Teaching pre-service teachers to integrate Serious Games in the primary education curriculum

Margarida Romero[1], Sylvie Barma[2]

[1]First Author *Université Laval (Canada), Margarida.Romero@fse.ulaval.ca*
[2] *Université Laval (Canada), Sylvie.Barma@fse.ulaval.ca*

Abstract

Curriculum integration is one of the main factors in the teachers' decision-making process when deciding to use games in formal educational contexts. Based on this observation, we aim to introduce pre-service teachers to Game Based Learning (GBL) and Serious Games (SG) integration in the primary education curriculum. The teaching experience aims to facilitate different approaches to GBL and SG integration in the curriculum, including three types of GBL activities. Firstly, the use of SG designed for educational purposes from the start; secondly, the game creation as a learning activity through game authoring platforms; thirdly, the use of repurposed entertainment games, which, despite not having being intentionally designed for educational purposes, could be diverted for meeting the curriculum objectives of primary education. A group of 51 pre-service teachers participated in the teaching experience during which they selected a GBL activity among the three types of GBL and SG integration in the curriculum. Most of the teachers succeed to identify SG created for educational purposes, and we observed 6 entertainment games repurposed for educational objectives, none of the pre-service teachers decided to integrate a game creation activity as part of their curricular activities. We analyze the results of the teaching pre-service experience and the opportunities to introduce GBL and SG in pre-service teachers' education.

Keywords: *Serious Games, Primary Education, Curriculum, Teaching Practices*

1. Introduction

Although curriculum is one of the teachers' constraints in K-12 education, most teachers have the possibility to choose the teaching and learning methodologies they develop in their classroom. The curriculum "lies between the teacher and the learners" [14:96] resulting in a social interaction in an specific formal education context where teachers often use the curriculum as a rationale for the learning activities decision making. Teachers have the possibility to allow children to thrive and achieve the curriculum objectives through engaging leaner-centered activities. Game Based Learning (GBL) aims at making the learning activities more enjoyable and engaging by using the potential of games mechanics for achieving the (curricular) learning objectives. Many educators believe that the use of games has many benefits in the educational context [2]. There are different approaches for integrating GBL in the curriculum and the creation of educational digital GBL activities has been one of them. There is an increasing number of Serious Games (SG) addressing the curriculum objectives which could be used for achieving the curricular pedagogical goals in an efficient manner. We find it relevant to point out that many educators believe that the use of games has many benefits in the educational context [2]. *Serious games* primary purpose is something other than mere entertainment. They "invite the user to interact with a computer application designed to combine elements of teaching, learning, training, communicating and information processing with playful aspects provided by the video game. Such an association is designed to supplement utilitarian content (serious content) with a *videoludic* approach (a game)" [In French, translation by authors]

This study aims to analyze the pre-service teachers' strategies to integrate GBL in the primary education. The paper starts by introducing the role of teachers' in the use of GBL in formal

education, including their attitudes toward GBL and the factors facilitating or hindering the integration of SG in the classroom. We then introduce three types of GBL integration in the curriculum and the pre-service teachers' experience in relation to these different typologies.

2. Integration of Serious Games in primary education

This section aims to explore the role of teachers' in the use of GBL and SG in formal education, with a focus on primary education level. One broad argument that should be taken into account when examining the pertinence of having teachers integrating ICT in the elementary classroom is that young people are Digital Natives, and a part of the Game Generation [24,25]. The author also argues that the young generation is able to assimilate information much more quickly than their parents because they have always lived in a world of ubiquitous technologies. The critical review of Bennett, Maton and Kervin [6] suggests that younger generations use technologies for leisure and social activities; nevertheless, they highlight the lack of homogeneity in the digital generation. Despite an increased use of technologies among the younger generations, most educators have remained skeptical about the relevance of digital platforms to facilitate learning [23]. To pinpoint on some important elements related to this situation, we review the SG opportunities for primary education and the factors susceptible to facilitate or hinder the integration of GBL focusing on the teachers' attitudes towards GBL and SG.

