly higher than for studies in proceedings and unpublished studies (journals: d = .44; proceedings: d = .08; unpublished: d = .14). (Abstract)

Wrzesien, M., & Alcañiz Raya, M. (2010). Learning in serious virtual worlds: Evaluation of learning effectiveness and appeal to students in the E-Junior project. *Computers & Education*, 55(1), 178-187. DOI: 10.1016/j.compedu.2010.01.003

Keywords : interactive learning environments; virtual reality; pedagogical issues; elementary education

The objective of this study is to present and to evaluate the E-Junior application: a serious virtual world (SVW) for teaching children natural science and ecology. E-Junior was designed according to pedagogical theories and curricular objectives to help children learn about the Mediterranean Sea and its environmental issues while playing. In this study, we present data about the E-Junior evaluation. A class in a serious virtual world (virtual group) was compared with a traditional type of class (traditional group) that contained identical learning objectives and contents but lacked a gaming aspect. Data collection consisted of quantitative and qualitative measures on a sample of 48 children. With regards to learning effectiveness, the results showed that the serious virtual world does not present statistically significant differences with the traditional type of class. However, students from the virtual group reported enjoying the class more, being more engaged, and having greater intentions to participate than students from the traditional group. The plausible explanation for this can be found in the qualitative data. The implications of these results and improvement proposals are also discussed in this work. (Abstract)

Wu, W. H., Chiou, W. B., Kao, H. Y., Hu, C. H. A., & Huang, S. H. (2012). Re-exploring game-assisted learning research: The perspective of learning theoretical bases. *Computers & Education*, *59*(4), 1153-1161.

Keywords: game-assisted learning, interactive learning environments, pedagogical issues, learning theory

Previous literature reviews or meta-analysis based studies on game-assisted learning have provided important results, but few studies have considered the importance of learning theory, and coverage of papers after 2007 is scant. This study presents a systematic review of the literature using a meta-analysis approach to provide a more comprehensive analysis and synthesis of relevant studies based on four orientations of learning theories and principles: behaviorism, cognitivism, humanism, and constructivism. Major findings of this study include that the majority of published studies were not based on learning theory and the development of learning theory orientations has prompted more studies to focus on constructivism and humanism than on behaviorism and cognitivism. In addition, most studies adopted a descriptive approach, followed by experimental methods and surveys, and most presented positive outcomes. These findings not only advance understanding of game-assisted learning from the important perspective of learning theory, but also provide useful insights for researchers and educators in issues related to game-assisted learning. (Abstract)

Yan, W., Culp, C., & Graf, R. (2011). Integrating BIM and gaming for real-time interactive architectural visualization. *Automation in Construction*, 20(4), 446-458. DOI: 10.1016/j.autcon.2010.11.013

Keywords : gaming; Building Information Modeling (BIM); visualization; interoperability

This paper presents our findings of current applications of computer games in design visualization and education, and our solution to address interoperability between games and building models to enhance architectural visualization and education. We demonstrate our BIM-Game prototype that integrates Building Information Modelling (BIM) and gaming into architectural visualization. Our system supports an innovative Design-Play process that allows designers to play in their own designed environments with the capability for simulations of physical dynamics and user activities. The implementation of this BIM-Game provides a variety of connections among several fields including architecture, engineering, computer science, visualization, and game development. These connections bridge diverse areas such as building modelling, equipment simulation and visualization, character modelling and animation, collision detection, navigation, path planning, materials and lighting, and interaction through game controllers and user interfaces. The paper presents a framework for integrating BIM and games, and a sample experiment of real-time, interactive, and photorealistic walkthrough with a virtual user model to demonstrate the use and the potentials of the framework. We expect this research to extend the study and adaptability of computer games in design education. (Abstract)

Yang, Y.-T. C. (2012). Building virtual cities, inspiring intelligent citizens: Digital games for developing students' problem solving and learning motivation. *Computers & Education*, 59(2), 365-377. DOI: 10.1016/j.compedu.2012.01.012

Keywords : interactive learning environments; computer-mediated communication; media in education; teaching/learning strategies

