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FINAL DRAFT

Game-Based Learning in Schools: Trainee Teacher Perceptions in Implementing Gamified Approaches.

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Abstract

Many children play games. Most notably, in the twenty first century, these games are digital in appearance and played across a variety of platforms. Gaming can form an immense part of a child's identity development as they grow through their childhood and beyond. The digital games they play frequently offer continuous player feedback as well as propose challenge and clear pathways for progress. Additionally, the player learns to fail in order to progress within the game. Games capture fun, mystery, surprise, uncertainty, exploration and abstract risk. They develop resilience, mastery and problem solving capability in something that is voluntarily engaged with by the child. With all these qualities in mind, the synergy between games and learning would perhaps appear convincing. However, is this happening in our schools as a means to contextualise learning in a form that is familiar and engaging to our pupils? Do teachers know what is required to develop game-based pedagogy that has a tangible impact on the engagement, and inevitably the attainment, of their pupils? This paper presents the beginnings of a small-scale study that considers twenty-one, east London (England) based, computer science pre-service teachers and their perceptions of the knowledge and understanding needed to successfully incorporate game-based learning pedagogy into their practice. The study also deliberates barriers that pre-service teachers may face in trying to implement a game-based learning approach in their classrooms. The findings from this study suggest that trainee teachers are keen to experiment, adopt and develop new game-based pedagogies for learning with their pupils. They are keen to become change agents and support pedagogical shift in their schools but inevitably barriers are met and must be overcome for this to be successful. This research investigation will benefit both pre-service and in-service teachers who are interested in using video games as a means to enhance learning in their classrooms.

Key words: video games; game-based learning; pre-service teachers; pedagogy; secondary school teachers

Introduction

In the United Kingdom (UK), technology and digital media are highly influential in how we live our lives (Belshaw, 2008). Many children are immersed in the daily experience of using digital tools and technological products (McClarty *et al*, 2012). Young people play games from a very early age and are said to have spent 10,000 hours gaming by the time they reach young adulthood (McGonigal, 2011). It is estimated that 99% of children in the UK, between the ages of 8 and 15, play digital video games (Internet Advertising Bureau, 2014). Yet arguably our classrooms are not reflective of these contemporary experiences our children are consistently exposed to. Many 21st century secondary school classrooms still have a similar appearance to that of a classroom located in

the Victorian era. With this in mind, education may be seen by many young people as dull and outmoded, and perhaps because of this stance, schools face problems with the motivation and engagement of their pupils (Lee & Hammer, 2011; Dicheva *et al*, 2014; Hamari, 2015; Lynch, 2016). Using video games and game-based learning approaches in the classroom can contribute to this argument and help improve pupil engagement, motivation and inevitably their learning. The synergy between video games and learning appears compelling, and has formed the basis of many research studies over recent years (Prensky, 2001; Gee, 2008; Kenny & McDaniel, 2009; Oei & Patterson, 2013). This paper documents the preliminary findings from a small-scale study that considers twenty-one, east London (England) based, computer science pre-service teachers and their perceptions of the knowledge and understanding needed to successfully incorporate game-based learning pedagogy into their practice.

Background

The use of games to support learning and teaching is not a contemporary concept and has been historically entrenched in education (e.g. Ward-Crampton, 1909; Mead, 1934; Dewey, 1938; Bettelheim, 1972). Learning through games and play is not innovative (Plass *et al*, 2016), but is the key developmental mechanism that connects animal and human existence and advancement (Van Eck, 2006; Plass *et al*, 2016). Today, learning through the use of video games is often seen as more advantageous than play (Marchetti & Valente, 2015). With this in mind, various commentators have contributed to the debate that surrounds the influence of video games on (for example) learning outcomes, attitudes and cognitive development (e.g. Prensky, 2001; Gee, 2008; Kenny & McDaniel, 2009; Rondon *et al*, 2013). This debate is located in various disciplines including Education (Kenny & McDaniel, 2009; Amory, 2010), Medicine (Rondon *et al*, 2013), Psychology (Bushman & Anderson, 2002; Chan & Rabinowitz, 2006), Pediatrics (Sharif & Sargent, 2006; Dworak *et al*, 2007) and General Sciences (Shawn Green *et al*, 2010).