2.1 Serious Games opportunities for primary education

GBL and SG combine the active pedagogy and the playful character of games with learning objectives based in knowledge or competences [15,29]. According to Connolly, Stansfield and Hainey [10], the educational digital games support the teaching, learning, and evaluation processes. In primary education, Bottino, Ott and Tavella [5] analyse the use of serious games for developing students' reasoning and logical abilities in Europe. While game does not influence the students' level of achievement, they observe a high level of motivation and engagement in all the students. Cheng, Lou, Kuo and Shih [8] observe a relation between the primary education learners' acceptance of digital games and their usefulness for their academic goals in Taiwan. The literature review of Haney and colleagues [16] on the use of serious games in primary education observe that most of the games are used for learning mathematics, science and language. They observe that part of the studies on the effectiveness of learning through serious games leads to better results with the use of SG [36], but other studies observes no differences between the learning gains of the control and experimental groups [38]. In most of the cases, and despite of the learning effectiveness, the motivation and engagement of the learners is claimed as a positive outcome in the use of SG in primary education.

2.2 Serious Games opportunities for primary education

Despite the interest of games for sustaining the primary education learners' motivation [5] and the growing number of SG available most educators remain skeptical about the relevance of using them [2]. It still remains a challenge for most elementary and secondary teachers. So far, very little has been done during the formative years of pre-service elementary teachers to make sure they develop an awareness of resources available to them and understand the potential of SG with their students. While some teachers do not feel tech-savvy and are afraid to incorporate new technologies to their practice other teachers does not consider games useful for primary education goals [26]. Games are often perceived as a diversion from curricular pedagogical goals and even considered by some teachers as "frivolous, unproductive, and apart from the real world" [12:8]. According to McFarlane, Sparrowhawk and Heald, "obstacles to game use in schools is a mismatch between game content and curriculum content, and the lack of opportunity to gain recognition for skill development" [20:4]. Similarly, after interviewing 259 exemplar teachers in the USA, Proctor and Marks [26] observe that usefulness and the lack of game content matching to the curriculum are the most important barriers in the integration of games in the primary and secondary education. In some cases, educational games are offered to students as a reward but not as a primary learning activity [7]. In addition to the perception of games as a second-order learning activities, other factors hindering the SG integration in the classroom invoked by the teachers are the inflexibility of the curriculum and the lack of teaching time [1]. However, at the present time, the pervasive use of digital technologies as tools of mediation in cultural practises, both in the

West and elsewhere in the world, has to be taken into account. As the Canadian Council on Learning's report on virtual learning stated [6:9]: "Canada's younger generation is primed to exploit the potential of learning technologies. Computers, multimedia programs, chat rooms and other manifestations of the digital age are now common throughout children's developmental years – as almost any parent or educator will attest". Developing pre-service teachers ICT competencies could be a strategy to exploit this potential, and allow future teachers to be more knowledgeable about the ICT technologies that could be integrated in education, in general, and have a better knowledge about the GBL and SG opportunities for achieving their curricular objectives.

3. Strategies for integrating SG in the primary education curriculum

In order to identify the (serious) games that could be integrated in the primary education curriculum we have developed a two axis criteria. The first axis, considers the curriculum, including the 8 areas of the primary education disciplinary fields in the province of Quebec (Canada): (1) French, (2) Mathematics, (3) Physical education and health, (4) English Second Language, (5) Arts education, (6) Ethics and religious culture, (7) Geography, history and citizenship education; and (8) Science and Technology. The second axis integrates the strategies for adapting (serious) games to the curriculum objectives: (1) using SG or customizing existing games, (2) repurposing existing games and (3) creating new games.

We introduce the strategies for adapting (serious) games to the curriculum objectives in the next section before introducing the (serious) games identified for the primary education curriculum.