This study investigates the effectiveness digital game-based learning (DGBL) on students' problem solving, learning motivation, and academic achievement. In order to provide substantive empirical evidence, a quasi-experimental design was implemented over the course of a full semester (23 weeks). Two ninth-grade Civics and Society classes, with a total of 44 students (15–16 years old),

were randomly assigned to one of two conditions: an experimental group (incorporating DGBL) and a comparison group (taught using traditional instruction). Two-way mixed ANOVA was employed to evaluate changes in problem solving ability and compare the effectiveness the two strategies, while ANCOVA was used to analyze the effects on learning motivation and academic achievement. The results of this study are summarized as follows: (1) The DGBL strategy was clearly effective in promoting students' problem solving skills, while the control group showed no improvement. Additionally, data from the mid-test and post-test demonstrate that, as a higher order thinking skill, problem-solving requires a full semester to develop. (2). DGBL resulted in better learning motivation for students in the experimental group as compared to learners receiving TI. (3) Contrary to some suggestions that digital games could inhibit academic achievement, no statistically significant difference was found between the two groups. Most importantly, the quantitative improvement in problem-solving and learning motivation suggest that DGBL can be exploited as a useful and productive tool to support students in effective learning while enhancing the classroom atmosphere. Future research in DGBL should emphasize the evaluation of other higher order elements of the cognitive domain in terms of academic achievement outcomes and skills, such as critical and creative thinking. (Abstract)

Yi-Huang, L., & Yeh, Y.-c. (2016). Mediated enactive experience versus perceieved mastery experience: An enhancing mechanism verus a mediator of character attachment and internal political efficacy in serious games. *Computers in Human Behavior, 55*(B), 1085-1096. DOI: 10.1016/j.chb.2015.10.029

Keywords : mastery experience; path model; political efficacy; serious game

This study aimed to investigate whether mediated enactive mastery experiences provided by a serious game could enhance players' internal political efficacy (IPE) and further, to examine a path model of how character attachment and pretest IPE might influence perceived mastery experience and posttest IPE. A serious game that incorporates the enactive mastery experience and includes inventories of the measured variables was developed using Adobe Flash and JavaScript. One hundred thirteen college students participated in this study. The results of repeated measure analysis of variance revealed that the participants improved their IPE after playing the game, suggesting that the employed enactive mastery experience is effective. Moreover, results of structural equation modeling suggest that perceived mastery experience is an important mediator of character attachment and posttest IPE as well as a mediator of pretest IPE and posttest IPE. The findings of this study shed light on how to incorporate effective psychological mechanisms to enhance IPE in serious games. (Abstract)

Young, M. F., Slota, S., Cutter, A. B., Jalette, G., Mullin, G., Lai, B., . . . Yukhymenko, M. (2012). Our princess is in another castle: A review of trends in serious gaming for education. *Review of Educational Research, 82*(1), 61-89. DOI: 10.3102/0034654312436980

Keywords: video games; meta review; situated learning

Do video games show demonstrable relationships to academic achievement gains when used to support the K-12 curriculum? In a review of literature, we identified 300+ articles whose descriptions related to video games and academic achievement. We found some evidence for the effects of video

games on language learning, history, and physical education (specifically exergames), but little support for the academic value of video games in science and math. We summarize the trends for each subject area and supply recommendations for the nascent field of video games research. Many educationally interesting games exist, yet evidence for their impact on student achievement is slim. We recommend separating simulations from games and refocusing the question onto the situated nature of game-player-context interactions, including meta-game social collaborative elements. (Abstract)

Young, M. F., Slota, S., & Lai, B. (2012). Comments on "reflections on a 'review of trends in serious gaming'". *Review of Educational Research*, 82(3), 296-299. DOI: 10.3102/0034654312456606

Keywords: video game; technology; situated cognition; instruction; learning

In large measure the authors agree with Tobias and Fletcher's (2012) comments stating that clearer operational definitions of game features are needed to enable research on games and learning. The authors cannot accept that games are a subset of simulations, preferring to identify instances when games and simulations overlap and when they do not. The authors caution that research focused solely on cognitive processes risks missing fundamental environmental dynamics and their rich interactions with the intentional dynamics of situated cognition. The authors point out that their specific review of games and academic achievement is complemented by the broader survey of dependent variables reviewed by Tobias and Fletcher. (Abstract)