Defining video games

These (often opposing) disciplines contributing to game-based research and game studies have led to difficulty in determining what video games are and how their perceived impact has been investigated, positioned and interpreted. Hamari and Keronen (2017) suggest that the body of literature that encapsulates video games has not been meta-analysed to ascertain why people choose to play or engage with games. Notwithstanding these challenges, various commentators have worked to define what a video game is (e.g. McGonigal, 2011; Kapp, 2012; Carse, 2013). Rooted in these definitions is the notion that video games need goals, rules and outcomes. They need a clear beginning, middle and end, and players play voluntarily and without restrictions (McGonigal, 2011; Kapp, 2012; Carse, 2013). Games offer continuous feedback and they are 'fun' (Miller, 2013). At the same time, they offer the 21st century skills need of challenge, resilience and problem solving that enable the player to accomplish the goals of the game and develop mastery within this challenge (Lee & Hammer, 2011). The facets contributing to these video game definitions have clear resonance with education and schools, and as such, it seems difficult to disassociate video game play from learning. For example, the 'player' (or learner) is autonomously constructing their learning of the game and its requirements through what they are doing and

the decisions they are having (or choosing) to make (Van Eck, 2006). Intrinsically, “*when people are learning to play video games, they are learning*” (Gee, 2003:13). The stigma of failure is removed when playing games, since failure must occur for the player to progress (Gee, 2008) and therefore learn what is needed to succeed within the game.

Video games and identity

According to several authors (e.g. Gee, 2008; Lee & Hammer, 2011), video game players develop an identity that becomes fundamental to the game they are playing. This identity builds on existing identities the player may already have assumed and formed. Gee (2008) pertains that these identities are considered from three viewpoints: virtual, real world and projective. A player’s *virtual identity* is dependent on the character they are playing the video game through. A *real-world identity* references the ‘real’ person playing the game and the multi identities they have that will impact on how they play and interact with this game. Finally, a *projective identity* is how a player anticipates their ontological values and fidelities in creating the character used to play in the virtual world of the game. There is a synergy between Gee’s work and that of Bergin (1999). Bergin posits that people identify and label themselves as part of distinctive groups. This identification leads people to develop schemata around these labels and if something does not fit this ‘pattern of thought’ they will not be interested in it. Game design, gameplay, game definitions, and choices are arguably positioned in this sphere. The suggestion here is that learning should be framed within the schema of a pupil’s identity for it to have impact. Once this is determined the pupil can assume the required facets of a virtual, ‘alter ego’ identity connected with their real-world beliefs. This will enable them to engage with, value and learn the new content being presented to them (Gee 2008).

Types of video games

Video games used to enhance computer science (or indeed any) learning can generally be organized into three broad categories (Van Eck, 2006) – commercial off the shelf (COTS) games, serious games and student created games (Van Eck, 2006; Simoes *et al*, 2013). Each of these categories present challenges for game-based learning. For example, COTS are often seen as limited as a teaching tool (Simoes *et al*, 2013). COTS are classified within further game subtypes for example puzzle, action, sport, racing, role playing, adventure, strategy and shooter (Jabbar & Felicia, 2015). These game types may be interesting, fun and engaging but the education quality may not be maintained (Shi & Shih, 2015). The game designers lack the skillset to offer the educational and pedagogic learning potential required (Cozar-Gutierrez & Saez-Lopez, 2016) and thus the educational stimulus is limited for the learner (Simoes *et al*, 2013). Serious games are designed for non-entertainment purposes (Deterding *et al*, 2011). They are designed with education as the focus and, as such, are not created to be ‘fun’ (Cozar-Gutierrez & Saez-Lopez, 2016) but rather concentrate on the provision of formal knowledge and learning content. The pedagogy and educational quality is there but the game ‘design’ quality is often lacking (Van Eck, 2006) and this could mean that pupils will be disinterested in the game (Shi & Shih, 2015). Student created games are developed by the pupils, as part of their taught curricula, and this theme very much fits with the Computing national curriculum programme of study for England and Wales (DfE, 2013). From primary school age, pupils are

beginning to engage with designing their own games, using suitable software to develop their coding and programming skillset, and to engage with problem solving and computational thinking proficiency.

Game genre

Game genre is descriptive of the game's context and content (eg. Drama, fantasy, science fiction or crime) (Jabbar & Felicia, 2015), and is different to game type (eg. see previous section). Game genre helps to differentiate one game from other types of games in defining the common characteristics of the game. Games are "*complex genres of learning environments*" (Plass *et al*, 2016: 258) because they span different disciplines, as discussed earlier in this paper, but also because they engage with different (21st century) learning concepts such as challenge, interaction, social engagement, motivation, cognitive load, problem solving and collaboration. Game genre engagement choices will be dictated by player identity and ontologies, and need consideration when designing game based learning approaches, content and contexts.