3.1 Serious Games opportunities for primary education

Computer games are techno-pedagogical artifacts that are still considered quite complex to design by teachers. Despite the growing number of technological solutions which are offered for creating games (e.g. Unity, Ren'py, Scratch…) the techno-pedagogical skills and the time required for developing a game from scratch are important barriers to engage primary education teachers to develop their own computer games. When introducing games in their practice, teachers engage in a decision making process in which they should select an existing game that fits with the curriculum objectives or repurpose an existing entertainment game, which has maybe not being designed initially with an educational objective but which could be used as part of a learning activity [35]. The perfect matching between the pedagogical intentions of the teacher in relation to the curricular objectives and the pedagogical use of (serious) games requires time, adaptations or customization. In Canada, there are groups of researchers who are reflecting on ways to have teachers integrate serious games to the provincial curricula. Serious games are seen as a way to engage students in inquiry-based learning, an important competency in the Canadian educational settings. A study involving pre-service teachers' analysis of different SG, illustrated that SG are in most cases not fully adapted in terms of curriculum objectives, but also in terms of the "design (colors, shapes, pictures etc.), scenarios, characters, levels, points, and feedback", which requires a redesign of the game in order to fit an appropriate curriculum integration in the classroom [32:1351]. In order to face the challenge of adapting the game to the curriculum goal, there are mainly three strategies that we will describe in the next section: (1) customizing existing games, (2) repurposing existing games and (3) creating new games.

Table 1. Strategies for integrating (serious) games in education.

Customization of existing SG	Firstly, there is the possibility the redesign and customization of games to fully match the learners' needs to achieve the curricular goals. Adaptation and customization of the games could be made in terms of difficulty, language, knowledge content, metacognitive supports [3], learner skills and competence assessment SG [30], among other adaptive characteristics of SG. This first strategy requires the SG to be technologically advanced enough in order to support a certain degree of adaptability, but more importantly, this strategy requires technological skills that could became a barrier to the integration of SG in the formal education.

Repurposing existing games	Secondly, the teacher could decide to adapt the learning sequence in order to integrate computer entertainment games or SG in a way that could help achieve the curricular objectives and avoid losing the "educational focus" [22]. Popular entertainment games such *Angry Birds* could be repurposed in the context of mathematical learning [28] if the teacher succeeded to integrate the learning objectives and the use of the game within the curricular objectives. Entertainment games can be used as popular content in the classroom, such as the use of newspapers or other type of media, when the teacher organizes the learning sequence as a resource in one of the phases of the teaching or learning process. Playing simulation and virtual words, such *SimCity* could be a possibility to introduce the urban geography curriculum [37], providing an environment of simulation before starting to introduce the concepts of urban geography of the curriculum. Nevertheless, games are often used at the end of the learning sequence as a way to evaluate or transfer the knowledge and competences developed through the learning sequence. Sancar, Tokmak and Ozgelen observed pre-service teachers integration of (serious) games for curricular objective, and pointed out that "the computer games selected required students to have pre-knowledge to play. For example, children had to know addition and subtraction process in order to play the computer game on basic operations." [32:1354].
Creating (serious) games as a learning activity	Finally, we should consider the strategy of creating games as a learning activity helping to achieve some curriculum objectives. Kangas [18] develops creative and collaborative learning competencies through the development of a playful learning environment where the children are invited to co-create and play computer games. The MAGICAL project [19] aims to develop also the creative and teamwork competences through the use of a game-authoring environment where the children create games collaboratively. The game authoring platforms Scratch (http://scratch.mit.edu/) and Ren'py (http://www.renpy.org/) are specially adapted for introducing children to game development, which contributes to their digital literacy skills, their algorithmic, algebraic and geometrical mathematical knowledge; but also to the narrative development of the language curriculum by creating a scenario for the game and their characters [27].

3.2 Creating (serious) games as a learning activity

The third strategy introduced in the last section aims to engage learners in the creation of (serious) games as a powerful interdisciplinary strategy. Kafai [17:74] discusses the opportunities of the game creation learning activity for allowing children to be placed "in a situation that requires them to design, plan, reflect, evaluate and modify their programs on a constant basis", which could contribute to "development of children's abilities to deal with complex tasks". Game creation and programming has been introduced as learning activities in many schools with initiatives such as the one of *Hour of Code* promoting programming skills among K-12 children in the USA, or the www.code.org's tutorial, which "teaches basic coding principles through gameplay" [9:99]. Little by little, these initiatives seen as informal education are becoming formal; in July 2013, UK has become the first country to integrate programming as an official objective of the primary education curriculum [11]. The creation game strategy requires the teacher to develop her own programming skills or be able to delegate this expertise to other colleagues or the children. Teachers are sometimes behind a lot of their pupils when it comes to the general usage of ICTs. That doesn't mean that they cannot put in place a classroom management strategy where the more advanced ICT people (often part of the pupils) have the responsibility to help the other members of the Community of Learners (CoL), including the other pupils and teachers. When teachers are not very confident about their use of ICTs in education, their starting point is often similar to those of the