Yilmaz, R. M., Baydas, O., Karakuş, T., & Goktas, Y. (2015). An examination of interactions in a three-dimensional virtual world. *Computers & Education, 88*, 256-267. DOI: 10.1016/j.compedu.2015.06.002

Keywords: interactive learning environments; media in education; virtual reality

Three-dimensional (3D) virtual worlds hold the users' attention by providing rich interaction in an environment similar to the real world. User engagement duration is known to increase in environments with intense interaction. However, information in the literature about whether gender, experience, or spatial ability affects interaction in these environments is limited. In this study, these three factors are compared to users' depth of interaction in a 3D virtual world. In addition, the relationships between engagement duration, spatial ability, and depth of interaction are examined to investigate whether the first two factors can predict the third. Findings showed that users' depth of interaction was not influenced by gender, but experience and spatial ability did affect interaction. A strong relationship was determined between depth of interaction and engagement duration, and a moderate relationship was found between depth of interaction and spatial ability. Findings indicated that when designing 3D environments, it is important to consider which kinds of tasks provide more interaction and to what extent spatial abilities affect interaction, as well as to prepare activities that will increase engagement duration and to devise strategies to enhance depth of interaction. (Abstract)

Ypsilanti, A., Vivas, A. B., Räisänen, T., Viitala, M., Ijäs, T., & Ropes, D. (2014). Are serious video games something more than a game? A review on the effectiveness of serious games to facilitate intergenerational learning. *Education and Information Technologies*, 19(3), 515-529. (3), 515-529. DOI: 10.007/s10639-014-9325-9

Keywords: serious games; intergenerational learning; older workers; aging; knowledge transfer; organizations; innovation

Aging diversity in organizations creates potential challenges, particularly for knowledge management, skills update and skills obsolescence. Intergenerational learning (IGL) involves knowledge building, innovation and knowledge transfer between generations within an organization (Ropes 2011). Serious games refer to the use of computer games in raising awareness about educational topics, acquiring new knowledge and skills by enabling learners to engage and participate in situations that would otherwise be impossible to experience (Corti 2006). Although learning with the use of serious games is similar to traditional learning in several cognitive respects, there are noted differences in the learning style and structure of learning using serious games. The success of learning using serious games lies in the actual involvement of a participant playing the game, which in turn, creates increased cognitive links with real-life situations allowing the individual to make relevant associations, to use mnemonic strategies with the facilitation of multi-dimensional educational aids (e.g., visual, auditory). Some of the beneficial aspects of learning with the use of serious games include the elevation of several cognitive skills, which are directly or indirectly implicated in the learning process. Among them are attention and visuo-spatial abilities, memory and motor skills. However, several barriers have been noted that fall into two general categories: a) health issues (e.g., cognitive strain, headaches) and b) psychological issues (e.g., social isolation, emotional disturbances). Since the training conditions are learner-centered and highly determined by the individual, there is increased need for evaluating the learning outcomes using specific success indicators. Examples of games that are designed to facilitate IGL are scarce, while there are no examples of IGL games in most EU countries. The purpose of this paper is to critically evaluate the current literature of theories on learning through serious games in adults and the elderly with reference to the cognitive mechanisms implicated, benefits and barriers in learning using new technologies in different generations. Secondly, this paper reviews the existence of serious games designed to facilitate IGL in Europe, as well as the characteristics of serious games in raising awareness that could be used to facilitate IGL. In doing so, specific focus is placed on the development of success indicators that determine the effectiveness of serious games on raising awareness on IGL. (Abstract)

Zyda, M. (2005). From visual simulation to virtual reality to games. *Computer, 38*(9), 25-32. DOI: 10.1109/MC.2005.297

Keywords: 3D graphics; America's Army project; entertainment computing; serious games; video games; virtual reality

During the past decades, the virtual reality community has based its development on a synthesis of earlier work in interactive 3D graphics, user interfaces, and visual simulation. Currently, the VR field is transitioning into work influenced by video games. Because much of the research and development being conducted in the games community parallels the VR community's efforts, it has

the potential to affect a greater audience. Given these trends, VR researchers who want their work to remain relevant must realign to focus on game research and development. Leveraging technology from the visual simulation and virtual reality communities, serious games provide a delivery system for organizational video game instruction and training. (Abstract)