Game and game based learning design

In consideration of the literature engaged with for this paper, the game design is critical if we are to successfully implement gamified learning approaches in the computer science classroom. Game based learning (GBL) must focus on both the fun and entertaining aspects of game design as well as the educational learning and knowledge content required (Jabbar & Felicia, 2015; Plass *et al*, 2016). If this is achieved then key learning concepts such as motivation, engagement, adaptivity and resilience will be enhanced (Plass *et al*, 2016) as will perceived 21st century skills including creativity, collaboration, communication and problem solving. Shi & Shih (2015) suggest four components are required in designing a GBL educational game system. These are game goals, game mechanisms, game fantasy and game value. Game goals provide the fundamental elements around which the game is designed (McGonigal, 2011; Kapp, 2012; Carse, 2013). In a GBL system this would refer to learning objectives and the activities, challenge and pedagogies wanted within the game to offer the experience required (Sh & Shih, 2015). Game mechanisms refer to the mechanics of realising the game goals including the interaction and freedom afforded within the virtual world the player is occupying and the gamer identity they are assuming (Gee, 2008; Lee & Hammer, 2011). This would require a clear feedback system (McGonigal, 2011) that will enable the 'player' to understand their successes in achieving the game goals. Game fantasy denotes the story, feeling, immersion, emotional engagement and motivation in playing the game. Game value is what attracts players to play the game and what makes them voluntarily engage (McGonigal, 2011; Kapp, 2012; Carse, 2013). The goals, mechanisms and fantasy will influence the value a player places on the game and therefore the learning.

Plass *et al* (2016) contest that very different modes of learning exist in GBL systems. These include behaviourist (e.g. Pavlov, Skinner, Bandura), cognitivism (e.g. Bruner) and constructivist (e.g. Vygotsky, Piaget, Dewey). Plass *et al* argue that any GBL system needs to incorporate these learning models into one broad modelled approach. They propose game-based learning design to be underpinned by *affect* (e.g. attitude, emotion and interaction), *motivation* (e.g. self-determination (see Ryan & Deci, 2000), self-efficacy, goals, interest), *cognition* (e.g. context, scaffold, feedback) and *social/ cultural* (e.g. agency, interactions, relatedness, belonging) facets. These feed into

decisions required about the game design elements which in turn will boost affective, behavioural, cognitive and motivational engagement in the learning.

Both perspectives engaged with here, appear to be foundationed by the Mechanics, Dynamics and Aesthetics (MDA) approach to video game design (Hunicke *et al*, 2004; Herbert, 2014; Hamzah *et al*, 2015). Game mechanics are the rules and extrinsic rewards achievable in playing the game, through levels, points, leaderboards and challenges. From a learning standpoint, this incorporates the behaviourist model in that the player is being 'conditioned' to learn through the external rewards on offer. Dynamics provide the narrative and storyline to the game (Chandler, 2013) with the player (or learner) responding to the 'rules' of the mechanics and constructing their knowledge of the game as they play (Van Eck, 2006). How they construct this knowledge will dictate the status, reward and achievement gained through playing the game. Aesthetics form the fun, excitement, mystery, pleasure and thus emotional response to playing the game.

With all this in mind, GBL systems and design for delivering computer science education should focus on the learning goals, outcomes and rules required to support their achievement – the mechanics or game mechanisms (Shi & Shih, 2015). They should be fun and created in a way that pupils will happily volunteer to engage with them (Miller, 2013) and recognise the learning value of doing so. There should be clear and continuous feedback that assesses progress within the game (McGonigal, 2011) and adjusts the challenge accordingly. The challenge should incorporate the dynamics of the narrative and the fantasy including surprise, mystery, achievement and altruism. The game should be aesthetically pleasurable for the learner and should be designed with 21st century skills need in mind. The game should be conceived within the schema of pupil identity (Bergin, 1999) for it to impact on the learning required.

In considering the literature surrounding games, game play, game definitions, successful game elements, game based learning and gamer identity, the author of this paper propose that there is a clear relationship between video game play and learning. This relationship also connects seamlessly with the argument outlined in the introduction of 21st Century learners and what might motivate them to engage with their studies.

Meta-analysis computer science GBL

The electronic database EBSCO was searched to ascertain an overview of current game-based learning studies within the computer science classroom. The search parameters concentrated on peer reviewed academic journals within the broad and varied multi (and importer) discipline that is Education (Pring, 2012). The aim of this meta-analysis was to develop an increased understanding of GBL in computer science education with a particular emphasis on the successes and barriers faced in using gamified approaches. The initial search found 281 relevant articles. This decreased to 48 when the search was narrowed to programming and game-based learning. A selection of results can be seen in Table A.