children they teach. Teachers who engage in such a learning journey are in fact active in developing some of the 21st century competencies such as learning to learn, teamwork and collaborative learning, and also problem solving strategies to overcome the technological challenges emerging in the classroom.

4. Methodology

4.1 Context

The study of the way (serious) games integration happens in the context of primary education is developed with a group of pre-service teachers in Quebec (Canada). The strategies for adapting (serious) games to the curriculum objectives are coherent with the goals of the Quebec education program in primary education. One of the most important aspects of the Quebec curriculum is that teachers are invited to focus less on content and have students engage in an active process to develop competencies. Those competencies can be specific to each disciplinary field but can also refer to cross-curricular ones. Amongst the cross-curricular competencies, two of them appear to be especially relevant to GBL and SG. "The intellectual competencies call on even the youngest students to go beyond superficial memorization of content and mindless conformity, and to aim for a higher level of skills. They define an active relationship to knowledge, and enable students to relate to reality—to grasp, interpret and understand it" [21:13]. As for the methodological cross-curricular competencies, teachers have to put forward learning activities that promote the use of ICT. Such a process also espouses some goals of the Quebec curriculum since teachers become more familiar with ICT by starting to master its basic procedures and vocabulary as they make more use of games and potential educational applications [21].

4.2 Sample

A group of 51 pre-service teachers have been engaged in a learning activity inviting them to integrate a GBL in the primary education curriculum. The pre-service teachers were engaged in the "Pedagogical uses of ICT" compulsory course during their third year of the Bachelor's Degree in Education and Primary Education program (BEPEP) at Université Laval in 2014. Université Laval is Canada's oldest institution of higher education and North America's first to offer instruction in French. Pre-service teachers' mean age is 23 with a low standard deviation (SD=2,28). Most of them do not play digital games (62%) or rarely (12%), but the great majority uses Internet for search information everyday (68%) or several times per week (27%). None of the pre-service teachers had ever heard before about the existence of SG and they did not foresee the possibilities to repurpose existing games or create new ones using the game authoring platforms.

4.3 Procedure

The group of 51 pre-service teachers was introduced to the three strategies of GBL integration in the classroom in two classes at the end of the course, once the students had developed their basic ICT competencies. In the first class of the GBL activity, a short introduction was facilitated by the professor, who introduced each of the (serious) games integration into the curriculum and provided one example for each of the strategies: (1) customizing existing games, (2) repurposing existing games and (3) creating new games. After the introduction of each strategy, the students were invited to develop an individual activity where they would choose a GBL integration strategy among the three, or combine them, in order to achieve one (or more) of the learning objectives of the primary education curriculum. Each student had to justify the choice of the GBL activity and the educational value for the curriculum objectives in a document where they should introduce the (1) curriculum area, (2) learning objectives (3) strategy of (serious) game integration, (4) the game selected to be customized, repurposed or the game creation activity and (5) the justification of the previous selections for the primary education target in terms of the added value brought by the use of (serious) games for developing the learning objectives selected. The students were given 5 days to complete the activity and they had to submit their work through the Virtual Learning Environment (VLE) two days before the next class. In the following class, the professor engaged a discussion in the classroom to invite pre-service teachers to justify the choice of their strategies and the games selected.

5. Results

Most students (50 over 51) succeeded to integrate a (serious) game in the primary curriculum. Table 1 introduces the results of the GBL activities. The strategies of games integration described in section 3 constitute the second axis of the matrix for identifying the (serious) games that could help develop the curriculum areas (first axis) of primary education in Quebec. The integration strategies include (1) using SG for children education or customizing existing games, (2) repurposing existing games and (3) creating new games. In order to facilitate the use of the SG identification in other international contexts, we added a column in Table 1, specifying the language availabilities of the games.