TABLE A

Selected results of a meta-analysis of peer reviewed journal paper search of EBSCO database

Paper	Context	Game/ tool	Successes	Barriers
Bliemel, M., & Ali-Hassan, H. (2014)	Experiential learning through a real time game to solve IT management and systems issues.	Simulation - IT Manager 3: Unseen Force	<ul style="list-style-type: none"> • GBL enabled mistakes to be made in a simulated environment; • Good game contribution and pedagogical value established. 	<ul style="list-style-type: none"> • Technological breakdown; • Feedback within game insufficient to support access to the next 'level' for a number of earners; • Students not sharing game issues via their online forum for fear of looking unskilled.
Fotaris <i>et al.</i> (2016)	Applying gamification strategy to a higher education computer programming class to support formative assessment opportunity.	<ul style="list-style-type: none"> • Kahoot • Classroom version of 'Who Wants to be a Millionaire' • Codecademy.com 	<ul style="list-style-type: none"> • Pedagogical goals achieved by using the game based approach; • Effective way of assessing in contrast to traditional assessment methods; • Allowed students to engage with their assessment in a fun and motivating way. 	<ul style="list-style-type: none"> • Loss of student interest with Kahoot once they began to trail behind on the leaderboard; • Some lesson content quality issues that meant students associated this content as difficult to comprehend when in reality it might not be; • Possible 'novelty' factor skewing outcomes.
Connolly, T.M., Stansfield, M., McLellan, E. (2006)	A constructivist and problem solving approach to learning database design using an online collaborative GBL system in higher education.	<ul style="list-style-type: none"> • Simulation game replicating real world issues that students may have to work through in industry. 	<ul style="list-style-type: none"> • Low dropout rate in using the online GBL system (lower than those experiencing face to face learning of the same content). 	<ul style="list-style-type: none"> • Development costs for the online environment and sustaining this over time.
Olsson, M., Mozelius, P., & Collin, J. (2015)	Gamification and software visualization in a VLE to increase learners' control and motivation.	<ul style="list-style-type: none"> • Dynamic and animated visualisation software approach to programming incorporating progress bars and digital badges to support engagement 	<ul style="list-style-type: none"> • Visualisation channel improved the student learning outcomes. 	<ul style="list-style-type: none"> • Not all students used the progress bars; • Some indifference to the use of digital badges; • Gamification not attracting all.
Mathrani, A., Christian, S., & Ponder-Sutton, A. (2016)	Using a GBL approach to enhance student learning and programming skills in a higher education course.	<ul style="list-style-type: none"> • Light Bot 2.0 	<ul style="list-style-type: none"> • Much of the feedback suggests the GBL approach has enhanced engagement and confidence in programming – particularly from those about to start the module; • Useful introductory approach to programming to secure engagement and enjoyment for what is to come. 	<ul style="list-style-type: none"> • Not all participants enjoyed the GBL approach; • Less impactful for those students who were close to completing the module and therefore reflecting on the work they had completed; • GBL approach only introductory and not appropriate for more advanced programming.
Wang, L. C., & Chen, M, P. (2010)	Game strategy on novice programmers' performance and 'flow' motivation using an experiential gaming activity.	<ul style="list-style-type: none"> • Matching game to identify critical concepts of programming; • Challenging game to further the above learning. 	<ul style="list-style-type: none"> • Embedding the matching game enhanced learners' performance in programming in consolidating their conceptual understanding. 	<ul style="list-style-type: none"> • Game choices did not improve the 'flow' experience of learners; • Challenging game-play did not enhance the learners' performance.
Tsalapatas, H., Heidmann, O., Alimisi, R., & Houstis, E. (2012)	Game based visual programming in developing computational thinking skills in primary school children.	<ul style="list-style-type: none"> • Various game activities selected from the cMinds platform. 	<ul style="list-style-type: none"> • Software supported critical, analytical and creative thinking mindsets from the pupils; • Easy introduction increased pupil confidence and participation in the learning. 	<ul style="list-style-type: none"> • Teachers needed face to face or online support in understanding programming concepts, and thus be able to offer instructional support within the cMinds platform.

Slussareff, M., & Bohackova, P. (2016)	Comparison study investigating learning by playing a location based game and learning by designing a location based game.	<ul style="list-style-type: none"> • Activities following game design themology. 	<ul style="list-style-type: none"> • Game design (active) approach had positive impact; • Supported the acquisition of 21st century skills – collaboration, responsibility and lifelong learning; 	<ul style="list-style-type: none"> • Student focus was not consistent all the time; • Complex planning and preparation.
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TABLE A offers an insight into several GBL studies that have been undertaken. The academic papers were selected at random by the author, from the EBSCO database, following the keyword search identified earlier. The studies are varied in context but with many centred within a higher education environment. All appear to have identified clear positives in adopting GBL approaches in the computer science classroom with research goals being achieved. Many suggest the link to ‘soft skills’ and 21st century skills development is also evident in using GBL systems. A common implicit theme is the need for the game design to be thought through very carefully if success is to be achieved in engagement, motivation and pupil outcome.

Methods

The research for this paper was conducted with 21 postgraduate computer science trainee teachers who were aged between 21 and 46, with 16 males and 5 females on the course. Gaming is not discriminatory across genders and sees a comparatively equal proportion of males and females playing video games (Sardone & Devlin-Scherer, 2009; Quandt *et al*, 2015). However, there is still a considerable imbalance in the UK regarding male and female uptake of computing/gaming focused undergraduate degrees, and within the computing industry itself (Robertson *et al*, 2001; Philbin, 2016). A range of backgrounds and academic history are identified within this group, with 14 trainees having a computer science undergraduate degree and 6 educated outside of this discipline. Two were game developers and programmers.

Interviews were used to ascertain how these trainee teachers visualised the successful incorporation of game-based learning pedagogy into their practice. Interviews are the most used data collection tool in qualitative research, in which this foundation study is positioned (Punch & Oancea, 2014). The interviews were semi structured in nature (O’Leary, 2017) to allow for the questioning to adapt to the responses of the participants and developing themes to be explored (Creswell, 2003). The initial defined questions were premised upon the trainee teachers’ experiences and perceptions of adopting GBL pedagogy in their classroom. These questions included:

- What knowledge and skills are required for teachers to adopt GBL strategies?
- What GBL examples have you seen or used in the classroom?
- What barriers exist in implementing a GBL system in the classroom?
- How can you support the adoption of GBL approaches?

A focus group interview also took place where a discussion was held regarding the significance of GBL in the computer science curriculum allowing the participants to engage with and affect each other’s opinions (O’Leary, 2017).

The study questioned the barriers that pre-service teachers may face in trying to implement a game-based learning approach in their classroom. At the time of the interviews taking place, each trainee teacher was concluding their first school-based teaching placement. The results are discussed in the next section of this paper.

Results and discussion

The current investigation for this paper explored English Computer Science secondary school pre-service teachers' perceptions in implementing gamified approaches to learning in their classrooms. The preliminary results indicate that successful implementation of game-based learning faces potential barriers. Varied perceptions are offered. For example, participant A (who has been educated in game design and development as an undergraduate) suggests:

“Teachers must at the very least have a basic understanding of how a game works and how children react to a game. An example of this would be that I wanted to implement a system which had students ‘levelling up’ and receiving a reward. However, I was told that rewards are not part of video games and I should not include it”.

This presents a knowledge barrier with in-service teachers charged with mentoring their trainees and is a viewpoint shared by 60% (12) of those interviewed. It also presents the issue of the mentoring teacher having a diverging vision to that of their trainee but demanding conformity within his or her own conceptual thinking (Kagan, 1992). This will inevitably create tension with the trainee teacher attempting to implement ‘different’ approaches. This teacher ‘mindset’ is considered to be an issue, with participant B suggesting:

“The main barrier I faced is the mindset that games make children more excited so they don’t really learn anything and secondly the emphasis on teacher-led, traditional learning being strong in my training school”.

The notion that games create too much excitement that inevitably leads to engagement and learning problems was shared by 40% (8) of the interviewees. This is not the participant’s perceptions, but rather that of their mentoring colleagues in their school-based placement. For example, participant C posits:

“Unfortunately, the culture that school is a place of learning and not a playground seems to dominate how teaching is delivered”.

This insight seems to be reflective of what many are seeing in their schools, with numerous teachers not able to make the connection between, games, play, excitement and learning – perhaps because they were not educated in this way themselves and therefore their schema (Bergin, 1999) is not situated in this sphere of interest. To

further develop this argument, various trainees suggested teacher creativity is required for game-based learning to be fully realised. Participant D states:

“From my experience from what I have seen, a lot of teachers suffer from teaching within a comfort zone that has been built on the notion of teach-activity-teach-activity...”

This suggests particular learning structures are being adopted that teachers are finding very difficult to deviate from. Whether this is in fact due to ‘comfort zones’ or rigid lesson structures being imposed by their schools needs further investigation. Trainee teachers’ potential to ‘change’ and implement difference may be constrained by existing school rules, cultures, practices and structures.