Table 2. Games classification according to curriculum areas and integration strategies.

Curriculum Area (*Axis 1*)	(Serious) Game	Language	Integration Strategy (*Axis 2*)
(1) French	*Les mots du Visuel*. Spelling and orthography.	FR	SG for children education
	Du plaisir à lire. French literacy.	FR	SG for children education
	Magimot. Orthography	FR	SG for children education
	Thélème. Social network for learning French as a Second Language	FR	SG for children and adults
(2) Mathematics	*La Souris Web*. Geometry, symmetry.	FR	SG for children education
	Timez Attack. Mental calculations [13].	FR	SG for children education
	Bejeweled Blitz. Casual games for learning geometry, shapes and algebra.	EN, FR	Repurposed game
	Angry Birds. Casual games for learning	EN	Repurposed game
	CalculaTice. Mental calculation.	FR	SG for children education
	MathémaTice. Mental calculation.	FR	SG for children education
	Le café des MATHadores. Venn diagrams, algebra, applied mathematics.	FR	SG for children and young
	Math Mountain. Mental calculation.	EN	SG for children education
(3) Physical education and health	*Vinz et Lou mettent les pieds dans le plat*. Nutrition and Health.	FR	SG for children education
(4) English Second Language	*The Sims*, English Second Language	EN	Repurposed game
	Wordspot, English word identification.	EN	SG for children and adults
(5) Arts education	*Crayons Physics*, Arts.	EN	SG for children and adults
(6) Ethics and religious culture	*World of Warcraft*, Using the game to reflect on violence and ethics.	EN	Repurposed game
(7) Geography, history and citizenship education	*Pays du monde*. Geography, list of countries.	FR	SG for children and adults
	Happy wood. Geography and citizenship.	FR	SG for children and young
	Le code perdu. Citizenship.	FR	SG for children and young
	Civilization. Geography and urban context.	EN	Repurposed game
	SimCity. Geography and urban context.	EN	Repurposed game
(8) Sciences and technology	*Lake Adventures*. Water management and sustainable development.	FR	SG for children education
	Donjons & RaDon. Introduction to physics [33].	FR	SG for children and young
	Énerguy. Energy management and sustainable development.	FR	SG for children and adults
	Crazy Machines. Introduction to physics.	EN	SG for children and adults

The results of our study are similar to those obtained through the literature review of Haney and colleagues [16], who observed that most of the serious games analysed in the studies integrating

SG in primary education were focused in the areas of mathematics, science and language. In our study, we observe a prevalence of the integration of SG in the area of mathematics (n=8 different SG), however the second are of the curriculum with a higher number of different SG is Geography, history and citizenship education (n=5). The third area is French (n=4), Science and technology (n=4) and English as a Second Language (n=2). The main difference remains in the use of Geography, history and citizenship education, which is proportionally higher among the group of pre-service teachers in Quebec participating in the study.

6.   Discussion

Schools and teachers in primary education in Quebec have an important flexibility with regards to time allocation to different disciplines, leading to the opportunity of using innovative and interdisciplinary teaching and learning approach. The discussion with pre-service teachers leads to consider a higher opportunity to use (serious) games in primary education rather than in secondary education. The pre-service teachers thought that in the context of primary education, there is a greater flexibility when it comes to their teaching planning than it is with secondary education. Despite the greater opportunity to integrate SG in primary education, the effective integration of SG in primary education is still limited to innovative projects [34]. Quebec primary education teachers' are used to introduce popular culture and characters in the classroom [31], which could be favorable to help integrating games as popular cultural artifacts in the classroom. In both contexts, European and Quebec elementary schools have been provided with different types of educational technologies through the last decade, including computer or media labs, laptops and tablet computers and interactive whiteboards in different degrees, creating a big diversity of educational technologies landscapes in each school. While educational technologies are still diverse and not available for all the learners and primary teachers, the integration of computer games faces a technological challenge in their integration to primary education.

7.   Conclusion

As mentioned previously, this study aimed to identify SG that could be used in the context of the primary education curriculum in Quebec. The (serious) games identification process leads to an observation of a majority of SG being used in mathematics, followed by science and technology. In mathematics, we observe the higher rates of using repurposed games. Despite a higher use of repurposed games in mathematics, pre-service teachers showed a preference for using existing SG designed specifically for the primary education curricular objectives in order to allow a more flexible integration of SG. The integration of SG in the primary education curriculum should not be expected to be done during a complete learning sequence; SG could be integrated as a part of a learning sequence where the use of the SG is combined to other resources, activities and learning methodologies to provide an enriched learning experience. For pre-service teachers, the rationale behind the use of existing SG lies in the facility of its integration. These results point out the pre-teachers avoidance of customizing, adapting or creating new games due to the technological requirements for developing these strategies. There is a need to allow pre-service teachers to develop the strategies of customization, repurposing and game creations, and limit the expectations of finding a perfect match between the SG and the curricular objectives. With this objective, we aim to highlight two main ideas to increase the (serious) game integration in the primary classroom. Firstly, teachers' have the possibility to adapt existing games and technology. There is no need to wait for the perfect SG matching perfectly each curriculum objectives. We have observed different strategies that could help introduce existing (serious) games for developing the curriculum objectives through customization, repurposing existing games or by creating games as a learning strategy. Even when the school facilities does not provide computer equipment for all the learners, teachers could organize the classroom activities in order to run games in collaborative challenges, or even invite the children to bring their laptops, smartphones or tablets to the classroom through a "Bring Your Own Device" (BYOD) policy. Introducing games in the classroom should not be limited by the existing (serious) games neither by technology when the teacher is able to customize, repurpose or engage in creating games in technologically diverse contexts. Secondly, teachers do not need to become tech-savvy before integrating computer games in the classroom, they just should change their paradigm from "I'm-the-Teacher-I-know-

everything" to a Community of Learners (CoL) paradigm where the teacher is the facilitator of the learning experience but does not control everyone and everything (domain knowledge, technologies, software…) but allows the emergence of collaborative solution solving strategies. In relation to the use of ICTs, teachers are sometimes behind part of their pupils; but can develop a classroom management strategy were the more advanced ICT people (often part of the pupils) have the responsibility to help the other members of the Community of Learners (CoL), including the other pupils and teachers. When teachers join the learning journey from the same starting point than children as they integrate ICTs to their pedagogy, teachers model parts of the 21st century competencies of learning to learn (lifelong learning), teamwork and collaborative learning, but also problem solving strategies to overcome the technological challenges appearing in the classroom. Prensky [24], describe young people as *Digital Natives*, and as the *Game Generation*. Primary education teachers should made be aware of those facts and invited to take part in a Community of Practice (CoP) and other professional events and networks in order to develop a better awareness of the SG integration in the classroom. Developing their personal network to improve their game integration projects successfully and reflect on their practices with other colleagues could reveal an important step in changing their teaching practices for the benefit of the learners.

References

[1] Baek, Y.K., "What hinders teachers in using computer and video games in the classroom? Exploring factors inhibiting the uptake of computer and video games". *CyberPsychology & Behavior,* vol. 11, no. 6, pp. 665–671, 2008. http://dx.doi.org/10.1089/cpb.2008.0127

[2] Barma, S., Power, M., Daniel, S., "Réalité augmentée et jeu mobile pour une éducation aux sciences et à la technologie". *Actes du colloque scientifique Ludovia 2010 «Interactivité/interactions–Enjeux relationnels*, 2010.

[3] Bellotti, F., Kapralos, B., Lee, K., Moreno-Ger, P., Berta, R., "Assessment in and of Serious Games: an overview". *Advances in Human-Computer Interaction*, 1, 2013. http://dx.doi.org/10.1155/2013/136864

[4] Bennett, S., Maton, K., Kervin, L., "The 'digital natives' debate: A critical review of the evidence". *British journal of educational technology,* vol. 39, no. 5, pp. 775–786, 2008. http://dx.doi.org/10.1111/j.1467-8535.2007.00793.x

[5] Bottino, R.M., Ott, M., Tavella, M., "Serious Gaming at School: Reflections on Students' Performance, Engagement and Motivation". *International Journal of Game-Based Learning*, vol. 4, no. 1, pp. 21–36, 2014. http://dx.doi.org/10.4018/IJGBL.2014010102

[6] Canadian Council on Learning, *State of E-learning in Canada.* Ottawa, Canada.