Despite these potential barriers, 70% (14) of the trainee teacher interviewed could implement a gamified approach to learning during part of their school-based training. This was generally using relatively simple tools such as YacaPaca, class bingo and voting systems, although one trainee could incorporate Minecraft into a sequence of programming lessons. Broader aspects of game design were mentioned by the trainee teachers during the interviews. This feedback included leaderboards, scores, feedback, mystery, themes, checkpoints, fun, excitement, badges, and achievements. Trainees suggested this had been harder to make happen in their school-based placement. However, all participants were very positive about the prospect of incorporating gamified strategy into the learning of their pupils, particularly when they were qualified and therefore had more autonomy over what goes on in their classroom.

Current limitations

This study is part of an ongoing research investigation. Therefore, the limitations are that only interviews and focus groups have been used so far with a very limited sample of 21 participants engaging.

Conclusion

The current results of this study are varied. Trainee teachers appear keen to experiment, adopt, and develop new game-based pedagogies for learning with their pupils. To a certain extent this has been proved possible by using simple and free to use gamified technological tools. However, more complex and, perhaps meaningful, gamified strategy has been harder to implement. This often emerges to be because of traditional, teacher-led structures existing in schools that the trainee teachers are finding difficult to break through. These structures are arguably at odds with the identities of 21st Century learners and how they construct their learning. What is of some concern here is that the barriers faced exist in Computer Science classrooms – a discipline that should be encouraging innovation, exploration and creativity. For games and gamified learning to be embedded into our secondary school classrooms, initial teacher education programmes need to promote its potential for engagement and learning progression and game design requirements for GBL need to be engaged with. Trainee teachers must be encouraged to act as agents of change in their schools and be given the opportunity to collaborate in order to change and transform thinking within their schools and classrooms. They need to be

inspired to think judiciously and critically, and question the existing practices of their school-based mentoring colleagues (Lane *et al*, 2003) in a supportive and open environment.

Future work

To further and complete this research study so as to enable more detailed drawing of conclusions, the authors intend to use a questionnaire to investigate pre-service teacher and pupil perceptions of game based learning at the end of their second school-based training experience. A focus group will also be extracted from this to help qualify the outcomes of the survey responses. Finally, to assess gamification's impact on learning, there will be a quasi-experimental study comparing academic performance data between two groups of students from the same class: the control group will be taught following a traditional learning approach, while the experimental group will receive a gamified method of delivery of the same learning material.

References

- Amory, A. (2010). 'Learning to play games or playing games to learn? A health education case study with Soweto teenagers'. *Australasian Journal of Educational Technology*, 26(6): 810-829
- Belshaw, D. (2008). 'What does it mean to be 'educated' and 'digitally literate'? The impact of ICT and the knowledge society upon education in the 21st century.' Online: <http://dougbelshaw.com/blog/2008/05/17/my-edd-thesis-proposal-what-does-it-mean-to-be-digitally-literate/> (Accessed 28th October 2016).
- Bergin, D.A. (1999). 'Influences on classroom interest'. *Educational Psychologist*. 34(2). 87-98
- Bettelheim, B. (1972). 'Play and Education'. *School Review*, 81(1): 1-13
- Bliemel, M., & Ali-Hassan, H. (2014). 'Game-Based Experiential Learning in Online Management Information Systems Classes Using Intel's IT Manager 3'. *Journal of Information Systems Education*. 25(2). 117-124.
- Bushman, B., and Anderson, C. (2002). 'Violent Video Games and Hostile Expectations: A Test of the General Aggression Model'. *PSPB*, 28(12): 1679 – 1686
- Carse, J.P. (2013). 'Finite and Infinite Games'. Free Press.
- Chan, P., & Rabinowitz, T. (2006). 'A cross-sectional analysis of video games and attention deficit hyperactivity disorder symptoms in adolescents'. *Annals of General Psychiatry*. 5(16).
- Chandler, C. (2013). 'The use of game dynamics to enhance curriculum and instruction: what teachers can learn from the design of video games'. *Journal of Curriculum and Instruction*. 6(2). 60-75.
- Connolly, T.M., Stansfield, M., and McLellan, E. (2006). 'Using an Online Games-Based Learning Approach to Teach Database Design Concepts'. *Electronic Journal of e-Learning*. 4(1). 103-109.
- Cozar-Gutierrez, R., and Saez-Lopez, J.M. (2016). 'Game-based learning and gamification in initial teacher training in social sciences: an experiment with MinecraftEdu'. *International Journal of Educational Technology in Higher Education*. 13(2). 1-11.
- Creswell, J.W. (2003). 'Research Design: Qualitative, Quantitative and Mixed Methods Approaches 2nd Edition'. London: Sage.

Department for Education. (2013). 'National Curriculum in England: computing programmes of study'. Online: <https://www.gov.uk/government/publications/national-curriculum-in-england-computing-programmes-of-study> (Accessed 13th January 2017).