[7] Can, G., Cagiltay, K., "Turkish Prospective Teachers' Perceptions Regarding the Use of Computer Games with Educational Features". *Journal of Educational Technology & Society*, vol. 9, no. 1, 2006.

[8] Cheng, Y.-M., Lou, S.-J., Kuo, S.-H., Shih, R.-C., "Investigating elementary school students' technology acceptance by applying digital game-based learning to environmental education". *Australasian Journal of Educational Technology*, vol. 29, no. 1, 2013.

[9] Computer Society Connection, "Hour of Code kicks off to introduce K-12 students to computer programming". *IEEE Xplore,* vol. 46, no. 11, p. 99, 2013.

[10] Connolly, T.M., Stansfield, M., Hainey, T., "An alternate reality game for language learning: ARGuing for multilingual motivation". *Computers & Education,* vol. 57, no. 1, pp. 1389–1415, 2011. http://dx.doi.org/10.1016/j.compedu.2011.01.009

[11] Curtis, S., "Teaching our children to code: a quiet revolution". *The Telegraph*, 2013. http://www.telegraph.co.uk/technology/news/10410036/Teaching-our-children-to-code-a-quiet-revolution.html.

[12] deWinter, J., Griffin, D., McAllister, K.S., Moeller, R.M., Ruggill, J.E., "Computer games across the curriculum: A critical review of an emerging techno-pedagogy". *Currents in Electronic Literacy*, 2010.

[13] Fargeot, B., Thibaud, M., *L'utilisation d'un jeu serieux dans l'acquisition de l'automaticite des tables de multiplication en cycle 3. L'exemple de «Timez Attack».* Université Claude Bernard Lyon 1, Institut Universitaire de Formation des Maitres de l'Académie de Lyon, Lyon, France, 2013.

[14] Groundwater-Smith, S. White, V. *Improving our primary schools: Evaluation & assessment through participation.* Harcourt Brace, 1995.

[15] Guillén-Nieto, V., Aleson-Carbonell, M., "Serious games and learning effectiveness: The case of 'It'sa Deal!'". *Computers & Education,* vol. 58, no. 1, pp. 435–448, 2012. http://dx.doi.org/10.1016/j.compedu.2011.07.015

[16] Hainey, T., Connolly, T., Boyle, E., et al., "A Systematic Literature Review to Identify Empirical Evidence on the use of Games-Based Learning in Primary Education for Knowledge Acquisition and Content Understanding". *8th European Conference on Games Based Learning: ECGBL2014*, p. 167, 2014.

[17] Kafai, Y.B., "Learning design by making games". *Constructionism in practice: Designing, thinking and learning in a digital world*, pp. 71–96, 1996.

[18] Kangas, M., "Creative and playful learning: Learning through game co-creation and games in a playful learning environment". *Thinking Skills and Creativity,* vol. 5, no. 1, pp. 1–15, 2010. http://dx.doi.org/10.1016/j.tsc.2009.11.001

[19] Kiili, K., Kiili, C., Ott, M., Jönkkäri, T., "Towards creative pedagogy: Empowering students to develop games". *6th European Conference on Games Based Learning*, Academic Conferences Limited, p. 250, 2012.

[20] McFarlane, A., Sparrowhawk, A., Heald, Y., and others., *Report on the educational use of games.* Teachers evaluating educational multimedia, 2002.

[21] MEQ. *Québec Education Program: New directions for success together.* Ministère de l'Education du Québec, Québec, QC, 2001.

[22] Mor, Y., Winters, N., Cerulli, M., Björk, S., "Literature review on the use of games in mathematical learning, Part I: Design. Report of the Learning Patterns for the Design and Deployment of Mathematical Games project", 2006.