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). 'From game design elements to gamefulness: Defining gamification'. Proceedings of the 15th international Academic Mindtrek Conference (pgs 9-15). ACM.

Dicheva, D., Dichev, C., Agre, C., and Angelova, G. (2015). 'Gamification in Education: A Systematic Mapping Study'. *Educational Technology and Society*. 18(3), 75-88.

Dewey, J. (1938). 'Experience and Education'. New York: Macmillan.

Dworak, M., Schierl, T., Bruns, T., and Struder, H.K. (2007). 'Impact of Singular Excessive Computer Game and Television Exposure on Sleep Patterns and Memory Performance of School-Aged Children'. *Journal of the American Academy of Pediatrics*. 120(978).

Fotaris, P., Mastoras, T., Leinfellner, R., and Rosunally, Y. (2016). 'Climbing Up the Leaderboard: An Empirical Study of Applying Gamification Techniques to a Computer Programming Class'. *Electronic Journal of e-Learning*. 14(2). 94-110.

Gee, J.P. (2003). 'What Video Games Have to Teach Us About Learning and Literacy'. New York: Palgrave Macmillan.

Gee, J.P. (2008). 'Learning and games'. In: Salen, K., (Ed.) *The ecology of games: connecting youth, games and learning*. MIT Press: Cambridge, MA.

Hamari, J. (2015). 'Challenging games help students learn'. Gamification Research Network. Online: <http://gamification-research.org/2015/11/challenging/> (Accessed 13th January 2017)

Hamari, J., & Keronen, L. (2017). 'Why do people play games? A meta-analysis'. *International Journal of Information Management*. 37, 125-141.

Hamzah, W., Ali, N., Saman, Y., Yusoff, M., & Yacob, A. (2015). 'Influence of Gamification on Students' Motivation in using E-Learning Applications Based on the Motivational Design Model'. *ijET*. 10(2), 30-34.

Herbert, B. (2014). 'The Gamification of Learning in Virtual Worlds'. Unpublished Doctoral Thesis. University of Ulster.

Hunicke, R., LeBlanc, M., and Zubek, R. (2004). 'MDA: A Formal Approach to Game Design and Game Research'. Paper presented for the Game Design and Tuning Workshop at the Game Developers Conference, San Jose 2001-2004.

IAB (2014). 'Gaming Revolution'. Online: <https://www.iabuk.net/research/library/gaming-revolution> (Accessed 28th October 2016).

Jabbar, A,I,A., and Felicia, P. (2015). 'Gameplay Engagement and Learning in Game-Based Learning: A Systematic Review'. *Review of Educational Research*, 1-40.

Kagan, D. (1992). 'Professional growth among preservice and beginning teachers'. *Review of Educational Research*, 62(2), 129-169.

Kapp, K. (2012). 'The gamification of learning and instruction: game-based methods and strategies for training and education'. Wiley.

- Kapp, K. (2014). 'Gamification of learning'. Online: <https://www.lynda.com/Higher-Education-tutorials/Gamification-Learning/173211-2.html>. (Accessed 09th November 2016).
- Kenny, R., & McDaniel, R. (2009). 'The role teachers' expectations and value assessments of video games play in their adopting and integrating them into their classrooms' *BJET*. 42(2). 197-213.
- Lane, S., Lacefield-Parachini, N., & Isken J. (2003). 'Developing Novice Teachers as Change Agents: Student Teacher Placements "Against the Grain"', *Teacher Education Quarterly*, 55-68.
- Lee, JJ, & Hammer, J. (2011). 'Gamification in Education: What, How. Why Bother?'. *Academic Exchange Quarterly*. 15(2), 1-5.
- Lynch, M. (2016). 'Gamification Can Reinvigorate Teaching and Learning: An Introduction'. Online: http://blogs.edweek.org/edweek/education_futures/2016/10/gamification_can_reinvigorate_teaching_and_earning_an_introduction.html. (Accessed 11th January 2017).
- Marchetti, E., & Valente, A. (2015). 'Learning via Game Design: From Digital to Card Games and Back Again'. *The Electronic Journal of e-Learning*. 13(3). 167-180.
- Mathrani, A., Christian, S., and Ponder-Sutton, A. (2016). 'PlayIT: Game Based Learning Approach for Teaching Programming Concepts'. 19(2). 5-17.
- McClarty, K., Orr, A., Frey, P., Dolan, R., Vassileva, V., & McVay, A. (2012). 'A Literature Review of Gaming in Education'. Pearson.
- McGonigal, J. (2011). 'Reality is Broken Why Games Make Us Better and How They Can Change the World'. London: Vintage Books.
- Mead, G.H. (1934). 'Mind, Self and Society: 1 (Works of George Herbert Mead)' Morris C (Ed.) USA: University of Chicago Press.
- Miller, C. (2013). 'The Gamification of Education'. *Developments in Business Simulation and Experiential Learning*. 40, 196-200.
- Oei, A., & Patterson, M. (2013). 'Enhancing Cognition with Video Games: A Multiple Game Training Study'. *PLoS ONE*, 8(3).
- O'Leary, Z. (2017). 'The Essential Guide to Doing Your Research Project 3rd Edition'. London: Sage.
- Olsson, M., Mozelius, P., & Collin, J. (2015). 'Visualisation and Gamification of e-Learning and Programming Education'. *The Electronic Journal of e-Learning*. 13(6). 441-454.
- Philbin, C.A. (2016). 'Too geeky for girls? Tech industry stereotypes are hindering equality'. *The Guardian*. Online: <https://www.theguardian.com/sustainable-business/2016/may/13/geeky-image-girls-tech-industry-stereotypes-hinder-equality> (Accessed 27th April 2016).
- Plass, J., Homer, B., and Kinzer, C. (2016). 'Foundations of Game-Based Learning'. *Educational Psychologist*, 50(4), 258-283.
- Prensky, M. (2001). 'Digital Natives, Digital Immigrants'. *On the Horizon*. 9(5). 1-6
- Pring, R. (2012) 'Importance of Philosophy in the Conduct of Educational Research'. *Journal of International and Comparative Education*, 1(1)
- Punch, K.J., and Oancea, A. (2014). 'Introduction to Research Methods in Education 2nd Edition'. London: Sage.
- Quandt, T., Van Looy, J., Vogelgesang, J., Elson, M., Ivory, J.D., Consalvo, M., & Mayra, F. (2015). 'Digital Games Research: A Survey Study on an Emerging Field and Its Prevalent Debates'. *Journal of Communication*. 975-996.

- Robertson, M., Newell, S., Swan, J., Mathiassen, L., & Bjerknes, G. (2001). 'The issue of gender within computing: reflections from the UK and Scandinavia'. *Information Systems Journal*. 11(2), 111-126.
- Rondon, S., Sassi, F.C., and Furquim de Andrade, C.R. (2013). 'Computer game-based and traditional learning method: a comparison regarding students' knowledge retention'. *BMC Medical Education*, 13(30).
- Ryan, R., and Deci, E. (2000). 'Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development and Well-Being'. *American Psychologist*. 55(1), 68-78.
- Sardone, N. B., & Devlin-Sherer, R. (2009). 'Teacher Candidates' Views of Digital Games as Learning Devices'. *Issues in Teacher Education*. 18(2), 47-67.
- Sharif, I., & Sargent, J. (2006). 'Association Between Television, Movie and Video Game Exposure and School Performance'. *Paediatrics*. 118(4).
- Shawn Green, C., Pouget, A., and Bavelier, D. (2010) 'Improved Probabilistic Inference as a General Learning Mechanism with Action Video Games'. *Current Biology* 20(17): 1578.
- Shi, Y-R., and Shih, J-L. (2015). 'Game Factors and Game Based Learning Design Model'. *International Journal of Games Technology*, 1-11.
- Simoes, J., Redondo, R.D., and Vilas, A.F. (2013). 'A social gamification framework for a K-6 learning platform'. *Computers in Human Behaviour*. 29, 345-353
- Slussareff, M., and Bohackova, P. (2016). 'Students as Game Designers vs. "Just" Players: Comparison of Two Different Approaches to Location-Based Games Implementation into the School Curricula'. *Digital Education Review*. 29. 284-297.
- Tsalapatas, H., Heidmann, O., Alimisi, R., and Houstis, E. (2012). 'Game-Based Programming Towards Developing Algorithmic Thinking Skills in Primary Education'. *Scientific Bulletin of the Petru Maior University of Targu Mures*. 9(1). 56-63.
- Van Eck, R. (2006) 'Digital Game-Based Learning: It's Not Just the Digital Natives Who Are Restless'. *EDUCAUSE Review*. 41(2). 16-30. Online: <http://er.educause.edu/articles/2006/1/digital-gamebased-learning-its-not-just-the-digital-natives-who-are-restless> (Accessed 25th November 2016).
- Wang, L. C., and Chen, M, P. (2010). 'The effects of game strategy and preference-matching on flow experience and programming performance in game-based learning'. *Innovation in Education and Teaching International*. 47(1). 39-52.
- Ward Crampton, C. (1909). 'Education by Play'. *Educational Review*, 38(5): 488-492.