[23] Pachler, N., Cook, J., Bachmair, B., "Appropriation of mobile cultural resources for learning". *International Journal of Mobile and Blended Learning*, vol. 2, no. 1, pp. 1–21, 2010. http://dx.doi.org/10.4018/jmbl.2010010101

[24] Prensky, M., "Digital natives, digital immigrants part 1". *On the horizon,* vol. 9, no. 5, pp. 1–6, 2001. http://dx.doi.org/10.1108/10748120110424816

[25] Prensky, M., *Fun, play and games: What makes games engaging.* McGraw-Hill, California, 2001.

[26] Proctor, M.D., Marks, Y., "A survey of exemplar teachers' perceptions, use, and access of computer-based games and technology for classroom instruction". *Computers & Education,* vol. 62, pp. 171–180, 2013. http://dx.doi.org/10.1016/j.compedu.2012.10.022

[27] Robertson, J., Good, J., "Children's narrative development through computer game authoring". *TechTrends,* vol. 49, no. 5, pp 43–59, 2005.

[28] Rodrigues, M., Carvalho, P.S., "Teaching physics with Angry Birds: exploring the kinematics and dynamics of the game". *Physics Education*, vol. 48, no.4, p. 431, 2013. http://dx.doi.org/10.1088/0031-9120/48/4/431

[29] Romero, M., Gebera, O.T., "Serious Games para el desarrollo de las competencias del siglo XXI". *RED. Revista de Educación a Distancia*, vol. 34, pp. 1–22, 2012.

[30] Romero, M., Usart, M., Popescu, M., Boyle, E., "Interdisciplinary and international adaption and personalization of the metavals serious games". In *Serious Games Development and Applications*. Springer, pp. 59–73, 2012. http://dx.doi.org/10.1007/978-3-642-33687-4_5

[31] Saint-Jacques, D., Chené, A., Lessard, C., Riopel, M.-C., "Les représentations que se font les enseignants du primaire de la dimension culturelle du curriculum". *Revue des sciences de l'éducation,* vol. 28, no. 1, pp. 39–62, 2002. http://dx.doi.org/10.7202/007148ar

[32] Sancar Tokmak, H., Ozgelen, S., "The ECE Pre-service Teachers' Perception on Factors Affecting the Integration of Educational Computer Games in Two Conditions: Selecting versus Redesigning". *Educational Sciences: Theory & Practice,* vol. 13, no. 2, pp. 1345-1356, 2013.

[33] Sanchez, E., Ney, M., Labat, J.-M., "Jeux sérieux et pédagogie universitaire : de la conception à l'évaluation des apprentissages". *Revue Internationale des Technologies en Pédagogie Universitaire*, vol. 8, Journées scientifiques "Pédagogie Universitaire Numérique", pp. 48–57, 2011.

[34] Sauvé, L., Kaufman, D., *Jeux et Simulations éducatifs: Études de Cas et leçons Apprises.* PUQ, 2010.

[35] Shelton, B.E., Scoresby, J., "Aligning game activity with educational goals: Following a constrained design approach to instructional computer games". *Educational Technology Research and Development,* vol. 59, no. 1, pp. 113–138, 2011. http://dx.doi.org/10.1007/s11423-010-9175-0

[36] Shin, N., Sutherland, L.M., Norris, C.A., Soloway, E., "Effects of game technology on elementary student learning in mathematics". *British journal of educational technology*, vol. 43, no. 4, pp. 540–560, 2012. http://dx.doi.org/10.1111/j.1467-8535.2011.01197.x

[37] Tüzün, H., Yılmaz-Soylu, M., Karakuş, T., İnal, Y., Kızılkaya, G., "The effects of computer games on primary school students' achievement and motivation in geography learning". *Computers & Education,* vol. 52, no. 1, pp. 68–77, 2009. http://dx.doi.org/10.1016/j.compedu.2008.06.008

[38] Wrzesien, M., Alcañiz Raya, M., "Learning in serious virtual worlds: Evaluation of learning effectiveness and appeal to students in the E-Junior project". *Computers & Education,* vol. 55, no. 1, pp. 178–187, 2010. http://dx.doi.org/10.1016/j.compedu.2010.01.003